Thomas Højlund Christensen - DTU Orbit (30/03/2019)

Research outputs:

Deriving Environmental Life Cycle Inventory Factors for Land Application of Garden Waste Products Under Northern European Conditions

The amount of waste which is being recycled is increasing in Europe. Garden waste is increasingly composted and land applied. However, composting to full maturity requires resources in terms of space, equipment and labour. Alternatives could include a simple shredding, or composting for a shorter time. Finally, an option could be to remove trunks and large branches which are not easy to compost and incinerate them to recover energy. In order to assess these options and the associated environmental impacts, it is necessary to have good estimates of emissions and other inventory factors during the different steps of the life cycle of the compost products. Especially, the impacts occurring after land application are difficult to estimate. The objective of the current paper is to estimate environmental inventory factors for land application of four garden waste products: shredded garden waste, shredded garden waste after removal of the woody fraction, immature garden waste compost and mature garden waste compost. Soil incubations of the materials were conducted in order to assess the carbon (C) and nitrogen (N) dynamics occurring after incorporation in soil. Subsequently, the results were used to simulate the mineralisation kinetics of the materials in the agroecosystem model Daisy. Subsequently, the model was used to simulate C and N dynamics under different environmental conditions and emissions to the environment and used to derive inventory factors. Nine soil and climate combinations were included in the simulation study to cover local conditions commonly found in Northern Europe. The degradability of the garden waste products increased when the woody fraction of garden waste was removed and generally the degradability of the product was decreased by composting. All four products showed initial immobilisation of N in soil, but it was clear that removal of the woody fraction and composting reduced the length and severity of the immobilisation phase. The approach taken in the current paper using soil incubations to estimate decomposition parameters for the materials and subsequently an agroecosystem model to extrapolate the observations proved efficient at estimating inventory factors under various environmental conditions and fertilisation levels. Under low N availability conditions, the harvest factor, which estimates the fraction of N harvested in response to application of an amount of compost ranged between 0.10 and 0.18 for a sandy loam soil and medium precipitation conditions for Northern European while it ranged from negative values to 0.12 under conditions of ample N supply. These results were also clearly reflected in the emission factors for N leaching to the groundwater and losses to surface water, which were higher under high N availability than under low. The harvest factor, emission factors for ammonia, N leaching to ground water and loss to surface water proved to be very dependent on the local conditions like the soil type, precipitation regime and general fertilisation level, whereas the biochemical composition of the materials was of less importance for these factors. In contrast, the C sequestration factor was almost unaffected by the environmental conditions but depended to a large extent on the degradability of the added material.

General information

State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Air, Land & Water Resources, University of Copenhagen
A life cycle assessment (LCA) was performed on five garden waste treatment practices: the production of mature compost including the woody fraction (MCIW), the production of mature compost without the woody fraction (MCWW), the production of immature compost without the woody fraction (ICWW), fresh garden waste including the woody fraction (GWIW) and fresh garden waste without the woody fraction (GWWW). The assessment included carbon sequestration after land application of the garden waste and composts, and associated emissions. The removed woody fraction was incinerated and energy recovery included as heat and electricity. The functional unit of the assessment was treatment of 1000kg of garden waste generated in Denmark. Overall, the results showed that composting of garden waste resulted in comparable or higher environmental impact potentials (depletion of abiotic resources, marine eutrophication, and terrestrial eutrophication and acidification) than no treatment before land application. The toxicity potentials showed the highest normalised impact potentials for all the scenarios, but were unaffected by the different garden waste treatments. The choice of energy source for substituted heat and electricity production affected the performance of the different treatment scenarios with respect to climate change. The scenarios with removal of the woody fraction performed better than the scenarios without removal of the woody fraction when fossil energy sources were substituted, but performed worse when renewable energy sources were substituted. Furthermore, the study showed the importance of including long-term emission factors after land application of fresh and composted garden waste products since the greatest proportion of carbon and nitrogen emissions occurred after land application in three out of the five scenarios for carbon and in all scenarios for nitrogen.
Bioethanol from corn stover – a review and technical assessment of alternative biotechnologies

Reviewing the literature from the last decade regarding the bioconversion of corn stover into ethanol, 474 references were identified containing 561 datasets. We found 144 datasets which were sufficiently consistent and detailed to address the current state of the art of corn stover conversion to bioethanol, and we were able to categorise 93% of these datasets into eight different technological configurations for the production of bioethanol, based on the pretreatment approaches used.
After pretreating, the corn stover is subject to hydrolysis and fermentation, but these two process steps were largely identical in all datasets, albeit a range of operating conditions was reported. The final distillation of the ethanol was very rarely included in the datasets. By parameterising the bioethanol production by 26 parameters, including corn stover compositions, solid loadings, operational conditions, conversion efficiencies and material consumption, we were able to quantify the material flows for each technological configuration and estimate the uncertainty of the flows. The eight technological configurations produced 11–22% ethanol from the dry solid content of the corn stover. Technologies using alkaline-, solvent or ammonia-based pretreatments produced the largest amount of ethanol (19–22%), while fungi-based pretreatment produced much less (11%). All technological configurations resulted in large flows of solid as well as liquid residues, typically containing 60 to 70% of the dry solid corn stover content. Based on the selected datasets, statistical description is provided for all parameters, including mode, median, average and deviation, within each technological configuration. Bivariate correlation analysis across and within all technological configurations indicates that some operational parameters usually considered crucial in laboratory studies, e.g. pretreatment severity, show from a statistical perspective very little correlation with the yields. The review reveals that a great deal of research has addressed the challenge of converting corn stover into bioethanol, but a significant part of these studies is of limited value in terms of scope and documentation when addressing overall material flows and key parameters in a technological context.

General information
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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Water Technologies, Beijing Normal University
Contributors: Zhao, Y., Damgaard, A., Christensen, T. H.
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BFI (2019): BFI-level 2
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BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 24.19 SJR 6.751 SNIP 9.626
Web of Science (2017): Impact factor 25.242
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 19.82 SJR 5.443 SNIP 9.119
Web of Science (2016): Impact factor 17.382
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 21.6 SJR 8.077 SNIP 10.2
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 21.55 SJR 7.426 SNIP 11.879
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 22.43 SJR 8.259 SNIP 12.951
Web of Science (2013): Impact factor 16.909
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 17.82 SJR 5.859 SNIP 12.194
Web of Science (2012): Impact factor 15.089
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
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Web of Science (2011): Impact factor 14.22
Combined uncertainty and scenario analysis within Life Cycle Assessment of waste management systems

**General information**
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Image Analysis & Computer Graphics, Department of Applied Mathematics and Computer Science
Contributors: Bisinella, V., Conradsen, K., Christensen, T. H., Astrup, T. F.
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Life Cycle Assessment of biorefineries: how robust are the results?

**General information**
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Organisations: Residual Resource Engineering, Department of Environmental Engineering, Image Analysis & Computer Graphics, Department of Applied Mathematics and Computer Science
Life cycle assessment of sewage sludge management options including long-term impacts after land application

A life cycle assessment (LCA) was performed on five commonly applied sewage sludge treatment practices: dewatering of mixed sludge (DMS), lime stabilisation of dewatered sludge (LIMS), anaerobic digestion of mixed sludge (ADS), dewatering of anaerobically-digested sludge (DADS) and incineration of dewatered anaerobically-digested sludge (INC).

In the first four scenarios, the sludge residues were applied on agricultural land, while in the fifth scenario ash from sludge incineration was landfilled. It was found that the sludge treatment technology influenced in which processes C and N emissions happened. In general, the INC scenario performed better than or comparably to the scenarios with land application of the sludge. Human toxicity (non-carcinogenic) and eco-toxicity showed the highest normalised impact potentials for all the scenarios with land application. In both categories, impacts were dominated by the application of zinc and copper to agricultural soil. For the eutrophication potentials, different scenarios appeared beneficial depending on the receiving compartment in focus. The fate of P dominated freshwater eutrophication, while the fate of N had a profound effect on all non-toxic impact categories other than freshwater eutrophication. The sensitivity analysis showed that the results were sensitive to soil and precipitation conditions. The ranking of scenarios was affected by local conditions for marine eutrophication. Overall, the present study highlighted the importance of including all sludge treatment stages and conducting a detailed N flow analysis, since the emission of reactive N into the environment is the major driver for almost all non-toxic impact categories.
Waste management in the Irkutsk region, Siberia, Russia: An environmental assessment of alternative development scenarios

The current waste management system, handling around 500,000 t of household, commercial, and institutional waste annually in the Irkutsk region, Siberia, is based on landfilling in an old landfill with no controls of leachate and gas. Life-cycle assessment modelling of the current system shows that it is a major load on the environment, while the simulation of
seven alternative systems results in large savings in many impact categories. With respect to climate change, it is
estimated that a saving of about 1200 kg CO2 equivalents is possible per year, per inhabitant, which is a significant
reduction in greenhouse gas emissions. The best alternatives involve efficient energy recovery from waste and recycling
by source separation for commercial and institutional waste, the major waste type in the Irkutsk region. Recycling of
household waste seems less attractive, and it is therefore recommended only to consider this option after experience has
been gained with the commercial and institutional waste. Sensitivity analysis shows that recovery of energy - in particular
electricity, heat, and steam - from waste is crucial to the environmental performance of the waste management system.
This relates to the efficiencies of energy recovery as well as what the recovered energy substitutes, that is, the 'dirtier' the
off-set energy, the higher the environmental savings for the waste management system. Since recovered energy may be
utilised by only a few energy grids or industrial users, it is recommended to perform additional local assessments of the
integration of the waste energy into existing systems and facilities.

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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Water Technologies, Irkutsk
National Research Technical University
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BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Decision making within waste management: combined uncertainty and scenario analysis for the life cycle assessment of a danish case study

General information

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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Technical University of Denmark
Contributors: Binella, V., Conradsen, K., Christensen, T. H., Astrup, T. F.
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Source-ID: 2396723189
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Environmental impacts and resource losses of incinerating misplaced household special wastes (WEEE, batteries, ink cartridges and cables)

The contribution of misplaced special waste (sWEEE, lamps, CRT, batteries, ink cartridges and cables) to environmental impacts from incineration of residual household waste was quantified through life cycle assessment (LCA)-modelling. Misplaced special waste was quantified to constitute less than 1% of the net impact for most environmental impact categories, except for the toxic impact categories (4–28% of toxic impacts) and the impact on abiotic resource depletion. It was found that the main contributor (96%) to the toxic impact categories was related to the presence of mercury (Hg) from lamps and batteries. However as shown by sensitivity analysis, lack of good data on the transfer of rare and hazardous metals to the flue gas in the incineration process should receive further investigation before the environmental impacts from misplaced incinerated special waste can fully be concluded upon. Although the misplaced special waste is only 0.5% of residual household waste, it constitutes in the residual household waste the most significant fraction with respect to metal content when iron and aluminum are excluded. By extending the boundary of the LCA beyond the traditional “zero burden boundary”, we were able to quantify the impact of abiotic resources not recovered from incineration residues. This appeared to be a significant impact category, and the special waste contributed about 96% of this category although it by weight makes up only 0.5% of the waste. Furthermore, enhancing the recovery of iron (Fe) and aluminum (Al) from the ashes would not affect the loss of abiotic resources significantly. Only by recovering elements as platinum (Pt), copper (Cu), gold (Au), and silver (Ag) would it be possible to reduce the loss of abiotic resources from the system. These elements are primarily found in misplaced special waste (sWEEE, lamps, CRT, batteries, ink cartridges, and cables).

General information

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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.31 SJR 1.462 SNIP 2.11
Web of Science (2017): Impact factor 5.12
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.73 SJR 1.211 SNIP 1.804
Web of Science (2016): Impact factor 3.313
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.98 SJR 1.284 SNIP 1.947
Web of Science (2015): Impact factor 3.28
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 3.7 SJR 1.324 SNIP 2.048
Web of Science (2014): Impact factor 2.564
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.34 SJR 1.424 SNIP 2.228
Web of Science (2013): Impact factor 2.692
ISI indexed (2013): ISI indexed yes
Environmental performance of household waste management in Europe - an example of 7 countries

An attributional life cycle assessment (LCA) of the management of 1 ton of household waste was conducted in accordance with ISO 14044:2006 and the ILCD Handbook for seven European countries, namely Germany, Denmark, France, UK, Italy, Poland and Greece, representing different household waste compositions, waste management practices, technologies, and energy systems. National data were collected from a range of sources regarding household waste composition, household sorting efficiency, collection, waste treatments, recycling, electricity and heat composition, and technological efficiencies. The objective was to quantify the environmental performance in the different countries, in order to analyze the sources of the main environmental impacts and national differences which affect the results. In most of the seven countries, household waste management provides environmental benefits when considering the benefits of recycling of materials and recovering and utilization of energy. Environmental benefits come from paper recycling and, to a lesser extent, the recycling of metals and glass. Waste-to-energy plants can lead to an environmental load (as in France) or a saving (Germany and Denmark), depending mainly on the composition of the energy being substituted. Sensitivity analysis and a data quality assessment identified a range of critical parameters, suggesting from where better data should be obtained. The study concluded that household waste management is environmentally the best in European countries with a minimum reliance on landfilling, also induced by the implementation of the Waste Hierarchy, though environmental performance does not correlate clearly with the rate of material recycling. From an environmental point of view, this calls for a change in the waste management paradigm, with less focus on where the waste is routed and more of a focus on the quality and utilization of recovered materials and energy.
Web of Science (2016): Impact factor 3.173
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.49 SJR 1.53 SNIP 1.579
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.65 SJR 1.726 SNIP 1.78
Web of Science (2014): Impact factor 3.988
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.35 SJR 1.672 SNIP 1.978
Web of Science (2013): Impact factor 3.089
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 2.89 SJR 1.529 SNIP 1.707
Web of Science (2012): Impact factor 2.773
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 2.82 SJR 1.595 SNIP 1.737
Web of Science (2011): Impact factor 2.362
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.447 SNIP 1.826
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.247 SNIP 1.644
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.885 SNIP 1.397
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.813 SNIP 1.222
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.573 SNIP 1.339
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.648 SNIP 1.777
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.653 SNIP 1.437
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.517 SNIP 1.731
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.288 SNIP 0.954
Scopus rating (2001): SJR 0.49 SNIP 1.456
Scopus rating (2000): SJR 0.413 SNIP 1.862
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Future scenario analysis within waste management and life cycle assessment of waste management solutions

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Importance of waste composition for Life Cycle Assessment of waste management solutions

The composition of waste materials has fundamental influence on environmental emissions associated with waste treatment, recycling and disposal, and may play an important role also for the Life Cycle Assessment (LCA) of waste management solutions. However, very few assessments include effects of the waste composition and waste LCAs often rely on poorly justified data from secondary sources. This study systematically quantifies the influence and uncertainty on LCA results associated with selection of waste composition data. Three archetypal waste management scenarios were modelled with the waste LCA model EASETECH based on detailed waste composition data from the literature. The influence from waste composition data on the LCA results was quantified with a step-wise Global Sensitivity Analysis (GSA) approach involving contribution, sensitivity, uncertainty and discernibility analyses. The waste composition data contributed significantly to the LCA results and the uncertainty associated with these results. The importance of 405 individual waste properties was evaluated in comparison with 345 technology parameters. Overall, less than 10 physico-chemical properties dominated the output uncertainty of the LCA results, although these properties had low sensitivity in the model. Moreover, the uncertainties associated with the physico-chemical properties were responsible for output uncertainties that spanned from impacts to benefits. The GSA approach applied in this study constitutes a valuable tool for systematically assessing the importance of waste composition and for consciously collecting and using waste composition data within LCAs of waste management systems.
A global approach for sparse representation of uncertainty in Life Cycle Assessments of waste management systems

Purpose: Identification of key inputs and their effect on results from Life Cycle Assessment (LCA) models is fundamental. Because parameter importance varies greatly between cases due to the interaction of sensitivity and uncertainty, these features should never be defined a priori. However, exhaustive parametrical uncertainty analyses may potentially be complicated and demanding, both with analytical and sampling methods. Therefore, we propose a systematic method for selection of critical parameters based on a simplified analytical formulation that unifies the concepts of sensitivity and uncertainty in a Global Sensitivity Analysis (GSA) framework. Methods: The proposed analytical method based on the calculation of sensitivity coefficients (SC) is evaluated against Monte Carlo sampling on traditional uncertainty assessment procedures, both for individual parameters and for full parameter sets. Three full-scale waste management scenarios are modelled with the dedicated waste LCA model EASETECH and a full range of ILCD recommended impact categories. Common uncertainty ranges of 10% are used for all parameters, which we assume to be normally distributed. The applicability of the concepts of additivity of variances and GSA is tested on results from both uncertainty propagation methods. Then, we examine the differences in discernibility analyses results carried out with varying numbers of sampling points and parameters. Results and discussion: The proposed analytical method complies with the Monte Carlo results for all scenarios and impact categories, but offers substantially simpler mathematical formulation and shorter computation times. The coefficients of variation obtained with the analytical method and Monte Carlo differ only by 1%, indicating that the analytical method provides a reliable representation of uncertainties and allows determination of whether a discernibility analysis is required. The additivity of variances and the GSA approach show that the uncertainty in results is determined by a limited set of important parameters. The results of the discernibility analysis based on these critical parameters vary only by 1% from discernibility analyses based on the full set, but require significantly fewer Monte Carlo runs. Conclusions: The proposed method and GSA framework provide a fast and valuable approximation for uncertainty quantification. Uncertainty can be represented sparsely by contextually identifying important parameters in a systematic manner. The proposed method integrates with existing step-wise approaches for uncertainty analysis by introducing a global importance analysis before uncertainty propagation.
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.65 SJR 1.726 SNIP 1.78
Web of Science (2014): Impact factor 3.988
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.35 SJR 1.672 SNIP 1.978
Web of Science (2013): Impact factor 3.089
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 2.89 SJR 1.529 SNIP 1.707
Web of Science (2012): Impact factor 2.773
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 2.82 SJR 1.595 SNIP 1.737
Web of Science (2011): Impact factor 2.362
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.447 SNIP 1.826
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.247 SNIP 1.644
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.885 SNIP 1.397
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.813 SNIP 1.222
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.573 SNIP 1.339
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.648 SNIP 1.777
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.653 SNIP 1.437
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.517 SNIP 1.731
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.288 SNIP 0.954
Scopus rating (2001): SJR 0.49 SNIP 1.456
Scopus rating (2000): SJR 0.413 SNIP 1.862
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Estimation of long-term environmental inventory factors associated with land application of sewage sludge

Land application of sewage sludge has a number of advantages over other alternatives, but is also associated with environmental impacts. To make proper assessments of different sludge treatments, it is crucial to have reliable estimates of emissions after the application of different sludge types. However, because of the complexity of the agricultural production system, it is difficult to estimate emissions consistently under different conditions. In the current paper, a mechanistic agro-ecosystem model was calibrated to be able to simulate different sludge types stabilized using different techniques. Subsequently, 100 year model simulations were used to provide emission factors as well as harvest and carbon sequestration factors (collectively called environmental inventory factors) under a variety of environmental conditions. Environmental inventory factors were calculated under both high crop response conditions (i.e. when nitrogen was limiting) and low crop response conditions (i.e. when nitrogen was not limiting). The average high response nitrogen harvest factor over the tested environmental conditions was ranging from 0.06 to 0.30 for the different sludge types included. This means that if an additional 1 kg of nitrogen is applied with sludge, between 0.06 and 0.30 kg additional nitrogen is harvested. This is considerably lower than for mineral fertilizer with an average value of 0.63. The low response harvest factors were considerably lower, ranging from 0.03 to 0.13. The emission factor for nitrous oxide nitrogen was ranging from 0.024 to 0.034, consistently being higher under high response conditions. For nitrogen leaching to the groundwater, the high response emission factor ranged from 0.20 to 0.50 for the different sludge types while the low response were slightly higher ranging from 0.18 to 0.55. The average carbon sequestration factor across the different environmental conditions ranged from 0.03 to 0.05 for the different sludge types. In conclusion, the approach using an agro-ecosystem model to estimate inventory factors associated with land application of sludge under varying conditions proved very powerful and would have been virtually impossible by experimental means.

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BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 5.79 SJR 1.467 SNIP 2.194
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.83 SJR 1.659 SNIP 2.502
Web of Science (2016): Impact factor 5.715
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.57 SJR 1.635 SNIP 2.375
Web of Science (2015): Impact factor 4.959
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.6 SJR 1.665 SNIP 2.481
Web of Science (2014): Impact factor 3.844
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.47 SJR 1.618 SNIP 2.527
Web of Science (2013): Impact factor 3.59
Life cycle assessment of capital goods in waste management systems

The environmental importance of capital goods (trucks, buildings, equipment, etc.) was quantified by LCA modelling 1 tonne of waste treated in five different waste management scenarios. The scenarios involved a 240L collection bin, a 16m³ collection truck, a composting plant, an anaerobic digestion plant, an incinerator and a landfill site. The contribution of capital goods to the overall environmental aspects of managing the waste was significant but varied greatly depending on the technology and the impact category: Global Warming: 1-17%, Stratospheric Ozone Depletion: 2-90%, Ionising Radiation, Human Health: 2-91%, Photochemical Ozone Formation: 2-56%, Freshwater Eutrophication: 0.05-99%, Marine Eutrophication: 0.03-8%, Terrestrial Acidification: 2-13%, Terrestrial Eutrophication: 1-8%, Particulate Matter: 11-26%, Human Toxicity, Cancer Effect: 10-92%, Human Toxicity, non-Cancer Effect: 1-71%, Freshwater Ecotoxicity: 3-58%, Depletion of Abiotic Resources - Fossil: 1-31% and Depletion of Abiotic Resources - Elements (Reserve base): 74-99%.

The single most important contribution by capital goods was made by the high use of steel. Environmental impacts from capital goods are more significant for treatment facilities than for the collection and transportation of waste and for the landfilling of waste. It is concluded that the environmental impacts of capital goods should always be included in the LCA
modelling of waste management, unless the only impact category considered is Global Warming.

**General information**

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Contributors: Brogaard, L. K., Christensen, T. H.
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- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 2
- Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
- Web of Science (2017): Impact factor 4.723
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- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
- Web of Science (2016): Impact factor 4.03
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
- Web of Science (2014): Impact factor 3.22
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
- Web of Science (2013): Impact factor 3.157
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
- Web of Science (2012): Impact factor 2.485
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071
- Web of Science (2011): Impact factor 2.428
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 1
- Scopus rating (2010): SJR 1.553 SNIP 1.821
- Web of Science (2010): Impact factor 2.358
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 1.519 SNIP 1.919
Long-Term Emission Factors for Land Application of Treated Organic Municipal Waste

The agro-ecosystem model Daisy was used to explore the long-term fate of nitrogen (N) after land application of compost and digestate (based on source separated organic municipal solid waste (MSW)). The cumulative crop N yield response and emissions for mineral fertilizer (MF), anaerobically digested organic waste (MSW-D), and composted organic waste (MSW-C) were derived by fitting a linear mixed model to the outcomes of the simulations. The non-linearity of crop N yield responses and emission responses to increasing N fertilizer application was addressed by dividing these responses into high and low crop response conditions. The crop N yield response cumulated over time from the application of N fertilizer almost levelled out for MF within 3 to 5 years after application, while it increased over a time period of 100 years for MSW-C. In addition, MSW-D showed features of both MF and MSW-C, a steep rise in crop N yield response due to high inorganic N content and a gradual increase thereafter, due to the slow mineralization of organic N. Overall, 52–69 % of N applied as MF was up-taken by plant biomass, while plant uptakes of 15–28 % by MSW-D and 19–29 % by MSW-C were measured under high response conditions. When the N fertilizer application rate exceeded the rate of plant uptake, the rate of N utilization dropped by 80–90 % for MF, albeit to lesser degree for MSW-D and MSW-C. The simulations showed that emissions to the environment from organic fertilizers took place over a longer time and omission of the long-term effects could result in underestimation of potential impacts to the environment. As well as the time scope of assessment, local conditions were determining the N emissions. For the N2O emission, there were very small differences between high and low response conditions for organic fertilizer. The N2O emission factors varied for 1.8–3.0 % for MSW-D and 1.7–5.1 % for MSW-C. For NO3− leaching to groundwater, there were large differences between high and low response conditions. For high response conditions, the emission factors varied from 6 to 39, 17 to 68, and 9 to 59 of input N from the application of MF, MSW-D, and MSW-C, respectively. Under low response conditions, much higher leaching emission factors were estimated ranging from 21 to 61 % for MF, 20 to 73 % for MSW-D, and 11 to 66 % for MSW-C.

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General information
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Organisations: Office for Innovation & Sector Services, Department of Environmental Engineering, Department of Civil Engineering, Environmental Chemistry, Water Resources Engineering, Section for Geotechnics and Geology, Center for Energy Resources Engineering, Section for Building Design, Residual Resource Engineering, Water Technologies, Production and Service Management, Department of Management Engineering, Engineering Systems, Department of Transport, Transport policy and behaviour, Geological Survey of Denmark and Greenland, Aarhus University, Danish Centre for Environment and Energy, Geological Survey of Denmark
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URLs: http://naturstyrelsen.dk/nyheder/2016/jan/ny-rapport-samler-viden-om-skifergas/
Source: PublicationPreSubmission
Source-ID: 120778580
Research output: Commissioned › Report – Annual report year: 2016

A comprehensive substance flow analysis of a municipal wastewater and sludge treatment plant
The fate of total organic carbon, 32 elements (Al, Ag, As, Ba, Be, Br, Ca, Cd, Cl, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, N, Na, Ni, Pb, S, Sb, Se, Sn, Sr, Ti, V, and Zn) and 4 groups of organic pollutants (linear alkylbenzene sulfonates, bis(2-ethylhexyl)phthalate, polychlorinated biphenyl and polycyclic aromatic hydrocarbons) in a conventional wastewater treatment plant were assessed. Mass balances showed reasonable closures for most of the elements. However, gaseous emissions were accompanied by large uncertainties and show the limitation of mass balance based substance flow analysis. Based on the assessment, it is evident that both inorganic and organic elements accumulated in the sewage sludge, with the exception of elements that are highly soluble or degradable by wastewater and sludge treatment processes. The majority of metals and metalloids were further accumulated in the incineration ash, while the organic pollutants were effectively destroyed by both biological and thermal processes. Side streams from the sludge treatment process (dewatering and incineration) back to the wastewater treatment represented less than 1% of the total volume entering the wastewater treatment processes, but represented significant substance flows. In contrast, the contribution by spent water from the flue gas treatment process was almost negligible. Screening of human and eco-toxicity by applying the consensus-based environmental impact assessment method USEtox addressing 15 inorganic constituents showed that removal of inorganic constituents by the wastewater treatment plant reduced the toxic impact potential by 87-92%. © 2013 Elsevier Ltd. All rights reserved.

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State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Avedøre Wastewater Services
Contributors: Yoshida, H., Christensen, T. H., Guildal, T., Scheutz, C.
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Peer-reviewed: Yes
Early online date: 2014

Publication information
Journal: Chemosphere
Assessing the importance of machinery, buildings and infrastructure in LCA of waste management systems

Construction and demolition waste: Comparison of standard up-flow column and down-flow lysimeter leaching tests

Five samples of construction and demolition waste (C&DW) were investigated in order to quantify leaching of inorganic elements under percolation conditions according to two different experimental setups: standardised up-flow saturated columns (-1TS) for Al, As, Ba, Cd, Cu, DOC, Mg, Mn, Ni, P, Pb, Sb, Se, Si, Zn. Observed differences between tests are likely to be due to differences in pH related to crushing and exposure of fresh particle surfaces, as well as in equilibrium conditions. In the case of C&DW, the standardised column tests, which are more practical, are considered to acceptably describe cumulative releases at L/S 10 l·kg⁻¹TS in percolation scenarios. However, when the focus is on estimation of initial concentrations for (for example) risk assessment, data from standardised column tests may not be fully applicable, and data from lysimeters may be used for validation purposes. Se, Cr and, to a lesser extent, SO₄ and Sb were leaching from C&DW in critical amounts compared with existing limit values.
Effects of sewage sludge stabilization on fertilizer value and greenhouse gas emissions after soil application

Application of sewage sludge on agricultural land becomes more and more common in many parts of the world in order to recycle the nutrients from the sludge. A range of sewage sludge stabilization techniques are available to make the sludge more stable prior to storage, transportation, and application. These stabilization techniques include dewatering, drying, anaerobic digestion, composting, and reed bed sludge treatment. However, very few studies have investigated the effect of these techniques after the sludge has been applied to agricultural land. The objective of the current study was therefore to investigate the effect of sewage sludge stabilization techniques on the C and N mineralization and gaseous emissions from soil. A soil incubation was conducted to determine the rate of C and N mineralization and N2O and CH4 emissions of sewage sludge stabilized using different techniques. Unstabilized sludge released up to 90% of their C content as CO2, part of which could be caused by release of CO2 from carbonates. Compared with this, sludge stabilization including anaerobic digestion and drying resulted in a reduction of the C mineralization rate of about 40%. Liming reduced C mineralization with around 29%, while treatment in a reed bed system reduced it by 74%. The current study thus clearly demonstrated that stabilization techniques resulted in sludge that was more stable once they were applied to agricultural land. Stabilization also reduced the N immobilization phase, potentially improving the value of the sludge as a fertilizer. Emissions of CH4 were also reduced through sludge stabilization and mainly occurred after application of easily degradable sludge types, which is likely to have enhanced the creation of anaerobic microsites. The stabilization processes also decreased emissions of N2O. The results for both CH4 and N2O indicate that the stabilization tends to reduce the chance of developing conditions where these gases could be produced.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Atmospheric Environment, Water Technologies, University of Copenhagen, Orbicon
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Publication information
Journal: Acta Agriculturae Scandinavica, Section B - Soil & Plant Science
Volume: 65
Issue number: 6
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BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.95 SJR 0.414 SNIP 0.747
Web of Science (2017): Impact factor 0.894
Life cycle assessment of construction and demolition waste management

Life cycle assessment (LCA) modelling of construction and demolition waste (C&DW) management was carried out. The functional unit was management of 1 Mg mineral, source separated C&DW, which is either utilised in road construction as a substitute for natural aggregates, or landfilled. The assessed environmental impacts included both non-toxic and toxic impact categories. The scenarios comprised all stages of the end-of-life management of C&DW, until final disposal of all
residues. Leaching of inorganic contaminants was included, as was the production of natural aggregates, which was avoided because of the use of C&DW. Typical uncertainties related to contaminant leaching were addressed. For most impact categories, utilisation of C&DW in road construction was preferable to landfilling; however, for most categories, utilisation resulted in net environmental burdens. Transportation represented the most important contribution for most nontoxic impacts, accounting for 60-95 per cent of these impacts. Capital goods contributed with negligible impacts. Leaching played a critical role for the toxic categories, where landfilling had lower impacts than utilisation because of the lower levels of leachate per ton of C&DW reaching the groundwater over a 100-year perspective. Leaching of oxyanions (As, V and Sb) was critical with respect to leaching. Typical experimental uncertainties in leaching data did not have a pivotal influence on the results; however, accounting for Cr immobilisation in soils as part of the impact assessment was critical for modelling the leaching impacts. Compared with the overall life cycle of building and construction materials, leaching emissions were shown to be potentially significant for toxicity impacts, compared with contributions from production of the same materials, showing that end-of-life impacts and leaching should not be disregarded when assessing environmental impacts from construction products and materials. CO2 uptake in the C&DW corresponding to 15 per cent carbonation could out-balance global warming impacts from transportation; however, carbonation would also likely result in increased toxicity impacts due to higher leaching of oxyanions. (C) 2015 Elsevier Ltd. All rights reserved.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Butera, S., Christensen, T. H., Astrup, T. F.
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
Web of Science (2012): Impact factor 2.485
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071
Web of Science (2011): Impact factor 2.428
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.553 SNIP 1.821
Web of Science (2010): Impact factor 2.358
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.519 SNIP 1.919
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.375 SNIP 2.145
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.998 SNIP 1.785
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.021 SNIP 1.819
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.065 SNIP 1.653
Scopus rating (2004): SJR 1.271 SNIP 1.911
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.853 SNIP 1.234
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.498 SNIP 0.903
Scopus rating (2001): SJR 0.45 SNIP 0.731
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.328 SNIP 0.444
Scopus rating (1999): SJR 0.26 SNIP 0.541
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Life-cycle Models of Solid Waste Management: Defining the state-of-the-art for Collection, Material recovery, Combustion, biological Treatment, and Landfilling

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, North Carolina State University
Contributors: Levis, J., Damgaard, A., Astrup, T. F., Christensen, T. H., Barlaz, M.
Number of pages: 1
Publication date: 2015
Quantifying capital goods for biological treatment of organic waste

Materials and energy used for construction of anaerobic digestion (AD) and windrow composting plants were quantified in detail. The two technologies were quantified in collaboration with consultants and producers of the parts used to construct the plants. The composting plants were quantified based on the different sizes for the three different types of waste (garden and park waste, food waste and sludge from wastewater treatment) in amounts of 10,000 or 50,000 tonnes per year. The AD plant was quantified for a capacity of 80,000 tonnes per year. Concrete and steel for the tanks were the main materials for the AD plant. For the composting plants, gravel and concrete slabs for the pavement were used in large amounts. To frame the quantification, environmental impact assessments (EIAs) showed that the steel used for tanks at the AD plant and the concrete slabs at the composting plants made the highest contribution to Global Warming. The total impact on Global Warming from the capital goods compared to the operation reported in the literature on the AD plant showed an insignificant contribution of 1–2%. For the composting plants, the capital goods accounted for 10–22% of the total impact on Global Warming from composting.

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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Ramboll Group AS, Assentoft Silo A/S
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Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
Quantifying uncertainty in sustainability assessments: from feedstock to end-of-life

General information
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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics
Contributors: Bisinella, V., Conradsen, K., Damgaard, A., Christensen, T. H., Astrup, T. F.
Number of pages: 1
Publication date: 2015
Recent LCA Developments In Waste Management

Based on 10 years of experience we briefly present key issues which should receive special attention when waste LCA is performed. Attention paid to the importance of good data on waste composition, the contribution of environmental impacts from capital goods, assessing the value of recovered materials, nutrients and energy, the representativity of external life cycle inventory data bases, how we adress uncertainty and important factors in defining future scenarios.

General Information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Christensen, T. H., Astrup, T. F., Brogaard, L. K., Bisinella, V., Damgaard, A.
Number of pages: 8
Publication date: 2015

Soil retention of hexavalent chromium released from construction and demolition waste in a road-base-application scenario

We investigated the retention of Cr(VI) in three subsoils with low organic matter content in laboratory experiments at concentration levels relevant to represent leachates from construction and demolition waste (C&DW) reused as unbound material in road construction. The retention mechanism appeared to be reduction and subsequent precipitation as Cr(III) on the soil. The reduction process was slow and in several experiments it was still proceeding at the end of the six-month experimental period. The overall retention reaction fit well with a second-order reaction governed by actual Cr(VI) concentration and reduction capacity of the soil. The experimentally determined reduction capacities and second-order kinetic parameters were used to model, for a 100-year period, the one-dimensional migration of Cr(VI) in the subsoil under a layer of C&DW. The resulting Cr(VI) concentration would be negligible below 7–70 cm depth. However, in rigid climates and with high water infiltration through the road pavement, the reduction reaction could be so slow that Cr(VI) might migrate as deep as 200 cm under the road. The reaction parameters and the model can form the basis for systematically assessing under which scenarios Cr(VI) from C&DW could lead to an environmental issue for ground- and receiving surface waters.

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Organisations: Department of Environmental Engineering, Environmental Chemistry, Residual Resource Engineering
Contributors: Butera, S., Trapp, S., Astrup, T. F., Christensen, T. H.
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Peer-reviewed: Yes
Understanding uncertainty propagation in life cycle assessments of waste management systems
Uncertainty analysis in Life Cycle Assessments (LCAs) of waste management systems often results obscure and complex, with key parameters rarely determined on a case-by-case basis. The paper shows an application of a simplified approach to uncertainty coupled with a Global Sensitivity Analysis (GSA) perspective on three alternative waste management systems for Danish single-family household waste. The approach provides a fast and systematic method to select the most important parameters in the LCAs, understand their propagation and contribution to uncertainty.

General information
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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics
Contributors: Bisinella, V., Conradsen, K., Christensen, T. H., Astrup, T. F.
Number of pages: 8
Publication date: 2015

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Place of publication: Cagliari, Italy
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Electronic versions: Bisinella_Sardinia_2015.pdf
Research output: Research - peer-review » Article in proceedings – Annual report year: 2015

Waste to energy the carbon perspective
Waste to energy plants are key treatment facilities for municipal solid waste in Europe. The technology provides efficient volume reduction, mass reduction and hygienisation of the waste. However, the technology is highly disputed in some countries. It is crucial to understand the role of waste to energy with respect to potential contributions to CO₂ emissions and savings.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Christensen, T. H., Damgaard, A., Astrup, T. F.
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Peer-reviewed: Yes

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ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: English
Electronic versions: 2015_Christensen_et_al_Waste_to_energy_the_carbon_perspective_postprint.pdf
Source: PublicationPreSubmission
An environmental assessment system for environmental technologies

A new model for the environmental assessment of environmental technologies, EASETECH, has been developed. The primary aim of EASETECH is to perform life-cycle assessment (LCA) of complex systems handling heterogeneous material flows. The objectives of this paper are to describe the EASETECH framework and the calculation structure. The main novelties compared to other LCA software are as follows. First, the focus is put on material flow modelling, as each flow is characterised as a mix of material fractions with different properties and flow compositions are computed as a basis for the LCA calculations. Second, the tool has been designed to allow for the easy set-up of scenarios by using a toolbox, the processes within which can handle heterogeneous material flows in different ways and have different emission calculations. Finally, tools for uncertainty analysis are provided, enabling the user to parameterise systems fully and propagate probability distributions through Monte Carlo analysis. © 2014 Elsevier Ltd.
Composition and leaching of construction and demolition waste: Inorganic elements and organic compounds

Thirty-three samples of construction and demolition waste collected at 11 recycling facilities in Denmark were characterised in terms of total content and leaching of inorganic elements and presence of the persistent organic pollutants PCBs and PAHs. Samples included (i) "clean" (i.e. unmixed) concrete waste, (ii) mixed masonry and concrete, (iii) asphalt and (iv) freshly cast concrete cores; both old and newly generated construction and demolition waste was included. PCBs and PAHs were detected in all samples, generally in non-critical concentrations. Overall, PAHs were comparable to background levels in urban environments. "Old" and "new" concrete samples indicated different PCB congener profiles and the presence of PCB even in new concrete suggested that background levels in raw materials may be an issue. Significant variability in total content of trace elements, even more pronounced for leaching, was observed indicating that the number of analysed samples may be critical in relation to decisions regarding management and utilisation of the materials. Higher leaching of chromium, sulphate and chloride were observed for masonry-containing and partly carbonated samples, indicating that source segregation and management practices may be important. Generally, leaching was in compliance with available leaching limits, except for selenium, and in some cases chromium, sulphate and antimony. © 2014 Elsevier B.V.
EASETECH – A LCA model for assessment of environmental technologies

EASETECH is a new model for the environmental assessment of environmental technologies developed in collaboration between DTU Environment and DTU Compute. EASETECH is based on experience gained in the field of waste management modelling over the last decade and applies the same concepts to systems with different kinds of material flows, such as sludge, wastewater, biomass for energy production and treatment of contaminated soil. The primary aim of EASETECH is to perform life cycle assessment (LCA) of complex systems handling heterogeneous material flows. The main novelties of the model compared to other LCA software are as follows. The focus is put on material flow modelling. This means that each material flow is characterized as a mix of material fractions with different properties. Flows in terms of mass and composition are computed throughout the integrated system including rejects, slags, ashes and products as a basis for the LCA calculations. These flows are handled as a matrix of waste fractions and material properties, and each fraction can be handled independently or grouped based on general similarity (e.g. PE bottle and plastic waste) in different processes. This is very important because different materials have different chemical compositions, and the optimal treatment for one material fraction might be suboptimal for another fraction. It is therefore critical that the starting point of the modelling process is a composition matrix where each material fraction is specified in terms of chemical, as well as fraction-specific parameters (e.g. water content, heating value).

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Department of Applied Mathematics and Computer Science, Software and Process Engineering
Contributors: Damgaard, A., Baumeister, H., Astrup, T. F., Christensen, T. H.
Number of pages: 1
Publication date: 2014

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Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Research output: Research - peer-review » Conference abstract in proceedings – Annual report year: 2014

Environmental benefits of compost use on land through LCA – a review of the current gaps
The use of biowaste compost on land can have beneficial effects on the plant–soil system. While the environmental impacts associated with compost production have been successfully assessed in previous studies, the assessment of the benefits of compost on plant and soil has been only partially included in few published works. In the present study, we reviewed the recent progresses made in the quantification of the effects associated to biowaste compost use on land by using life cycle assessment (LCA). Different research efforts are required for a full assessment of the potential benefits, apart from nutrient supply and carbon sequestration; additional impact categories – dealing with phosphorus resources, biodiversity, soil losses, and water depletion – may be needed for a comprehensive assessment of compost application.
Several of the natural mechanisms identified and the LCA procedures discussed in the paper could be extensible to other organic fertilizers and compost from other feedstocks.

**General information**
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Organisations: Department of Environmental Engineering, Residual Resource Engineering, University of California at Davis, Autonomous University of Barcelona, French National Institute for Agricultural Research, Institute of Agri-food Research and Technology, Institut de Recerca i Tecnologia Agroalimentàries
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**Environmental evaluation of plastic waste management scenarios**
The management of the plastic fraction is one of the most debated issues in the discussion on integrated municipal solid waste systems. Both material and energy recovery can be performed on such a waste stream, and different separate collection schemes can be implemented. The aim of the paper is to contribute to the debate, based on the analysis of different plastic waste recovery routes. Five scenarios were defined and modelled with a life cycle assessment approach using the EASEWASTE model. In the baseline scenario (P0) the plastic is treated as residual waste and routed partly to incineration with energy recovery and partly to mechanical biological treatment. A range of potential improvements in plastic management is introduced in the other four scenarios (P1–P4). P1 includes a source separation of clean plastic fractions for material recycling, whereas P2 a source separation of mixed plastic fraction for mechanical upgrading and separation into specific polymer types, with the residual plastic fraction being down-cycled and used for “wood items”. In P3 a mixed plastic fraction is source separated together with metals in a “dry bin”. In P4 plastic is mechanically separated from residual waste prior to incineration.

A sensitivity analysis on the marginal energy was carried out. Scenarios were modelled as a first step assuming that marginal electricity and heat were based on coal and on a mix of fuels and then, in the sensitivity analysis, the marginal energy was based on natural gas.

The study confirmed the difficulty to clearly identify an optimal strategy for plastic waste management. In fact none of the examined scenarios emerged univocally as the best option for all impact categories. When moving from the P0 treatment strategy to the other scenarios, substantial improvements can be obtained for “Global Warming”. For the other impact categories, results are affected by the assumption about the substituted marginal energy. Nevertheless, irrespective of the assumptions on marginal energy, scenario P4, which implies the highest quantities of specific polymer types sent to recycling, resulted the best option in most impact categories.

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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Polytechnic University of Milan
Contributors: Rigamonti, L., Grosso, M., Møller, J., Martínez-Sanchez, V., Magnani, S., Christensen, T. H.
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Scopus rating (2005): SJR 0.725 SNIP 1.42
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Scopus rating (2003): SJR 0.566 SNIP 1.061
Scopus rating (2002): SJR 0.392 SNIP 0.837
Scopus rating (2001): SJR 0.327 SNIP 0.956
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Evaluation of life cycle inventory data for recycling systems
This paper reviews databases on material recycling (primary as well as secondary production) used in life cycle assessments (LCA) of waste management systems. A total of 366 datasets, from 1980 to 2010 and covering 14 materials, were collected from databases and reports. Totals for CO2-equivalent emissions were compared to illustrate variations in the data. It was hypothesised that emissions from material production and the recycling industry had decreased over time due to increasing regulation, energy costs and process optimisation, but the reported datasets did not reveal such a general trend. Data representing the same processes varied considerably between databases, and proper background information was hard to obtain, which in turn made it difficult to explain the large differences observed. Those differences between the highest and lowest estimated CO2 emissions (equivalents) from the primary production of newsprint, HDPE and glass were 238%, 443% and 452%, respectively. For steel and aluminium the differences were 1761% and 235%, respectively. There is a severe lack of data for some recycled materials; for example, only one dataset existed for secondary cardboard. The study shows that the choice of dataset used to represent the environmental load of a material recycling process and credited emissions from the avoided production of virgin materials is crucial for the outcome of an LCA on waste management. Great care and a high degree of transparency are mandatory, but advice on which datasets to use could not be determined from the study. However, from the gathered data, recycling in general showed lower emission of CO2 per kg material than primary production, so the recycling of materials (considered in this study) is thus beneficial in most cases.

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Web of Science (2013): Impact factor 2.692
A Life Cycle Assessment (LCA) of a municipal wastewater treatment plant (WWTP) was conducted to illustrate the effect of an emission inventory data collection scheme on the outcomes of an environmental impact assessment. Due to their burden in respect to data collection, LCAs often rely heavily on existing emission and operational data, which are gathered under either compulsory monitoring or reporting requirements under law. In this study, an LCA was conducted using three input data sources: Information compiled under compulsory disclosure requirements (the European Pollutant Release and Transfer Registry), compliance with national discharge limits, and a state-of-the-art emission data collection scheme conducted at the same WWTP. Parameter uncertainty for each collection scheme was assessed through Monte Carlo simulation. The comparison of the results confirmed that LCA results depend heavily on input data coverage. Due to the threshold on reporting value, the E-PRTR did not capture the impact for particulate matter emission, terrestrial acidification, or terrestrial eutrophication. While the current practice can capture more than 90% of non-carcinogenic human toxicity and marine eutrophication, an LCA based on the data collection scheme underestimates impact potential due to limitations of substance coverage. Besides differences between data collection schemes, the results showed that 3-13,500% of the impacts came from background systems, such as from the provisioning of fuel, electricity, and chemicals, which do not need to be disclosed currently under E-PRTR. The incidental release of pollutants was also assessed by employing a scenario-based approach, the results of which demonstrated that these non-routine emissions could increase overall WWTP greenhouse gas emissions by between 113 and 210%. Overall, current data collection schemes have the potential to provide standardized data collection and form the basis for a sound environmental impact assessment, but several improvements are recommended, including the additional collection of energy and chemical usage data, the elimination of a reporting threshold, the expansion of substance coverage, and the inclusion of non-point fugitive gas.
emissions.

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Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355  
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ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 2  
Scopus rating (2010): SJR 2.592 SNIP 2.192  
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LCA – Life-Cycle-Assessment Modeling has come to stay in waste management but does it also play a role in hazardous and special waste management?

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Contributors: Christensen, T. H., Damgaard, A.
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Life cycle assessment of sewage sludge treatment and its use on land
Sewage sludge is generated as an end-product of wastewater treatment processes, and its management holds importance in the operation of wastewater treatment plants from both an economic and an environmental point of view. At the same time, the management of sewage sludge is becoming increasingly multi-focused, as renewable energy and nutrient recovery have been added to the list beyond sanitation and stabilisation of sewage sludge. In order to organise and quantify environmental benefits and associated burdens, in order to facilitate an informed decision making process, life cycle assessments (LCAs) have been applied in the field of sewage sludge management for the past two decades. While providing a flexible platform for comparing a range of sewage sludge management options, a knowledge gap has been identified through the review of existing studies, including inconsistencies in pollutant coverage and quantification,
the omission of unmetered gaseous emissions and a lack of long-term emission data regarding the land application of sewage sludge. An LCA depends heavily on existing emission and operational data, as generating such data could be prohibitively time- and resource-consuming. Emission and operational data are already collected by wastewater treatment plants for compliance with pollutant discharge requirements, but a part of this pollutant discharge is also reported to a web-based registry (European Pollutant Release and Transfer Registry (E-PRTR)) and is available to the public free of charge. While this data source provides a standardised data collection format, its viability has been questioned due to its limited pollutant coverage and the thresholds regarding reporting requirements. To address this issue, a targeted input data collection campaign was conducted at a municipal wastewater treatment plant. The substance flow analysis of a municipal wastewater treatment plant was conducted to identify the fate of 32 elements, and a reduction in toxicity potential was evaluated by applying USETox. The result was largely confirmative of previous studies, in that wastewater treatment is effective at removing pollutants from wastewater and concentrates them in sewage sludge. Efforts to collect site-specific emission data were also expanded to gaseous emission measurements. The tracer dilution method was applied to measure a plant-integrated emission of N₂O and CH₄ from the wastewater treatment plant. Large variations in emissions were found within and between measurement campaigns, and almost ten times more emissions were found during periods of operational difficulty such as foaming or the malfunction of in-line control systems. The LCA was based on three input data collection schemes: a compulsory environmental information disclosure requirement, a pollutant discharge monitoring requirement and state-of-the-art on-site data collection. While adequately capturing impacts in relation to global warming and marine eutrophication, an LCA based on existing data sources might underestimate impacts associated with wastewater and sludge treatment processes. Finally, the effort to collect emission data was expanded to the use of sludge on agricultural land. The long-term consequences of sewage sludge application on land were evaluated by applying the DAISY dynamic agro-ecosystem model. The C and N mineralisation rates obtained from the 190-day laboratory-scale incubation test for sewage sludge were used to calibrate the DAISY model, and the fates of C and N in the agricultural field were simulated over a 100-year period. The outcome of the simulation was deduced further to emission factors per unit application of N fertiliser on land by fitting a linear mixed-effect model to the outcome of simulations with varying N application levels. It was evident that the effects of inorganic N fertiliser appear immediately after its application, while improvements in crop yield and emissions of reactive N from organic fertilisers persist over time. The window of emission is dependent on the degree of stabilisation: while the effect from treated sewage sludge ceases after 25 years, the effect from the application of more stable material such as composted municipal solid waste persists over 100 years. Large variations in emission factors, due to local conditions, were observed, especially in the case of the liquid application of sludge. When these emission factors were applied to an LCA comparing sewage sludge treatment alternatives, emissions of reactive N (NH₃, N₂O, NH₄⁺, NO₃⁻) into the environment were major contributors to almost all of the non-toxic impact categories. Hence, a depiction of the N balance through the target systems, beyond energy and C balance, often included in environmental assessments is vital for accurately evaluating the environmental performance of sewage sludge management options.

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Life cycle assessment of the management of special waste types: WEEE and batteries
There has been an increased focus on special waste types (WEEE, batteries, ink cartridges and cables) in Denmark and abroad, as many of these fractions constitute a special threat to the environment, due to their content of hazardous compounds and valuable resources. Waste Electrical and Electronic Equipment (WEEE) and batteries are some of the special waste types receiving significant focus as hazardous and valuable substances in WEEE and batteries are plentiful. WEEE and batteries, which are not sorted out for recycling and recovery, do not only imply a loss of materials and metals but could also lead to pollution of other waste streams. In addition to this, there are significant environmental benefits to be obtained when recycling special wastes.

Many of the raw materials found in special waste are in an immediate supply risk for the development of emerging green technologies. The inherent resources in waste have become an obvious focus as a source of these critical raw materials, and the municipal solid waste is considered to be one of the largest potential sources for the recovery and recycling of scarce elements. Special waste streams should, therefore, be collected and recycled. In particular, precious and scarce metals should be recovered due to environmental as well as sustainability issues. In Denmark, there are still waste flows that are unaccounted for. One of these flows is the special waste that is being misplaced with residual household waste. Bigum et al. (II) investigated this by conducting a sorting analysis of the Danish
residual household waste. The analysis showed that especially small household appliances, lamps, toys, leisure and sports equipment, and portable batteries were frequently misplaced with residual household waste. Misplaced special waste will, in Denmark, be incinerated. This leads to pollution of the surrounding environment with heavy and toxic metals, as well as being a significant source for abiotic resource depletion (Bigum et al., III).

Improvements with respect to the treatment of special waste are necessary. Traditional pre-treatment facilities seem to focus primarily on the traditional metals such as iron (Fe), aluminium (Al), and copper (Cu), which can be recovered in bulk amounts. Recovery of the precious and scarce metals is to a lesser degree carried out, as these appear in much smaller amounts. Future recovery facilities should, however, aim at recovering these metals, even though they appear in smaller concentrations, as the recovery of these can have larger environmental relevance exceeding that of the traditionally recovered metals (Bigum et al., I).

Life cycle assessments (LCAs) are used as decision-making tools for supporting waste management decisions. LCAs must therefore also be able to incorporate issues related to special waste streams and management. The ability for LCAs to incorporate these issues is crucial for the tool to be able support decisions and to further justify the use of waste-LCAs when decisions are made.

One of these issues is related to special waste being a very heterogeneous waste type. The variation in composition is significant and data availability is scarce, which can make it difficult to include special waste in waste-LCAs. This also means that the environmental aspects connected with the special waste types can be difficult to fully assess, and that the consequences of these may risk being overlooked or underestimated.

The field of environmental assessment of special waste is relatively new, and many issues need to be resolved. One of these issues is the evaluation of resource depletion and scarcity. This area is in need of a much broader consensus and further scientific development in order to ensure that LCA is applicable and accepted as a decision-making tool.

This thesis shows the importance of including a detailed composition of the special waste types, as well as the importance of incorporating the resource depletion of unrecovered elements in waste-LCAs (Bigum et al., III). The thesis also shows that the recycling of metals is of significant environmental importance (Bigum et al., I) and quantifies the amount of special waste types being misplaced with residual household waste (Bigum et al., II). The thesis also concludes that there are still many issues that need to be resolved and suggested which areas need further research in order to improve the field of environmental assessments of special waste types.

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Review of LCA studies of solid waste management systems – Part II: Methodological guidance for a better practice

Life cycle assessment (LCA) is increasingly used in waste management to identify strategies that prevent or minimise negative impacts on ecosystems, human health or natural resources. However, the quality of the provided support to decision- and policy-makers is strongly dependent on a proper conduct of the LCA. How has LCA been applied until now? Are there any inconsistencies in the past practice? To answer these questions, we draw on a critical review of 222 published LCA studies of solid waste management systems. We analyse the past practice against the ISO standard requirements and the ILCD Handbook guidelines for each major step within the goal definition, scope definition, inventory analysis, impact assessment, and interpretation phases of the methodology. Results show that malpractices exist in several aspects of the LCA with large differences across studies. Examples are a frequent neglect of the goal definition, a frequent lack of transparency and precision in the definition of the scope of the study, e.g. an unclear delimitation of the system boundaries, a truncated impact coverage, difficulties in capturing influential local specificities such as representative waste compositions into the inventory, and a frequent lack of essential sensitivity and uncertainty analyses. Many of these aspects are important for the reliability of the results. For each of them, we therefore provide detailed recommendations to practitioners of waste management LCAs.
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Review of LCA studies of solid waste management systems – Part I: Lessons learned and perspectives

The continuously increasing solid waste generation worldwide calls for management strategies that integrate concerns for environmental sustainability. By quantifying environmental impacts of systems, life cycle assessment (LCA) is a tool, which can contribute to answer that call. But how, where and to which extent has it been applied to solid waste management systems (SWMSs) until now, and which lessons can be learnt from the findings of these LCA applications? To address these questions, we performed a critical review of 222 published LCA studies of SWMS. We first analysed the geographic distribution and found that the published studies have primarily been concentrated in Europe with little application in developing countries. In terms of technological coverage, they have largely overlooked application of LCA to waste prevention activities and to relevant waste types apart from household waste, e.g. construction and demolition waste. Waste management practitioners are thus encouraged to abridge these gaps in future applications of LCA. In addition to this contextual analysis, we also evaluated the findings of selected studies of good quality and found that there is little agreement in the conclusions among them. The strong dependence of each SWMS on local conditions, such as waste composition or energy system, prevents a meaningful generalisation of the LCA results as we find it in the waste hierarchy. We therefore recommend stakeholders in solid waste management to regard LCA as a tool, which, by its ability of capturing the local specific conditions in the modelling of environmental impacts and benefits of a SWMS, allows identifying critical problems and proposing improvement options adapted to the local specificities.

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Scopus rating (2008): SJR 1.375 SNIP 2.145
Web of Science (2008): Indexed yes
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Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.021 SNIP 1.819
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.065 SNIP 1.653
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Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.853 SNIP 1.234
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Scopus rating (2002): SJR 0.498 SNIP 0.903
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The Biogeochemistry of Contaminant Groundwater Plumes Arising from Waste Disposal Facilities

Landfills with solid waste are abundant sources of groundwater pollution all over the world. Old uncontrolled municipal landfills are often large, heterogeneous sources with demolition waste, minor fractions of commercial or industrial waste, and organic waste from households. Strongly anaerobic leachate with a high content of dissolved organic carbon, salts, and ammonium, as well as specific organic compounds and metals is released from the waste for decades or centuries. Landfill leachate plume hosts a variety of biogeochemical processes, which is the key to understand the significant potential for natural attenuation of specific organic contaminants in a leachate plume. The complexity of this system is exemplified with the presentation of two comprehensive field studies at the Norman Landfill (United States) and the Grindsted Landfill (Denmark). The key findings from these integrated studies and the literature are the following: (1) Local hydrogeological conditions in the landfill area may affect the spreading of the contaminants; (2) investigations of landfill leachate plumes in geologic settings with clayey till deposits and fractured consolidated sediments are lacking; (3) the size of the landfill and the heterogeneity of the source may create a variable leaching pattern and maybe also multiple plumes; and (4) significant natural attenuation of xenobiotic organic compounds occurs, but the complexity of leachate plumes with respect to compounds (inorganic and xenobiotic organic compounds) and biogeochemical processes may be an obstacle for the implementation of natural attenuation as a remedy. These findings highlight that demonstration of natural attenuation in terms of contaminant mass reduction at the field scale is difficult. However, very few alternatives to natural attenuation exist for remediation at landfill sites. Finally, the potential chemical or ecological impact from landfills located in former wetlands or near surface water bodies may deserve attention in future studies.

Waste management in the Irkutsk Region, Siberia, Russia: Environmental assessment of current practice focusing on landfilling

The municipal waste management system of the region of Irkutsk is described and a life cycle assessment (LCA) performed to assess the environmental performance of the system. Annually about 500 000 tons of waste are managed. The waste originates from three sources: household waste (27%), commercial waste (23%) and office & institutional waste (44%). Other waste of unknown composition constitutes 6%. Only 3% of the waste is recycled; 97% of the municipal waste is disposed of at the old Alexandrovsky landfill. The environmental impact from the current system is dominated by the landfill, which has no gas or leachate collection system. The global warming contribution is due to the emission of methane of the order of 420 000 tons CO2-equivalents per year. Collection and transport of the waste are insignificant compared with impacts from the landfill. As the old landfill runs out of capacity in a few years, the LCA modelling showed that introduction of a new and modern landfill with gas and leachate collection could improve the performance of the waste management system significantly. Collection of landfill gas and utilization for 30 years for electricity production (gas turbine) would reduce the global warming completely and result in a net saving of 100 000 CO2-equivalents per year due to storage of biogenic carbon in the landfill beyond 100 years. Considering other first-order degradation rates for the landfilled organic matter did not overtly affect the results, while assumptions about the top cover oxidation of methane significantly affected the results. This shows the importance of controlling the gas escape from the landfill.
A critical review of life cycle assessment applied to solid waste management systems

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Assessing the Environmental Benefits of Compost Use-on-Land through an LCA Perspective

Due to increasing compost use in agriculture, there is an urgent need to evaluate compost benefits and impacts versus other fertilizers. Here we review the recent progress made in the quantification of positive effects associated with compost use on land using life cycle assessment (LCA), an internationally recognised environmental tool. Nine environmental benefits were identified in an extensive literature review: nutrient supply, carbon sequestration, weed pest and disease suppression, increase in crop yield, decreased soil erosion, retention of soil moisture, increased soil workability, enhanced soil biological properties and biodiversity, and gain in crop nutritional quality. Quantitative figures for each benefit were drawn from the literature and classified into short-term: less than 1 year; mid-term: less than 10 years and long-term: less than 100 years.

The review shows that 5–60% of the applied compost N is mineralized, depending on the time frame. Mineralisation ranges from 35% to 100% for P and from 75% to 100% for K. Carbon sequestration rates are higher in the short term, up to 40% of the applied C, decreasing over time to 16%. Impacts on crop yields vary from decreases of 495% to increases of 52%. Compost increases 29–63% soil aggregate stability, reducing 5–36% soil loss. Soil bulk density decreases of 0.7–20% after compost application, potentially increasing soil workability. Also, water holding capacity and plant available water can increase by 50% and 34% respectively. Data on compost impacts on soil biodiversity is scarce and restricted to microorganisms. Compost may decrease microbial diversity by 2% or increase it by 4%. Clear impacts are also observed.
on microbial biomass, of 3.2–242% increase after compost application, and microbial activity: 43–344% increase. For weed, pest and disease suppression, along with nutritional content increase, quantitative figures could not be provided, either because of lack of data or because the effects are very variable and depend on specific local conditions. For soil erosion and soil moisture content, effects could be quantitatively addressed, but suitable impact assessment methodologies were not available. Additional impact categories dealing with phosphorus resources, biodiversity, soil losses, and water depletion are needed for a comprehensive assessment of compost application.

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Compost benefits for agriculture evaluated by life cycle assessment. A review
As compost use in agriculture increases, there is an urgent need to evaluate the specific environmental benefits and impacts as compared with other types of fertilizers and soil amendments. While the environmental impacts associated with compost production have been successfully assessed in previous studies, the assessment of the benefits of compost on plant and soil has been only partially included in few published works. In the present study, we reviewed the recent progresses made in the quantification of the positive effects associated to biowaste compost use on land by using life cycle assessment (LCA). A total of nine environmental benefits were identified in an extensive literature review and quantitative figures for each benefit were drawn and classified into short-, mid-, and long-term. The major findings are the following: (1) for nutrient supply and carbon sequestration, the review showed that both quantification and impact assessment could be performed, meaning that these two benefits should be regularly included in LCA studies. (2) For pest and disease suppression, soil workability, biodiversity, crop nutritional quality, and crop yield, although the benefits were proved, quantitative figures could not be provided, either because of lack of data or because the benefits were highly variable and dependent on specific local conditions. (3) The benefits on soil erosion and soil moisture could be quantitatively addressed, but suitable impact assessment methodologies were not available. (4) Weed suppression was not proved. Different research efforts are required for a full assessment of the benefits, apart from nutrient supply and carbon sequestration; additional impact categories—dealing with phosphorus resources, biodiversity, soil losses, and water depletion—may be needed for a comprehensive assessment of compost application. Several of the natural mechanisms identified and the LCA procedures discussed in the paper could be extensible to other organic fertilizers and compost from other feedstocks.

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Journal: Agronomy for Sustainable Development
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BFI (2019): BFI-level 1
Environmental assessment of waste management in Greenland: current practice and potential future developments

The majority of the waste in Greenland is disposed of in open dumps or incinerated in simple small-scale incinerators. There are relatively few environmental regulations that control the emissions of leachate, landfill gas and/or flue gases from incineration. Only some scrap metal and hazardous waste are collected separately and exported to Europe. The impacts from the current waste management system were modelled from a life-cycle perspective using the LCA-waste model EASEWASTE. Impacts with regard to global warming, acidification, etc. are small (a few hundred person-equivalents (PE) for a system serving 56 000 inhabitants), but significant environmental loads are caused by air emissions from the incinerators and leachate from the landfills. Several alternative management scenarios were modelled and results show that increased use of incineration, full utilization of the heat production for district heating and separation of hazardous waste probably could improve Greenland’s waste management system. Segregation of recyclable materials as paper, cardboard and biowaste will do little to environmentally improve the waste management system due to loss of energy recovery from incineration and the long transport of the recyclables to markets. Export of waste to Denmark for incineration at modern waste incinerators with advanced flue gas cleaning could also be considered as a means to achieve better environmental performance of the waste management system.

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Contributors: Eisted, R., Christensen, T. H.
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BFI (2017): BFI-level 1
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Environmental impact assessment of leachate recirculation in landfill of municipal solid waste by comparing evaporation and discharge (EASEWASTE)

In some arid regions where landfill produces minimal amount of leachate, leachate recirculation is suggested as a cost-effective option. However, its long-term impacts to environment remain disputed. For the purpose of revealing the environmental impacts of leachate recirculation in landfill, four scenarios were modeled using EASEWASTE, comparing the strategies of leachate recirculation (with or without gas management), evaporation and discharge. In the current situation (Scenario A), a total of 280t of waste was generated and then transported to a conventional landfill for disposal. A number of contaminants derived from waste can be stored in the landfill for long periods, with 11.69 person equivalent (PE) for stored ecotoxicity in water and 29.62 PE for stored ecotoxicity in soil, considered as potential risks of releasing to the environment someday. Meanwhile, impacts to ecotoxicity and human toxicity in surface water, and those to groundwater, present relatively low levels. In Scenario B, leachate evaporation in a collecting pool has minimal impacts on surface water. However, this strategy significantly impacts groundwater (1055.16 PE) because of the potential infiltration of leachate, with major contaminants of As, ammonia, and Cd. A number of ions, such as Cl$$^-$, Mg$$^{2+}$$, and Ca$$^{2+}$$, may also contaminate groundwater. In Scenario C, the direct discharge of leachate to surface water may result in acidification (2.71 PE) and nutrient enrichment (2.88 PE), primarily attributed to soluble ammonia in leachate and the depositional ammonia from biogas. Moreover, the direct discharge of leachate may also result in ecotoxicity and human toxicity via water contaminated by heavy metals in leachate, with 3.96 PE and 11.64 PE respectively. The results also show that landfill gas is the main contributor to global warming and photochemical ozone formation due to methane emission. In Scenario D, landfill gas flaring was thus be modeled and proven to be efficient for reducing impacts by approximately 90% in most categories, like global warming, photochemical ozone formation, acidification, nutrient enrichment, ecotoxicity, and human toxicity. Therefore, leachate recirculation is considered a cost-effective and environmentally viable solution for the current situation, and landfill gas treatment is urgently required. These results can provide important evidence for leachate and gas management of landfill in arid regions.

General information
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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Tsinghua University, Hong Kong Institute of Education, Beijing Normal University
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Web of Science (2018): Indexed yes
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BFI (2016): BFI-level 2
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Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
Life cycle assessment of sewage sludge management: A review

In this article, 35 published studies on life cycle assessment (LCA) of sewage sludge were reviewed for their methodological and technological assumptions. Overall, LCA has been providing a flexible framework to quantify environmental impacts of wastewater and sewage sludge treatment and disposal processes for multiple scales, ranging from process selection to policy evaluation. The results of LCA are, in principle, unique to the goal and scope of each study, reflecting its local conditions and comparison between different LCAs is not intended. Furthermore, the assessments are limited by the methodological development of the life cycle impact assessment (LCIA) and the advancement of research in quantifying environmental emissions associated with wastewater and sewage sludge treatment processes. Thus, large discrepancies were found in the selection of the environmental emissions to be included and how they were estimated in the analysis. In order to reduce these choice uncertainties, consolidation of the modelling
approach in the following area are recommended: quantification of fugitive gas emissions and modelling of disposal practices. Besides harmonization of the key technical assumptions, clear documentation of the modelling approach and the uncertainties associating with each assumption is encouraged so as to improve the integrity and robustness of assessment.

**General information**

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Organisations: Department of Environmental Engineering, Residual Resource Engineering  
Contributors: Yoshida, H., Christensen, T. H., Scheutz, C.  
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Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 2  
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059  
Web of Science (2017): Impact factor 4.723  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 2  
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159  
Web of Science (2016): Impact factor 4.03  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 2  
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263  
Web of Science (2015): Impact factor 3.829  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49  
Web of Science (2014): Impact factor 3.22  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413  
Web of Science (2013): Impact factor 3.157  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18  
Web of Science (2012): Impact factor 2.485  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071  
Web of Science (2011): Impact factor 2.428  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 1.553 SNIP 1.821  
Web of Science (2010): Impact factor 2.358
Modelling sensitivity and uncertainty in a LCA model for waste management systems - EASETECH

In the new model, EASETECH, developed for LCA modelling of waste management systems, a general approach for sensitivity and uncertainty assessment for waste management studies has been implemented. First general contribution analysis is done through a regular interpretation of inventory and impact assessment results. Based on findings from this step, the user can carry out sensitivity analysis on numerous key parameters through the use of parameters at most input places. For every parameter the users can then specify a list of values, termed a numberlist, to represent different values for each parameter, that is then propagated throughout the model. This means that all results are obtained in the form of numberlists. In the next step, uncertainty propagation is done through the use of single probability distributions in lieu of the parameters. Uncertainty contribution analysis can next be generated based on the results of steps 1 & 2. The 4th step of combined sensitivity analysis can currently not be carried out graphically in the model, but can be performed by calculating in EASETECH for two scenarios’ results for different combinations of values for two parameters and extrapolating the results to delimitate the space of predominance of each scenario.
Modelling uncertainties in a LCA model for waste management systems - EASETECH

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Quantifying capital goods for waste incineration
Materials and energy used for the construction of modern waste incineration plants were quantified. The data was collected from five incineration plants (72,000–240,000 tonnes per year) built in Scandinavia (Norway, Finland and Denmark) between 2006 and 2012. Concrete for the buildings was the main material used amounting to 19,000–26,000 tonnes per plant. The quantification further included six main materials, electronic systems, cables and all transportation. The energy used for the actual on-site construction of the incinerators was in the range 4000–5000 MWh. In terms of the environmental burden of producing the materials used in the construction, steel for the building and the machinery contributed the most. The material and energy used for the construction corresponded to the emission of 7–14 kg CO₂ per tonne of waste combusted throughout the lifetime of the incineration plant. The assessment showed that, compared to data reported in the literature on direct emissions from the operation of incinerators, the environmental impacts caused by the construction of buildings and machinery (capital goods) could amount to 2–3% with respect to kg CO₂ per tonne of waste combusted.

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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
Quantifying capital goods for waste landfilling

Materials and energy used for construction of a hill-type landfill of 4 million m$^3$ were quantified in detail. The landfill is engineered with a liner and leachate collections system, as well as a gas collection and control system. Gravel and clay were the most common materials used, amounting to approximately 260 kg per tonne of waste landfilled. The environmental burdens from the extraction and manufacturing of the materials used in the landfill, as well as from the construction of the landfill, were modelled as potential environmental impacts. For example, the potential impact on global warming was 2.5 kg carbon dioxide (CO$_2$) equivalents or 0.32 milli person equivalents per tonne of waste. The potential impacts from the use of materials and construction of the landfill are low-to-insignificant compared with data reported in the literature on impact potentials of landfills in operation. The construction of the landfill is only a significant contributor to the impact of resource depletion owing to the high use of gravel and steel.

General information

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Organisations: Department of Environmental Engineering, COWI AS, LFG-Consult ApS
Contributors: Brogaard, L. K., Stentsøe, S., Willumsen, H. C., Christensen, T. H.
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  BFI (2018): BFI-level 1
  Web of Science (2018): Indexed yes
  BFI (2017): BFI-level 1
  Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
  Web of Science (2017): Impact factor 1.631
  Web of Science (2017): Indexed yes
  BFI (2016): BFI-level 1
  Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
  Web of Science (2016): Impact factor 1.803
  BFI (2015): BFI-level 1
  Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
  Web of Science (2015): Impact factor 1.338
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 1
  Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
  Web of Science (2014): Impact factor 1.297
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 1
  Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
  Web of Science (2013): Impact factor 1.114
  ISI indexed (2013): ISI indexed yes
  Web of Science (2013): Indexed yes
  BFI (2012): BFI-level 1
  Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
  Web of Science (2012): Impact factor 1.047
  ISI indexed (2012): ISI indexed yes
  Web of Science (2012): Indexed yes
  BFI (2011): BFI-level 1
  Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
  Web of Science (2011): Impact factor 1.193
  ISI indexed (2011): ISI indexed yes
Stochastic and epistemic uncertainty propagation in LCA

When performing uncertainty propagation, most LCA practitioners choose to represent uncertainties by single probability distributions and to propagate them using stochastic methods. However, the selection of single probability distributions appears often arbitrary when faced with scarce information or expert judgement (epistemic uncertainty). The possibility theory has been developed over the last decades to address this problem. The objective of this study is to present a methodology that combines probability and possibility theories to represent stochastic and epistemic uncertainties in a consistent manner and apply it to LCA. A case study is used to show the uncertainty propagation performed with the proposed method and compare it to propagation performed using probability and possibility theories alone. Basic knowledge on the probability theory is first recalled, followed by a detailed description of epistemic uncertainty representation using fuzzy intervals. The propagation methods used are the Monte Carlo analysis for probability distribution and an optimisation on alpha-cuts for fuzzy intervals. The proposed method (noted as Independent Random Set, IRS) generalizes the process of random sampling to probability distributions as well as fuzzy intervals, thus making the simultaneous use of both representations possible. The results highlight the fundamental difference between the probabilistic and possibilistic representations: while the Monte Carlo analysis generates a single probability distribution, the IRS method yields a family of probability distributions bounded by an upper and a lower distribution. The distance between these two bounds is the consequence of the incomplete character of information pertaining to certain parameters. In a real situation, an excessive distance between these two bounds might motivate the decision-maker to increase the information base regarding certain critical parameters, in order to reduce the uncertainty. Such a decision could not ensue from a purely probabilistic calculation based on subjective (postulated) distributions (despite lack of information), because there is no way of distinguishing, in the variability of the calculated result, what comes from true randomness and what comes from incomplete information. The method presented offers the advantage of putting the focus on the information.
rather than deciding a priori how to represent it. If the information is rich, then a purely statistical representation mode is adequate, but if the information is scarce, then it may be better conveyed by possibility distributions.
WEEE and portable batteries in residual household waste: Quantification and characterisation of misplaced waste

A total of 26.1 Mg of residual waste from 3129 households in 12 Danish municipalities was analysed and revealed that 89.6 kg of Waste Electrical and Electronic Equipment (WEEE), 11 kg of batteries, 2.2 kg of toners and 16 kg of cables had been wrongfully discarded. This corresponds to a Danish household discarding 29 g of WEEE (7 items per year), 4 g of batteries (9 batteries per year), 1 g of toners and 7 g of unidentifiable cables on average per week, constituting 0.34% (w/w), 0.04% (w/w), 0.01% (w/w) and 0.09% (w/w), respectively, of residual waste. The study also found that misplaced WEEE and batteries in the residual waste constituted 16% and 39%, respectively, of what is being collected properly through the dedicated special waste collection schemes. This shows that a large amount of batteries are being discarded with the residual waste, whereas WEEE seems to be collected relatively successfully through the dedicated special waste collection schemes. Characterisation of the misplaced batteries showed that 20% (w/w) of the discarded batteries were discarded as part of WEEE (built-in). Primarily alkaline batteries, carbon zinc batteries and alkaline button cell batteries were found to be discarded with the residual household waste. Characterisation of WEEE showed that primarily small WEEE (WEEE directive categories 2, 5a, 6, 7 and 9) and light sources (WEEE directive category 5b) were misplaced. Electric tooth brushes, watches, clocks, headphones, flashlights, bicycle lights, and cables were items most frequently found. It is recommended that these findings are taken into account when designing new or improving existing special waste collection schemes. Improving the collection of WEEE is also recommended as one way to also improve the collection of batteries due to the large fraction of batteries found as built-in. The findings in this study were comparable to other western European studies, suggesting that the recommendations made in this study could apply to other western European countries as well.

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A comparison of uncertainty propagation methods in an LCA study

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Contributors: Clavreul, J., Guyonnet, D., Christensen, T. H.
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A new modeling framework for environmental assessment of waste and energy systems

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Assessing recycling versus incineration of key materials in municipal waste: The importance of efficient energy recovery and transport distances

Recycling of materials from municipal solid waste is commonly considered to be superior to any other waste treatment alternative. For the material fractions with a significant energy content this might not be the case if the treatment alternative is a waste-to-energy plant with high energy recovery rates. The environmental impacts from recycling and from incineration of six material fractions in household waste have been compared through life cycle assessment assuming high-performance technologies for material recycling as well as for waste incineration. The results showed that there are environmental benefits when recycling paper, glass, steel and aluminium instead of incinerating it. For cardboard and
plastic the results were more unclear, depending on the level of energy recovery at the incineration plant, the system boundaries chosen and which impact category was in focus. Further, the environmental impact potentials from collection, pre-treatment and transport was compared to the environmental benefit from recycling and this showed that with the right means of transport, recyclables can in most cases be transported long distances. However, the results also showed that recycling of some of the material fractions can only contribute marginally in improving the overall waste management system taking into consideration their limited content in average Danish household waste.

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Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
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Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
Web of Science (2012): Impact factor 2.485
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071
Web of Science (2011): Impact factor 2.428
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Assessment of leaching from Construction & Demolition Waste concrete

Construction and demolition waste features two very important properties when considering its management options: the large amounts, and the low environmental hazardousness. Therefore, concrete waste can be recycled relatively easily: most common end-of-life option is utilization as unbound aggregates in road sub-bases, where it substitutes for natural aggregates such as gravel and crushed rocks.

However, leaching of heavy metals may occur in such uncontrolled environmental conditions, and become a limiting factor for utilization. Therefore, proper assessment of leaching is crucial. Different approaches exist, often implying unrealistic or not relevant conditions if compared to real life utilization scenarios.

A modified version of the CEN/TS 14405 column percolation test has been implemented on four crushed concrete samples, with the purpose of analysing the release of chromium, one of the elements of biggest concern. Main differences from the standard test include particles size, non saturated conditions and downflow intermittent watering.

The results of these experiments will be utilized to assess the actual potential for soil and groundwater pollution in a broader perspective.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Butera, S., Christensen, T. H., Astrup, T.
Number of pages: 5
Publication date: 2012

Host publication information
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Editors: Arm, M., Vandecasteele, C., Heynen, J., Suer, P., Lind, B.
Keywords: leaching, Concrete, Columns, Construction and demolition waste, Chromium
Source: dtu
Source-ID: u::4480
Research output: Research - peer-review › Article in proceedings – Annual report year: 2012
Bulky waste quantities and treatment methods in Denmark

Bulky waste is a significant and increasing waste stream in Denmark. However, only little research has been done on its composition and treatment. In the present study, data about collection methods, waste quantities and treatment methods for bulky waste were obtained from two municipalities. In addition a sorting analysis was conducted on combustible waste, which is a major fraction of bulky waste in Denmark. The generation of bulky waste was found to be 150–250 kg capita⁻¹ year⁻¹, and 90% of the waste was collected at recycling centres; the rest through kerbside collection. Twelve main fractions were identified of which ten were recyclable and constituted 50–60% of the total quantity. The others were combustible waste for incineration (30–40%) and non-combustible waste for landfilling (10%). The largest fractions by mass were combustible waste, bricks and tile, concrete, non-combustible waste, wood, and metal scrap, which together made up more than 90% of the total waste amounts. The amount of combustible waste could be significantly reduced through better sorting. Many of the waste fractions consisted of composite products that underwent thorough separation before being recycled. The recyclable materials were in many cases exported to other countries which made it difficult to track their destination and further treatment.

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State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Econet AS
Contributors: Larsen, A. W., Petersen, C., Christensen, T. H.
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BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Development of substance flow based Life Cycle Assessment tool for sewage sludge treatment and disposal

Life Cycle Assessment (LCA) is a method to quantify environmental impacts of products or systems. It is often done by correlating material and energy demands with certain input characteristics. An attempt was made to evaluate the robustness of the substance flow based LCA for wastewater and sludge treatment processes. Operational data of a conventional wastewater treatment plant over 12 years was collected. A cluster analysis was conducted to determine the relatedness of each input and output characteristic at the whole plant level. The results indicate that the output from the wastewater and sludge treatment processes correlate sufficiently with the solids content of wastewater influent, while energy use correlates with the total input volume. However, the correlations appeared to be stronger when individual treatment processes were separately analysed.

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State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Yoshida, H., Clavreul, J., Scheutz, C., Christensen, T. H.
Number of pages: 7
Publication date: 2012
Peer-reviewed: Yes
Event: Abstract from EcoTechnologies for Wastewater Treatment 2012 , Santiago de Compostela, Spain.

SUMMARY: Biomass and waste are expected to play a key role in future energy systems based on large shares of renewable energy resources. The LCA model EASETECH Energy was developed specifically for modelling large and complex energy systems including various technologies and several processing steps. The model allows simultaneous balancing of mass and energy flows of the system under assessment, and is equipped with advanced tools for sensitivity/uncertainty analysis. EASETECH Energy was used to assess the environmental footprint of the Danish energy system in 2050 (based on 100% renewables) and compare it to the current situation. The results show that the future Danish energy systems will have a rather different environmental footprint than the current one.

Environmental impact assessment of the incineration of municipal solid waste with auxiliary coal in China

The environmental impacts of waste incineration with auxiliary coal were investigated using the life-cycle-based software, EASEWASTE, based on the municipal solid waste (MSW) management system in Shuozhou City. In the current system, MSW is collected, transported, and incinerated with 250kg of coal per ton of waste. Based on observed environmental impacts of incineration, fossil CO2 and heavy metals were primary contributors to global warming and ecotoxicity in soil, respectively. Compared with incinerators using excess coal, incineration with adequate coal presents significant benefits in mitigating global warming, whereas incineration with a mass of coal can avoid more impacts to acidification, photochemical ozone and nutrient enrichment because of increased electricity substitution and reduced emission from coal power plants. The "Emission standard of air pollutants for thermal power plants (GB13223-2011)" implemented in 2012 introduced stricter policies on controlling SO2 and NOx emissions from coal power plants. Thus, increased use of auxiliary coal during incineration yields fewer avoided impacts on acidification and nutrient enrichment. When two-thirds of ash is source-separated and landfilled, the incineration of rest-waste presents better results on global warming, acidification, nutrient enrichment, and even ecotoxicity in soil. This process is considered a promising solution for MSW management in Shuozhou City. Weighted normalized environmental impacts were assessed based on Chinese political reduction targets. Results indicate that heavy metal and acidic gas emissions should be given more attention in waste incineration. This study provides scientific support for the management of MSW systems dominated by incineration with auxiliary coal in China.
Home composting as an alternative treatment option for organic household waste in Denmark: An environmental assessment using life cycle assessment-modelling

An environmental assessment of the management of organic household waste (OHW) was performed from a life cycle perspective by means of the waste-life cycle assessment (LCA) model EASEWASTE. The focus was on home composting of OHW in Denmark and six different home composting units (with different input and different mixing frequencies) were modelled. In addition, incineration and landfilling was modelled as alternatives to home composting. The most important processes contributing to the environmental impact of home composting were identified as greenhouse gas (GHG) emissions (load) and the avoided emissions in relation to the substitution of fertiliser and peat when compost was used in hobby gardening (saving). The replacement of fertiliser and peat was also identified as one of the most sensible parameters, which could potentially have a significant environmental benefit. Many of the impact categories (especially human toxicity via water (HTw) and soil (HTs)) were affected by the heavy metal contents of the incoming OHW. The concentrations of heavy metals in the compost were below the threshold values for compost used on land and were thus not considered to constitute a problem. The GHG emissions were, on the other hand, dependent on the management of the composting units. The frequently mixed composting units had the highest GHG emissions. The environmental profiles of the home composting scenarios were in the order of −2 to 16 milli person equivalents (mPE) Mg⁻¹ wet waste (ww) for the non-toxic categories and −0.9 to 28mPEMg⁻¹ ww for the toxic categories. Home composting performed better than or as good as incineration and landfilling in several of the potential impact categories. One exception was the global warming (GW) category, in which incineration performed better due to the substitution of heat and electricity based on fossil fuels.

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Contributors: Andersen, J., Boldrin, A., Christensen, T. H., Scheutz, C.
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Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Leaching of heavy metals from construction & demolition waste

General information
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Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Butera, S., Christensen, T. H., Astrup, T. F.
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Title of host publication: Crete 2012 - 3rd International Conference on Hazardous and Industrial Waste Management
Publisher: Technical University of Crete
Editors: Gidarokos, E., Cossu, R., Stegmann, R.
Source: dtu
Source-ID: u::5185
Research output: Research - peer-review › Article in proceedings – Annual report year: 2012

Livscyklusvurdering og samfundsøkonomisk vurdering af forskellige alternativer for håndtering og behandling af gipsaffald

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, COWI AS
Contributors: Møller, J., Butera, S., Martinez-Sanchez, V., Christensen, T. H., Kromann, M., Willumsen, E.
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121207 Livscyklusvurdering og samfundsøkonomisk vurdering af forskellige alternativer til håndtering af gipsaffald.pdf

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Source-ID: u::10439
Research output: Research - peer-review › Report – Annual report year: 2012

Metal recovery from high-grade WEEE: A life cycle assessment
Based on available data in the literature the recovery of aluminium, copper, gold, iron, nickel, palladium and silver from high-grade WEEE was modeled by LCA. The pre-treatment of WEEE included manual sorting, shredding, magnetic sorting, Eddy-current sorting, air classification and optical sorting. The modeled metallurgical treatment facility included a Kaldo plant, a converter aisle, an anode refinery and a precious metal refinery. The metallurgic treatment showed significant environmental savings when credited the environmental load from avoided production of the same amount of metals by mining and refining of ore. The resource recovery per tonne of high-grade WEEE ranged from 2 g of palladium to 386 kg of iron. Quantified in terms of person-equivalents the recovery of palladium, gold, silver, nickel and copper constituted the major environmental benefit of the recovery of metals from WEEE. These benefits are most likely underestimated in the model, since we did not find adequate data to include all the burdens from mining and refining of ore; burdens that are avoided when metals are recovered from WEEE. The processes connected to the pre-treatment of WEEE were found to have little environmental effect compared to the metallurgical treatment. However only 12-26% of silver, gold and palladium are recovered during pre-treatment, which suggest that the reduction of the apparent losses of precious metals as palladium, gold and silver during pre-treatment of WEEE is of environmental importance. Our results support in a quantitative manner that metal recovery from WEEE should be quantified with respect to the individual metals recovered and not as a bulk metal recovery rate.

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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Bigum, M., Brogaard, L. K., Christensen, T. H.
Pages: 8-14
The capital goods for collection and transport of waste were quantified for different types of containers (plastic containers, cubes and steel containers) and an 18-tonnes compacting collection truck. The data were collected from producers and vendors of the bins and the truck. The service lifetime and the capacity of the goods were also assessed. Environmental impact assessment of the production of the capital goods revealed that, per tonne of waste handled, the truck had the largest contribution followed by the steel container. Large high density polyethylene (HDPE) containers had the lowest impact per tonne of waste handled. The impact of producing the capital goods for waste collection and transport cannot be neglected as the capital goods dominate (>85%) the categories human-toxicity (non-cancer and cancer), ecotoxicity, resource depletion and aquatic eutrophication, but also play a role (>13%) within the other impact categories when compared with the impacts from combustion of fuels for the collection and transport of the waste, when a transport distance of 25 km was assumed.
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.56 SNIP 0.817

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Electronic versions:
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Quantifying uncertainty in LCA-modelling of waste management systems

Uncertainty analysis in LCA studies has been subject to major progress over the last years. In the context of waste management, various methods have been implemented but a systematic method for uncertainty analysis of waste-LCA studies is lacking. The objective of this paper is (1) to present the sources of uncertainty specifically inherent to waste-LCA studies, (2) to select and apply several methods for uncertainty analysis and (3) to develop a general framework for quantitative uncertainty assessment of LCA of waste management systems. The suggested method is a sequence of four steps combining the selected methods: (Step 1) a sensitivity analysis evaluating the sensitivities of the results with respect to the input uncertainties, (Step 2) an uncertainty propagation providing appropriate tools for representing uncertainties and calculating the overall uncertainty of the model results, (Step 3) an uncertainty contribution analysis quantifying the contribution of each parameter uncertainty to the final uncertainty and (Step 4) as a new approach, a combined sensitivity analysis providing a visualisation of the shift in the ranking of different options due to variations of selected key parameters. This tiered approach optimises the resources available to LCA practitioners by only propagating the most influential uncertainties.

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State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, BRGM
Contributors: Clavreul, J., Guyonnet, D., Christensen, T. H.
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Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
SEWAS (Sustainable European Waste Systems) Life cycle assessment of prospective integrated waste management schemes

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Møller, J., Grosso, M., Martinez-Sanchez, V., Clavreul, J., Barahona, K. L., Ramirez, S., Magnani, S., Christensen, T. H.
Publication date: 2012

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Title of host publication: Proceedings of Venice 2012 : Fourth International Symposium on Energy from Biomass and Waste
Research output: Research - peer-review › Article in proceedings – Annual report year: 2012
Solid waste characterization in Kétao, a rural town in Togo, West Africa

In Africa the majority of solid waste data is for big cities. Small and rural towns are generally neglected and waste data from these areas are often unavailable, which makes planning a proper solid waste management difficult. This paper presents the results from two waste characterization projects conducted in Kétao, a rural town in Togo during the rainy season and the dry season in 2010. The seasonal variation has a significant impact on the waste stream. The household waste generation rate was estimated at 0.22 kg person\(^{-1}\) day\(^{-1}\) in the dry season and 0.42 in the rainy season. Likewise, the waste moisture content was 4% in the dry season while it was 33–63% in the rainy season. The waste consisted mainly of soil and dirt characterized as ‘other’ (41%), vegetables and putrescibles (38%) and plastic (11%). In addition to these fractions, considerable amounts of material are either recycled or reused locally and do not enter the waste stream.

The study suggests that additional recycling is not feasible, but further examination of the degradability of the organic fraction is needed in order to assess whether the residual waste should be composed or landfilled.

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Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Edjabou, V. M. E., Møller, J., Christensen, T. H.
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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
Sustainable European Waste Systems “SEWAS”: Life cycle assessment of prospective integrated waste management schemes

General information
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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Polytechnic University of Milan, Technical University of Denmark
Contributors: Møller, J., Grosso, M., Rigamonti, L., Martinez-Sanchez, V., Clavreul, J., Barahona Ramirez, K. L., Magnani, S., Christensen, T. H.
Number of pages: 136
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Bibliographical note
A report for CEWEP Confederation of European Waste-to-Energy Plants
Research output: Research › Report – Annual report year: 2012
Anaerobic Digestion: Mass Balances and Products

While the basic processes involved in anaerobic digestion of waste are described in Chapter 9.4 and the main digestion technologies are presented in Chapter 9.5, this chapter focuses on mass balances, gas production and energy aspects, environmental emissions and unit process inventories. Understanding these issues and being able to account for them is a prerequisite in digestion engineering and for establishing and running a successful anaerobic digestion facility. Of specific importance is the final use of the digestate. Use in agriculture as a fertilizer is described in Chapter 9.10 and use after composting of the digestate as a soil amendment product is analogous to issues presented in Chapter 9.9 for compost.

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Møller, J., Christensen, T. H., Jansen, J. L. C.
Pages: 618-627
Publication date: 2011

Charaterization of household waste in Greenland
The composition of household waste in Greenland was investigated for the first time. About 2 tonnes of household waste was sampled as every 7th bag collected during 1 week along the scheduled collection routes in Sisimiut, the second largest town in Greenland with about 5400 inhabitants. The collection bags were sorted manually into 10 material fractions. The household waste composition consisted primarily of biowaste (43%) and the combustible fraction (30%), including anything combustible that did not belong to other clean fractions as paper, cardboard and plastic. Paper (8%) (dominated by magazine type paper) and glass (7%) were other important material fractions of the household waste. The
remaining approximately 10% constituted of steel (1.5%), aluminum (0.5%), plastic (2.4%), wood (1.0%), non-combustible waste (1.8%) and household hazardous waste (1.2%). The high content of biowaste and the low content of paper make Greenlandic waste much different from Danish household waste. The moisture content, calorific value and chemical composition (55 elements, of which 22 were below detection limits) were determined for each material fraction. These characteristics were similar to what has been found for material fractions in Danish household waste. The chemical composition and the calorific value of the plastic fraction revealed that this fraction was not clean but contained a lot of biowaste. The established waste composition is useful in assessing alternative waste management schemes for household waste in Greenland.

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Contributors: Eisted, R., Christensen, T. H.
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Web of Science (2017): Indexed yes
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
Web of Science (2012): Impact factor 2.485
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071
Web of Science (2011): Impact factor 2.428
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Commercial and Institutional Waste

Commercial and institutional waste is primarily from retail (stores), hotels, restaurants, health care (except health risk waste), banks, insurance companies, education, retirement homes, public services and transport. Within some of these sectors, e.g. retail and restaurants, large variations are found in terms of which products and services are offered. Available data on unit generation rates and material composition as well as determining factors are discussed in this chapter. The characterizing of commercial and institutional waste is faced with the problem that often only a part of the waste is handled in the municipal waste system, where information is easily accessible. An important part of commercial and institutional waste is packaging waste, and enterprises with large quantities of clean paper, cardboard and plastic waste may have their own facilities for baling and storing their waste, which then can be sold to wholesale companies within the secondary raw material sector. The data presented in this chapter is from many different sources and should be used with caution only.

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Composting: Mass Balances and Product Quality

While the basic processes involved in composting of waste are described in Chapter 9.1 and the main composting technologies are presented in Chapter 9.2, this chapter focuses on mass balances, environmental emissions, unit process inventories and the quality of the compost produced. Understanding these issues and being able to account for them is a prerequisite in compost engineering and for establishing and running a successful composting facility. Of specific importance is the final use of the compost product. Use in agriculture is described in Chapter 9.10 and the use of compost in soil amendment products are presented in Chapter 9.9.

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Construction and Demolition Waste

Construction and demolition waste (C&D waste) is the waste generated during the building, repair, remodeling or removal of constructions. The constructions can be roads, residential housing and nonresidential buildings. C&D waste has traditionally been considered without any environmental problems and has just been landfilled. However, in recent years more focus has been put on C&D waste and data are starting to appear. One reason is that it has been recognized that C&D waste may include many materials that are contaminated either as part of their original design or through their use and therefore should be managed accordingly. Another reason is that it has been documented that a large fraction of C&D waste (about 90%) can be easily recycled and thus can conserve landfill capacity. C&D waste may conveniently be divided into three subcategories: Buildings, roads and excavations. This chapter describes and, where possible, provides quantitative information about C&D waste. C&D waste appears also in large quantities during war and natural catastrophes, but this kind of C&D waste is of a somewhat different nature due to its chaotic generation and potential pathogenic and ethical issues. Such waste is not included in this chapter.

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Environmental Aspects Of Home Composting Of Organic Household Waste

Six composting units were monitored during a two-year long experimental campaign. Data regarding chemical compositions of waste inputs and outputs, gaseous emissions and leachate productions were collected, organized in mass balances and assessed by means of LCA. The management of the home composting unit was very relevant for the environmental performance of home composting, as the turning frequency influence the emissions of CH4 which is the main responsible for potential impacts on global warming. Results showed that overall home composting has low environmental impacts (between -2 and 16 mPE Mg-1ww for the non-toxic categories and between -0.9 and 28 mPE Mg-1ww for the toxic categories) and has similar or even better environmental profile that incineration and landfilling in some of the impact categories.
Environmental assessment of different management options for individual waste fractions by means of life-cycle assessment modelling

Several alternatives exist for handling of individual waste fractions, including recycling, incineration and landfilling. From an environmental point of view, the latter is commonly considered as the least desirable option. Many studies based on life-cycle assessment (LCA) highlight the environmental benefits offered by incineration and especially by recycling. However, the landfilling option is often approached unjustly in these studies, maybe disregarding the remarkable technological improvements that landfills have undergone in the last decades in many parts of the world. This study, by means of LCA-modelling, aims at comparing the environmental performance of three major management options (landfilling, recycling and incineration or composting) for a number of individual waste fractions. The landfilling option is here approached comprehensively, accounting for all technical and environmental factors involved, including energy generation from landfill gas and storage of biogenic carbon. Leachate and gas emissions associated to each individual waste fraction have been estimated by means of a mathematical modelling. This approach towards landfilling emissions allows for a more precise quantification of the landfill impacts when comparing management options for selected waste fractions. Results from the life-cycle impact assessment (LCIA) show that the environmental performance estimated for landfilling with energy recovery of the fractions “organics” and “recyclable paper” is comparable with composting (for “organics”) and incineration (for “recyclable paper”). This however requires high degree of control over gas and leachate emissions, high gas collection efficiency and extensive gas utilization at the landfill. For the other waste fractions, recycling and incineration are favourable, although specific emissions of a variety of toxic compounds (VOCs, PAHs, NOx, heavy metals, etc.) may significantly worsen their environmental performance.
Environmental assessment of garden waste management in the Municipality of Aarhus, Denmark

An environmental assessment of six scenarios for handling of garden waste in the Municipality of Aarhus (Denmark) was performed from a life cycle perspective by means of the LCA-model EASEWASTE. In the first (baseline) scenario, the current garden waste management system based on windrow composting was assessed, while in the other five scenarios alternative solutions including incineration and home composting of fractions of the garden waste were evaluated. The environmental profile (normalised to Person Equivalent, PE) of the current garden waste management in Aarhus is in the order of −6 to 8mPEMg−1ww for the non-toxic categories and up to 100mPEMg−1ww for the toxic categories. The
potential impacts on non-toxic categories are much smaller than what is found for other fractions of municipal solid waste. Incineration (up to 35% of the garden waste) and home composting (up to 18% of the garden waste) seem from an environmental point of view suitable for diverting waste away from the composting facility in order to increase its capacity. In particular the incineration of woody parts of the garden waste improved the environmental profile of the garden waste management significantly.
Environmental evaluation of municipal waste prevention

Waste prevention has been addressed in the literature in terms of the social and behavioural aspects, but very little quantitative assessment exists of the environmental benefits. Our study evaluates the environmental consequences of waste prevention on waste management systems and on the wider society, using life-cycle thinking. The partial prevention of unsolicited mail, beverage packaging and food waste is tested for a “High-tech” waste management system relying on high energy and material recovery and for a “Low-tech” waste management system with less recycling and relying on landfilling. Prevention of 13% of the waste mass entering the waste management system generates a reduction of loads and savings in the waste management system for the different impacts categories; 45% net reduction for nutrient enrichment and 12% reduction for global warming potential. When expanding our system and including avoided production incurred by the prevention measures, large savings are observed (15-fold improvement for nutrient enrichment and 2-fold for global warming potential). Prevention of food waste has the highest environmental impact saving. Prevention generates relatively higher overall relative benefit for “Low-tech” systems depending on landfilling. The paper provides clear evidence of the environmental benefits of waste prevention and has specific relevance in climate change mitigation.

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Environmental impact assessment of solid waste management in Beijing City, China

The environmental impacts of municipal solid waste management in Beijing City were evaluated using a life-cycle-based model, EASEWASTE, to take into account waste generation, collection, transportation, treatment/disposal technologies, and savings obtained by energy and material recovery. The current system, mainly involving the use of landfills, has manifested significant adverse environmental impacts caused by methane emissions from landfills and many other emissions from transfer stations. A short-term future scenario, where some of the landfills (which soon will reach their capacity because of rising amount of waste in Beijing City) are substituted by incinerators with energy recovery, would not result in significant environmental improvement. This is primarily because of the low calorific value of mixed waste, and it is likely that the incinerators would require significant amounts of auxiliary fuels to support combustion of wet waste. As for the long-term future scenario, efficient source separation of food waste could result in significant environmental improvements, primarily because of increase in calorific value of remaining waste incinerated with energy recovery. Sensitivity analysis emphasized the importance of efficient source separation of food waste, as well as the electricity recovery in incinerators, in order to obtain an environmentally friendly waste management system in Beijing City.

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Incineration: Utilization of Residue in Construction

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Contributors: Arm, M., Eighmy, T., Christensen, T. H.
Industrial Waste

Industrial waste is waste from industrial production and manufacturing. Industry covers many industrial sectors and within each sector large variations are found in terms of which raw materials are used, which production technology is used and which products are produced. Available data on unit generation rates and material composition as well as determining factors are discussed in this chapter. Characterizing industrial waste is faced with the problem that often only a part of the waste is handled in the municipal waste system, where information is easily accessible. In addition part of the industrial waste may in periods, depending on market opportunities and prices, be traded as secondary raw materials. Production-specific waste from primary production, for example steel slag, is not included in the current presentation. In some countries industries must be approved or licensed and as part of the system industry has to inform at the planning stage and afterwards in yearly reports on their waste arising and how the waste is managed. If available such information is very helpful in obtaining information about that specific industry. However, in many countries there is very little information available about industrial waste – maybe also influenced by the policy of the industry as to making information publicly available. The data presented in this chapter is scarce and maybe not fully representative for the industrial sectors and hence should be used with caution only.

Introduction to Waste Economics

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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Merrild, H. K., Christensen, T. H.
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Introduction to Waste Engineering
Solid waste management as introduced in Chapter 1.1 builds in many ways on engineering. Waste engineering here means the skills and ability to understand quantitatively how a waste management system works in such a detail that waste management can be planned, facilities can be designed and sited and systems can be operated in a way that is environmentally sound, technically feasible, economically efficient and socially acceptable. This applies to all scales of relevance: (1) national surveys of energy use and material flows determining the frame for politically setting goals in waste management, (2) regional plans for waste management, including (3) the selection of main management technologies and siting of facilities, (4) the design of individual technological units and, for example, (5) the operation of recycling schemes within a municipality. This chapter gives an introduction to waste engineering, including issues such as terminology, material flow analysis, mass balances, energy budgets and emission accounts. The concept of unit process inventories is also introduced.

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Introduction to Waste Management
Solid waste management is as old as human civilization, although only considered an engineering discipline for about one century. The change from the previous focus on public cleansing of the cities to modern waste management was primarily driven by industrialization, which introduced new materials and chemicals, dramatically changing the types and composition of waste, and by urbanization making waste management in urban areas a complicated and costly logistic operation. This book focuses on waste that commonly appears in the municipal waste management system. This chapter gives an introduction to modern waste management, including issues as waste definition, problems associated with waste, waste management criteria and approaches to waste management. Later chapters introduce aspects of engineering (Chapter 1.2), economics (Chapter 1.3) and regulation (Chapter 1.4).

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Landfilling: Bottom Lining and Leachate Collection
The critical element of a landfill, which is essential for the protection of the environment in general, and prevention of contamination of the underlying soils and groundwater in particular, is the bottom lining system. The major focus of the bottom lining system development is to prevent leachate from entering the groundwater or surface water. The bottom lining system should cover the full footprint area of the landfill, including both the relatively flat bottom and the sideslopes in the case of an excavated configuration. This prevents the lateral migration of leachate from within the landfill, as well as the migration of landfill gas, preventing contact between gas and groundwater. The bottom lining system is composed of a relatively impermeable liner or lining system. This very low hydraulic conductivity system controls the movement of the leachate out of the landfill. The bottom lining system works together with the overlying leachate management system, also referred to as the leachate collection and removal system (LCRS), which consists of a drainage layer that provides easy
horizontal drainage of the leachate to a point of gravitational collection or pumping. Although individual liners, whether composed of soils or geosynthetic barriers, are able to prevent leachate emission to the environment for a relatively long time (50 years or longer), it should be realized that no liner is 100% efficient. However, modern lining systems, which include composite liners and multiple (double, or even triple) liners, are extremely effective in preventing leachate from entering into the environment. In addition, the risk of polluting the groundwater at a landfill by any leakage of leachate depends on several factors related to siting of the landfill: distance to the water table, distance to surface water bodies, and the properties of the soil beneath the landfill. In addition to the lining and drainage systems described in this chapter, the siting and hydrogeology of the landfill site (Chapter 10.12) and the top cover (Chapter 10.9) are also part of the barrier system, contributing to reducing the environmental risk associated with landfills. This chapter provides information about the materials used in the construction of liners and drainage systems, tools to calculate migrations through liners, as well as information about requirements for lining systems in the European Union (EU) and the United States (USA).
the technical environmental protection measures introduced, the daily operation and the timescale. This chapter describes the main potential environmental impacts from landfills. The modern landfill is able to avoid most of these impacts. However, in the planning and design of landfills it is important to understand the potential environmental impacts, which must be avoided. The emissions of landfill gas and leachate causing most of the environmental risks are described in detail in the chapters addressing specific landfill types: Chapter 10.5 (mineral waste landfill), Chapter 10.6 (reactor landfill) and Chapter 10.7 (pretreated waste landfill).

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Landfilling: Reactor Landfills

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LCA and economic evaluation of landfill leachate and gas technologies
Landfills receiving a mix of waste, including organics, have developed dramatically over the last 3–4 decades; from open dumps to engineered facilities with extensive controls on leachate and gas. The conventional municipal landfill will in most climates produce a highly contaminated leachate and a significant amount of landfill gas. Leachate controls may include bottom liners and leachate collection systems as well as leachate treatment prior to discharge to surface water. Gas controls may include oxidizing top covers, gas collection systems with flares or gas utilization systems for production of electricity and heat. The importance of leachate and gas control measures in reducing the overall environmental impact from a conventional landfill was assessed by life-cycle-assessment (LCA). The direct cost for the measures were also estimated providing a basis for assessing which measures are the most cost-effective in reducing the impact from a conventional landfill. This was done by modeling landfills ranging from a simple open dump to highly engineered conventional landfills with energy recovery in form of heat or electricity. The modeling was done in the waste LCA model EASEWASTE. The results showed drastic improvements for most impact categories. Global warming went from an impact of 0.1 person equivalent (PE) for the dump to ~0.05 PE for the best design. Similar improvements were found for photochemical ozone formation (0.02 PE to 0.002 PE) and stratospheric ozone formation (0.04 PE to 0.001 PE). For the toxic and spoiled groundwater impact categories the trend is not as clear. The reason for this was that the load to the environment shifted as more technologies were used. For the dump landfill the main impacts were impacts for spoiled groundwater due to lack of leachate collection, 2.3 PE down to 0.4 PE when leachate is collected. However, at the same time, leachate collection causes a slight increase in eco-toxicity and human toxicity via water (0.007E to 0.013PE and 0.002 to 0.003 PE respectively). The reason for this is that even if the leachate is treated, slight amounts of contaminants are released through emissions of treated wastewater to surface waters. The largest environmental improvement with regard to the direct cost of the landfill was the capping and leachate treatment system. The capping, though very cheap to establish, gave a huge benefit in lowered impacts, the leachate collection system though expensive gave large benefits as well. The other gas measures were found to give further improvements, for a minor increase in cost.
Lifecycle assessment (LCA) modeling provides a quantitative statement about resource issues and environmental issues in waste management useful in evaluating alternative management systems and in mapping where major loads and savings take place within existing systems. Chapter 3.1 describes the concepts behind LCA modeling and Chapter 3.2 gives an overview of existing models and shows examples of their application. A recent comprehensive review of publicly available LCA studies (WRAP, 2006) concluded that, on a material basis, LCA modeling in general confirms the validity of the waste hierarchy and shows that recycling is superior to incineration with energy recovery, which again is better than landfilling. Cleary (2010) reviewed 20 waste management scenarios assessed in 11 studies published in the period 2002–2008 and concluded that, due to lack of transparency regarding boundary conditions and exchange with the energy systems, a comparison of results was hampered on a system level. In addition, differences in waste composition may affect the LCA results. This chapter provides results of LCA modeling of 40 waste management scenarios handling the same municipal waste (MSW) and using different combinations of waste recycling, biological treatment, incineration, mechanical–biological treatment and landfilling. The purpose is to compare waste management on a system level and to indentify the steps and treatments within the system contributing the most to the environmental performance of waste management systems. The study focuses on Europe in terms of waste composition and exchange with the energy system. The waste management systems modeled are described with respect to waste composition, waste management technologies, mass flows and energy exchange in the systems. Results are first presented with respect to Global Warming contributions (kg of CO2-eq./t of waste). These data are identical to those presented in Christensen et al. (2009). Finally also results for other impact categories are presented.
LCA of Recycling Options for Gypsum from Construction and Demolition Waste

Large amounts of gypsum waste are annually produced from the construction and demolition sector. Its landflling is becoming more and more expensive due to stricter EU regulations, while its recycling together with the rest of construction and demolition waste might be hampered due to technical restrictions; source separation, however, makes gypsum waste recycling feasible. Different alternatives for recycling exist, but their overall environmental impacts have never been quantified and compared in details. This study investigates from a life cycle perspective the environmental impacts of two of the four main recycling options currently carried out in Denmark: recycling for production of new gypsum plasterboards, and utilization on land mixed with compost as soil amendment. Life cycle assessment results indicate that the option of gypsum recycling to new plasterboard provides environmental savings for most of the impact categories and proves to be more environmentally friendly than the alternative of use on land; substitution of virgin gypsum is one of the key parameters.

Life cycle assessment of capital goods related to waste incineration

The environmental impacts from the life cycle of products and systems were evaluated using Life Cycle Assessment (LCA) as a tool. Today most LCAs of waste management systems only considers the impacts from the operation of the system but neglects the environmental impacts from construction, maintenance and demolition of capital goods. Capital goods are defined as buildings, machinery, trucks and infrastructure at the facility. A LCA was performed using two modelling programmes: Simapro and EASEWASTE. This paper assesses the importance of including capital goods when performing LCAs of waste incineration with efficient energy recovery. The environmental costs of the capital goods related to an incinerator was assessed and compared to the operation of the incinerator. The environmental loads from the capital goods were found to be insignificant compared to the benefits from the energy recovery from the operation of the system. The reason for this is the significant savings on all impacts categories from energy substitution. The study also found that the resource consumption for the capital goods is not negligible when assessing the life cycle of an incineration plant.
scrubber was quantified from the stoichiometric reaction of NOx and ammonia assuming no other reaction products was formed. Of the ammonia slip, 37% was associated with the fly-ash and 63% was in the effluent of the acidic scrubber. Based on NOx-cleaning efficiency, the fate of the ammonia slip as well as the environmental impact from ammonia production, the potential acidification and nutrient enrichment from NOx-cleaning was calculated as a function of ammonia dosage. Since the exact fate of the ammonia slip could not be measured directly, a number of scenarios were set up ranging from “best case” with no ammonia from the slip ending up in the environment to “worst case” where all the ammonia slip eventually ended up in the environment and contributed to environmental pollution. In the “best case” scenario the highest ammonia dosage was most beneficial demonstrating that the environmental load associated with ammonia production is of minor importance. In contrast, in a “worst case” scenario NOx-cleaning using SNCR is not recommendable at all, since the impacts from the ammonia slip exceed the saved impacts from the NOx removal. Increased dosage of ammonia for removal of NOx is recommendable as long as less than 10–20% of the ammonia slip to the effluent of the acidic scrubber ends up in the environment and less than 40% of the slip to the fly-ash ends up in the environment. The study suggests that the actual fate of the ammonia slip is crucial, but since the release of the ammonia may take place during transport and at the facilities that treat the wastewater and treat the fly-ash this factor depends strongly on local conditions and may be hard to determine. Thus, LCA-modeling proved useful in assessing the balance between ammonia dosage and NOx-removal in flue-gas cleaning from waste incineration.
Mass balances and life cycle inventory of home composting of organic waste

A comprehensive experimental setup with six single-family home composting units was monitored during 1 year. The composting units were fed with 2.6–3.5 kg organic household waste (OHW) per unit per week. All relevant consumptions and emissions of environmental relevance were addressed and a full life-cycle inventory (LCI) was established for the six home composting units. No water, electricity or fuel was used during composting, so the major environmental burdens were gaseous emissions to air and emissions via leachate. The loss of carbon (C) during composting was 63–77% in the six composting units. The carbon dioxide (CO2) and methane (CH4) emissions made up 51–95% and 0.3–3.9% respectively of the lost C. The total loss of nitrogen (N) during composting was 51–68% and the nitrous oxide (N2O) made up 2.8–6.3% of this loss. The NH3 losses were very uncertain but small. The amount of leachate was 130 L Mg−1 wet waste (ww) and the composition was similar to other leachate compositions from home composting (and centralised composting) reported in literature. The loss of heavy metals via leachate was negligible and the loss of C and N via leachate was very low (0.3–0.6% of the total loss of C and 1.3–3.0% of the total emitted N). Also the compost composition was within the typical ranges reported previously for home composting. The level of heavy metals in the compost produced was below all threshold values and the compost was thus suitable for use in private gardens.

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Mechanical Biological Treatment

The basic processes and technologies of composting and anaerobic digestion, as described in the previous chapters, are usually used for specific or source-separated organic waste flows. However, in the 1990s mechanical biological waste treatment technologies (MBT) were developed for unsorted or residual waste (after some recyclables removed at the source). The concept was originally to reduce the amount of waste going to landfill, but MBT technologies are today also seen as plants recovering fuel as well as material fractions. As the name suggests the technology combines mechanical treatment technologies (screens, sieves, magnets, etc.) with biological technologies (composting, anaerobic digestion).

Two main technologies are available: Mechanical biological pretreatment (MBP), which first removes an RDF fraction and then biologically treats the remaining waste before most of it is landfilled, and mechanical biological stabilization (MBS), which first composts the waste for drying prior to extraction of a large RDF fraction. Only a small fraction is landfilled. The latter technology is also referred to as biodrying. Within each of the two main technologies, a range of variations is available depending on waste received and routing of the RDF fraction. This chapter offers an introduction to the two technologies. Box 9.7.1 shows the types of MBT plants found in Germany.

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Mechanical Treatment: Material Recovery Facilities

A wide variety of mechanical treatment unit processes, including manual sorting, is described in Chapter 7.1. These unit processes may be used as a single separate operation (e.g. baling of recyclable cardboard) or as a single operation before or after biological and thermal treatment processes (e.g. shredding prior to incineration or screening after composting). The mechanical treatment unit process is in the latter case an integrated part of the overall treatment usually with the purpose of improving the quality of the input material, or the efficiency or stability of the biological or thermal process, or improving the quality of the output material. Examples hereof appear in the chapters on biological and thermal
treatment. Mechanical treatment unit processes may also appear at industries using recycled material as part of their feedstock, for example, for removing impurities and homogenizing the material. Examples hereof appear in the chapters describing the recycling of materials. Mechanical treatment unit processes most often perform only one function, but placing different mechanical unit processes in a series or 'treatment train' creating a material recovery facility, often called an MRF, output materials of much higher quality and value can be obtained. This chapter describes the key issues of material recovery facilities (MRFs). Box 7.2.1 describes the historical aspects of MRFs.

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Contributors: Christensen, T. H., Bilitewski, B.
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Modelling of environmental impacts from biological treatment of organic municipal waste in EASEWASTE
The waste-LCA model EASEWASTE quantifies potential environmental effects from biological treatment of organic waste, based on mass and energy flows, emissions to air, water, soil and groundwater as well as effects from upstream and downstream processes. Default technologies for composting, anaerobic digestion and combinations hereof are available in the model, but the user can change all key parameters in the biological treatment module so that specific local plants and processes can be modelled. EASEWASTE is one of the newest waste LCA models and the biological treatment module was built partly on features of earlier waste-LCA models, but offers additional facilities, more flexibility, transparency and user-friendliness. The paper presents the main features of the module and provides some examples illustrating the capability of the model in environmentally assessing and discriminating the environmental performance of alternative biological treatment technologies in relation to their mass flows, energy consumption, gaseous emissions, biogas recovery and compost/digestate utilization.

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Contributors: Boldrin, A., Neidel, T. L., Damgaard, A., Bhande, G. S., Møller, J., Christensen, T. H.
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Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
Other Special Waste
In addition to the main types of special waste related to municipal solid waste (MSW) mentioned in the previous chapters (health care risk waste, WEEE, impregnated wood, hazardous waste) a range of other fractions of waste have in some countries been defined as special waste that must be handled separately from MSW. Some of these other special wastes are briefly described in this chapter with respect to their definition, quantity and composition, and management options. The special wastes mentioned here are batteries, tires, polyvinylchloride (PVC) and food waste.

Quantification Of Greenhouse Gases From Three Danish Composting Facilities
A measurement method combining a controlled trace gas release with downwind concentrations measurements was successfully used to quantify greenhouse gas (GHG) emissions from three Danish open windrow composting facilities. Overall, the results showed that composting of organic waste generate GHG emissions in terms of methane (CH4) and nitrous oxide (N2O) and thus contribute to climate change. At all three facilities significant CH4 emissions were occurring. The CH4 emission varied between 0.50 and 5.73 kg CH4 h-1. The highest CH4 emission (5.73 kg CH4 h-1) were measured at the Aarhus composting facility and was believed to be a result of the windrow lay-out with very broad and high windrows and a low turning frequency. The lowest CH4 emission (0.50 kg CH4 h-1) was measured at Fakse composting area and was most likely a result of the relatively small windrows and frequent weekly turnings. For all three facilities, the N2O emissions were significantly smaller than the CH4 emissions ranging from 0.08 to 1.18 kg N2O h-1.
Recycling of Glass
Glass is used for many purposes, but in the waste system glass is predominantly found in terms of beverage and food containers with a relatively short lifetime before ending up in the waste. Furthermore there is a large amount of flat glass used in building materials which also ends up in the waste system; this glass though has a long lifetime before ending up in the waste. Altogether these product types add up to 82% of the production of the European glass industry (IPCC, 2001). Recycling of glass in terms of cleaning and refilling of bottles as well as the use of broken glass in the production of new glass containers is well established in the glass industry. This chapter describes briefly how glass is produced and how waste glass is recycled in the industry. Quality requirements and use of recycled products are discussed, as are the resource and environmental issues of glass recycling.

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Contributors: Christensen, T. H., Damgaard, A.
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Recycling of Metals
Metals like iron and aluminium are produced from mineral ore and used for a range of products, some of which have very short lifetimes and thus constitute a major fraction of municipal waste. Packaging in terms of cans, foils and containers are products with a short lifetime. Other products like appliances, vehicles and buildings, containing iron and aluminium metals, have long lifetimes before they end up in the waste stream. The recycling of production waste and postconsumer metals has a long history in the metal industry. Some metal smelters are today entirely based on scrap metals. This chapter describes briefly how iron and aluminium are produced and how scrap metal is recycled in the industry. Quality requirements and use of recycled products are discussed, as are the resource and environmental issues of metal recycling. Copper and other metals are also found in waste but in much smaller quantities than iron and aluminium; and the majority of these metals are found in waste electrical and electronic equipment (WEEE). A description of this can be found in Chapter 11.2.

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Contributors: Damgaard, A., Christensen, T. H.
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Recycling of Paper and Cardboard

Paper and cardboard are produced from pulp derived from plant fibers, primarily wood. Paper and cardboard is used for many different products, such as for packaging material, newsprint and advertisements. Most of these products have very short lifetimes and thus constitute a major fraction of most waste. Recycling of paper and cardboard production waste and postconsumer waste has a long history in the pulp and paper industry. The recycled material now makes up more than half of the raw material used in European pulp and paper industry (ERPC, 2004). This chapter describes briefly how paper and cardboard are produced and how waste paper is recycled in the industry. Quality requirements and use of recycled products are discussed, as are the resource and environmental issues of paper recycling.

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Recycling of Plastic

Plastic is produced from fossil oil. Plastic is used for many different products. Some plastic products like, for example, wrapping foil, bags and disposable containers for food and beverage have very short lifetimes and thus constitute a major fraction of most waste. Other plastic products like, for example, gutters, window frames, car parts and transportation boxes have long lifetimes and thus appear as waste only many years after they have been introduced on the market. Plastic is constantly being used for new products because of its attractive material properties: relatively cheap, easy to form, good strength and long durability. Recycling of plastic waste from production is well-established, while recycling of postconsumer plastic waste still is in its infancy. This chapter describes briefly how plastic is produced and how waste plastic is recycled in the industry. Quality requirements and use of recycled products are discussed, as are the resource and environmental issues of plastic recycling.

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Residential Waste

Residential waste comes from residential areas with multi-family and single-family housing and includes four types of waste: household waste, garden waste, bulky waste and household hazardous waste. Typical unit generation rates, material composition, chemical composition and determining factors are discussed in this chapter. Characterizing residential waste is faced with the problem that many residences already divert some waste away from the official collection systems, for example performing home composting of vegetable waste and garden waste, having their bundled newspaper picked up by the scouts twice a year or bringing their used furniture to the flea markets organized by charity clubs. Thus, much of the data available on residential waste represents collected waste and not necessarily all generated waste. The latter can only be characterized by careful studies directly at the source, but such studies are very expensive if fair representation of both spatial and temporal variations should be obtained. In addition, onsite studies may affect the waste generation in the residence because of the increased focus on the issue. Residential waste is defined in different ways in different countries, which makes a comparison among countries difficult. In addition the statistical base may vary
among countries. The difficulties in comparing data from various European countries are clearly described by Fischer and Crowe (2000). The data presented in this chapter therefore should be used with care.

Source Segregation and Collection of Source-Segregated Waste

The Segregation of individual material fractions at the waste source and keeping the fractions separate for collection is one of the key issues in modern waste management. In most cases the waste is just kept segregated from other waste according to certain criteria that improve the possibility of optimal handling of the waste. But in a few cases, the waste must also be separated at source, for example removing the protective plastic cover from a commercial advertisement received by mail, prior to putting the advertisement into the waste collection bin for recyclable paper. These issues are often termed source separation or sorting at source. Here the word segregation has been chosen to indicate the importance of keeping the waste fractions apart by sorting waste and by separating waste into segregated materials as it is generated. The more waste that a physically defined source generates the more important it is to consider source segregation of the waste, since the amount of waste links to the possibility of obtaining manageable amounts of segregated waste with reasonable logistics as well as to the manpower that can be allocated at the source to perform source segregation of waste. Therefore, source segregation usually makes most sense in industry, where the waste often also is more well defined and cleaner, while residential waste containing relatively small amounts of each material fraction is a bigger and much more difficult challenge. This chapter describes the main issues in wastes segregation addressing: - Purpose of source segregation. - Segregation criteria and guidance. - Segregation potentials and efficiencies. - Systems for collecting segregated fraction.
Uncertainties in life cycle assessment of waste management systems

Life cycle assessment has been used to assess environmental performances of waste management systems in many studies. The uncertainties inherent to its results are often pointed out but not always quantified, which should be the case to ensure a good decisionmaking process. This paper proposes a method to assess all parameter uncertainties and quantify the overall uncertainty of the assessment. The method is exemplified in a case study, where the goal is to determine if anaerobic digestion of organic waste is more beneficial than incineration in Denmark, considering only the impact on global warming. The sensitivity analysis pointed out ten parameters particularly highly influencing the result of the study. In the uncertainty analysis, the distributions of these ten parameters were used in a Monte Carlo analysis, which concluded that incineration appeared more favourable than anaerobic digestion in 91% of the cases.

Waste Characterization: Approaches and Methods

Characterization of solid waste is usually a difficult task because of the heterogeneity of the waste and its spatial as well as temporal variations. This makes waste characterization costly if good and reliable data with reasonable uncertainty is to be obtained. Therefore, a waste characterization is often narrowly defined to meet specific needs for information. This may however limit the general usefulness of the information gained, for example, if the specific purpose limited the characterization to a subset of variables. In general, data available in the solid waste area are limited and often with limited representation. This chapter describes common approaches and methods in waste characterization including common terms, sampling, characterization methods and data evaluation. The focus is on the characterization of waste as it is generated or collected, while specific issues on characterization related to individual treatment processes and waste products are dealt with in the following chapters: Characteristic data on residential waste (Chapter 2.2), commercial and institutional waste (Chapter 2.3), industrial waste (Chapter 2.4) and construction and demolition waste (Chapter 2.5). If information about waste is required, it is always advisable to check the literature and the internet to see if relevant data is available already. However, in all cases the relevance of the data with respect to cultural, climatic and economical basis as well as the quality and age of the data available must be carefully assessed.
Waste Collection: Systems and Organization

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Waste Electrical and Electronic Equipment
Waste electrical and electronic equipment (WEEE) is one of the fastest growing special waste types with an estimated growth of 3–5% per year (Cui and Forssberg, 2003). WEEE is a very heterogeneous waste type that contains many compounds that are considered to be harmful to both humans and the environment, as well as many metals that have the potential of being recycled and reused. This makes the waste fraction (WEEE) very interesting as it is a problematic waste as well as an important secondary resource.

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Waste management in Greenland: current situation and challenges
Waste management in Greenland (56 000 inhabitants) is characterized by landfilling, incineration and export to Denmark of small quantities of metals and hazardous waste. The annual amount of waste is estimated to about 50 000 tons but actual data are scarce. Data on the waste composition is basically lacking. The scattered small towns and settlements, the climate and the long transport distances between towns and also to recycling industries abroad constitute a complex situation with respect to waste management. The landfills have no collection of gas and leachate and the incinerators are small and equipped with only moderate flue gas cleaning technology. This report summarizes the current waste management situation in Greenland and identifies important challenges in improving the waste management.

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Waste Transfer Stations

Transport and transport is usually the most costly part of any waste management system; and when waste is transported over a considerable distance or for a long time, transferring the waste from the collection vehicles to more efficient transportation may be economically beneficial. This involves a transfer station where the transfer takes place. These stations may also be accessible by private people, offering flexibility to the waste system, including facilities for bulky waste, household hazardous waste and recyclables. Waste transfer may also take place on the collection route from small satellite collection vehicles to large compacting vehicles that cannot effectively travel small streets and alleys within the inner city or in residential communities with narrow roads. However, mobile transfer is not dealt with in this chapter, which focuses on stationary transfer stations. This chapter describes the main features of waste transfer stations, including some considerations about the economical aspects on when transfer is advisable.

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Implementation of life cycle assessment models in solid waste management

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Contribution of individual waste fractions to the environmental impacts from landilling of municipal solid waste

A number of LCA-based studies have reported on the environmental performance of landilling of mixed waste, but little is known about the relative contributions of individual waste fractions to the overall impact potentials estimated for the mixed waste. In this paper, an empirical model has been used to estimate the emissions to the environment from landilling of individual waste fractions. By means of the LCA-model EASEWASTE, the emissions estimated have been used to quantify how much of the overall impact potential for each impact category is to be attributed to the individual waste fractions. Impact potentials are estimated for 1 tonne of mixed waste disposed off in a conventional landfill with bottom liner, leachate collection and treatment and gas collection and utilization for electricity generation. All the environmental aspects are accounted for 100 years after disposal and several impact categories have been considered, including standard categories, toxicity-related categories and groundwater contamination. Amongst the standard and toxicity-related categories, the highest potential impact is estimated for human toxicity via soil (HTs: 12 mPE/tonne). This is mostly caused by leaching of heavy metals from ashes (e.g. residues from roads cleaning and vacuum cleaning bags), batteries, paper and metals. On the other hand, substantial net environmental savings are estimated for the categories Global Warming (GW; -31 mPE/tonne) and Eco-Toxicity in water chronic (ETwc; -53 mPE/tonne). These savings are mostly determined by the waste fractions characterized by a high content of biogenic carbon (paper, organics, other combustible waste). These savings are due to emissions from energy generation avoided by landfill gas utilization, and by the storage of biogenic carbon in the landfill due to incomplete waste degradation. (c) 2009 Elsevier Ltd. All rights reserved.
EASEWASTE - Environmental assessment of solid waste technologies and systems

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EASEWASTE-life cycle modeling capabilities for waste management technologies

Background, Aims and Scope The management of municipal solid waste and the associated environmental impacts are subject of growing attention in industrialized countries. EU has recently strongly emphasized the role of LCA in its waste and resource strategies. The development of sustainable solid waste management systems applying a life-cycle perspective requires readily understandable tools for modelling the life cycle impacts of waste management systems. The aim of the paper is to demonstrate the structure, functionalities and LCA modelling capabilities of the PC-based life cycle oriented waste management model EASEWASTE, developed at the Technical University of Denmark specifically to meet the needs of the waste system developer with the objective to evaluate the environmental performance of the various elements of existing or proposed solid waste management systems. Materials and methods The EASEWASTE model supports a full life cycle assessment of any user defined residential, bulky waste or garden waste management system. The model focuses on the major components of the waste and reviews each component in terms of the available waste management options, including bio-gasification and composting, thermal treatment incineration, use-on-land, material sorting and recycling, bottom and fly ash handling, material and energy utilization and landfilling. In order to allow the use of the model in an early stage where local data may be limited, default data sets are provided for waste composition and quantities as well as for the waste technologies mentioned above. The model calculates environmental impacts and resource consumptions and allows the user to trace all impacts to their source in a waste treatment processes or in a specific waste material fraction. In addition to the traditional impact indicators, EASEWASTE incorporates impact categories on stored eco-toxicity, specifically developed for representation of the long term impacts of persistent pollutants in land filled waste. The model reports data at any stage of the LCA and supports identification of most sensitive parameters as well as overall sensitivity analysis and material balances for all substances passing through the system.

Results and Discussion The structure of the model is presented and its functionalities are demonstrated on a hypothetical case study based on waste data from a large Danish municipality. The aim of the case is to demonstrate new waste treatment technologies and their modelling capabilities as well as the LCA modelling capabilities in EASEWASTE to identify the most important impact categories and the main sources of contributions to these in the system for treating the waste. Based on the results, the modelling features, user flexibility and transparency of the EASEWASTE model are discussed. Conclusion EASEWASTE is demonstrated to be a versatile and detailed (engineering) model with a strong differentiation of individual fractions, but it requires an engineering background to use all the features. The model is especially developed for the modelling of the handling of municipal solid wastes and therefore it does not support other wastes such as demolition and large commercial waste. The model is useful for an iterative approach to waste system modelling; its database access supports a quick primary calculation of the impacts from a designed waste system using default data, and based on this, a gradually refined focusing on the parts which contribute the most to the total impacts. The EASEWASTE model allows the user to supply detailed data for waste generation, waste composition including material fractions and chemical properties, sorting efficiencies, waste collection and waste treatment technologies. More generic LCA modelling tools developed for LCA of products do not support these steps of the modelling to the same extent, and also the creation and evaluation of waste collection, waste transportation and waste treatment technology individually or in a designed scenario is much easier in EASEWASTE. Recommendation and Outlook EASEWASTE has been used in the modelling of a number of real case studies and much data have been incorporated into it. Several research projects are currently underway under the Danish 3R (Residual Resources Recovery) research school in support of its further development. There are, however still many issues that have to be improved significantly to facilitate application by other users than model developers. The improvements in consideration are to provide data for more treatment and disposal technologies, and more flexibility. The current version of the model supports the environmental assessment (environmental impacts and resource consumption) of household and small commercial business units waste treatment systems in a Danish context, but it is the ambition that future versions of the model shall support the inclusion of other waste types as well as economic evaluation and that the geographical coverage shall be extended to other countries.

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Energy recovery from waste incineration: Assessing the Importance of district heating networks

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Web of Science (2014): Impact factor 3.22
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Web of Science (2013): Impact factor 3.157
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The environmental performance of two low-organic waste landfill scenarios ('low-organic-energy' and 'low-organic-flare') was developed and compared with two household waste landfill scenarios ('household-energy' and 'household-flare') by means of LCA-modelling. The LCA-modelling was made for 1 tonne of wet waste landfilled and the environmental aspects were evaluated for a 100-year period after disposal. The data utilized in the LCA-calculations to model the first 10-20 years of landfilling of the two low-organic waste scenarios make extensive use of site-specific data from the Nauerna Landfill (The Netherlands), but average data from other comparable, existing landfills were used too. As data from full-scale landfills do not cover more than 30-40 years of landfilling, data from laboratory simulations and accelerated tests of limited scale were also utilized. The life-cycle impact assessments show that the low-organic waste scenarios achieved better environmental performance than the household waste scenarios with regard to both ordinary and toxicity-related environmental impact categories. This indicates that the reduction of organic matter accepted at landfills (as prescribed by the European Union Landfill Directive: Council Directive 1999/31/EC, EU, Brussels, 1999) can be a successful approach to decrease the environmental loads in several impact categories in comparison with landfilling of waste with significant organic content. However, when utilization of landfill gas is accounted for in the life-cycle impact assessment calculation, the small gas generation in low-organic waste landfills reduced the actual potential for energy generation and therefore the environmental savings obtained were reduced proportionally. Groundwater pollution from input of leachate was also
evaluated and the WHO (Guidelines for Drinking-water Quality; WHO, Geneva, 2006) guideline for drinking water quality was assumed as reference. The results show that low-organic waste landfills pose a smaller risk of groundwater contamination, but the impact potentials estimated still remain a lot higher than estimated in other categories.

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Web of Science (2015): Impact factor 1.338  
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Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925  
Web of Science (2013): Impact factor 1.114  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053  
Web of Science (2012): Impact factor 1.047  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858  
Web of Science (2011): Impact factor 1.193  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 0.662 SNIP 0.957  
Web of Science (2010): Impact factor 1.222  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 1
Environmental inventory modelling of the use of compost and peat in growth media preparation

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Boldrin, A., Hartling, K. R., Laugen, M., Christensen, T. H.
Pages: 1250-1260
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Resources, Conservation and Recycling
Volume: 54
Issue number: 12
ISSN (Print): 0921-3449
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.31 SJR 1.462 SNIP 2.11
Web of Science (2017): Impact factor 5.12
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.73 SJR 1.211 SNIP 1.804
Web of Science (2016): Impact factor 3.313
Web of Science (2016): Indexed yes
Greenhouse gas emissions from home composting of organic household waste

General information
State: Published
Life-cycle assessment (EASEWASTE) of two municipal solid waste incineration technologies in China

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Chen, D., Christensen, T. H.
Pages: 508-519
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 28
Issue number: 6
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
Incineration of municipal solid waste is a debated waste management technology. In some countries it is the main waste management option whereas in other countries it has been disregarded. The main discussion point on waste incineration is the release of air emissions from the combustion of the waste, but also the energy recovery efficiency has a large importance.

The historical development of air pollution control in waste incineration was studied through life-cycle-assessment.
modelling of eight different air pollution control technologies. The results showed a drastic reduction in the release of air emissions and consequently a significant reduction in the potential environmental impacts of waste incineration. Improvements of a factor 0.85–174 were obtained in the different impact potentials as technology developed from no emission control at all, to the best available emission control technologies of today (2010).

The importance of efficient energy recovery was studied through seven different combinations of heat and electricity recovery, which were modelled to substitute energy produced from either coal or natural gas. The best air pollution control technology was used at the incinerator. It was found that when substituting coal based energy production total net savings were obtained in both the standard and toxic impact categories. However, if the substituted energy production was based on natural gas, only the most efficient recovery options yielded net savings with respect to the standard impacts. With regards to the toxic impact categories, emissions from the waste incineration process were always larger than those from the avoided energy production based on natural gas. The results shows that the potential environmental impacts from air emissions have decreased drastically during the last 35 years and that these impacts can be partly or fully offset by recovering energy which otherwise should have been produced from fossil fuels like coal or natural gas.

**General information**

State: Published
Organisations: Department of Environmental Engineering
Contributors: Damgaard, A., Riber, C., Frueergaard, T., Hulgaard, T., Christensen, T. H.
Pages: 1244-1250
Publication date: 2010
Peer-reviewed: Yes

**Publication information**

Journal: Waste Management
Volume: 30
Issue number: 7
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
Web of Science (2012): Impact factor 2.485
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Mass balances and life-cycle inventory for a garden waste windrow composting plant (Aarhus, Denmark)

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Andersen, J. K., Boldrin, A., Christensen, T. H., Scheutz, C.
Pages: 1010-1020
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 28
Issue number: 11
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1

Electronic versions:
2010_Damgaard_et_al_Incineration_Technologies_PostPrint.pdf
DOIs:
10.1016/j.wasman.2010.03.025
Source: orbit
Source-ID: 268275
Research output: Research - peer-review › Journal article – Annual report year: 2010
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Models for waste life cycle assessment: Review of technical assumptions

A number of waste life cycle assessment (LCA) models have been gradually developed since the early 1990s, in a number of countries, usually independently from each other. Large discrepancies in results have been observed among different waste LCA models, although it has also been shown that results from different LCA studies can be consistent. This paper is an attempt to identify, review and analyse methodologies and technical assumptions used in various parts of selected waste LCA models. Several criteria were identified, which could have significant impacts on the results, such as the functional unit, system boundaries, waste composition and energy modelling. The modelling assumptions of waste management processes, ranging from collection, transportation, intermediate facilities, recycling, thermal treatment, biological treatment, and landfilling, are obviously critical when comparing waste LCA models. This review infers that some of the differences in waste LCA models are inherent to the time they were developed. It is expected that models developed later, benefit from past modelling assumptions and knowledge and issues. Models developed in different countries furthermore rely on geographic specificities that have an impact on the results of waste LCA models. The review concludes that more effort should be employed to harmonise and validate non-geographic assumptions to strengthen waste LCA modelling.
Ratings:

BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
Web of Science (2012): Impact factor 2.485
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071
Web of Science (2011): Impact factor 2.428
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.553 SNIP 1.821
Web of Science (2010): Impact factor 2.358
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.519 SNIP 1.919
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.375 SNIP 2.145
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.998 SNIP 1.785
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.021 SNIP 1.819
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.065 SNIP 1.653
Scopus rating (2004): SJR 1.271 SNIP 1.911
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.853 SNIP 1.234
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.498 SNIP 0.903
Scopus rating (2001): SJR 0.45 SNIP 0.731
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.328 SNIP 0.444
Scopus rating (1999): SJR 0.26 SNIP 0.541
Original language: English
DOIs: 10.1016/j.wasman.2010.06.004
Source: orbit
Source-ID: 268093
Research output: Research - peer-review › Journal article – Annual report year: 2010

Quantification of Greenhouse Gas Emissions from Windrow Composting of Garden Waste

Microbial degradation of organic wastes entails the production of various gases such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and carbon monoxide (CO). Some of these gases are classified as greenhouse gases (GHGs), thus contributing to climate change. A study was performed to evaluate three methods for quantifying GHG emissions from central composting of garden waste. Two small-scale methods were used at a windrow composting facility: a static flux chamber method and a funnel method. Mass balance calculations based on measurements of the C content in the in- and out-going material showed that 91 to 94% of the C could not be accounted for using the small-scale methods, thereby indicating that these methods significantly underestimate GHG emissions. A dynamic plume method (total emission method) employing Fourier Transform Infra Red (FTIR) absorption spectroscopy was found to give a more accurate estimate of the GHG emissions, with CO2 emissions measured to be 127 +/- 15% of the degraded C. Additionally, with this method, 2.7 +/- 0.6% and 0.34 +/- 0.16% of the degraded C was determined to be emitted as CH4 and CO. In this study, the dynamic plume method was a more effective tool for accounting for C losses and, therefore, we believe that the method is suitable for measuring GHG emissions from composting facilities. The total emissions were found to be 2.4 +/- 0.5 kg CH4-C Mg-1 wet waste (ww) and 0.06 +/- 0.03 kg N2O-N Mg-1 ww from a facility treating 15,540 Mg of garden waste yr(-1), or 111 +/- 30 kg CO2-equivalents Mg-1 ww.

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Andersen, J. K., Boldrin, A., Samuelsson, J., Christensen, T. H., Scheutz, C.
Pages: 713-724
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Journal of Environmental Quality
Volume: 39
Issue number: 2
ISSN (Print): 0047-2425
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 2.54 SJR 1.092 SNIP 1.066
Web of Science (2017): Impact factor 2.405
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.51 SJR 1.065 SNIP 1.157
Web of Science (2016): Impact factor 2.344
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.69 SJR 1.269 SNIP 1.237
Web of Science (2015): Impact factor 2.238
Web of Science (2015): Indexed yes
Seasonal generation and composition of garden waste in Aarhus (Denmark)

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Boldrin, A., Christensen, T. H.
Substitution of peat, fertiliser and manure by compost in hobby gardening: User surveys and case studies

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Andersen, J. K., Christensen, T. H., Scheutz, C.
Pages: 2483-2489
Publication date: 2010
Peer-reviewed: Yes

**Publication information**
Journal: Waste Management
Volume: 30
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Waste collection systems for recyclables: An environmental and economic assessment for the municipality of Aarhus (Denmark)

Recycling of paper and glass from household waste is an integrated part of waste management in Denmark, however, increased recycling is a legislative target. The questions are: how much more can the recycling rate be increased through improvements of collection schemes when organisational and technical limitations are respected, and what will the environmental and economic consequences be? This was investigated in a case study of a municipal waste management system. Five scenarios with alternative collection systems for recyclables (paper, glass, metal and plastic packaging) were assessed by means of a life cycle assessment and an assessment of the municipality's costs. Kerbside collection would provide the highest recycling rate, 31% compared to 25% in the baseline scenario, but bring schemes with drop-off...
containers would also be a reasonable solution. Collection of recyclables at recycling centres was not recommendable because the recycling rate would decrease to 20%. In general, the results showed that enhancing recycling and avoiding incineration was recommendable because the environmental performance was improved in several impact categories. The municipal costs for collection and treatment of waste were reduced with increasing recycling, mainly because the high cost for incineration was avoided. However, solutions for mitigation of air pollution caused by increased collection and transport should be sought. (C) 2009 Elsevier Ltd. All rights reserved.
Anaerobic digestion and digestate use: accounting of greenhouse gases and global warming contribution

Anaerobic digestion (AD) of source-separated municipal solid waste (MSW) and use of the digestate is presented from a global warming (GW) point of view by providing ranges of greenhouse gas (GHG) emissions that are useful for calculation of global warming factors (GWFs), i.e. the contribution to GW measured in CO2-equivalents per tonne of wet waste. The GHG accounting was done by distinguishing between direct contributions at the AD facility and indirect upstream or downstream contributions. GHG accounting for a generic AD facility with either biogas utilization at the facility or upgrading of the gas for vehicle fuel resulted in a GWF from —375 (a saving) to 111 (a load) kg CO2-eq. tonne—1 wet waste. In both cases the digestate was used for fertilizer substitution. This large range was a result of the variation found for a number of key parameters: energy substitution by biogas, N2O-emission from digestate in soil, fugitive emission of CH4, unburned CH4, carbon bound in soil and fertilizer substitution. GWF for a specific type of AD facility was in the range —95 to —4 kg CO2-eq. tonne—1 wet waste. The ranges of uncertainty, especially of fugitive losses of CH4 and carbon sequestration highly influenced the result. In comparison with the few published GWFs for AD, the range of our data was much larger demonstrating the need to use a consistent and robust approach to GHG accounting and simultaneously accept that some key parameters are highly uncertain.

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Møller, J., Boldrin, A., Christensen, T. H.
Pages: 813-824
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 27
Issue number: 8
ISSN (Print): 0734-242X
Ratings:
C balance, carbon dioxide emissions and global warming potentials in LCA-modeling of waste management systems

**General information**
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Quantitative Sustainability Assessment, Department of Management Engineering
Pages: 707-715
Publication date: 2009
Peer-reviewed: Yes

**Publication information**
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Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Chemical composition of material fractions in Danish household waste

The chemical composition of Danish household waste was determined by two approaches: a direct method where the chemical composition (61 substances) of 48 material fractions was determined after hand sorting of about 20 tonnes of waste collected from 2200 households; and an indirect method where batches of 80-1200 tonnes of unsorted household waste was incinerated and the content of the waste determined from the content of the outputs from the incinerator. The indirect method is believed to better represent the small but highly contaminated material fractions (e.g., batteries) than the direct method, because of the larger quantities included and the more homogenous material to sample from.

Differences between the direct and the direct methods led to corrections in the of heavy metal concentration of a few fractions. The majority of the energy content of the waste originates from organic waste like paper, cardboard anti organic fractions. The single fraction contributing most to the total energy content is the non-recyclable plastic fraction, contributing 21% of the energy content and 60% of the chlorine content, although this fraction comprises less than 7% by weight.

Heavy metals originate mainly from inert fractions, primarily batteries.
Collection, transfer and transport of waste: accounting of greenhouse gases and global warming contribution

The collection, transfer and transport of waste are basic activities of waste management systems all over the world. These activities all use energy and fuels, primarily of fossil origin. Electricity and fuel consumptions of the individual processes were reviewed and greenhouse gases (GHG) emissions were quantified. The emission factors were assigned a global warming potential (GWP) and aggregated into global warming factors (GWFs), which express the potential contribution to global warming from collection, transport and transfer of 1 tonne of wet waste. Six examples involving collection, transfer and transport of waste were assessed in terms of GHG emissions, including both provision and use of energy. (GHG emissions related to production, maintenance and disposal of vehicles, equipment, infrastructure and buildings were excluded.) The estimated GWFs varied from 9.4 to 368 kg CO2-equivalent (kg CO2-eq.) per tonne of waste, depending on method of collection, capacity and choice of transport equipment, and travel distances. The GHG emissions can be reduced primarily by avoiding transport of waste in private cars and by optimization of long distance transport, for example, considering transport by rail and waterways.

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Eisted, R., Larsen, A. W., Christensen, T. H.
Pages: 738-745
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 27
Issue number: 8
ISSN (Print): 0734-242X

Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.14
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.56 SNIP 0.817
Composting and compost utilization: accounting of greenhouse gases and global warming contributions

Greenhouse gas (GHG) emissions related to composting of organic waste and the use of compost were assessed from a waste management perspective. The GHG accounting for composting includes use of electricity and fuels, emissions of methane and nitrous oxide from the composting process, and savings obtained by the use of the compost. The GHG account depends on waste type and composition (kitchen organics, garden waste), technology type (open systems, closed systems, home composting), the efficiency of off-gas cleaning at enclosed composting systems, and the use of the compost. The latter is an important issue and is related to the long-term binding of carbon in the soil, to related effects in terms of soil improvement and to what the compost substitutes; this could be fertilizer and peat for soil improvement or for growth media production. The overall global warming factor (GWF) for composting therefore varies between significant savings (—900 kg CO2-equivalents tonne—1 wet waste (ww)) and a net load (300 kg CO2-equivalents tonne —1 ww). The major savings are obtained by use of compost as a substitute for peat in the production of growth media. However, it may be difficult for a specific composting plant to document how the compost is used and what it actually substitutes for. Two cases representing various technologies were assessed showing how GHG accounting can be done when specific information and data are available.

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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Boldrin, A., Andersen, J. K., Møller, J., Christensen, T. H., Favino, E.
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Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Diesel consumption in waste collection and transport and its environmental significance

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Organisations: Department of Environmental Engineering
Contributors: Larsen, A. W., Vrgoc, M., Christensen, T. H., Lieberknecht, P.
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Environmental assessment of Ammassuo Landfill (Finland) by means of LCA-modelling (EASEWASTE)
The Old Ammassuo Landfill (Espoo, Finland) covers an area of 52 hectares and contains about 10 million tonnes of waste that was landfilled between 1987 and 2007. The majority of this waste was mixed, of which about 57% originated from households. This paper aims at describing the management of the Old Ammassuo Landfill throughout its operational lifetime (1987-2007), and at developing an environmental evaluation based on life-cycle assessment (LCA) using the EASEWASTE-model. The assessment criteria evaluate specific categories of impact, including standard impact categories, toxicity-related impact categories and an impact categorized as spoiled groundwater resources (SGR). With respect to standard and toxicity-related impact categories, the LCA results show that substantial impact potentials are estimated for global warming (GW), ozone depletion (OD), human toxicity via soil (HTs) and ecotoxicity in water chronic (ETwc). The largest impact potential was found for SGR and amounted to 57.6 person equivalent (PE) per tonne of landfilled waste. However, the SGR impact may not be viewed as a significant issue in Finland as the drinking water is mostly supplied from surface water bodies. Overall, the results demonstrate that gas management has great importance to the environmental performance of the Old Ammassuo Landfill. However, several chemicals related to gas composition (especially trace compounds) and specific emissions from on-site operations were not available or were not measured and were therefore taken from the literature. Measurement campaigns and field investigations should be undertaken in order to obtain a more robust and comprehensive dataset that can be used in the LCA-modelling, before major improvements regarding landfill management are finalized.

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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Niskanen, A., Manfredi, S., Christensen, T. H., Anderson, R.
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Web of Science (2017): Impact factor 1.631
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Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
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Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
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Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
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Scopus rating (2010): SJR 0.662 SNIP 0.957
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Scopus rating (2009): SJR 0.869 SNIP 1.251
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Web of Science (2008): Indexed yes
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Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.56 SNIP 0.817
Environmental assessment of gas management options at the Old Ämmässuo landfill (Finland) by means of LCA-modeling (EASEWASTE)

The current landfill gas (LFG) management (based on flaring and utilization for heat generation of the collected gas) and three potential future gas management options (LFG flaring, heat generation and combined heat and power generation) for the Old Ammassuo landfill (Espoo, Finland) were evaluated by life-cycle assessment modeling. The evaluation accounts for all resource utilization and emissions to the environment related to the gas generation and management for a life-cycle time horizon of 100 yr. The assessment criteria comprise standard impact categories (global warming, photochemical ozone formation, stratospheric ozone depletion, acidification and nutrient enrichment) and toxicity-related impact categories (human toxicity via soil, via water and via air, eco-toxicity in soil and in water chronic). The results of the life-cycle impact assessment show that disperse emissions of LFC from the landfill surface determine the highest potential impacts in terms of global warming, stratospheric ozone depletion, and human toxicity via soil. Conversely, the impact potentials estimated for other categories are numerically-negative when the collected LFG is utilized for energy generation, demonstrating that net environmental savings can be obtained. Such savings are proportional to the amount of gas utilized for energy generation and the energy recovery efficiency achieved, which thus have to be regarded as key parameters. As a result, the overall best performance is found for the heat generation option - as it has the highest LEG utilization/energy recovery rates - whereas the worst performance is estimated for the LEG flaring option, as no LEG is here utilized for energy generation. Therefore, to reduce the environmental burdens caused by the current gas management strategy, more LEG should be used for energy generation. This inherently requires a superior LEG capture rate that, in addition, would reduce fugitive emissions of LFC, from the landfill surface, bringing further environmental benefits.

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Contributors: Manfredi, S., Niskanen, A., Christensen, T. H.
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Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
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Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
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Environmental assessment of gas management options at the Old Ammassuo landfill (Finland) by means of LCA-modeling (EASEWASTE) (vol 29, pg 1588, 2009)

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Environmental assessment of solid waste landfilling technologies by means of LCA-modeling

By using life cycle assessment (LCA) modeling, this paper compares the environmental performance of six landfilling technologies (open dump, conventional landfill with flares, conventional landfill with energy recovery, standard bioreactor landfill, flushing bioreactor landfill and semi-aerobic landfill) and assesses the influence of the active operations practiced on these performances. The environmental assessments have been performed by means of the LCA-based tool EASEWASTE, whereby the functional unit utilized for the LCA is “landfilling of 1 ton of wet household waste in a 10 m deep landfill for 100 years”. The assessment criteria include standard categories (global warming, nutrient enrichment, ozone depletion, photo-chemical ozone formation and acidification), toxicity-related categories (human toxicity and ecotoxicity) and impact on spoiled groundwater resources. Results demonstrate that it is crucially important to ensure the highest collection efficiency of landfill gas and leachate since a poor capture compromises the overall environmental performance. Once gas and leachate are collected and treated, the potential impacts in the standard environmental categories and on spoiled groundwater resources significantly decrease, although at the same time specific emissions from gas treatment lead to increased impact potentials in the toxicity-related categories. Gas utilization for energy recovery leads to saved emissions and avoided impact potentials in several environmental categories. Measures should be taken to prevent leachate infiltration to groundwater and it is essential to collect and treat the generated leachate. The bioreactor technologies recirculate the collected leachate to enhance the waste degradation process. This allows the gas collection period to be reduced from 40 to 15 years, although it does not lead to noticeable environmental benefits when considering a 100 years LCA-perspective. In order to more comprehensively understand the influence of the active operations (i.e., leachate recirculation, waste flushing and air injection) on the environmental performance, the time horizon of the assessment has been split into two time periods: years 0–15 and 16–100. Results show that if these operations are combined with gas utilization and leachate treatment, they are able to shorten the time frame that emissions lead to environmental impacts of concern.

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Evaluation of field-scale emissions from utilization of MSWI air-pollution-control residues stabilized with FeSO4

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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Hyks, J., Astrup, T., Christensen, T. H.
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Research output: Research › Conference abstract in proceedings – Annual report year: 2009

Global warming factor of municipal solid waste management in Europe
The global warming factor (GWF; CO2-eq. tonne—1 waste) performance of municipal waste management has been investigated for six representative European Member States: Denmark, France, Germany, Greece, Poland and the United Kingdom. The study integrated European waste statistical data for 2007 in a life-cycle assessment modelling perspective. It is shown that significant GWF benefit was achieved due to the high level of energy and material recovery substituting fossil energy and raw materials production, especially in Denmark and Germany. The study showed that, despite strong regulation of waste management at European level, there are major differences in GWF performance among the member states, due to the relative differences of waste composition, type of waste management technologies available nationally, and the average performance of these technologies. It has been demonstrated through a number of sensitivity analyses that, within the national framework, key waste management technology parameters can influence drastically the national GWF performance of waste management.

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BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Global warming factors modelled for 40 generic municipal waste management scenarios

Global warming factors (kg CO2-eq.·tonne−1 of waste) have been modelled for 40 different municipal waste management scenarios involving a variety of recycling systems (paper, glass, plastic and organics) and residual waste management by landfilling, incineration or mechanical—biological waste treatment. For average European waste composition most waste management scenarios provided negative global warming factors and hence overall savings in greenhouse gas emissions: Scenarios with landfilling saved 0—400, scenarios with incineration saved 200—700, and scenarios with mechanical-biological treatment saved 200—750 kg CO2-eq.·tonne−1 of municipal waste depending on recycling scheme and energy recovery. Key parameters were the amount of paper recycled (it was assumed that wood made excessive by paper recycling substituted for fossil fuel), the crediting of the waste management system for the amount of energy recovered (hard-coal-based energy was substituted), and binding of biogenic carbon in landfills. Most other processes were of less importance. Rational waste management can provide significant savings in society’s emission of greenhouse gas depending on waste composition and efficient utilization of the energy recovered.

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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Christensen, T. H., Simion, F., Tonini, D., Møller, J.
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BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
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Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Greenhouse gas accounting and waste management

Accounting of emissions of greenhouse gas (GHG) is a major focus within waste management. This paper analyses and compares the four main types of GHG accounting in waste management including their special features and approaches: the national accounting, with reference to the Intergovernmental Panel on Climate Change (IPCC), the corporate level, as part of the annual reporting on environmental issues and social responsibility, life-cycle assessment (LCA), as an environmental basis for assessing waste management systems and technologies, and finally, the carbon trading methodology, and more specifically, the clean development mechanism (CDM) methodology, introduced to support cost-effective reduction in GHG emissions. These types of GHG accounting, in principle, have a common starting point in technical data on GHG emissions from specific waste technologies and plants, but the limited availability of data and, moreover, the different scopes of the accounting lead to many ways of quantifying emissions and producing the accounts. The importance of transparency in GHG accounting is emphasised regarding waste type, waste composition, time period considered, GHGs included, global warming potential (GWP) assigned to the GHGs, counting of biogenic carbon dioxide, choice of system boundaries, interactions with the energy system, and generic emissions factors. In order to enhance transparency and consistency, a format called the upstream-operating-downstream framework (UOD) is proposed for reporting basic technology-related data regarding GHG issues including a clear distinction between direct emissions from waste management technologies, indirect upstream (use of energy and materials) and indirect downstream (production of
energy, delivery of secondary materials) activities.

**General information**

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BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Landfilling of individual waste fractions: Contribution to the environmental impacts in a life cycle perspective

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Editors: Cossu, R., Diaz, L., Stegmann, R.
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Landfilling of waste: accounting of greenhouse gases and global warming contributions
Accounting of greenhouse gas (GHG) emissions from waste landfilling is summarized with the focus on processes and technical data for a number of different landfilling technologies: open dump (which was included as the worst-case-scenario), conventional landfills with flares and with energy recovery, and landfills receiving low-organic-carbon waste. The results showed that direct emissions of GHG from the landfill systems (primarily dispersive release of methane) are the major contributions to the GHG accounting, up to about 1000 kg CO2-eq. tonne —1 for the open dump, 300 kg CO2-eq. tonne —1 for conventional landfilling of mixed waste and 70 kg CO2-eq. tonne—1 for low-organic-carbon waste landfills. The load caused by indirect, upstream emissions from provision of energy and materials to the landfill was low, here estimated to be up to 16 kg CO2-eq. tonne—1. On the other hand, utilization of landfill gas for electricity generation contributed to major savings, in most cases, corresponding to about half of the load caused by direct GHG emission from the landfill. However, this saving can vary significantly depending on what the generated electricity substitutes for. Significant amounts of biogenic carbon may still be stored within the landfill body after 100 years, which here is counted as...
a saved GHG emission. With respect to landfilling of mixed waste with energy recovery, the net, average GHG accounting ranged from about —70 to 30 kg CO2-eq. tonne—1, obtained by summing the direct and indirect (upstream and downstream) emissions and accounting for stored biogenic carbon as a saving. However, if binding of biogenic carbon was not accounted for, the overall GHG load would be in the range of 60 to 300 kg CO2-eq. tonne—1. This paper clearly shows that electricity generation as well as accounting of stored biogenic carbon are crucial to the accounting of GHG of waste landfilling.
Leaching from MSWI bottom ash: Evaluation of non-equilibrium in column percolation experiments

Impacts of non-equilibrium on results of percolation experiments on municipal solid waste incineration (MSWI) bottom ash were investigated. Three parallel column experiments were performed: two columns with undisturbed percolation and one column with two sets of 1-month-long flow interruptions applied at liquid-to-solid (L/S) ratios of L/S 2 L/kg and 12 L/kg, respectively. Concentrations of Na, K, Cl−, Ca, Si, SO42−, Al, Cu, Ni, Mo, Ba, Pb, Zn, and dissolved organic carbon (DOC) were monitored throughout the entire leaching period: geochemical modeling was used to identify non-equilibrium-induced changes in the solubility control. Despite both physical and chemical non-equilibrium, the Columns were found to provide adequate information for readily soluble compounds (i.e., Na, Cl−, and K) and solubility-controlled elements (i.e., Ca, SO42−, Ba, Si, Al, Zn, and Pb). The leaching of Cu and Ni was shown to depend strongly on DOC leaching, which was likely affected by physical non-equilibrium during flow interruptions. Consequently, the leaching of Cu and Ni in the undisturbed Columns was shown to be by about one order of magnitude lower compared with the interrupted column. The results indicate that the leaching of DOC-related metals in laboratory column experiments may be considerably underestimated compared with full-scale scenarios in which the impacts from non-equilibrium may be significantly lower. The leaching of Mo (or MoO42−) may be controlled solely by its availability in the mobile zone, which in turn appeared to be controlled by diffusion from the stagnant zone: no Mo controlling minerals were predicted by the geochemical modeling.
Life-cycle assessment of the municipal solid waste management system in Hangzhou, China (EASEWASTE)

With the purpose of assessing the environmental impacts and benefits of the current municipal solid waste management system and two modified systems, EASEWASTE, a life-cycle-based model, was used to evaluate the waste system of Hangzhou city in China. An integrated model was established, including waste generation, collection, transportation, treatment, disposal and accompanying external processes. The results showed that CH4 released from landfilling was the primary pollutant contributing to global warming, and HCl and NH3 from incineration contributed most to acidification. Material recycling and incineration with energy recovery were important because of the induced savings in material production based on virgin materials and in energy production based on coal combustion. A modified system in which waste is transported to the nearest incinerators would be relatively better than the current system, mainly due to the decrease of pollution from landfilled waste and the increase in energy production from waste avoiding energy production by traditional power plants. A ban on free plastic bags for shopping was shown to reduce most environmental impacts due to saved oil resources and other materials used in producing the plastic bags. Sensitivity analysis confirmed the robustness of the results. LCA methodology and a model like EASEWASTE are very suitable for evaluating the overall environmental consequences, and can be used for decision support and strategic planning in developing countries such as China where pollution control has become increasingly important with the rapid increase of waste generation as well as the increasing public awareness of environmental protection.
Long-term leaching from MSWI air-pollution-control residues: Leaching characterization and modeling

Long-term leaching of Ca, Fe, Mg, K, Na, S, Al, As, Ba, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Zn, Mo, Sb, Si, Sr, Ti, V, P, Cl, and dissolved organic carbon from two different municipal solid waste incineration (MSWI) air-pollution-control residues was monitored during 24 months of column percolation experiments; liquid-to-solid (L/S) ratios of 200-250 L/kg corresponding to more than 10,000 years in a conventional landfill were reached. Less than 2% of the initially present As, Cu, Pb, Zn, Cr, and Sb had leached during the course of the experiments. Concentrations of Cd, Fe, Mg, Hg, Mn, Ni, Co, Sn, Ti, and P were generally below 1 μg/L; overall less than 1% of their mass leached. Column leaching data were further used in a two-step geochemical modeling in PHREEQC in order to (i) identify solubility controlling minerals and (ii) evaluate their interactions in a water-percolated column system over L/S of 250 L/kg. Adequate predictions of pH, alkalinity, and the leaching of Ca, S, Al, Si, Ba, and Zn were obtained in a simultaneous calculation. Also, it was suggested that removal of Ca and S together with depletion of several minerals apparently caused dissolution of ettringite-like phases. In turn, significant increase in leaching of oxyanions (especially Sb and Cr) was observed at late stage of leaching experiments.

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Web of Science (2017): Impact factor 6.434
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Web of Science (2016): Impact factor 6.065
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
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Scopus rating (2014): CiteScore 5.21 SJR 1.814 SNIP 2.258
Web of Science (2014): Impact factor 4.529
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 5.09 SJR 1.822 SNIP 2.43
Web of Science (2013): Impact factor 4.331
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Methods for quantification of GHG emissions from composting of garden waste

General information
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Organisations: Department of Environmental Engineering
Contributors: Andersen, J. K., Boldrin, A., Christensen, T. H., Scheutz, C.
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Title of host publication: Sardinia 2009 : Twelth International Waste Management and Landfill Symposium, 5-9 October, Sardinia, Italy
Volume: Proceedings. CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Recycling of glass: accounting of greenhouse gases and global warming contributions

Greenhouse gas (GHG) emissions related to recycling of glass waste were assessed from a waste management perspective. Focus was on the material recovery facility (MRF) where the initial sorting of glass waste takes place. The MRF delivers products like cullet and whole bottles to other industries. Two possible uses of reprocessed glass waste were considered: (i) remelting of cullet added to glass production; and (ii) re-use of whole bottles. The GHG emission accounting included indirect upstream emissions (provision of energy, fuels and auxiliaries), direct activities at the MRF and bottle-wash facility (combustion of fuels) as well as indirect downstream activities in terms of using the recovered glass waste in other industries and, thereby, avoiding emissions from conventional production. The GHG accounting was presented as aggregated global warming factors (GWFs) for the direct and indirect upstream and downstream processes, respectively. The range of GWFs was estimated to 0—70 kg CO2eq. tonne—1 of glass waste for the upstream activities and the direct emissions from the waste management system. The GWF for the downstream effect showed some significant variation between the two cases. It was estimated to approximately —500 kg CO2-eq. tonne—1 of glass waste for the remelting technology and —1500 to —600 kg CO2-eq. tonne—1 of glass waste for bottle re-use. Including the downstream process, large savings of GHG emissions can be attributed to the waste management system. The results showed that, in GHG emission accounting, attention should be drawn to thorough analysis of energy sources, especially electricity, and the downstream savings caused by material substitution.

General information

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Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Larsen, A. W., Merrild, H. K., Christensen, T. H.
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Recycling of metals: accounting of greenhouse gases and global warming contributions

Greenhouse gas (GHG) emissions related to recycling of metals in post-consumer waste are assessed from a waste management perspective; here the material recovery facility (MRF), for the sorting of the recovered metal. The GHG accounting includes indirect upstream emissions, direct activities at the MRF as well as indirect downstream activities in terms of reprocessing of the metal scrap and savings in terms of avoided production of virgin metal. The global warming factor (GWF) shows that upstream activities and the MRF causes negligible GHG emissions (12.8 to 52.6 kg CO2-equivalents tonne—1 recovered metal) compared to the reprocessing of the metal itself (360—1260 kg CO2-equivalents tonne—1 of recovered aluminium and 400— 1020 kg CO2-equivalents tonne— 1 of recovered steel). The reprocessing is however counterbalanced by large savings of avoided virgin production of steel and aluminium. The net downstream savings were found to be 5040—19 340 kg CO2-equivalents tonne—1 of treated aluminium and 560—2360 kg CO2-equivalents tonne—1 of treated steel. Due to the huge differences in reported data it is hard to compare general data on the recovery of metal scrap as they are very dependent on the technology and data choices. Furthermore, the energy used in both the recovery process as well as the avoided primary production is crucial. The range of avoided impact
shows that recovery of metals will always be beneficial over primary production, due to the high energy savings, and that the GHG emissions associated with the sorting of metals are negligible.

**General information**

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Contributors: Damgaard, A., Larsen, A. W., Christensen, T. H.  
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Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 1  
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92  
Web of Science (2017): Impact factor 1.631  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 1  
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091  
Web of Science (2016): Impact factor 1.803  
BFI (2015): BFI-level 1  
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893  
Web of Science (2015): Impact factor 1.338  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 1  
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097  
Web of Science (2014): Impact factor 1.297  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925  
Web of Science (2013): Impact factor 1.114  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053  
Web of Science (2012): Impact factor 1.047  
ISI indexed (2012): ISI indexed yes  
Web of Science (2012): Indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858  
Web of Science (2011): Impact factor 1.193  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 0.662 SNIP 0.957  
Web of Science (2010): Impact factor 1.222  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 1
Recycling of paper: Accounting of greenhouse gases and global warming contributions

Greenhouse gas (GHG) emissions have been established for recycling of paper waste with focus on a material recovery facility (MRF). The MRF upgrades the paper and cardboard waste before it is delivered to other industries where new paper or board products are produced. The accounting showed that the GHG contributions from the upstream activities and operational activities, with global warming factors (GWFs) of respectively 1 to 29 and 3 to 9 kg CO2-eq. tonne—1 paper waste, were small in comparison with the downstream activities. The GHG contributions from the downstream reprocessing of the paper waste ranged from approximately 490 to 1460 kg CO2-eq. tonne—1 of paper waste. The system may be expanded to include crediting of avoided virgin paper production which would result in GHG contributions from —1270 to 390 kg CO2-eq. tonne—1 of paper waste. It may also be assumed that the wood not used for virgin paper production instead is used for production of energy that in turn is assumed to substitute for fossil fuel energy. This would result in GHG contributions from —1850 to —4400 kg CO2-eq. tonne—1 of paper waste. These system expansions reveal very large GHG savings, suggesting that the indirect upstream and operational GHG contributions are negligible in comparison with the indirect downstream emissions. However, the data for reprocessing of paper waste and the data for virgin paper production are highly variable. These differences are mainly related to different energy sources for the mills, both in regards to energy form (heat or electricity) and fuel (biomass or fossil fuels).

General information

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Contributors: Merrild, H. K., Damgaard, A., Christensen, T. H.
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Web of Science (2018): Indexed yes
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Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Recycling of plastic: accounting of greenhouse gases and global warming contributions

Major greenhouse gas (GHG) emissions related to plastic waste recycling were evaluated with respect to three management alternatives: recycling of clean, single-type plastic, recycling of mixed/contaminated plastic, and use of plastic waste as fuel in industrial processes. Source-separated plastic waste was received at a material recovery facility (MRF) and processed for granulation and subsequent downstream use. In the three alternatives, plastic was assumed to be substituting virgin plastic in new products, wood in low-strength products (outdoor furniture, fences, etc.), and coal or fuel oil in the case of energy utilization. GHG accounting was organized in terms of indirect upstream emissions (e.g. provision of energy, fuels, and materials), direct emissions at the MRF (e.g. fuel combustion), and indirect downstream emissions (e.g. avoided emissions from production of virgin plastic, wood, or coal/oil). Combined, upstream and direct emissions were estimated to be roughly between 5 and 600 kg CO2-eq. tonne —1 of plastic waste depending on treatment at the MRF and CO2 emissions from electricity production. Potential downstream savings arising from substitution of virgin plastic, wood, and energy fuels were estimated to be around 60— 1600 kg CO2-eq. tonne —1 of plastic waste depending on substitution ratios and CO2 emissions from electricity production. Based on the reviewed data, it was concluded that substitution of virgin plastic should be preferred. If this is not viable due to a mixture of different plastic types and/or contamination, the plastic should be used for energy utilization. Recycling of plastic waste for substitution of other materials such as wood provided no savings with respect to global warming.
Recycling of wood for particle board production: accounting of greenhouse gases and global warming contributions

The greenhouse gas (GHG) emissions related to the recycling of wood waste have been assessed with the purpose to provide useful data that can be used in accounting of greenhouse gas emissions. Here we present data related to the activities in a material recovery facility (MRF) where wood waste is shredded and foreign objects are removed in order to produce wood chips for use in the production of particleboard. The data are presented in accordance with the UOD (upstream, operational, downstream) framework presented in Gentil et al. (Waste Management & Research, 27, 2009). The GHG accounting shows that the emissions related to upstream activities (5 to 41 kg CO2-equivalents tonne —1 wood waste) and to activities at the MRF (approximately 5 kg CO2-equivalents tonne —1 wood waste) are negligible compared to the downstream processing (—560 to —120 kg CO2-equivalents tonne —1 wood waste). The magnitude of the savings in GHG emissions downstream are mainly related to savings in energy consumption for drying of fresh wood for particleboard production. However, the GHG account highly depends on the choices made in the modelling of the downstream system. The inclusion of saved electricity from avoided chipping of virgin wood does not change the results radically (—665 to —125 kg CO2-equivalents tonne —1 wood waste). However, if in addition it is assumed that the GHG emissions from combustion of wood has no global warming potential (GWP) and that the energy produced from excess wood due to recycling substitutes energy from fossil fuels, here assumed to be coal, potentially large downstream GHG emissions savings can be achieved by recycling of waste wood (—1.9 to —1.3 tonnes CO2-equivalents tonne —1 wood waste). As the data ranges are broad, it is necessary to carefully evaluate the feasibility of the data in the specific system which the GHG accounting is to be applied to.

General information
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Contributors: Merrild, H. K., Christensen, T. H.
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
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ISI indexed (2012): ISI indexed yes
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Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.56 SNIP 0.817
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Waste and climate – energy recovery and greenhouse gases

General information
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Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 106-114
Publication date: 2009

Host publication information
Title of host publication: Engineering challenges : energy, climate chance & health
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Why a special issue on greenhouse gas accounting in waste management? Preface

General information
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Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Christensen, T. H.
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
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Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
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Biogenic carbon accounting in LCA-modelling: Comparison of different criteria

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Research output: Research › Article in proceedings – Annual report year: 2008
Effect of drying on leaching testing of treated municipal solid waste incineration APC-residues

Air-pollution-control (APC) residues from waste incinerators are hazardous waste according to European legislation and must be treated prior to landfilling. Batch and column leaching data determine which type of landfill can receive the treated APC-residues. CEN standards are prescribed for the batch and column leaching test; however, these standards do not specify whether or not the residue samples should be dried prior to the leaching testing. Laboratory tests were performed in parallel (dried/nondried) on treated APC-residue samples and evaluated with respect to Cr, Cd, Cu, Pb and Zn leaching. The effect of drying of the wet APC-residue samples was particularly dramatic regarding the leaching of Cr. Drying resulted in 10—100 times more Cr leaching in both batch and columns test. Drying also affected the leaching of Cd, Cu and Pb. Initial Cd leaching was up to 100 times higher in column tests with dried APC-residue than in tests with wet residues. The effect of drying appeared to be a combination of decreasing the reduction capacity of the sample (Cr), decreasing pH (Cd, Cu) and in column tests also a wash-out of salts (probably affecting Cd and Pb). If the leaching tests are intended to mimic landfill conditions, the results of this paper suggest that the tests should be done on wet, non-dried residue samples, although this may be less practical than testing dried samples.
Environmental assessment of waste incineration in a life-cycle-perspective (EASEWASTE)

A model for life-cycle assessment of waste incinerators is described and applied to a case study for illustrative purposes. As life-cycle thinking becomes more integrated into waste management, quantitative tools for assessing waste management technologies are needed. The presented model is a module in the life-cycle assessment model EASEWASTE. The module accounts for all uses of materials and energy and credits the incinerator for electricity and heat recovered. The energy recovered is defined by the user as a percentage of the energy produced, calculated on the lower heating value of the wet waste incinerated. Emissions are either process-specific (related to the amount of waste incinerated) or input-specific (related to the composition of the waste incinerated), while mass transfer to solid outputs are governed by transfer coefficients specified by the user. The waste input is defined by 48 material fractions and their chemical composition. The model was used to quantify the environmental performance of the incineration plant in Aarhus, Denmark before and after its upgrading in terms of improved flue gas cleaning and energy recovery. It demonstrated its usefulness in identifying the various processes and substances that contributed to environmental loadings as well as to environmental savings. The model was instrumental in demonstrating the importance of the energy recovery system not only for electricity but also heat from the incinerator.

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- BFI (2017): BFI-level 1
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- Web of Science (2017): Impact factor 1.631
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
- Web of Science (2016): Impact factor 1.803
- BFI (2015): BFI-level 1
- Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
- Web of Science (2015): Impact factor 1.338
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 1
LCA-modelling (EASEWASTE) of growth media preparation: comparison between peat and compost
Life cycle assessment of waste paper management: The importance of technology data and system boundaries in assessing recycling and incineration

The significance of technical data, as well as the significance of system boundary choices, when modelling the environmental impact from recycling and incineration of waste paper has been studied by a life cycle assessment focusing on global warming potentials. The consequence of choosing a specific set of data for the reprocessing technology, the virgin paper manufacturing technology and the incineration technology, as well as the importance of the recycling rate, was studied. Furthermore, the system was expanded to include forestry and to include fossil fuel energy substitution from saved biomass, in order to study the importance of the system boundary choices. For recycling, the choice of virgin paper manufacturing data is most important, but the results show that also the impacts from the reprocessing technologies fluctuate greatly. For the overall results the choice of the technology data is of importance when comparing recycling including virgin paper Substitution with incineration including energy Substitution. Combining an environmentally high or low performing recycling technology with an environmentally high or low performing incineration technology can give quite different results. The modelling showed that recycling of paper, from a life cycle point of view, is environmentally equal or better than incineration with energy recovery only when the recycling technology is at a high environmental performance level. However, the modelling also showed that expanding the system to include Substitution of fossil fuel energy by production of energy from the saved biomass associated with recycling will give a completely different result. In this case recycling is always more beneficial than incineration, thus increased recycling is desirable. Expanding the system to include forestry was shown to have a minor effect on the results. As assessments are often performed with a set choice of data and a set recycling rate, it is questionable how useful the results from this kind of LCA are for a policy maker. The high significance of the system boundary choices stresses the importance of scientific discussion on how to best address system analysis of recycling, for paper and other recyclable materials.
Livscyklusvurdering og økonomisk vurdering af husholdningsaffald i Århus Kommune: Nuværende system.
Dagenovation, storskrald og farligt affald

Web of Science (2016): Impact factor 3.313
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BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.98 SJR 1.284 SNIP 1.947
Web of Science (2015): Impact factor 3.28
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 3.7 SJR 1.324 SNIP 2.048
Web of Science (2014): Impact factor 2.564
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.34 SJR 1.424 SNIP 2.228
Web of Science (2013): Impact factor 2.692
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.236 SNIP 1.845
Web of Science (2012): Impact factor 2.319
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
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ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.16 SNIP 1.812
Web of Science (2010): Impact factor 1.974
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.132 SNIP 1.643
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.815 SNIP 1.366
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.715 SNIP 1.685
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.905 SNIP 1.733
Scopus rating (2005): SJR 0.725 SNIP 1.42
Scopus rating (2004): SJR 1.02 SNIP 1.4
Scopus rating (2003): SJR 0.566 SNIP 1.061
Scopus rating (2002): SJR 0.392 SNIP 0.837
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Source: orbit
Source-ID: 228494
Research output: Research - peer-review › Journal article – Annual report year: 2008

Livscyklusvurdering og økonomisk vurdering af husholdningsaffald i Århus Kommune: Nuværende system.
Dagenovation, storskrald og farligt affald
Methods for quantifying gaseous emissions from full-scale windrow composting of garden waste

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Andersen, J. K., Boldrin, A., Christensen, T. H., Scheutz, C.
Pages: 088
Publication date: 2008

Host publication information
Volume: Proceedings. CD-ROM
Place of publication: Weimar, Germany
Publisher: Verlag ORBIT e.V.
Source: orbit
Source-ID: 224643
Research output: Research › Article in proceedings – Annual report year: 2008

Miljøvurdering af affaldsforbrænding og alternativer

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Møller, J., Fruergaard, T., Riber, C., Astrup, T., Christensen, T. H.
Publication date: 2008

Publication information
Publisher: DTU Miljø, Institut for Vand og Miljøteknologi, Danmarks Tekniske Universitet
Original language: Danish
Electronic versions:
ENV2008-098.pdf
Source: orbit
Source-ID: 220896
Research output: Research › Report – Annual report year: 2008

Projekt 2: Vurdering af fremtidige indsamlingssystemer for husholdningsaffald i Århus Kommune: Miljø, økonomi og service

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Larsen, A. W., Møller, J., Merrill, H. K., Christensen, T. H.
Publication date: 2008

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Vand og Miljøteknologi, Danmarks Tekniske Universitet
Seasonal variation of garden waste composition of Århus Waste Centre (Denmark)

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Boldrin, A., Andersen, J. K., Christensen, T. H.
Pages: 313
Publication date: 2008

Host publication information
Volume: Proceedings. CD-ROM
Place of publication: Weimar, Germany
Publisher: Verlag ORBIT e.V.
Source: orbit
Source-ID: 224640
Research output: Research › Article in proceedings – Annual report year: 2008

Waste management modeling with PC-based model EASEWASTE

General information
State: Published
Organisations: Department of Management Engineering, Innovation and Sustainability, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Bhander, G. S., Hauschild, M. Z., Christensen, T. H.
Pages: 133-142
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Environmental Progress
Volume: 27
Issue number: 1
ISSN (Print): 0278-4491
Ratings:
BFI (2017): BFI-level 1
BFI (2016): BFI-level 1
BFI (2015): BFI-level 1
BFI (2014): BFI-level 1
BFI (2013): BFI-level 1
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Web of Science (2010): Impact factor 1.308
BFI (2009): BFI-level 1
BFI (2008): BFI-level 1
Web of Science (2008): Indexed yes
Web of Science (2003): Indexed yes
Original language: English
DOIs:
Composition of source-sorted municipal organic waste collected in Danish cities

Source-sorted municipal organic waste from different dwelling types in five Danish cities was sampled during one year. The samples were from permanent, full-scale systems or temporary, experimental systems for collection of source-sorted municipal organic waste. Pre-treatment of the organic waste prior to biological treatment was used in all cities to remove foreign objects and provide size reduction. All sampling was performed after pre-treatment in order to obtain more homogeneous and representative samples. The sampling included both the pre-treated waste and the reject from the pre-treatment allowing for estimation of the composition of the original waste. A total of 40 waste samples were chemically characterised with respect to 15 parameters. The waste generally consisted of around 88% VS of which an average of 80% was easily degradable. The average content of N, P and K in the dry matter of the organic waste was 2.5%, 0.4% and 0.9%, respectively. A general analysis of variance was applied to show the influence of the collection system, dwelling type and annual season on the waste composition. The content of plastic and crude fibres in the waste differed the most among the samples, probably due to use of different bag types (plastic and paper) in the different collection systems. Variations in the ash content and the calorific value might be explained by differences in the sorting instructions (whether soil and cat litter are allowed in the organic fraction). Significant seasonal variations were seen for ash, S and Cl. Dwelling type showed no statistically significant influence on any waste components. A test for uniform distribution of the p-values from the analysis of variance (Kolmogorov-Smirnov test) showed that the overall composition of the collected waste was strongly affected by the collection system (city) and season, while dwelling type had no significant influence. (c) 2006 Elsevier Ltd. All rights reserved.

General information
State: Published
Organisations: Department of Environmental Engineering, Mathematical Statistics, Department of Informatics and Mathematical Modeling, Department of Environmental Science and Engineering, Lund University
Contributors: Hansen, T. L., Jansen, J. L. C., Spliid, H., Davidsson, A., Christensen, T. H.
Pages: 510-518
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 27
Issue number: 4
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Determination of solute organic concentration in contaminated soils using a chemical-equilibrium soil column system

Groundwater risk assessment of contaminated soils implies determination of the solute concentration leaching out of the soil. Determination based on estimation techniques or simple experimental batch approach has proven inadequate. Two chemical equilibrium soil column leaching tests for determination of solute concentration in a contaminated soil were developed; (1) a chemical Equilibrium and Recirculation column test for Volatile organic chemicals (ER-V) and (2) a chemical Equilibrium and Recirculation column test for Hydrophobic organic chemicals (ER-H). The two test systems were evaluated using two soils with different content of organic carbon (f(oc) of 1.5 and 6.5%, respectively). A quadruple blind test of the ER-V system using glass beads in stead of soil showed an acceptable recovery (65-85%) of all of the 11 VOCs tested. Only for the most volatile compound (heptane, K-H similar to 80) an unacceptable recovery was found (9%). The contact time needed for obtaining chemical equilibrium was tested in the ER-H system by performing five test with different duration (1, 2, 4, 7 and 19 days) using the low organic carbon soil. Seven days of contact time appeared sufficient for achieving a solute equilibrium concentration. The repeatability of both test systems (evaluated by performing five identical
tests) was considered acceptable (8-16% and 7-28% for the ER-V and ER-H system, respectively). Comparing determined solute concentration in both systems for volatile and hydrophobic chemicals with estimated concentrations using an K-ow-K-oc relation and determined total soil concentrations, large differences between measured and estimated solute concentrations were observed, especially for the hydrophobic chemicals (PAHs). This clearly illustrates the need for a reliable method to measure solute phase concentration of PAHs in contaminated soils. Overall a reliable and reproducible system for determining solute concentration of a wide range of organic compounds in contaminated soils has been developed.

**General information**

State: Published
Organisations: Department of Environmental Engineering
Contributors: Gamst, J., Kjeldsen, P., Christensen, T. H.
Pages: 377-389
Publication date: 2007
Peer-reviewed: Yes

**Publication information**

Journal: Water, Air and Soil Pollution
Volume: 183
Issue number: 1-4
ISSN (Print): 0049-6979
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.9
Web of Science (2017): Impact factor 1.769
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.77
Web of Science (2016): Impact factor 1.702
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.7
Web of Science (2015): Impact factor 1.551
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8
Web of Science (2014): Impact factor 1.554
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.8
Web of Science (2013): Impact factor 1.685
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.81
Web of Science (2012): Impact factor 1.748
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.72
Web of Science (2011): Impact factor 1.625
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Web of Science (2010): Impact factor 1.765
Effects of pre-treatment technologies on quantity and quality of source-sorted municipal organic waste for biogas recovery

Source-sorted municipal organic waste collected from different dwelling types in five Danish cities and pre-treated at three different plants was sampled and characterized several times during one year to investigate the origin of any differences in composition of the pre-treated waste introduced by city, pre-treatment technology, dwelling type or annual season.

The investigated pre-treatment technologies were screw press, disc screen and shredder + magnet. The average quantity of pre-treated organic waste (biomass) produced from the incoming waste varied between the investigated pre-treatment technologies: 59%, 66% and 98% wet weight, respectively (41%, 34% and 2% reject, respectively). The pre-treatment technologies showed differences with respect to distribution of the chemical components in the waste between the biomass and the rejected material (reject), especially for dry matter, ash, collection bag material (plastic or paper) and easily degradable organic matter. Furthermore, the particle size of the biomass was related to the pre-treatment technology. The content of plastic in the biomass depended both on the actual collection bag material used in the system and the pre-treatment technology. The sampled reject consisted mostly of organic matter. For cities using plastic bags for the source-separated organic waste, the expected content of plastic in the reject was up to 10% wet weight (in some cases up to 20%).

Batch tests for methane potential of the biomass samples showed only minor variations caused by the factors city, pre-treatment technology, dwelling type and season when based on the VS content of the waste (overall average 459 STP m(3)/t VS). The amount of methane generated from 1 t of collected waste was therefore mainly determined by the efficiency of the chosen pre-treatment technology described by the mass distribution of the incoming waste between biomass and reject. (c) 2006 Elsevier Ltd. All rights reserved.
Environmental assessment of garden waste management in the city of Herning (Denmark) by means of LCA-modeling (EASEWASTE)

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Boldrin, A., Christensen, T. H.
Publication date: 2007

Host publication information
Title of host publication: Sardinia 2007: Eleventh International Waste Management and Landfill Symposium, 1-5 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 205429
Research output: Research › Article in proceedings – Annual report year: 2007

Environmental assessment of solid waste landfilling technologies by means of LCA-modeling (EASEWASTE)

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Manfredi, S., Christensen, T. H.
Publication date: 2007

Host publication information
Title of host publication: Sardinia 2007: Eleventh International Waste Management and Landfill Symposium, 1-5 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 205443
Research output: Research › Article in proceedings – Annual report year: 2007

Experience with the use of LCA-modelling (EASEWASTE) in waste management

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Management Engineering, Innovation and Sustainability
Pages: 257-262
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 25
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Household hazardous waste: composition of paint waste

'Paint waste', a part of the 'household hazardous waste', amounting to approximately 5 tonnes was collected from recycling stations in two Danish cities. Sorting and analyses of the waste showed paint waste comprised approximately 65% of the mass, paint-like waste (cleaners, fillers, etc.) comprised 15-25% and foreign items comprised 10-20%. Water-based paint was the dominant part of the paint waste. The chemical composition of the paint waste and the paint-like waste was characterized by an analysis of 27 substances in seven waste fractions. The content of critical substances was low and the paint waste was less contaminated with heavy metals than was the ordinary household waste. This may suggest that households no longer need to source-segregate their paint if the household waste is incinerated, since the presence of a small quantity of solvent-based paint will not be harmful when incinerated. Allowing household paint waste to be collected with ordinary household waste is expected to reduce the cost of handling household hazardous waste, since paint waste in Denmark comprises the major fraction of household hazardous waste.

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Fjelsted, L., Christensen, T. H.
Pages: 502-509
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 25
Issue number: 6
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Indirect Determination of Chemical Composition and Fuel Characteristics of Solid Waste: Methodology and Application

Determination of chemical composition of solid waste can be performed directly or indirectly by analysis of combustion products. The indirect methodology instrumented by a full scale incinerator is the only method that can conclude on elements in trace concentrations. These elements are of great interest in evaluating waste management options by for example LCA modeling.

A methodology description of indirect determination of chemical composition and fuel properties of waste is provided and validated by examples.

Indirect analysis of different waste types shows that the chemical composition is significantly dependent on waste type. And the analysis concludes that the transfer of substances in the incinerator is a function of waste chemical content, incinerator technology and waste physical properties. The importance of correct representation of rare items in the waste with high concentrations of toxic elements is shown exemplified by Hg. The average concentration is evaluated to be affected by three occurrences; background, rare items and very rare items.
(1/800 tonnes), that are all important to the Hg average concentration.

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Riber, C., Christensen, T. H.
Number of pages: 24
Publication date: 2007

**Publication information**
Publisher: Environment & Resources DTU. Technical University of Denmark
Keywords: Indirect analysis, Waste characterization, Waste incineration, Household waste, Fuel properties of waste
Research output: Research › Working paper – Annual report year: 2007

**Influence of test conditions on solubility controlled leaching predictions from air-pollution-control residues**

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Hyks, J., Astrup, T., Christensen, T. H.
Pages: 457-466
Publication date: 2007
Peer-reviewed: Yes

**Publication information**
Journal: Waste Management and Research
Volume: 25
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
LCA af dagrenovationssystemet i syv nordsjællandske kommuner

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Christensen, T. H., Møller, J.
Number of pages: 107
Publication date: 2007

Publication information
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: English
Electronic versions:
MR2007_293.pdf
Research output: Research › Report – Annual report year: 2007
Leaching of PAHs from hot mix asphalt pavements

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Birgisdottir, H., Gamst, J., Christensen, T. H.
Pages: 1409-1421
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Environmental Engineering Science
Volume: 24
Original language: English
DOIs: 10.1089/ees.2005.0135
Source: orbit
Source-ID: 207344
Research output: Research - peer-review › Journal article – Annual report year: 2007

Life Cycle Assessment LCA of Waste Management Systems - LCA Oriented Solid Waste Management Model - EASEWASTE

General information
State: Published
Organisations: Department of Management Engineering, Residual Resource Engineering, Department of Environmental Engineering, Quantitative Sustainability Assessment
Contributors: Bhander, G. S., Christensen, T. H., Hauschild, M. Z., Das, T.
Publication date: 2007
Peer-reviewed: No
Source: orbit
Source-ID: 264510
Research output: Research › Conference abstract for conference – Annual report year: 2007

Life cycle assessment of disposal of residues from municipal solid waste incineration: Recycling of bottom ash in road construction or landfilling in Denmark evaluated in the ROAD-RES model

Two disposal methods for MSWI bottom ash were assessed in a new life cycle assessment (LCA) model for road construction and disposal of residues. The two scenarios evaluated in the model were: (i) landfilling of bottom ash in a coastal landfill in Denmark and (ii) recycling of bottom ash as subbase layer in an asphalted secondary road. The LCA included resource and energy consumption, and emissions associated with upgrading of bottom ash, transport, landfilling processes, incorporation of bottom ash in road, substitution of natural gravel as road construction material and leaching of heavy metals and salts from bottom ash in road as well as in landfill. Environmental impacts associated with emissions to air, fresh surface water, marine surface water, groundwater and soil were aggregated into 12 environmental impact categories: Global Warming, Photochemical Ozone Formation, Nutrient Enrichment, Acidification, Stratospheric Ozone Depletion, Human Toxicity via air/water/soil, Ecotoxicity in water/soil, and a new impact category, Stored Ecotoxicity to water/soil that accounts for the presence of heavy metals and very persistent organic compounds that in the long-term might leach. Leaching of heavy metals and salts from bottom ash was estimated from a series of laboratory leaching tests. For both scenarios, Ecotoxicity(water) was, when evaluated for the first 100 yr, the most important among the twelve impact categories involved in the assessment. Human Toxicity(soil) was also important, especially for the Road scenario. When the long-term leaching of heavy metals from bottom ash was evaluated, based on the total content of heavy metals in bottom ash, all impact categories became negligible compared to the potential Stored Ecotoxicity, which was two orders of magnitudes greater than Ecotoxicity(water) was the constituent that gave the strongest contributions to the ecotoxicities. The most important resources consumed were clay as liner in landfill and the groundwater resource which was potentially spoiled due to leaching of salts from bottom ash in road. The difference in environmental impacts between landfilling and utilization of bottom ash in road was marginal when these alternatives were assessed in a life cycle perspective. (c) 2007 Elsevier Ltd. All rights reserved.
Life-cycle assessment of waste incinerators - the significance of increasing air pollution control on the environmental impact

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Damgaard, A., Riber, C., Hulgaard, T., Christensen, T. H.
Publication date: 2007

Host publication information
Title of host publication: Sardinia 2007 : Eleventh International Waste Management and Landfill Symposium, 1-5 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 205439
Research output: Research › Article in proceedings – Annual report year: 2007

Methane yield in source-sorted organic fraction of municipal solid waste

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Davidsson, Å., Gruvberger, C., Christensen, T. H., Hansen, T. L., Jansen, J.
Pages: 406-414
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 27
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Method for fractional solid-waste sampling and chemical analysis

Chemical characterization of solid waste is a demanding task due to the heterogeneity of the waste. This article describes how 45 material fractions hand-sorted from Danish household waste were subsampled and prepared for chemical analysis of 61 substances. All material fractions were subject to repeated particle-size reduction, mixing, and mass reduction until a sufficiently small but representative sample was obtained for digestion prior to chemical analysis. The waste-fraction samples were digested according to their properties for maximum recognition of all the studied substances. By combining four subsampling methods and five digestion methods, paying attention to the heterogeneity and the material characteristics of the waste fractions, it was possible to determine 61 substances with low detection limits, reasonable variance, and high accuracy. For most of the substances of environmental concern, the waste-sample concentrations were above the detection limit (e.g. Cd > 0.001 mg kg\(^{-1}\), Cr > 0.01 mg kg\(^{-1}\), Hg > 0.002 mg kg\(^{-1}\), Pb > 0.005 mg kg\(^{-1}\)). The variance was in the range of 5-100%, depending on material fraction and substance as documented by repeated sampling of two highly different material fractions ("Vegetable food" and 'Shoes, leather, etc."). Statistical analysis showed for the 'Vegetable food' that the variance could not be attributed to a single step in the procedure, whereas in the case of 'Shoes, leather, etc.', the first coarse shredding was the main source of variance (20-85% of the overall variation). Only by increasing the sample size significantly can this variance be reduced. The accuracy and short-term reproducibility of the chemical characterization were good, as determined by the analysis of several relevant certified reference materials. Typically, six to eight different certified reference materials representing a range of concentrations levels and matrix characteristics were included. Based on the documentation provided, the methods introduced were considered satisfactory for characterization of the chemical composition of waste-material fractions. ©CPY 2007 Taylor & Francis.

General information

State: Published
Organisations: Department of Environmental Engineering, Department of Informatics and Mathematical Modeling
Contributors: Riber, C., Rodushkin, I., Spliid, H., Christensen, T. H.
Pages: 321-335
Publication date: 2007
Peer-reviewed: Yes

Publication information

Journal: International Journal of Environmental Analytical Chemistry
Volume: 87
Issue number: 5
ISSN (Print): 0306-7319
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.32 SJR 0.361 SNIP 0.489
Web of Science (2017): Impact factor 1.372
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.28 SJR 0.368 SNIP 0.514
Web of Science (2016): Impact factor 1.208
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.27 SJR 0.422 SNIP 0.539
Web of Science (2015): Impact factor 1.411
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.17 SJR 0.435 SNIP 0.576
Web of Science (2014): Impact factor 1.295
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.35 SJR 0.403 SNIP 0.557
Web of Science (2013): Impact factor 1.321
Miljøvurdering af husholdningsaffald i Herning Kommune: Dagrenovation, storskrald, farligt affald og haveaffald

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Larsen, A. W., Fjelsted, L., Boldrin, A., Riber, C., Christensen, T. H.
Publication date: 2007

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Danish
Electronic versions:
Source: orbit
Source-ID: 252560
Research output: Research › Report – Annual report year: 2007
Prediction of leaching from air pollution control residues

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Hyks, J., Astrup, T., Christensen, T. H.
Publication date: 2007

Host publication information
Title of host publication: Sardinia 2007 : Eleventh International Waste Management and Landfill Symposium, 1-5 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 205442
Research output: Research › Article in proceedings – Annual report year: 2007

Second generation methodology for chemical characterization of solid waste fractions

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Riber, C., Astrup, T., Christensen, T. H.
Publication date: 2007

Host publication information
Title of host publication: Sardinia 2007 : Eleventh International Waste Management and Landfill Symposium, 1-5 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 205446
Research output: Research › Article in proceedings – Annual report year: 2007
The dissolution kinetics of major elements in municipal solid waste incineration bottom ash particles

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Bendz, D., Tüchsen, P., Christensen, T. H.
Pages: 178-194
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 94
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Web of Science (2011): Impact factor 2.324
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.363 SNIP 1.194
Web of Science (2010): Impact factor 2.124
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.335 SNIP 1.4
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Application of processed organic municipal solid waste on agricultural land: a scenario analysis

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Bruun, S., Hansen, T. L., Christensen, T. H., Magid, J., Jensen, L.
Pages: 251-265
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Environmental Modeling and Assessment
Volume: 11
Original language: English
Source: orbit
Source-ID: 190672
Research output: Research - peer-review › Journal article – Annual report year: 2006

Assessment of long-term leaching from waste incineration air-pollution-control residues
Assessment of long-term leaching from MSWI air-pollution-control (APC) residues is discussed with respect to use in environmental impact assessment, such as life-cycle assessment (LCA). A method was proposed for estimating leaching as a function of the liquid-to-solid (L/S) ratio in a long-term perspective (L/S 5000/l/kg). Data for changes in residue pH as a function of L/S was used in combination with pH dependent leaching data to predict leachate concentrations of Al, Ca, Cd, Ba, Mg, Ni, Pb, S, Pb, V and Zn as a function of L/S. Mass balance calculations were used to determine the element fractions leached with respect to L/S. The estimated long-term leaching from a semi-dry residue and a fly ash was compared with short-term leaching determined by batch tests at L/S 10/l/kg, both carbonated and non-carbonated versions of the residues were investigated. Generally, very high L/S ratios above 2000/l/kg were required to leach 20–30% of the solid contents. However, Ca and S were depleted at L/S 200–900/l/kg. The long-term leachate concentrations were found to either remain at the same level as the initial leaching determined by the L/S 10 batch test, or to significantly decrease compared with the initial leaching. Only Al and Zn were found to show higher leachate concentrations at L/S ratios above 3000–5000/l/kg. Carbonation generally prolonged the time needed for depletion from the solid residues; however, Ca and S were depleted faster than in the case of non-carbonated residues. This study shows that uncritical use of batch leaching data for assessing the potential leaching is highly problematic, and evaluations of residue disposal should include scenario specific quantification of the long-term leaching.
Assessment of long-term pH developments in leachate from waste incineration residues

Environmental assessment of residue disposal needs to account for long-term changes in leaching conditions. Leaching of heavy metals from incineration residues are highly affected by the leachate pH; the overall environmental consequences of disposing of these residues are therefore greatly influenced by changes in pH over time. The paper presents an approach for assessing pH changes in leachate from municipal solid waste incineration (MSWI) air-pollution-control (APC) residues. Residue samples were subjected to a stepwise batch extraction method in order to obtain residue samples at a range of pH Values (similar to common pH-dependence tests), and then on these samples to determine leaching of alkalinity as well as remaining solid phase alkalinity. On a range of APC residues covering various pretreatment and disposal options, this procedure was used to determine leachable and residual alkalinity as a function of pH. Mass balance calculations for typical disposal scenarios were used to provide data on pH as a function of the liquid-to-solid (L/S) ratio in the leaching system. Regardless of residue type and pretreatment, pH was found to stay above 7 for L/S ratios up to about 2000 L kg(-1) corresponding to about 100 000 years in typical landfill scenarios. It was found that pH changes were mainly governed by alkalinity decreases from leaching processes rather than neutralization reactions. The results suggest that leaching testing for assessment purposes should be carried out in the alkaline range, for example, at pH 9. The paper offers a thorough basis for further modelling of incineration residue leaching and for modelling the environmental consequences of landfilling and utilization of these residues.
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Environmental assessment of roads constructed with and without bottom ash from municipal solid waste incineration

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Management Engineering, Innovation and Sustainability
Contributors: Birgisdottir, H., Pihl, K., Bhander, G. S., Hauschild, M. Z., Christensen, T. H.
Pages: 358-368
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Transportation Research, Part D, Environment and Transportation
Volume: 11
Original language: English
Source: orbit
Source-ID: 191200
Research output: Research - peer-review › Journal article – Annual report year: 2006

Environmental assessment of solid waste systems and technologies: EASEWASTE

A new model has been developed for evaluating the overall resource consumption and environmental impacts of municipal solid waste management systems by the use of life cycle assessment. The model is named EASEWASTE (Environmental Assessment of Solid Waste Systems and Technologies) and is able to compare different waste management strategies, waste treatment methods and waste process technologies. The potential environmental impacts can be traced back to the most important processes and waste fractions that contribute to the relevant impacts. A model like EASEWASTE can be used by waste planners to optimize current waste management systems with respect to environmental achievements and by authorities to set guidelines and regulations and to evaluate different strategies for handling of waste. The waste hierarchy has for decades been governing waste management but the ranking of handling approaches may not always be the most environmentally friendly. The EASEWASTE model can identify the most environmentally sustainable solution, which may differ among waste materials and regions and can add valuable information about environmental achievements from each process in a solid waste management system.

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Management Engineering, Innovation and Sustainability
Contributors: Kirkeby, J. T., Birgisdottir, H., Hansen, T. L., Christensen, T. H., Bhander, G. S., Hauschild, M. Z.
Pages: 3-15
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 24
Issue number: 1
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Environmental modelling of use of treated organic waste on agricultural land: a comparison of existing models for life cycle assessment of waste systems

Modelling of environmental impacts from the application of treated organic municipal solid waste (MSW) in agriculture differs widely between different models for environmental assessment of waste systems. In this comparative study five models were examined concerning quantification and impact assessment of environmental effects from land application of treated organic MSW: DST (Decision Support Tool, USA), IWM (Integrated Waste Management, UK), THE IFEU PROJECT (Germany), ORWARE (ORganic WAste REsearch, Sweden) and EASEWASTE (Environmental Assessment of Solid Waste Systems and Technologies, Denmark). DST and IWM are life cycle inventory (LCI) models, thus not performing actual impact assessment. The DST model includes only one water emission (biological oxygen demand) from compost leaching in the results and IWM considers only air emissions from avoided production of commercial fertilizers. THE IFEU PROJECT, ORWARE and EASEWASTE are life cycle assessment (LCA) models containing more detailed land application modules. A case study estimating the environmental impacts from land application of 1 ton of composted source sorted organic household waste was performed to compare the results from the different models and investigate the origin of any difference in type or magnitude of the results. The contributions from the LCI models were limited and did not depend on waste composition or local agricultural conditions. The three LCA models use the same overall approach for quantifying the impacts of the system. However, due to slightly different assumptions, quantification methods and environmental impact assessment, the obtained results varied clearly between the models. Furthermore, local conditions (e.g. soil type, farm type, climate and legal regulation) and waste composition strongly influenced the results of the environmental assessment.
Experiences on the use of LCA-modeling (EASEWASTE) in waste management

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Management Engineering, Innovation and Sustainability
Publication date: 2006

Host publication information
Title of host publication: ISWA Annual Congress 2006 "Waste Site Stories" 1-5 October 2006, Copenhagen, Denmark. Proceedings
Volume: CD-ROM
Place of publication: Copenhagen
Publisher: The International Solid Waste Association
Source: orbit
Source-ID: 192675
Research output: Research › Article in proceedings – Annual report year: 2006

Geochemical modeling of leaching from MSVI air-pollution-control residues
This paper provides an improved understanding of the leaching behavior of waste incineration air-pollution-control (APC) residues in a long-term perspective. Leaching was investigated by a series of batch experiments reflecting leaching conditions after initial washout of highly soluble salts from residues. Leaching experiments were performed at a range of pH-values using carbonated and noncarbonated versions of two APC residues. The leaching data were evaluated by geochemical speciation modeling and discussed with respect to possible solubility control. The leaching of major elements as well as trace elements was generally found to be strongly dependent on pH. As leaching characterization was performed in the absence of high salt levels, the presented results represent long-term leaching after initial washout from a disposal site, that is, liquid-to-solid ratios above 1-2 L/kg. The leaching of Al, Ba, Ca, Cr, Pb, S, Si, V, and Zn was found influenced by solubility control from Al2O3, Al(OH)3, Ba(S,Cr)O4 solid solutions, BaSO4, Ca6Al2(SO4)3(OH)12â26H2O, CaAl2Si4O12â2H2O, Ca(OH)2, CaSiO3, CaSO4â2H2O, CaZn2(OH)6â2H2O, KAlSi2O6, PbCO3, PbCrO4, Pb2O3, Pb2V2O7, Pb3(VO4)2, ZnO, Zn2SiO4, and ZnSiO3. The presented dataset and modeling results form a thorough contribution to the assessment of long-term leaching behavior of APC residues under a wide range of conditions.
Indledende miljømæssig vurdering af disponeringen af træaffald i Danmark

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Lindvall, H. K., Kirkeby, J., Christensen, T. H.
Publication date: 2006

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet i samarbejde med affald danmark
Original language: Danish
Electronic versions: MR2006-269.pdf
Source: orbit
Source-ID: 194988
Research output: Research › Report – Annual report year: 2006

Influence of conventional landfilling elements on environmental impact potentials assessed by an LCA-model (EASEWASTE)

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Damgaard, A., Manfredi, S., Christensen, T. H.
Pages: 69-70
Publication date: 2006

Host publication information
Title of host publication: Abstracts proceedings of the 4th intercontinental landfill research symposium, 14-16 June 2006, Gällivare, Sweden
Place of publication: Luleå
Life cycle assessment of residue use in road construction (ROAD-RES)

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Management Engineering, Innovation and Sustainability
Contributors: Christensen, T. H., Birgisdottir, H., Bhander, G. S., Hauschild, M. Z.
Pages: 617-627
Publication date: 2006

Host publication information
Place of publication: Utrecht, NL
Publisher: ISCOWA
Editors: Ilic, M., Goumans, J., Miletic, S., Heynen, J., Senden, G.
Source: orbit
Source-ID: 193351
Research output: Research › Article in proceedings – Annual report year: 2006

Life cycle modelling of environmental impacts from application of processed organic municipal solid waste on agricultural land (EASEWASTE)

A model capable of quantifying the potential environmental impacts of agricultural application of composted or anaerobically digested source-separated organic municipal solid waste (MSW) is presented. In addition to the direct impacts, the model accounts for savings by avoiding the production and use of commercial fertilizers. The model is part of a larger model, Environmental Assessment of Solid Waste Systems and Technology (EASEWASTE), developed as a decision support model, focusing on assessment of alternative waste management options. The environmental impacts of the land application of processed organic waste are quantified by emission coefficients referring to the composition of the processed waste and related to specific crop rotation as well as soil type. The model contains several default parameters based on literature data, field experiments and modelling by the agro-ecosystem model, Daisy. All data can be modified by the user allowing application of the model to other situations. A case study including four scenarios was performed to illustrate the use of the model. One tonne of nitrogen in composted and anaerobically digested MSW was applied as fertilizer to loamy and sandy soil at a plant farm in western Denmark. Application of the processed organic waste mainly affected the environmental impact categories global warming (0.4–0.7 PE), acidification (–0.06 (saving)–1.6 PE), nutrient enrichment (–1.0 (saving)–3.1 PE), and toxicity. The main contributors to these categories were nitrous oxide formation (global warming), ammonia volatilization (acidification and nutrient enrichment), nitrate losses (nutrient enrichment and groundwater contamination), and heavy metal input to soil (toxicity potentials). The local agricultural conditions as well as the composition of the processed MSW showed large influence on the environmental impacts. A range of benefits, mainly related to improved soil quality from long-term application of the processed organic waste, could not be generally quantified with respect to the chosen life cycle assessment impact categories and were therefore not included in the model. These effects should be considered in conjunction with the results of the life cycle assessment.

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Management Engineering
Contributors: Hansen, T. L., Bhander, G. S., Christensen, T. H., Bruun, S., Jensen, L.
Pages: 153-166
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 24
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
Måling af tungmetaller i dansk dagrenovation og småt brændbart

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Riber, C., Christensen, T. H.
Publication date: 2006

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 1085).
Source: orbit
Source-ID: 190569
Research output: Research › Report – Annual report year: 2006

Methane production during storage of anaerobically digested municipal organic waste

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Hansen, T. L., Sommer, S., Gabriel, S., Christensen, T. H.
Pages: 830-836
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Journal of Environmental Quality
Volume: 35
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 2.54 SJR 1.092 SNIP 1.066
Web of Science (2017): Impact factor 2.405
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.51 SJR 1.065 SNIP 1.157
Web of Science (2016): Impact factor 2.344
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.69 SJR 1.269 SNIP 1.237
Removal of readily soluble compounds prior to pH-static leaching experiments: effect of leaching predictions

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Hyks, J., Astrup, T., Christensen, T. H.
Pages: 199-204
Publication date: 2006
Characterization of solid waste by direct and indirect analysis

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Riber, C., Christensen, T. H.
Publication date: 2005

Chromium release from waste incineration air-pollution-control residues

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Rosenblad, C., Trapp, S., Christensen, T. H.
Pages: 3321-3329
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 23
ISSN (Print): 1382-3124
Ratings:
Web of Science (2019): Indexed yes
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed yes
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2001): Indexed yes
Web of Science (2000): Indexed yes
Original language: English
DOIs:
10.1021/es049346q
Source: orbit
Source-ID: 181489
Research output: Research - peer-review › Journal article – Annual report year: 2005
Heavy metal content of combustible municipal solid waste in Denmark

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Riber, C., Fredriksen, G. S., Christensen, T. H.
Pages: 126-132
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 23
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.56 SNIP 0.817
Original language: English
Source: orbit
Source-ID: 181241
Research output: Research - peer-review › Journal article – Annual report year: 2005

LCA-tool for disposal of MSWI residues: Recycling in road construction and landfilling

General information
State: Published
Organisations: Department of Environmental Engineering, Innovation and Sustainability, Department of Management Engineering
Contributors: Birgisdottir, H., Christensen, T. H., Bhander, R., Hauschild, M. Z.
Publication date: 2005

Host publication information
Title of host publication: Sardinia 2005 : Proceedings of the Tenth International Waste Management and Landfill Symposium
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 183537
Research output: Research › Article in proceedings – Annual report year: 2005

Miljøvurdering af genanvendelse og slutdisponering af spildevandsslam: en livscyklus screening af fire scenarier

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Environmental Science and Engineering
Contributors: Kirkeby, J. T., Gabriel, S., Christensen, T. H.
Publication date: 2005

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer , Danmarks Tekniske Universitet i samarbejde med Hedeselskabet, Århus og Fredericia Kommuner
Original language: Danish
URLs:
Predicting Cr leaching from MSWI residues

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Hyks, J., Christensen, T. H.
Publication date: 2005

Host publication information
Title of host publication: Sardinia 2005 : Tenth International Waste Management and Landfill Symposium, 3-7 October, Sardinia, Italy
Volume: Proceedings. CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 183533
Research output: Research › Article in proceedings – Annual report year: 2005

Waste incineration bottom ashes in Denmark: Status and development needs by 2003

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Christensen, T. H.
Publication date: 2005

Publication information
Place of publication: Kgs. Lyngby
Publisher: Affald Danmark & Environment & Resources DTU, Technical University of Denmark
Original language: English
Electronic versions:
Source: orbit
Source-ID: 155051
Research output: Research › Report – Annual report year: 2005

Assessment of sampling and chemical analysis of source-separated organic household waste

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling, Department of Environmental Engineering
Contributors: Jansen, J. L. C., Spliid, H., Hansen, T. L., Hansen, T. L., Svärd, Å., Christensen, T. H.
Pages: 541-549
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 24
Issue number: 6
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
Environmental assessment of household waste disposal in Kuala Lumpur

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Forti, M., Hansen, S., Kirkeby, J. T., Agamuthu, P., Christensen, T. H.
Pages: 115-123
Publication date: 2004
Peer-reviewed: Yes

**Publication information**
Volume: 23
ISSN (Print): 1394-1712
Ratings:
- ISI indexed (2013): ISI indexed no
- ISI indexed (2012): ISI indexed no
- ISI indexed (2011): ISI indexed no
Original language: English
Source: orbit
Source-ID: 154547
Research output: Research - peer-review > Journal article – Annual report year: 2004

Fremtidens regulering af indsamling og behandling af erhvervsaffald

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Pagh, P., Christensen, J., Christensen, T. H., Revsbech, K., Brisson, I.
Publication date: 2004

**Publication information**
Place of publication: København
Publisher: Dansk Byggeri
ISBN (Print): 87-989549-4-6
Original language: Danish
Source: orbit
Source-ID: 43834
Research output: Research - peer-review > Book – Annual report year: 2004

Genanvendelse af forbrændingsslagger

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Christensen, T. H.
Pages: 50-52
Publication date: 2004
Peer-reviewed: No

**Publication information**
Journal: Stads- og Havneingenioren
Volume: 95
Issue number: 6/7
Leaching from solid waste incineration ashes used in cement-treated base layers for pavements

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Cai, Z., Bager, D., Christensen, T. H.
Pages: 603-612
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 24
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.33 SJR 1.732 SNIP 2.263
Web of Science (2015): Impact factor 3.829
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.43 SJR 1.763 SNIP 2.49
Web of Science (2014): Impact factor 3.22
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.39 SJR 1.815 SNIP 2.413
Web of Science (2013): Impact factor 3.157
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.91 SJR 1.59 SNIP 2.18
Web of Science (2012): Impact factor 2.485
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.99 SJR 1.694 SNIP 2.071
Web of Science (2011): Impact factor 2.428
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Method for determination of methane potentials of solid organic waste

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Hansen, T. L., Schmidt, J. E., Angelidaki, I., Marca, E., Jansen, J., Mosbæk, H., Christensen, T. H.
Pages: 393-400
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Waste Management
Volume: 24
ISSN (Print): 0956-053X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.94 SJR 1.456 SNIP 2.059
Web of Science (2017): Impact factor 4.723
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4 SJR 1.407 SNIP 2.159
Web of Science (2016): Impact factor 4.03
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Miljøvurdering af affaldssystemet for dagrenovation i Århus Kommune

General information
Speciation of heavy metals in landfill leachate: a review

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Baun, D., Christensen, T. H.
Pages: 3-23
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 22
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Thermal treatment of stabilized air pollution control residues in a waste incinerator pilot plant. Part 1: fate of elements and dioxins

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Bergfeldt, B., Jay, K., Seifert, H., Vehlow, J., Christensen, T. H., Baun, D., Mogensen, E.
Pages: 49-57
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 22
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Thermal treatment of stabilized air pollution control residues in a waste incinerator pilot plant. Part 2: leaching characteristics of bottom ashes

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Baun, D., Christensen, T. H., Bergfeldt, B., Vehlow, J., Mogensen, E.
Pages: 58-68
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 22
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Xenobiotic organic compounds in leachates from ten Danish MSW landfills - chemical analysis and toxicity tests

General information
State: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Residual Resource Engineering
Contributors: Baun, A., Ledin, A., Reitzel, L., Bjerg, P. L., Christensen, T. H.
Pages: 3845-3858
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 38
ISSN (Print): 0043-1354
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.209 SNIP 2.108
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.702 SNIP 1.908
Assessment of long-term leaching of Pb, Cd and Cr from air-pollution-control residues

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Christensen, T. H.
Pages: 263-270
Publication date: 2003

Host publication information
Title of host publication: WASCON 2003: Fifth International Conference on the Environmental and Technical Implications of Construction with Alternative Materials
Place of publication: San Sebastian
Publisher: Inasmet
Editors: Ortiz de Urbina, G., Goumans, J. J. M.
Source: orbit
Source-ID: 135687
Research output: Research › Article in proceedings – Annual report year: 2003

Basisdokumentation for biogaspotentialet i organisk dagrenovation

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Hansen, T. L., Kirkeby, J. T., Jansen, J., Svärd, Å., Toudal, J., Hulgaard, T., Rasmussen, H., Gruvberger, C.
Publication date: 2003

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 802).
URLs:
Source: orbit
Source-ID: 43439
Research output: Research › Report – Annual report year: 2003

Chemical characteristics and methane potentials of source-separated and pre-treated organic municipal solid waste
A research project has investigated the biogas potential of pre-screened source-separated organic waste. Wastes from five Danish cities have been pre-treated by three methods: screw press; disc screen; and shredder and magnet. This paper outlines the sampling procedure used, the chemical composition of the wastes and the estimated methane potentials.

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Hansen, T. L., Svärd, Å., Angelidaki, I., Schmidt, J. E., Jansen, J., Christensen, T. H.
Correlation of Cadmium Distribution Coefficients to Soil Characteristics

Cadmium (Cd) distribution between the soil solid phase and the soil solution is a key issue in assessing the environmental effect of Cd in the terrestrial environmental. Previous studies have shown that many individual minerals and other components found in soils can bind Cd, but most studies on whole soil samples have shown that pH is the main parameter controlling the distribution. To identify further the components that are important for Cd binding in soil we measured Cd distribution coefficients (Kd) at two fixed pH values and at low Cd loadings for 49 soils sampled in Denmark. The Kd values for Cd ranged from 5 to 3000 L kg(-1). The soils were described pedologically and characterized in detail (22 parameters) including determination of contents of the various minerals in the clay fraction. Correlating parameters were grouped and step-wise regression analysis revealed that the organic carbon content was a significant variable at both pH values. Cation exchange capacity (CEC) and gibbsite were important at the low pH (5.3) while iron oxides also were important at the high pH (6.7). None of the other clay minerals present in the soils (illite, smectite, kaolinite, hydroxy interlayered clay minerals [HIM], chlorite, quartz, microcline, plagioclase) were significant in explaining the Cd distribution coefficient.

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Department of Environmental Engineering
Contributors: Holm, P. E., Rootzen, H., Borggaard, O. K., Maberg, J. P., Christensen, T. H.
Pages: 138-145
Publication date: 2003
Peer-reviewed: Yes

Publication information
Journal: Journal of Environmental Quality
Volume: 32
Issue number: 1
ISSN (Print): 0047-2425
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 2.54 SJR 1.092 SNIP 1.066
Web of Science (2017): Impact factor 2.405
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Datarapport om sammensætning og biogaspotentiale i organisk dagrenovation

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Jansen, J., Jørgensen, O.
Publication date: 2003

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 815).
URLs:
Source: orbit
Source-ID: 43440
Research output: Research › Report – Annual report year: 2003

Environmental assessment of source-separation of organic household waste

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Kirkeby, J. T., Hansen, T. L., Christensen, T. H., Jansen, J., Hulgaard, T.
Publication date: 2003

Host publication information
Title of host publication: Sardinia 2003 : Ninth International Waste Management and Landfill Symposium, 6-10 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 135720
Research output: Research › Article in proceedings – Annual report year: 2003

Estimating long-term leaching of heavy metals from MSWI APC residues

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Christensen, T. H.
Publication date: 2003

Host publication information
Title of host publication: Sardinia 2003 : Ninth International Waste Management and Landfill Symposium, 6-10 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 135688
Research output: Research › Article in proceedings – Annual report year: 2003

Evidence of A1-Cr-interactions affecting Cr-leaching from waste incineration ashes

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Cai, Z., Chen, D., Lundtorp, K., Christensen, T. H.
Pages: 89-95
Factors affecting chromium leaching from waste incineration residues

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Chen, D., Astrup, T., Rosenblad, C., Christensen, T. H.
Publication date: 2003

Host publication information
Title of host publication: Sardinia 2003 : Ninth International Waste Management and Landfill Symposium, 6-10 October, Sardinia, Italy. Proceedings
Volume: CD-ROM
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 135699
Research output: Research › Article in proceedings – Annual report year: 2003

In situ biodegradation determined by carbon isotope fractionation of aromatic hydrocarbons in an anaerobic landfill leachate plume (Vejen Denmark)

General information
State: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Residual Resource Engineering
Contributors: Richnow, H., Meckenstock, R., Reitzel, L., Baun, A., Ledin, A., Christensen, T. H.
Pages: 59-72
Publication date: 2003
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 64
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Web of Science (2011): Impact factor 2.324
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.363 SNIP 1.194
Web of Science (2010): Impact factor 2.124
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.335 SNIP 1.4
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.442 SNIP 1.525
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.546 SNIP 1.361
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.428 SNIP 1.48
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.416 SNIP 1.309
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.386 SNIP 1.395
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.33 SNIP 1.465
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.807 SNIP 1.669
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.557 SNIP 1.091
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.383 SNIP 1.036
Leaching from cement-treated base layers containing solid waste incineration bottom and fly ashes

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Cai, Z., Bager, D., Mosbæk, H.
Pages: 71-80
Publication date: 2003

Host publication information
Title of host publication: WASCON 2003 : Fifth International Conference on the Environmental and Technical Implications of Construction with Alternative Materials, June 4-6, 2003, San Sebastian
Place of publication: San Sebastian, Spain
Publisher: Inasmet
Editors: Ortiz de Urbina, G., Goumans, J. J. M.
Source-ID: 135701
Research output: Research › Article in proceedings – Annual report year: 2003

Leaching of PAH's from soil: Comparison of two conceptually different column tests and a batch tests

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Gamst, J., Kjeldsen, P., Hansen, J., Broholm, K., Christensen, T. H.
Pages: 173-177
Publication date: 2003

Host publication information
Title of host publication: Proceedings of the 2nd I
Place of publication: Tübingen
Publisher: Institut und Museum für Geologie und Paläontologie der Universität Tübingen
Editors: Halm, D., Grathwohl, P.
Source-ID: 135706
Research output: Research › Article in proceedings – Annual report year: 2003

Life cycle assessment of the reuse of waste incineration residues in road construction

General information
State: Published
Organisations: Department of Environmental Engineering, Innovation and Sustainability, Department of Management Engineering
Contributors: Birgisdottir, H., Christensen, T. H., Hauschild, M. Z.
Pages: 23-26
Publication date: 2003

Host publication information
Title of host publication: Proceedings of WASCON 2003 : Fifth International Conference on the Environmental and Technical Implications of Construction with Alternative Materials, June 4-6, 2003, San Sebastian
Place of publication: San Sebastian, Spain
Publisher: Inasmet
Editors: Ortiz de Urbina, G., Goumans, J. J. M.
Source-ID: 135691
Research output: Research › Article in proceedings – Annual report year: 2003
Metanemission fra lagring af bioforgasset organisk dagrenovation

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Gabriel, S., Hansen, T. L., Christensen, T. H., Sommer, S., Sørensen, K.
Publication date: 2003

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: English
URLs:
Source: orbit
Source-ID: 43533
Research output: Research › Report – Annual report year: 2003

Næsten samme miljøgevinst ved bioforgasning og forbrænding af affald

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Hansen, T. L., Kirkeby, J. T., Jansen, J., Svärd, Å., Toudal, J., Hulgaard, T., Rasmussen, H., Gruvberger, C.
Pages: 26-29
Publication date: 2003
Peer-reviewed: Unknown

Publication information
Journal: Ny Viden fra Miljøstyrelsen
Issue number: 4
Original language: Danish
Source: orbit
Source-ID: 43438
Research output: Communication › Journal article – Annual report year: 2003

Natural attenuation of xenobiotic organic compounds in a landfill leachate plume (Vejen, Denmark)

General information
State: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Residual Resource Engineering
Contributors: Baun, A., Reitzel, L., Ledin, A., Christensen, T. H., Bjerg, P. L.
Pages: 269-291
Publication date: 2003
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 65
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
Numerous pesticides found in leachates from engineered Danish landfills

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Baun, A., Ledin, A., Reitzel, L., Bjerg, P. L., Christensen, T. H.
Number of pages: 59
Publication date: 2003

Host publication information
Title of host publication: Non-agricultural use of pesticides - Environmental issues and alternatives: International Symposium Copenhagen, May 7-9. Abstracts
Place of publication: Copenhagen, Denmark
Publisher: The Royal Veterinary and Agricultural University
Source: orbit
Source-ID: 135562
Research output: Research › Conference abstract in proceedings – Annual report year: 2003

On-site treatment and landfilling of MSWI air pollution control residues
Air pollution control (APC) residues from municipal solid waste incineration (MSWI) are difficult to landfill due to substantial leaching of trace metals. An on-site pretreatment prior to landfilling of APC-residues was investigated in terms of bench-scale experiments with a semidry APC-residue and a fly ash. The treatment involved mixing of the residues with a ferrous sulphate solution and subsequent oxidation of the suspension. Afterwards, the suspension was spread on a dedicated landfill section and allowed to drain by gravity through the drainage system of the landfill. The wastewater from the process, collected through the drainage system, contained large concentrations of salts (Cl: 14–30 g/l, Na: 4–9 g/l, K: 5–11 g/l, Ca: 2–12 g/l) but low concentrations of trace metals (e.g. Pb: 14–100 μg/l, Cd: <2–7 μg/l). The treated residues left in the landfills were later subject to leaching by simulated rainfall. The leachate contained low concentrations of trace metals (Pb: <120 μg/l, Cd: <2 μg/l, Cr: <485 μg/l). The leachate concentrations from the treated APC-residues were substantially reduced compared to concentrations in leachate from untreated APC-residues. Particularly in the early stages of the leaching, concentrations of trace metals were reduced by up to four orders of magnitude.

General information
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Organisations: Department of Environmental Engineering
Contributors: Lundtorp, K., Jensen, D. L., Sørensen, M. A., Mosbæk, H., Christensen, T. H.
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Web of Science (2017): Impact factor 6.434
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Scopus rating (2016): CiteScore 6.31 SJR 1.742 SNIP 2.061
Web of Science (2016): Impact factor 6.065
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BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.54 SJR 1.633 SNIP 1.931
Web of Science (2015): Impact factor 4.836
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BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 5.21 SJR 1.814 SNIP 2.258
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Web of Science (2013): Impact factor 4.331
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 4.73 SJR 1.953 SNIP 2.443
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ISI indexed (2011): ISI indexed yes
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Scopus rating (2010): SJR 1.677 SNIP 1.706
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Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
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Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.25 SNIP 1.528
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Scopus rating (2007): SJR 0.894 SNIP 1.357
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Scopus rating (2006): SJR 1.059 SNIP 1.723
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Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.722 SNIP 1.258
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Redox properties of Cr under alkaline conditions and their effect on Cr leaching control from waste incineration ashes

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Contributors: Chen, D., Astrup, T., Christensen, T. H.
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Editors: Ortiz de Urbina, G., Goumans, J. J. M.
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Research output: Research › Article in proceedings – Annual report year: 2003

Re-use of stabilised flue gas ashes from solid waste incineration in cement-treated base layers for pavements
Fly ash from coal-burning power plants has been used extensively as a pozzolan and fine filter in concrete for many years. Laboratory experiments were performed investigating the effect of substituting the coal-based fly ash with chemically stabilised flue gas ashes (FGA) from waste incineration. Two types of FGA were treated by the Ferrox-process, which removes the majority of the easily soluble salts in the FGA and provides binding sites for heavy metals in terms of ferricydrate. Cubes of cement treated base layer materials containing 5% stabilised FGA were cast, sealed and cured for two weeks. Cylinders (diameter 100 mm, length 150 mm) were drilled from these cubes for tank leaching experiments. Duplicate specimens were subject to compression strength testing and to tank leaching experiments. The compressive strength of the CTB fulfilled the Danish requirements for CTB, i.e. strength more than 5 MPa after 7 days. The tank leaching tests revealed that leaching of heavy metals was not significantly affected by the use of chemically stabilised flue gas ashes from waste incineration. Assuming that diffusion controls the leaching process it was calculated that less than 1% of the metals would leach during a 100-year period from a 0.5 m thick concrete stab exposed to water on one side. Leaching of the common ions Ca, Cl, Na and SO4 was increased 3-20 times from the specimens with chemically stabilised flue gas ashes from waste incineration. However, the quantities leached were still modest. These experiments suggest that FGA from waste incineration after Ferrox-treatment could be re-used in CTB without compromising the strength and leaching from the base layer.

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Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
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BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
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Web of Science (2010): Impact factor 1.222
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BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
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Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
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Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
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Contributors: Jansen, J., Christensen, T. H.
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The groundwater geochemistry of waste disposal facilities

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The leaching quality of bottom ashes containing co-sintered treated APC-residues
### Viden gemt i forbrændingsanlæggenes grønne regnskaber

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### Attenuation processes in the Vejen Landfill leachate plume - 10 years on

**General information**

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Organisations: Residual Resource Engineering, Department of Environmental Engineering, Urban Water Engineering
Contributors: Christensen, T. H., Baun, A., Reitzel, L., Ledin, A., Bjerg, P. L.
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Place of publication: Sheffield, UK
Publisher: IAHS Press
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Keywords: landfill leachate, plumes, organic compounds, natural attenuation, MCPP, Denmark, DOC, Vejen Landfill
Source: orbit
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### Effect of complexation on copper mobility in landfill leachate polluted groundwater: A experimentally validated conceptual model for modeling heavy metals transport

**General information**

State: Published
Organisations: Department of Environmental Engineering
Contributors: Cai, Z., Christensen, T. H.
Publication date: 2002
Landfilling of waste incineration residues: Towards new approaches

Residues from waste incineration are bottom ashes and air-pollution-control (APC) residues including fly ashes. The leaching of heavy metals and salts from the ashes is substantial and a wide spectrum of leaching tests and corresponding criteria have been introduced to regulate the landfilling of the ashes. Leaching test, however, must be selected carefully to provide information relevant for the actual disposal scenario and for evaluating the benefits of pre-treating the residues prior to landfilling. This paper describes research at the Technical University of Denmark addressing some of these issues focusing on pH-development in landfilled residues, effects of leaching test conditions on Cr leaching and effects of pre-treatment with FeSO4.

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Contributors: Christensen, T. H., Astrup, T., Cai, Z., Chen, D.
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Modelling of transport and biogeochemical processes in pollution plumes: Vejen landfill, Denmark

A biogeochemical transport code is used to simulate leachate attenuation, biogeochemical processes, and development of redox zones in a pollution plume downstream of the Vejen landfill in Denmark. Calibration of the degradation parameters resulted in a good agreement with the observed distribution in the plume of a number of species, such as dissolved organic carbon (DOC), Fe(II), NO3-, HCO3-, SO42-, CH4, and pH. The simulated redox zones agree with observations confirming that the Fe-reducing zone played an important role in the attenuation of the DOC plume. Effective first-order rate constants for every redox zone were determined giving DOC half-lives ranging from 100 to 1-2 days going from the methanogenic to the aerobic zone. The order of decrease in DOC half-lives from the anaerobic to the aerobic zone corresponds to findings at other landfills. (C) 2002 Elsevier Science B.V. All rights reserved.

General information
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Pilot scale digestion of source-sorted household waste as a tool for evaluation of different pre-sorting and pre-treatment strategies

Pilot scale digestion of the organic fraction of source-sorted household waste from Sweden and Denmark was performed during one year. The study includes 17 waste types with differences in originating municipality, housing type, kitchen wrapping, sack type, pre-treatment method and season. The pilot scale digestion has been carried out in systems with a 35-litres digester connected to a 77-litres gas tank. Four rounds of digestion were performed including start-up periods, full operation periods for evaluation and post-digestion periods without feeding. Different pre-sorting and pre-treatment strategies is evaluated since the results are based on the measure of the realizable gas potential.

Present and long-term composition of MSW landfill leachate: A review

The major potential environmental impacts related to landfill leachate are pollution of groundwater and surface waters. Landfill leachate contains pollutants that can be categorized into four groups (dissolved organic matter, inorganic macrocomponents, heavy metals, and xenobiotic organic compounds). Existing data show high leachate concentrations of all components in the early acid phase due to strong decomposition and leaching. In the long methanogenic phase a more stable leachate, with lower concentrations and a low BOD/COD-ratio, is observed. Generally, very low concentrations of heavy metals are observed. In contrast, the concentration of ammonia does not decrease, and often constitutes a major long-term pollutant in leachate. A broad range of xenobiotic organic compounds is observed in landfill leachate. The long-term behavior of landfills with respect to changes in oxidation-reduction status is discussed based on theory and model simulations. It seems that the somewhere postulated enhanced release of accumulated heavy metals would not take place within the time frames of thousands of years. This is supported by a few laboratory investigations. The existing data and
model evaluations indicate that the xenobiotic organic compounds in most cases do not constitute a major long-term problem. This may suggest that ammonia will be of most concern in the long run.
Stabilization of APC residues from waste incineration with ferrous sulfate on a semi-industrial scale
A stabilization method for air pollution control (APC) residues from municipal solid waste incineration (MSWI) involving mixing of the residue with water and FeSO₄ has been demonstrated on a semi-industrial scale on three types of APC residues: a semidy (SD) APC residue, a fly ash (FA), and an FA mixed with sludge (FAS) from a wet flue gas cleaning system. The process was performed in batches of 165-175 kg residue. It generates a wastewater that is highly saline but has a low content of heavy metals such as Cd, Cr, and Pb. The stabilized and raw residues have been subject to a range of leaching tests: the batch leaching test, the pH-static leaching test, the availability test, and the column test. These tests showed that the stabilized residues have remarkably improved leaching properties, especially with respect to Pb but also with respect to Cd, Cu, and Zn. The release of Pb was reduced by a factor of 250-36,000.

The solubility of rhodochrosite (MnCO₃) and siderite (FeCO₃) in anaerobic aquatic environments
Natural groundwaters are often reported to be highly supersaturated with the carbonate minerals siderite (FeCO₃) and rhodochrosite (MnCO₃). The kinetics of precipitation and dissolution were determined in the light of new determinations of the solubility products of siderite and rhodochrosite. Laboratory experiments showed that the precipitation kinetics of siderite and rhodochrosite were much slower than that of calcite, and also much slower than their dissolution kinetics. Experiments with supersaturated solutions failed to reach steady state within 474 days in the case of siderite, whereas steady state for rhodochrosite was reached after 140 days. Suspensions of siderite and rhodochrosite crystals reached steady state after 10 and 80 days, respectively. The solubility product of siderite (log Kₛ₀(FeCO₃)) was 11.03 ± 0.10 for dried crystals and 10.43 ± 0.15 for wet crystals. For rhodochrosite the solubility product (log Kₛ₀(MnCO₃)) was 11.39 ± 0.14.
for dried crystals and 12.51 0.07 for wet crystals. The solubility product determined from supersaturated solutions was log $K_{S0}(\text{MnCO}_3)=11.65 0.14$. The observed slow precipitation kinetics of siderite and rhodochrosite might explain the apparent supersaturation that is often reported for anaerobic aquatic environments. # 2002 Elsevier Science Ltd. All rights reserved.
This paper describes a new concept for treatment of air-pollution-control (APC) residues from waste incineration and characterises the wastewater and stabilised residues generated by the process. The process involves mixing of APC-residues with a ferrous sulphate solution and subsequent oxidation of the suspension (Ferroxprocess 1996). The process results in a significant reduction in the leaching of salts and heavy metals from the residue, by washing out most of the salts and by binding the heavy metals in the iron oxides formed. In the laboratory, a semidry gas-cleaning residue and a fly ash were treated by the process. The generated wastewater contained low concentrations of heavy metals (e.g. Pb: 27–39 μg l–1 and Cd: 2.6–4.6 μg l–1), but high concentrations of salts (e.g. Cl, Na, K, and Ca). The treatment process reduced the leaching of Pb from the residues by more than two orders of magnitude at fixed pH as determined by pHstatic leaching tests. Likewise, the leaching of Cd, Zn and Cu was significantly reduced. The effect on elements that form oxyanions (e.g. Cr) is marginal and in the current process there is no reduction in the release of Hg.
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
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Web of Science (2014): Impact factor 1.297
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BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
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Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
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ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
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Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
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BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
ISI indexed (2010): ISI indexed yes
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
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Scopus rating (2004): SJR 0.478 SNIP 0.828
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Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
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Scopus rating (2000): SJR 0.517 SNIP 0.897
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Scopus rating (1999): SJR 0.56 SNIP 0.817

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Treatment of waste incinerator air-pollution-control residues with FeSO₄: Laboratory investigation of design parameters

The key design parameters of a new process for treatment of air-pollution-control (APC) residues (the Ferroxprocess) were investigated in the laboratory. The optimisation involved two different APC-residues from actual incinerator plants. The design parameters considered were: amount of iron oxide supplied, the liquid-to-solid ratio of the process, the separation of solids and wastewater, the sequence of material mixing, the possibilities of reuse of water, the feasibility of using secondary (brackish) water, and simple means to improve the wastewater quality. The investigation showed that an optimum process configuration could be obtained yielding a stabilised solid product with low leaching of heavy metals and a dischargable wastewater with high contents of salts (in order to remove salts from the solid product) and low concentrations of heavy metals. The amount of iron added to the APC-residues must be optimised for each residue. The overall water use can be limited to a L/S-ratio of 3 l kg⁻¹ including water used for washing of the treated products.
Waste related emissions scenarios for risk assessment of chemicals. Report to Danish Environmental Protection Agency

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A simple model for the distribution and fate of organic chemicals in a landfill: MOCLA

A simple mathematical model (MOCLA: Model for Organic Chemicals in Landfills) is presented, describing the distribution of organic chemicals between leachate, gas and solid waste. The model also predicts the fate of the chemicals in terms of emissions with leachate and landfill gas and in terms of degradation and transformation in the landfill. Local equilibrium is assumed for the distribution of the chemicals in the landfill as expressed by Henry’s Law for the leachate-gas interface, and by the linear partition coefficient based on the waste solid organic carbon content for the waste-leachate interface. Degradation of the chemicals is expressed as a first order reaction. Annual specific leachate and gas generation data in combination with data on landfill area and volume allow for prediction of main emission routes. Model simulations involving two landfill scenarios for a number of chemicals with different physico-chemical characteristics indicate that volatilisation is a likely route for some chemicals (e.g. vinyl chloride, and some of the freons), while other chemicals (e.g. phenol, lower chlorinated aliphatic compounds) more likely will appear as dissolved in the leachate. However, many chemicals will be strongly associated with the solid waste (e.g. dichlorobenzene, naphthalene, and higher Polycyclic Aromatic Hydrocarbons (PAHs), and the pool available will be able to supply the landfill gas and leachate with organic trace components for decades unless these are degraded in the landfill. The model suggests that, in addition to the physico-chemical characteristics of the organic chemical, the presence of free phases of organic chemicals and the degradability of the chemicals are the main factors controlling the fate and emissions of organic chemicals in the landfill environment.

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Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
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Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
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ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
Biogeochemistry of landfill leachate plumes
The literature has been critically reviewed in order to assess the attenuation processes governing contaminants in leachate affected aquifers. Attenuation here refers to dilution, sorption, ion exchange, precipitation, redox reactions and degradation processes. With respect to contaminants, focus is on dissolved organic matter, xenobiotic organic compounds, inorganic macrocomponents as anions and cations, and heavy metals. Laboratory as well as field investigations are included. This review is an up-date of an earlier comprehensive review. The review shows that most leachate contamination plumes are relatively narrow and do not in terms of width exceed the width of the landfill. The concept of redox zones being present in the plume has been confirmed by the reported composition of the leachate contaminated groundwater at several landfills and constitutes an important framework for understanding the behavior of the contaminants in the plume as the leachate migrates away from the landfill. Diverse microbial communities have been identified in leachate plumes and are believed to be responsible for the redox processes. Dissolved organic C in the leachate, although it appears to be only slowly degradable when the volatile organic acids are gone, apparently acts as substrate for the microbial, redox processes. Several xenobiotic organic compounds have been found to be degradable in leachate contaminated groundwater, but degradation rates under anaerobic redox conditions have only been determined in a few cases. Apparently, observations in actual plumes indicate more extensive degradation than has been documented in the laboratory. The behavior of cations in leachate plumes is strongly influenced by exchange with the sediment,
although the sediment often is very coarse and sandy. Ammonium seems to be subject to anaerobic oxidation, but the mechanisms are not yet understood. Heavy metals do not seem to constitute a significant pollution problem at landfills, partly because the heavy metal concentrations in the leachate often are low, and partly because of strong attenuation by sorption and precipitation. Although complexation of heavy metals with dissolved organic matter is significant, the heavy metals are in most cases still strongly attenuated in leachate-polluted aquifers. The information available on attenuation processes has increased dramatically during the last 15 a, but the number of well-documented full scale leachate plumes are still few and primarily from sandy aquifers. Thus, the diversity of attenuation processes in leachate plumes is probably not yet fully understood. Apparently, the attenuation processes in leachate plumes may for many contaminants provide significant natural remediation, limiting the effects of the leachate on the groundwater to an area usually not exceeding 1000 m from the landfill. (C) 2001 Elsevier Science Ltd. All rights reserved.
Co-sintering of treated APC-residues with bottom ash

Air pollution control residues stabilised by means of the Ferrox process can be safer disposed of due to lower contents of soluble salts and less soluble heavy metals stabilised in iron oxides. Co-combustion tests in the Karlsruhe test incinerator TAMARA were carried out in order to investigate the influence of co-sintering of Ferrox products with bottom ashes on the quality of the residues and the effects on the combustion process. Only few elements showed higher concentrations in the bottom ashes of these co-combustion tests compared to reference tests. No significant effect on the leaching behaviour of the bottom ashes could be found. During the co-combustion process an increase in SO2 concentrations in the raw gas and slightly lower temperatures in the fuel bed could be observed.

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Bergfeldt, B., Jensen, D. L., Vehlow, J., Mogensen, E., Christensen, T. H.
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Publication date: 2001
Co-sintering of treated APC-residues with bottom ash

General information
State: Published
Organisations: Department of Environmental Engineering, Forschungs Zentrum Karlsruhe GmbH, Babcock & Wilcox Velund A/S
Contributors: Jensen, D. L., Bergfeldt, B., Vehlow, J., Mogensen, E. P. B., Christensen, T. H.
Publication date: 2001
Peer-reviewed: Yes
Event: Abstract from Waste-to Energy seminar, Malmö, Sweden, 25-26 October, .
Source: orbit
Source-ID: 318810
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2001

Ferroxprocessen - en miljoforbedrende stabiliseringsmetode for roggasrensningsprodukter fra affaldsforbrænding

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Jensen, D. L., Sørensen, M. A., Christensen, T. H., Lundtorp, K., Mogensen, E., Nielsen, J., Andersen, U., Crielisen, K., Ornebjerg, H., Nedenskov, J., Bille, S.
Pages: 1
Publication date: 2001
Peer-reviewed: Unknown

Publication information
Journal: Byggeteknik. Energi og Miljø
Volume: 14
Issue number: 30. april
Original language: Danish
Source: orbit
Source-ID: 43645
Research output: Communication › Journal article – Annual report year: 2001

Groundwater pollution downgradient of the Vejen landfill: A revisit in the field after 10 years

General information
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Organisations: Residual Resource Engineering, Department of Environmental Engineering, Urban Water Engineering
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Title of host publication: Sardinia 2001 : Barriers, Waste Mechanics and Groundwater Pollution
Volume: vol. III
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 135816
Research output: Research › Article in proceedings – Annual report year: 2001

High temperature co-treatment of bottom ash and stabilized fly ashes from waste incineration

Bottom ashes from two Danish municipal solid waste incineration plants were heated at 900 degreesC with iron oxide stabilized air pollution control residues at actual mass flow ratios (9:1), simulating a treating method for the residues. The two residues were cotreated, producing one combined stream that may be utilized as a secondary road construction material. Scanning electron microscope analysis and grain size distribution analysis indicated that sintering of the particles did not occur. Batch leaching tests at liquid/solid 10 l/kg at a range of pH-values (6-10) quantified with respect to Cd, Cr and Pb revealed significant positive effects of co-heating the ashes, although Pb showed slightly increased leaching. At a liquid/solid ratio of 10 l/kg the leachate concentrations were still low at pH 7-10 and the release of Pb was, thus, not expected to limit the utilization of the mixed ashes. The process, thus, fixates the metals in the solid residues without altering the leaching properties of the bottom ash too significantly. (C) 2001 Elsevier Science Ltd. All rights reserved.
Long-term development in APC ash landfills with respect to pH

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Astrup, T., Hansen, J., Hjelmar, O., Christensen, T. H.
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Publication date: 2001

Host publication information
Title of host publication: Sardinia 2001 : The Sustainable Landfill
Volume: Vol. 1
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 135808
Research output: Research › Article in proceedings – Annual report year: 2001

Natural attenuation as an approach to remediation of groundwater pollution at landfills

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Bjerg, P. L., Kjeldsen, P.
Pages: 587-602
Publication date: 2001

Host publication information
Title of host publication: Treatment of contaminated soil. fundamentals, analysis, applications
Volume: Chapter 36
Place of publication: Berlin
Publisher: Springer
Editors: Stegmann, R., Brunner, G., Calmano, W., Matz, G.
Source: orbit
Natural attenuation of phenoxy acids in landfill leachate affected ground water

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Bjerg, P. L., Ejlskov, P., Jordt, B., Züricho, H., Christensen, T. H.
Number of pages: 115
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Title of host publication: Abstract of the Eighth Symposium on the Chemistry and Fate of Modern Pesticides
Place of publication: Copenhagen
Publisher: The Royal Veterinary and Agricultural University
Source: orbit
Source-ID: 135626
Research output: Research › Conference abstract in proceedings – Annual report year: 2001

 Naturlig nedbrydning af fanen nedstrøms for Vejen Losseplads: - hvordan ser det ud 10 år efter de første undersogelser?

General information
State: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Residual Resource Engineering
Pages: 21-31
Publication date: 2001

Host publication information
Title of host publication: Vintermøde om grundvandsforurening, ATV-Komiteen vedrørende Grundvandsforurening, Vingstedcentret 7-8 marts
Place of publication: Kgs. Lyngby
Publisher: ATV-fonden for Jord og Grundvand
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Source-ID: 135809
Research output: Research › Article in proceedings – Annual report year: 2001

Performance of the ferrox-process on a semi-industrial scale

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Lundtorp, K., Jensen, D. L., Christensen, T. H.
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Title of host publication: Sardinia 2001 : The Sustainable Landfill
Volume: vol. I
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
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Source: orbit
Source-ID: 135833
Research output: Research › Article in proceedings – Annual report year: 2001


General information
State: Published
Organisations: Department of Environmental Engineering
Stabilisation of APC-residues by the ferrox-process

Stabilisation of APC-residues by the ferrox-process

Aging of iron (hydr)oxides by heat treatment and effects on heavy metal binding

Aging of iron (hydr)oxides by heat treatment and effects on heavy metal binding

General information

General information

Publication information

Publication information
Characterization of redox conditions in groundwater contaminant plumes

Evaluation of redox conditions in groundwater pollution plumes is often a prerequisite for understanding the behaviour of the pollutants in the plume and for selecting remediation approaches. Measuring of redox conditions in pollution plumes is, however, a fairly recent issue and yet relative few cases have been reported. No standardised or generally accepted approach exists. Slow electrode kinetics and the common lack of internal equilibrium of redox processes in pollution plumes make, with a few exceptions, direct electrochemical measurement and rigorous interpretation of redox potentials dubious, if not erroneous. Several other approaches have been used in addressing redox conditions in pollution plumes: redox-sensitive compounds in groundwater samples, hydrogen concentrations in groundwater, concentrations of volatile fatty acids in groundwater, sediment characteristics and microbial tools, such as MPN counts, PLFA biomarkers and redox bioassays. This paper reviews the principles behind the different approaches, summarizes methods used and evaluates the approaches based on the experience from the reported applications. C 2000 Elsevier Science B.V. All rights reserved.

General Information
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Organisations: Residual Resource Engineering, Department of Environmental Engineering, Urban Water Engineering, University of Sheffield
Contributors: Christensen, T. H., Bjerg, P. L., Banwarth, S. A., Jakobsen, R., Heron, G., Albrechtsen, H.
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Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
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Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Web of Science (2011): Impact factor 2.324
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.363 SNIP 1.194
Web of Science (2010): Impact factor 2.124
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.335 SNIP 1.4
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.442 SNIP 1.525
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.546 SNIP 1.361
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Scopus rating (2006): SJR 1.428 SNIP 1.48
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.416 SNIP 1.309
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.386 SNIP 1.395
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.33 SNIP 1.465
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.807 SNIP 1.669
Web of Science (2002): Indexed yes
Characterization of redox conditions in pollution plumes

Evaluation of redox conditions in groundwater pollution plumes is often a prerequisite for understanding the behaviour of the pollutants in the plume and for selecting remediation approaches. Measuring of redox conditions in pollution plumes is, however, a fairly recent issue and yet relative few cases have been reported. No standardised or generally accepted approach exists. This paper evaluates the different methods for redox characterization based on the experiences from the reported applications.

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Organisations: Department of Environmental Science and Engineering, Department of Geology and Geotechnical Engineering, University of Sheffield
Contributors: Christensen, T. H., Bjerg, P. L., Banwart, S. A., Jakobsen, R., Heron, G., Albrechtsen, H.
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Keywords: groundwater, redox, bioassays, hydrogen, plume, site investigation, contaminated sites
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Copper and zinc distribution coefficients for sandy aquifer materials

Distribution coefficients (Kd) were measured for copper (Cu) and zinc (Zn) in laboratory batch experiments for 17 sandy aquifer materials at environmentally relevant solute concentrations (Cu: 5±300 mg/l, Zn: 20±3100 mg/l). The Kd values ranged two to three orders of magnitude (Cu: 70±10,800 l/kg; Zn: 6±22,800 l/kg) and correlating them to the characteristics of the aquifer material (particle size distribution, organic C content, surface area, pH) revealed good correlation with pH in the range 5.3±8.9 (Cu: r²=0.72; Zn: r²=0.94). Including any other of the measured aquifer characteristics improved the correlation only a few percent. The results indicate that the mobility of Cu and Zn in sandy aquifers, as reflected in the measured Kd values, is very restricted at pH values above 6, since the relative migration velocity is less than 1%. However, at lower pH values, Zn seems to become mobile in sandy aquifers. # 2000 Elsevier Science Ltd. All rights reserved

General information
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Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Astrup, T., Boddum, J. K., Hansen, B. Ø., Redemann, S.
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Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Effects of thermal treatment on mineralogy and heavy metal behavior in iron oxide stabilized air pollution control residues

Stabilization of air pollution control residues by coprecipitation with ferrous iron and subsequent thermal treatment (at 600 and 900 °C) has been examined as a means to reduce heavy metal leaching and to improve product stability. Changes in mineralogy and metal binding were analyzed using various analytical and environmental techniques. Ferrhydrite was formed initially but transformed upon thermal treatment to more stable and crystalline iron oxides (maghemite and hematite). For some metals leaching studies showed more substantial binding after thermal treatment, while other metals either volatilized or destabilized with respect to leaching. Pb, in particular, exhibited increased reactivity following the formation of an ordered iron oxide structure at 900 °C. The thermal treatment had a positive effect on Cr release, which was reduced significantly at 900 °C in the presence of organic matter. Thermal treatment of the stabilized residues produced structures with an inherently better iron oxide stability. However, the concentration of metals in the leachate generally increased as a consequence of the decreased solubility of metals in the more stable iron oxide structure.
Immobilization of chromate from coal fly ash leachate using an attenuating barrier containing zero-valent iron

The purpose of this investigation was (i) to test the effectiveness of a barrier engineered to remove Cr(VI) from leachates of higher pH and salinity typical of coal burning ashes and (ii) to determine which geochemical processes control Cr immobilization. Laboratory column and batch desorption experiments show that a barrier composed of sand, Fe(0), and bentonite irreversibly immobilizes Cr. Concentrations fall from 25 mg Cr L\(^{-1}\) in the leachate to below detection limits (0.0025 mg Cr L\(^{-1}\)) and solution pH increases by about two units. Solid-phase analytical techniques such as SEM, EDS, XPS, and TOFSIMS were used to characterize the barrier material prior to and after exposure to the Cr leachate. In the barrier material, Cr(III) was found associated with Fe(III)-oxides, as separate Cr oxides and as a Ca,Cr phase, probably Cachromite, CaCr\(_2\)O\(_4\). The attenuating barrier can be an alternative to traditional liners and leachate collection systems at coal ash storage and disposal sites.

Leachability of heavy metals from scrap dirt sampled at two scrap iron and metal recycling facilities

Column and batch leaching experiments were performed to quantify leaching of heavy metals (Pb, Cu, Cd and Zn) from scrap dirt representing different activities at two iron scrap and metal recycling facilities. The scrap dirt is often found directly upon the bare unprotected soil at recycling facilities. In most cases the leaching of heavy metals was modest, within \(\text{\%}\)ve times the leaching from reference soils, and the concentrations were usually within a factor of 2 of drinking water criteria. The high pH of the scrap dirt samples seemed to control the leaching. However, scrap dirt from car battery salvage locations was different, showing lower pH and significant leaching of lead (up to 8000 mg Pb l\(^{-1}\)), cadmium (up to 40 mg Cd l\(^{-1}\)), and zinc (up to 2000 mg Zn l\(^{-1}\)). The column and batch leaching experiments gave comparable results at the order of magnitude level, and both approaches are, at that level, useful for evaluation of leaching potentials from scrap dirt. The experiments showed that scrap dirt at recycling facilities constitutes only a modest leaching problem, but a long-term soil pollution problem from a land-use perspective. Leaching experiments with compost solution indicated that covering of the scrap dirt with an organic rich dressing for vegetation support would dramatically increase the leaching of heavy metals.
Natural attenuation: A feasible approach to remediation of groundwater pollution at landfills?

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Contributors: Christensen, T. H., Bjerg, P. L., Kjeldsen, P.
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Research output: Research - peer-review › Journal article – Annual report year: 2000

Natural attenuation: A feasible approach to remediation of landfill leachate plumes?

Natural attenuation has been implemented for petroleum hydrocarbons plumes and recently also for chlorinated solvent plumes, primarily in the USA, but natural attenuation has not yet gained a foothold with respect to leachate plumes. Based on the experiences gained from ten years of research on two Danish landfills, it is suggested that natural attenuation is a feasible approach, but much more complicated and demanding than in the case of petroleum hydrocarbons and chlorinated solvent.

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Contributors: Christensen, T. H., Kjeldsen, P., Bjerg, P. L.
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Soil and groundwater contamination with heavy metals at two scrap iron and metal recycling facilities

Field studies were performed at two actual scrap iron and metal recycling facilities in order to evaluate the extent of heavy metal migration into subsoil and groundwater caused by more than 25 years of handling scrap directly on the ground without any measures to prevent leaching. Surface soil samples, called 'scrap dirt', representing the different activities on the two recycling facilities, all showed very high concentrations of lead (Pb), copper (Cu) and zinc (Zn), high concentrations of cadmium (Cd), chromium (Cr) and nickel (Ni) and somewhat elevated concentrations of many other metals. In particular high concentrations were found for Pb at the car-battery salvage locations (13 to 26 g Pb kg⁻¹) and Cu at the cable burning location (22 g Cu kg⁻¹) at one site. The migration of metals below the surface in general (except at the car-battery salvage locations) was very limited even after approximately 25 years of activity. Soil and soil water profiles all showed elevated concentrations in the upper 40 cm but below this depth the soil concentrations as well as the soil water concentrations of metals were comparable with the concentrations found in uncontaminated reference profiles. The retention of the metals in the upper part of the profile was supposedly due to sorption as well as precipitation processes. At one site the metals had migrated to 80 cm depth at the car battery salvage location and at the other site with coarse sandy subsoils, elevated concentrations of Pb, Zn, and Cd were found in the groundwater 3 m below the ground surface. In the unsaturated soil, pH had decreased to about 3.5, facilitating the migration of the metals. This low pH value was presumably caused by the acids from the car batteries. The investigation concluded that the risk of metal migration to the groundwater is limited as long as pH stays high (above pH 6.5) in the top soils containing very high metal concentrations. The now abandoned car battery salvage operated directly on the ground surface has led to very high concentrations of metals in the soil and migration of metals that may affect the groundwater. However, the extent of the metal plume in the groundwater was not investigated.
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
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Web of Science (2002): Indexed yes
Stabilization of waste incinerator APC-residues with FeSO4

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Organisations: Department of Environmental Science and Engineering, Babcock & Wilcox Vølund A/S
Contributors: Christensen, T. H., Lundtorp, K., Jensen, D. L., Sørensen, M. A., Mogensen, E. P. B.
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Research output: Research › Article in proceedings – Annual report year: 2000

The effect of pH on the complexation of Cd, Ni and Zn by dissolved organic carbon from leachate-polluted groundwater
Complexation of cadmium (Cd), nickel (Ni) and zinc (Zn) by dissolved organic carbon (DOC) in leachate-polluted groundwater was measured using a resin equilibrium method. Metal-DOC complexation was measured at different DOC concentrations over a range of pH values. The results were compared to simulations made by two speciation models (WHAM and MINTEQA2). Of these models, WHAM came closest to simulating the experimental observations although it systematically overestimated the pH dependence of metal-DOC complexation. Accepting a variation in the free metal ion activity of a factor of 3±4 the WHAM model provided useful predictions of the complexation of Cd and Zn by DOC in the pH range 5–8, and of Ni in the pH range 5–7. At pH 8, however, the model overestimates the extent of Ni-DOC complexation to an unacceptable degree. The MINTEQA2 model predicts virtually no pH dependence for DOC complexation of Cd, Ni and Zn and is thus in very poor agreement with the experimental results. As an alternative approach, relations between the conditional complex formation constant (log Kc) and pH were estimated for each metal. Using these relations for estimating the complexation of Cd, Ni and Zn by DOC a deviation in the free metal ion activity up to a factor of 2 can be expected. 7 2000 Elsevier Science Ltd. All rights reserved

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Web of Science (2019): Indexed yes
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Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.209 SNIP 2.108
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.702 SNIP 1.908
Web of Science (2003): Indexed yes
Thermal Treatment of Iron Oxide Stabilized APC Residues from Waste Incineration and the Effect on Heavy Metal Binding
Iron oxide stabilized APC residues from MSWI were heat treated at 600°C and 900°C. The thermal treatments resulted in a change in product stability by forcing a transformation in the mineralogical structures of the products. The treatments, moreover, simulated somewhat the natural aging processes that would take place in a stabilized residue. Consequent changes in crystalline structure and heavy metal binding were examined.

Toxicity of organic chemical pollution in groundwater downgradient of a landfill (Grindsted, Denmark)
The aim of the present study was to describe the occurrence and distribution of toxicity related to organic chemical contaminants in the leachate plume downgradient of the Grindsted Landfill (Denmark). A total of 27 groundwater samples were preconcentrated by solid-phase extraction (SPE) using XAD-2 as the resin material. This treatment effectively eliminated sample matrix toxicity caused by inorganic salts and natural organic compounds and produced an aqueous concentrate of the nonvolatile chemical contaminants. The SPE extracts were tested in a battery of standardized short-term aquatic toxicity tests with luminescent bacteria (Vibrio fischeri), algae (Selenastrum capricornutum), and crustaceans (Daphnia magna). Additional genotoxicity tests were made using the umuC test (Salmonella typhimurium). Biotests with algae and luminescent bacteria were the most sensitive tests. On the basis of results with these two bioassays, it was concluded that SPE extracts of groundwater collected close to the landfill were toxic. The toxicity decreased with the distance from the landfill. At distances greater than 80 m from the border of the landfill, the groundwater toxicity was not significantly different from the background toxicity. SPE extracts were not toxic to Daphnia (preconcentration factor 10), and no genotoxicity was observed in the umuC test (preconcentration factor up to 120). The overall findings indicate that a battery of biotests applied on preconcentrated groundwater samples can be a useful tool for toxicity characterization and hazard ranking of groundwater polluted with complex chemical mixtures, such as landfill leachates.
An anaerobic field injection experiment in a landfill leachate plume (Grindsted, Denmark): 2. Deduction of anaerobic (methanogenic, sulfate- and Fe(III)-reducing) redox conditions

Redox conditions may be environmental factors which affect the fate of the xenobiotic organic compounds. Therefore the redox conditions were characterized in an anaerobic, leachate-contaminated aquifer 15–60 m downgradient from the Grindsted Landfill, Denmark, where an field injection experiment was carried out. Furthermore, the stability of the redox conditions spatially and over time were investigated, and different approaches to deduce the redox conditions were evaluated. The redox conditions were evaluated in a set of 20 sediment and groundwater samples taken from locations adjacent to the sediment samples. Samples were investigated with respect to groundwater chemistry, including hydrogen and volatile fatty acids (VFAs) and sediment geochemistry, and bioassays were performed. The groundwater chemistry, including redox sensitive species for a large number of samples, varied over time during the experimental period of 924 days owing to variations in the leachate from the landfill. However, no indication of change in the redox environment resulting from the field injection experiment or natural variation was observed in the individual sampling points. The methane, Fe(II), hydrogen, and VFA groundwater chemistry parameters strongly indicated a Fe(III)-reducing environment. This was further supported by the bioassays, although methane production and sulfate-reduction were also observed in a few samples close to the landfill. On the basis of the calculated carbon conversion, Fe(III) was the dominant electron acceptor in the region of the aquifer, which was investigated. Because of the complexity of a landfill leachate plume, several redox processes may occur simultaneously, and an array of methods must be applied for redox characterization in such multicomponent systems.
An anaerobic field injection experiment in a landfill leachate plume, Grindsted, Denmark: 1. Experimental setup, tracer movement, and fate of aromatic and chlorinated compounds

A continuous, natural-gradient field injection experiment, involving 18 xenobiotic compounds and bromide as tracers, was performed in the anaerobic region of a leachate plume downgradient from the Grindsted Landfill, Denmark. The injection lasted for 195 days, and within this period a continuous cloud was established. Over a period of 924 days the cloud movement was monitored in approximately 70 discrete sampling points in the central part of the cloud, and the spatial distribution was described by seven cloud snapshots involving 400-700 sampling points. The bromide cloud movement closely followed the varying flow direction predicted by the water table measurements. Moment analysis showed decreasing tracer flow velocities and reduced capture of bromide mass with time, which may be explained by varying flow conditions (direction, hydraulic gradient) and the heterogeneous geological conditions in the sandy aquifer. Naphthalene, having the highest log K-ow value, was the most retarded compound, with a retardation of less than 10%. Therefore sorption was not considered to be a significant attenuation process for any of the compounds studied. Transformation under iron-reducing conditions was observed for toluene, o-xylene, TeCM, 1,1,1-TCA, PCE, and TCE, while transformation of benzene and naphthalene was not detected in the aquifer within the time frame of this study. First-order transformation rates were in the range of 0.028-0.039 d\(^{-1}\) and 0.0014-0.0028 d\(^{-1}\) for the aromatic compounds toluene and o-xylene, respectively. The rates for the chlorinated aliphatic compounds, tetrachloromethane, 1,1,1-trichloroethane, tetrachloroethylene, and trichloroethylene, were >0.7 d\(^{-1}\), 0.0044-0.0054 d\(^{-1}\), 0.0012-0.0038 d\(^{-1}\), and 0.0003-0.001 d\(^{-1}\), respectively. Long lag periods and slow transformation rates were observed for some of the compounds, suggesting that lack of transformation reported in the literature may be attributable to short experimental periods in those studies.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resources
Contributors: Rügge, K., Bjerg, P., Pedersen, J., Mosbæk, H., Christensen, T.
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Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Water Resources Research
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BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.39 SJR 2.296 SNIP 1.555
Web of Science (2017): Impact factor 4.361
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.1 SJR 2.615 SNIP 1.633
Web of Science (2016): Impact factor 4.397
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.06 SJR 2.525 SNIP 1.593
Web of Science (2015): Impact factor 3.792
An approach to the development of rational limit values for regulatory testing of waste prior to disposal or utilisation
An approach to the development of risk-related limit values for regulatory testing of the leaching properties of waste prior to utilization

Binding of trace metals to iron oxides-stabilization of incineration residues. Abstract

Colloidal and dissolved metals in leachates from four Danish landfills
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.209 SNIP 2.108
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.702 SNIP 1.908
Complexation of Cd, Ni and Zn by DOC in polluted groundwater: A comparison of approaches using resin exchange, aquifer material sorption, and computer speciation models (WHAM and MINTEQA2)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, J., Christensen, T.
Pages: 3857 - 3863
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
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Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Complexation of Cu and Pb by DOC in polluted groundwater: A comparison of experimental data and predictions by computer speciation models (WHAM and MINTEQA2)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, J., Botma, J., Christensen, T.
Pages: 3231 - 3238
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Water Research
Issue number: 33
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BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.209 SNIP 2.108
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.702 SNIP 1.908
Degradation of aromatic and chlorinated aliphatic hydrocarbons in the anaerobic part of the Grindsted Landfill leachate plume: In situ microcosm and laboratory batch experiments

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Bjerg, P. L., Rügge, K., Cortsen, J., Nielsen, P. H., Christensen, T. H.
Pages: 113 - 121
Publication date: 1999
Peer-reviewed: Yes

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Journal: Ground Water
Volume: 37
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.63 SJR 0.886 SNIP 0.944
Web of Science (2017): Impact factor 1.9
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.56 SJR 1.081 SNIP 1.127
Web of Science (2016): Impact factor 2.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.6 SJR 1.094 SNIP 1.247
Web of Science (2015): Impact factor 1.947
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.76 SJR 1.258 SNIP 1.268
Web of Science (2014): Impact factor 2.307
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.75 SJR 1.238 SNIP 1.422
Web of Science (2013): Impact factor 1.953
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.6 SJR 1.464 SNIP 1.398
Web of Science (2012): Impact factor 2.132
Distribution and composition of microbial populations in a landfill leachate contaminated aquifer (Grindsted, Denmark)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ludvigsen, L., Albrechtsen, H., Ringelberg, D., Ekelund, F., Christensen, T.
Pages: 197 - 207
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Microbial Ecology
Volume: 37
Issue number: 3
Original language: English
Source: orbit
Source-ID: 172909
Research output: Research - peer-review › Journal article – Annual report year: 1999

Engineered attenuation liners for landfills of coal combustion residues

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Astrup, T., Stipp, S., Christensen, T.
Evaluating long term mobility of heavy metals in leachate plumes

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Hansen, J., Christensen, T.
Publication date: 1999

Host publication information
Title of host publication: Sardinia 99 (eds.: Christensen, T.H., Cossu, R., Stegmann, R.)
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 172924
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

Fate of MCPP and atrazine in an anaerobic landfill leachate plume (Grindsted, Denmark)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Rügge, K., Bjerg, P., Mosbæk, H., Christensen, T.
Pages: 2455 - 2458
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 33
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
Lead distribution and mobility in a soil embankment used as a lead bullet stop at a shooting range

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Astrup, T., Boddum, J., Christensen, T.
Pages: 653 - 665
Publication date: 1999
Metal uptake by plants from sludge-amended soils: caution is required in the plateau interpretation

Uptake of metals by plants growing in sewage sludge-amended soils frequently exhibits a plateau response at high sludge loading rates associated with high total concentrations of metals in the soil. This type of response has generally been attributed to attenuation of metal bioavailability by increased sorption sites provided by the sludge constituents at the high sludge loading rates. We grew Raphanus sativus L. in a soil historically amended with sewage sludge at different rates and examined concentrations of Cd and Zn in the plants and in corresponding rhizosphere soil solution. Metal concentrations in the plants displayed a plateau response. However, concentrations of total or free metals in the soil solution did not display a similar plateau response, therefore the pre-requisite for determining that metal uptake by plants was limited by sludge chemistry was not met. It was concluded that plant physiological factors were responsible for the plateau in plant metal concentrations observed in this study. Examination of data by other authors suggests that a plateau response due to plant physiological factors has routinely been misinterpreted as being the result of only attenuation by sludge chemistry. The serious implications of an incorrect interpretation of the factors underlying a plateau response are discussed.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Hamon, R., Holm, P. E., Lorenz, S., McGrath, S., Christensen, T. H.
Pages: 53 - 64
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Plant and Soil
Volume: 216
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Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.7 SJR 1.361 SNIP 1.435
Web of Science (2017): Impact factor 3.306
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.41 SJR 1.295 SNIP 1.437
Web of Science (2016): Impact factor 3.052
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.11 SJR 1.397 SNIP 1.372
Web of Science (2015): Impact factor 2.969
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.15 SJR 1.365 SNIP 1.47
Web of Science (2014): Impact factor 2.952
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.5 SJR 1.388 SNIP 1.649
Web of Science (2013): Impact factor 3.235
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Monitored natural attenuation: A remediation strategy at old landfills?

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Bjerg, P., Kjeldsen, P.
Publication date: 1999

Host publication information
Title of host publication: Sardinia 99 (eds.: Christensen, T.H., Cossu, R., Stegmann, R.)
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 172926
Research output: Research - peer-review » Article in proceedings – Annual report year: 1999
Monitoring toxicity of organic chemical pollution in a leachate plume (Grindsted, Denmark)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Baun, A., Bjerg, P., Nyholm, N., Ledin, A., Christensen, T.
Publication date: 1999

Host publication information
Title of host publication: Sardinia 99 (eds.: Christensen, T.H., Cossu, R., Stegmann, R.)
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 172925
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

Natural attenuation: A feasible approach to remediation of groundwater pollution at landfills?

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Kjeldsen, P., Bjerg, P.
Publication date: 1999

Host publication information
Title of host publication: Natural attenuation: A feasible approach to remediation of groundwater pollution at landfills?
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 172977
Research output: Research › Article in proceedings – Annual report year: 1999

Natural attenuation in a landfill leachate plume: The Grindsted landfill site

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Bjerg, P. L., Rügge, K., Kjeldsen, P., Albrechtsen, H., Ludvigsen, L. K., Heron, G., Christensen, T. H.
Pages: 5-13
Publication date: 1999

Host publication information
Title of host publication: Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater (Phase III)
Publisher: North Atlantic Treaty Organization (NATO/CCMS Pilot Study; No. 236).
Source: orbit
Source-ID: 175633
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

On-site treatment and landfilling of MSWI air pollution control residues

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lundtorp, K., Jensen, D., Sørensen, M., Christensen, T.
Publication date: 1999

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Title of host publication: Sardinia 99 (eds.: Christensen, T.H., Cossu, R., Stegmann, R.)
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Organics in landfill leachates - polar and ionic compounds

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ledin, A., Baun, A., Bjerg, P., Christensen, T.
Publication date: 1999

Host publication information
Title of host publication: Organics in landfill leachates - polar and ionic compounds
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 172983
Research output: Research › Article in proceedings – Annual report year: 1999

Polar and ionic organic compounds in landfill leachates: A new concern?

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Environmental Chemistry, Department of Environmental Engineering, Water Resources Engineering, Residual Resource Engineering
Contributors: Ledin, A., Baun, A., Bjerg, P. L., Nyholm, N., Christensen, T. H.
Pages: 119-126
Publication date: 1999

Host publication information
Title of host publication: Proceedings of the Sardinia 99, seventh international waste management and landfill symposium
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 172940
Research output: Research › Article in proceedings – Annual report year: 1999


General information
State: Published
Organisations: Department of Environmental Science and Engineering
Publication date: 1999

Publication information
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Original language: English
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Solid phase cadmium and reactions of aqueous cadmium with soil surfaces

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Huang, P.
Publication date: 1999
Speciation of heavy metals in landfill-leachate plume

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D., Ledin, A., Christensen, T.
Publication date: 1999

Host publication information
Title of host publication: Sardinia 99 (eds.: Christensen, T.H., Cossu, R., Stegmann, R.)
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 172938
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

Speciation of heavy metals in landfill-leachate polluted groundwater

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D., Ledin, A., Christensen, T.
Pages: 2642 - 2650
Publication date: 1999
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 33
Issue number: 11
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
Speciation of heavy metals in landfill-leachate polluted groundwater. Abstract

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D., Ledin, A., Christensen, T., Wenzel, W. A.
Publication date: 1999
Stabilization of APC-residues with FeSO4

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lundtorp, K., Jensen, D. L., Sørensen, M. A., Mogensen, E., Christensen, T. H.
Publication date: 1999

Host publication information
Title of host publication: Speciation of heavy metals in landfill-leachate polluted groundwater. Abstract
Place of publication: Wien
Publisher: Universität für Bodenkultur
Source: orbit
Source-ID: 172996
Research output: Research › Article in proceedings – Annual report year: 1999

Stabilization of APC-residues with FeSO4

Abstract

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lundtorp, K., Jensen, D. L., Sørensen, M. A., Mogensen, E., Christensen, T. H., Wenzel, W. A.
Publication date: 1999

Host publication information
Title of host publication: Sardinia 99
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 172944
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

Stabilization of APC-residues with FeSO4

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lundtorp, K., Jensen, D. L., Sørensen, M. A., Mogensen, E., Christensen, T. H.
Publication date: 1999

Host publication information
Title of host publication: 5th International Conference on the Biogeochemistry of Trace Elements, July 11-15, Proceedings of Extended Abstracts
Volume: II
Place of publication: Wien
Publisher: Universität für Bodenkultur
Source: orbit
Source-ID: 172999
Research output: Research › Article in proceedings – Annual report year: 1999

Stabilization of APC-residues with FeSO4

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lundtorp, K., Jensen, D. L., Sørensen, M. A., Mogensen, E. P. B., Christensen, T. H.
Publication date: 1999

Host publication information
Title of host publication: Proceedings of the 2nd International Symposium on Incineration and Flue Gas Treatment Technologies. 4-6 July, Flue Gas Treatment
Place of publication: Sheffield
Publisher: IchemE, University of Sheffield
Source: orbit
Source-ID: 172945
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

Stabilization of APC-residues with FeSO4
Characterization of an old municipal landfill (Grindsted, Denmark) as a groundwater pollution source: Landfill hydrology and leachate migration

The migration of leachate from an old municipal landfill (Grindsted, Denmark) was investigated by intensive mapping of groundwater potentials and groundwater quality at the downstream borders of the landfill and beneath the landfill. A groundwater mound controlling the migration of the leachate into the aquifer was observed beneath the landfill, especially after the wet season. The lateral spreading in the leachate plume was significantly increased due to the water table mound present and the seasonal variations of the mound. Also, a significant vertical transport of leachate in the aquifer was observed below the landfill. Detailed information about the spatial and seasonal changes in groundwater flow directions and location of intensive leaching is needed in order to design a cost effective delineation of the plume in the downstream aquifer and to establish appropriate remediation.
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Characterization of the dissolved organic carbon in landfill leachate-polluted groundwater

Samples of dissolved organic carbon (DOC) were obtained from landfill leachate-polluted groundwater at Vejen Landfill, Denmark. The humic acids, fulvic acids and the hydrophilic fraction were isolated and purified. Based on DOC measurements, the fulvic acid fraction predominated, accounting for about 60% of the total amount of DOC with an apparent molecular weight of about 1800 Da. The hydrophilic fraction constituted about 30% of the total amount of DOC with an apparent molecular weight of about 2100 Da, and the humic acid fraction made up about 10% of the total amount of DOC with an apparent molecular weight of about 2600 Da. The elemental compositions of the humic acids, fulvic acids and the hydrophilic fraction were in the ranges typical for humic substances from other origins. The O/C ratios for humic acids, fulvic acids and the hydrophilic fraction were similar in the leachate-polluted groundwater. For humic acids the O/C ratios were slightly higher than reported in the literature, indicating a high content of carboxylic groups, phenolic groups or carbohydrates. Acid-base titration indicated that, in the fulvic acids and the hydrophilic fraction, carboxylic acids were the dominating functional group, representing about 6 meg g(-1). The weakly acidic groups in fulvic acids and the hydrophilic fraction represented about 1 and 3 meg g(-1), respectively. The total acidity in fulvic acids and the hydrophilic fraction accounted for 48-57% of the O/C ratio. In the humic acids, carboxylic groups made up about 3 meg g(-1) and the weakly acidic groups made up about 1.5 meg g(-1). The total acidity accounted for 29-32% of the O/C ratio. The characterization of DOC in leachate-polluted groundwater in terms of humic acids, fulvic acids and hydrophilic fraction showed that the hydrophilic fraction resembles, in many ways, humic and fulvic acids; thus, a distinction between the fractions may be related to the methods only and be of little practical value. The three fractions constituting the DOC content in a sample should all be considered when evaluating processes such as metal complexation and transport of metals and hydrophobic, organic contaminants. (C) 1998 Elsevier Science Ltd. All rights reserved.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Risø National Laboratory for Sustainable Energy
Contributors: Christensen, J. B., Jensen, D. L., Grøn, C., Filip, Z., Christensen, T. H.
Pages: 125-135
Publication date: Jan 1998
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 32
Issue number: 1
ISSN (Print): 0043-1354
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
Affaldets mængde og sammensætning. Kapitel 2.1

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Jacobsen, H.
Pages: 33-52
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Source: orbit
Source-ID: 171532
Research output: Education › Book chapter – Annual report year: 1998

Affaldsteknologi

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. (ed.)
Publication date: 1998

Publication information
Place of publication: København
Publisher: Teknisk Forlag
Original language: Danish
Source: orbit
Source-ID: 171530
Research output: Research - peer-review › Book – Annual report year: 1998

Anaerobic microbial redox processes in a landfill leachate contaminated aquifer (Grindsted, Denmark)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ludvigsen, L., Albrechtsen, H., Heron, G., Bjerg, P. L., Christensen, T. H.
Pages: 273 - 291
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 33
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Characterization of Predominant Reductants in an Anaerobic Leachate-Contaminated Aquifer by Nitroaromatic Probe Compounds

The biogeochemical processes controlling the reductive transformation of contaminants in an anaerobic aquifer were inferred from the relative reactivity patterns of redox-sensitive probe compounds. The fate of five nitroaromatic compounds (NACs) was monitored under different redox conditions in a landfill leachate plume of a sandy aquifer. Results of field experiments (continuous injection and in situ microcosms) were compared to the findings of laboratory batch and column experiments (using aquifer matrix and model systems for sulfate- and iron-reducing conditions). NACs were transformed within 2-70 days in the leachate plume as well as in microbiologically active and in microbiologically deactivated experiments.

Generally, aromatic amines were the predominant reduction products, and these compounds were stable within the timeframe and under the conditions of our experiments. Despite the presence of various potential reductants (e.g., H(2)S/HS(-), Fe(II)(aq), reduced organic matter, microorganisms), the patterns of relative reactivity of the probe compounds indicated that ferrous iron associated with iron(lll) (hydr)oxide surfaces was the dominant reductant throughout the anaerobic region of the plume. Our results suggest that Fe(II) associated with ferric iron minerals is a highly reactive reductant in anaerobic aquifers, which may also determine the fate of other classes of reducible contaminants such as halogenated solvents, azo compounds, sulfoxides, chromate, or arsenate.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Pages: 23-31
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 32
Issue number: 1
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Web of Science (2012): Impact factor 5.257
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.16 SJR 3.18 SNIP 1.945
Web of Science (2011): Impact factor 5.228
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.979 SNIP 1.726
Web of Science (2010): Impact factor 4.827
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.86 SNIP 1.809
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.96 SNIP 1.935
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.774 SNIP 1.914
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.55 SNIP 1.893
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.608 SNIP 1.999
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.86 SNIP 2.046
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.54 SNIP 2.065
Comparison of field and laboratory methods for determination of potential for natural attenuation in a landfill leachate plume (Grindsle, Denmark)

Degradability of chlorinated aliphatic compounds in methanogenic leachates sampled at eight landfills
Degradability of organic chemicals in a landfill environment studied by in situ and laboratory leachate reactors

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kromann, A., Christensen, T. H.
Pages: 437 - 445
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 16
Issue number: 5
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Deponering: hydrologi. Kapitel 6.2

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kjeldsen, P., Christensen, T. H.
Pages: 535-553
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Source: orbit
Source-ID: 171544
Research output: Education › Book chapter – Annual report year: 1998

Deponering: principper og miljøpåvirkninger. Kapitel 6.1

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Kjeldsen, P.
Pages: 513-533
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Deponering: reaktordeponier. Kapitel 6.4

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kjeldsen, P., Willumsen, H. C., Christensen, T. H.
Pages: 577-611
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Source: orbit
Source-ID: 171545
Research output: Education › Book chapter – Annual report year: 1998

Deponering: udvaskningsdeponier. Kapitel 6.3

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Hjelmer, O., Christensen, T. H.
Pages: 555-576
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Source: orbit
Source-ID: 171542
Research output: Education › Book chapter – Annual report year: 1998

Geology and sediment geochemistry of a landfill leachate contaminated aquifer (Grindsted, Denmark)

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., Bjerg, P. L., Gravesen, P., Ludvigsen, L., Christensen, T. H.
Pages: 301 - 317
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 29
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
H2 Concentrations in a Landfill Leachate Plume (Grindsted, Denmark): In Situ Energetics of Terminal Electron Acceptor Processes

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Jakobsen, R., Albrechtsen, H., Bjerg, P. L., Rasmussen, M., Bay, H., Christensen, T. H.
Pages: 2142-2148
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 32
ISSN (Print): 1382-3124
Ratings:
Web of Science (2019): Indexed yes
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed yes
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2001): Indexed yes
Web of Science (2000): Indexed yes
Original language: English
Source: orbit
Source-ID: 170771
Research output: Research - peer-review › Journal article – Annual report year: 1998

Henry's law constant for trichloroethylene between 10 and 95 degree C

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., Christensen, T. H., Enfield, C. G.
Pages: 1433-1437
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 38
Issue number: 10
ISSN (Print): 1382-3124
Ratings:
Web of Science (2019): Indexed yes
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed yes
ISI indexed (2013): ISI indexed yes
ISI indexed (2012): ISI indexed yes
ISI indexed (2011): ISI indexed yes
Introduktion til affaldsteknologi. Kapitel 1.1

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Astrup, T.
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Source: orbit
Source-ID: 171534
Research output: Education › Book chapter – Annual report year: 1998

Kilder til uorganiske stoffer i grundvandet - herunder gamle lossempladser

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resources
Contributors: Nielsen, M.Æ., Carlson, B. B., Bjerg, P. L., Pedersen, J. K., Christensen, T. H.
Pages: 31-35
Publication date: 1998
Peer-reviewed: No

Publication information
Journal: Vand & Jord
Volume: 5
Issue number: 1
ISSN (Print): 0908-7761
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 171513
Research output: Research › Journal article – Annual report year: 1998

Kildesorteret affald. Kapitel 2.2

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Tønning, K.
Pages: 53-66
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Measured soil water concentrations of cadmium and zinc in plant pots and estimated leaching outflows from contaminated soils

Soil water concentrations of cadmium and zinc were measured in plant pots with 15 contaminated soils which differed in origin, texture, pH (5.1-7.8) and concentrations of cadmium (0.2-17 mg Cd kg(-1)) and zinc (36-1300 mg Zn kg(-1)). The soil waters contained total concentrations of 0.5 to 17 μg Cd L(-1) and 9 to 3600 μg Zn L(-1), which were dominated by free metal ions as measured by an ion exchange-resin method. Annual leaching outflows were estimated from soil water concentrations to be 0.5-17 g Cd ha(-1) y(-1) and 9-3600 g Zn ha(-1) y(-1) per 100 mm of net percolation, corresponding to 0.1% per year of the total soil content of cadmium and zinc. The measured soil water concentrations of cadmium and zinc did not correlate linearly with the corresponding soil concentrations but correlated fairly well with concentrations measured in Ca(NO(3))(2) extracts of the soils and with soil water concentrations estimated from soil concentrations and pH. Such concentration estimates may be useful for estimating amounts of cadmium and zinc being leached from soils.
MEASURED SOILWATER CONCENTRATIONS OF CADMIUM AND ZINC IN PLANT POTS AND ESTIMATED LEACHING OUTFLOWS FROM CONTAMINATED SOILS

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Holm, P. E., Christensen, T. H., Lorenz, S. E., Hamon, R. E., Domingues, H. C., Sequeira, E. M., McGrath, S. P.
Pages: 105-115
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 102
ISSN (Print): 0049-6979
Natural attenuation of aromatic and chlorinated aliphatic compounds: Comparison of field and laboratory experiments

General information
State: Published
Omlastestationer. Kapitel 3.4

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Andresen, S., Pedersen, M.
Pages: 117-125
Publication date: 1998

Host publication information
Title of host publication: Affaldsteknologi
Place of publication: København
Publisher: Nyt Teknisk Forlag
Editor: Christensen, T. H.
Source: orbit
Source-ID: 171537
Research output: Education » Book chapter – Annual report year: 1998

Proton binding by groundwater fulvic acids of different age, origin and structure modeled with Model V and the NICA-Donnan Model

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, J., Tipping, E., Kinniburgh, D., Grøn, C., Christensen, T.
Pages: 3346 - 3355
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 32
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Proton binding by groundwater fulvic acids of different age, origins, and structure modeled with the model V and NICA-Donnan model

General information
State: Published
Organisations: Risø National Laboratory for Sustainable Energy, Department of Environmental Science and Engineering
Contributors: Christensen, J. B., Tipping, E., Kinniburgh, D. G., Grøn, C., Christensen, T. H.
Pages: 3346-3355
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 32
Issue number: 21
ISSN (Print): 1382-3124
Ratings:
Web of Science (2019): Indexed yes
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed yes
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Web of Science (2005): Indexed yes
Web of Science (2004): Indexed yes
Web of Science (2001): Indexed yes
Web of Science (2000): Indexed yes
Original language: English
Source: orbit
Source-ID: 298039
Research output: Research - peer-review » Journal article – Annual report year: 1998

Screening of groundwater toxicity downgradient of a landfill (Grindsted, Denmark) using a biotest battery. Poster

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Baun, A., Nyholm, N., Bjerg, P. L., Christensen, T. H.
Pages: 1001-1002
Publication date: 1998

Host publication information
Title of host publication: Contaminated Soil '98
Place of publication: London, GB
Publisher: Thomas Telford
Source: orbit
Source-ID: 171523
Research output: Research » Article in proceedings – Annual report year: 1998

Soil heating for enhanced remediation of chlorinated solvents: A laboratory study on resistive heating and vapor extraction in a silty, low-permeable soil contaminated with trichloroethylene

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., van Zutphen, M., Christensen, T. H.
Pages: 1474 - 1481
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 32
Soil heating for remediation of dissolved trichloroethylene in low-permeable soil

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., Christensen, T. H., Van Zutphen, M., Enfield, C. G.
Pages: 37-42
Publication date: 1998

Host publication information
Title of host publication: Nonaqueous-phase lipids. 1st International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 18-21, Proceedings
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 171497
Research output: Research - peer-review › Article in proceedings – Annual report year: 1998

Speciation of dissolved iron(II) and manganese(II) in a groundwater pollution plume

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D. L., Boddum, J. K., Redemann, S., Christensen, T. H.
Pages: 2657-2664
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 32
Issue number: 18
ISSN (Print): 1382-3124
Ratings:
Web of Science (2019): Indexed yes
Web of Science (2018): Indexed yes
Web of Science (2017): Indexed yes
Web of Science (2016): Indexed yes
Web of Science (2015): Indexed yes
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Original language: English
Source: orbit
Source-ID: 171457
Research output: Research - peer-review › Journal article – Annual report year: 1998
Termisk assisterede oprensninger

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., Christensen, T.
Publication date: 1998

Publication information
Original language: Danish
Source: orbit
Source-ID: 171578
Research output: Research - peer-review › Report – Annual report year: 1998

Thermally enhanced remediation at DNAPL sites: The competition between downward mobilization and upward volatilization

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., Christensen, T. H., Heron, T., Larsen, T. H.
Pages: 193-198
Publication date: 1998

Host publication information
Title of host publication: Nonaqueous-phase Liquids. 1st International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 18-21, Proceedings
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 171498
Research output: Research - peer-review › Article in proceedings – Annual report year: 1998

Undersøgelse af toksiciteten af perkolatforurenet grundvand ved hjælp af biologiske testmetoder

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Baun, A., Jensen, S. D., Bjerg, P. L., Christensen, T. H., Nyholm, N.
Pages: 301-310
Publication date: 1998

Host publication information
Title of host publication: ATV vintermøde om grundvandsforurening, vingstedcentret 10.-11 marts 1998
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 171516
Research output: Research › Article in proceedings – Annual report year: 1998

Vejsalt genfindes i høje koncentrationer i grundvandet

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resocurces
Cadmium and zinc in plants and soil solutions from contaminated soils

In an experiment using ten heavy metal-contaminated soils from six European countries, soil solution was sampled by water displacement before and after the growth of radish. Concentrations of Cd, Zn and other elements in solution (K, Ca, Mg, Mn) generally decreased during plant growth, probably because of uptake by plants and the subsequent redistribution of ions onto soil exchange sites at lower ionic strength. Speciation analysis by a resin exchange method showed that most Cd and Zn in non-rhizosphere solutions was present as Cd\(^{2+}\) and Zn\(^{2+}\); respectively. The proportion of free ions was slightly lower in rhizosphere solutions, mainly due to an increase in dissolved organic carbon during plant growth. Solution pH increased during plant growth, although the bulk soil pH generally remained constant. Cd concentrations in leaves and tubers were more closely correlated with their total or free ionic concentrations in rhizosphere solutions (adjusted R\(^2\) greater than or equal to 0.90) than with their concentrations in soils (adj. R\(^2\) greater than or equal to 0.79). Cd concentrations in non-rhizosphere solutions were only poorly correlated with Cd concentrations in leaves and tubers. In contrast to Cd, there were no soil parameters that individually predicted Zn concentrations in leaves and tubers closely. However, multiple correlation analysis (including Zn concentrations in rhizosphere solutions and in bulk soils) closely predicted Zn concentrations in leaves and tubers (adj. R\(^2\) = 0.85 and 0.70, respectively). This suggests that the great variability among soils in the solubility of Zn affected the rate of release of Zn into solution, and thus Zn uptake. There was no such effect for Cd, for which solubility varied much less. Furthermore, the plants may have partly controlled Zn uptake, as they took up relatively less at high solution concentrations of Zn.

Free ionic concentrations in soil solution did not predict concentrations of Cd or Zn in plants better than their total
concentrations in solution. This suggests that with these soils, analysis of Cd and Zn speciation is of little practical importance when their bioavailability is assessed.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lorenz, S., Hamon, R., Holm, P., Domingues, H., Sequeira, E., Christensen, T.
Pages: 21 - 31
Publication date: 1997
Peer-reviewed: Yes

Publication information
Journal: Plant and Soil
Volume: 189
Issue number: 1
ISSN (Print): 0032-079X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.7 SJR 1.361 SNIP 1.435
Web of Science (2017): Impact factor 3.306
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.41 SJR 1.295 SNIP 1.437
Web of Science (2016): Impact factor 3.052
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.11 SJR 1.397 SNIP 1.372
Web of Science (2015): Impact factor 2.969
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.15 SJR 1.365 SNIP 1.47
Web of Science (2014): Impact factor 2.952
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.5 SJR 1.388 SNIP 1.649
Web of Science (2013): Impact factor 3.235
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.92 SJR 1.404 SNIP 1.44
Web of Science (2012): Impact factor 2.638
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.9 SJR 1.378 SNIP 1.481
Web of Science (2011): Impact factor 2.733
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.246 SNIP 1.419
Web of Science (2010): Impact factor 2.773
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
BFI (2008): BFI-level 2
Characterization of Colloids and Trace Elements Associated with Colloids in Landfill Leachates at Four Danish Landfills

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D., Christensen, T.
Publication date: 1997

Host publication information
Title of host publication: Characterization of colloids and trace elements associated with colloids in landfill leachates at four Danish landfills
Place of publication: Hanover, NH
Publisher: U.S. Army Cold Regions Research and Engineering Laboratory,
Source: orbit
Source-ID: 169692
Research output: Research - peer-review › Article in proceedings – Annual report year: 1997

Comparison of transformation of aromatic and chlorinated aliphatic compounds in anaerobic field and laboratory experiments. Abstract

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Bjerg, P., Rügge, K., Christensen, T.
Publication date: 1997

Host publication information
Title of host publication: Comparison of transformation of aromatic and chlorinated aliphatic compounds in anaerobic field and laboratory experiments. Abstract
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 169683
Research output: Research - peer-review › Article in proceedings – Annual report year: 1997
Correlating phospholipid fatty acids (PLFA) in a landfill leachate polluted aquifer with biogeochemical factors by multivariate statistical methods

Different multivariate statistical analyses were applied to phospholipid fatty acids representing the biomass composition and to different biogeochemical parameters measured in 37 samples from a landfill contaminated aquifer at Grindsted Landfill (Denmark). Principal component analysis and correspondence analysis were used to identify groups of samples showing similar patterns with respect to biogeochemical variables and phospholipid fatty acid composition. The principal component analysis revealed that for the biogeochemical parameters the first principal component was linked to the pollution effect and to redox processes and the second principal component described the geological and geochemical features of the samples. Dependent on the data transformation of the phospholipid fatty acid profiles in either absolute concentrations (logarithm transformed) or in mol% of total phospholipid fatty acids, different groups of samples and outliers were revealed by the principal component analysis. The principal component analysis on data in absolute concentrations revealed that many phospholipid fatty acids reflected the pollution effect on the biomass composition. In contrast, the phospholipid fatty acids in mol% divided the samples into one group of the more polluted samples and another with the nearly unpolluted samples. The important phospholipid fatty acids for this grouping were mainly a few of the normal saturated phospholipid fatty acids (10:0, 16:0 and 18:0). Discriminant analysis was used to allocate samples of phospholipid fatty acids into predefined classes. A large percentages of samples were classified correctly when discriminating samples into groups of dissolved organic carbon and specific conductivity, indicating that the biomass is highly influenced by the pollution. In contrast, the discriminant analysis revealed that on the basis of the profiles of phospholipid fatty acids no good discrimination between samples showing dominant sulfate reduction and dominant iron reduction could be made, nor between samples showing dominant nitrate reduction and aerobic respiration. Partial least square analysis related the phospholipid fatty acids data to the biogeochemical parameters assuming linear relationships. After selection of the optimal phospholipid fatty acid combination by genetic algorithms, good partial least squares models with low prediction errors were gained primarily between the biogeochemical parameters describing total contents of carbon, pH and chloride. The models predicting specific activity in terms of, e.g., sulfate reduction activity in a sample had relatively higher prediction errors and low correlation coefficients. This indicates that the phospholipid fatty acid profiles from complex habitats have limited value for identifying more specific microbial populations.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Environmental Engineering, Urban Water Engineering, Department of Applied Mathematics and Computer Science, Statistics and Data Analysis
Contributors: Ludvigsen, L., Albrechtsen, H., Rootzén, H., Christensen, T. H.
Pages: 447-460
Publication date: 1997
Peer-reviewed: Yes

Publication information
Journal: F E M S Microbiology Reviews
Volume: 20
Issue number: 3-4
ISSN (Print): 0168-6445
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 12.68 SJR 7.063 SNIP 3.444
Web of Science (2017): Impact factor 11.392
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 13.54 SJR 7.779 SNIP 3.916
Web of Science (2016): Impact factor 12.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 13.38 SJR 7.689 SNIP 4.216
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 12.9 SJR 7.192 SNIP 4.116
Determination of nonvolatile organic carbon in aquifer solids after carbonate removal by sulfurous acid

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Distributionskoefficienter for tungmetaller i sandede grundvandsmagasiner

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Redemann, S., Boddum, J., Astrup, T., Hansen, B., Holm, P., Christensen, J.
Publication date: 1997

Host publication information
Title of host publication: Distributionskoefficienter for tungmetaller i sandede grundvandsmagasiner
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 169728
Research output: Research - peer-review › Journal article – Annual report year: 1997

Effects of sampling well construction on H2 measurements made for characterization of redox conditions in a contaminated aquifer

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Geology and Geotechnical Engineering
Contributors: Bjerg, P., Jakobsen, R., Bay, H., Rasmussen, M., Albrechtsen, H., Christensen, T.
Pages: 3029 - 3031
Publication date: 1997
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 31
Issue number: 10
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Web of Science (2012): Impact factor 5.257
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.16 SJR 3.18 SNIP 1.945
Web of Science (2011): Impact factor 5.228
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.979 SNIP 1.726
Web of Science (2010): Impact factor 4.827
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.86 SNIP 1.809
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.96 SNIP 1.935
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.774 SNIP 1.914
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.55 SNIP 1.893
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.608 SNIP 1.999
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.86 SNIP 2.046
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.54 SNIP 2.065
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.392 SNIP 1.949
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 2.387 SNIP 1.968
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 3.03 SNIP 2.315
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 3.367 SNIP 2.351
Evaluating the distribution and fate of organic chemicals in a landfill by use of a simple model

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kjeldsen, P., Christensen, T.
Publication date: 1997

Host publication information
Title of host publication: Evaluating the distribution and fate of organic chemicals in a landfill by use of a simple model
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 169695
Research output: Research - peer-review › Article in proceedings – Annual report year: 1997

Fate of nitroaromatic compounds in an anaerobic leachate plume: Laboratory and field experiments. Abstract

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Rügge, K., Haderlein, S., Hofstetter, T., Bjerg, P., Mosbæk, H., Christensen, T.
Number of pages: 15
Publication date: 1997

Host publication information
Title of host publication: Fate of nitroaromatic compounds in an anaerobic leachate plume: Laboratory and field experiments. Abstract
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 169742
Research output: Research - peer-review › Book chapter – Annual report year: 1997

Importance of sediment fines in laboratory studies on the degradation of organic chemicals in aquifers

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Smith, P., Nielsen, P., Christensen, T.
Pages: 2287 - 2299
Publication date: 1997
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 31
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
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In-situ fixation as remediation of lead pollution in groundwater: A model aquifer study

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Hansen, B., Tirsgaard, D., Lehmann, N., Jensen, D.
Publication date: 1997

Host publication information
Title of host publication: In-situ fixation as remediation of lead pollution in groundwater: A model aquifer study
Place of publication: Hanover, NH
Publisher: U.S. Army Cold Regions Research and Engineering Laboratory,
Source: orbit
Source-ID: 169685
Research output: Research - peer-review › Article in proceedings – Annual report year: 1997

Kolloidt og opløst metal i lossepladsperkolat. Undersøgelse af 4 danske lossepladser

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D., Christensen, T.
Pages: 24 - 28
Publication date: 1997
Peer-reviewed: No

Publication information
Journal: INFO-NYT
Issue number: 16
Original language: Danish
Source: orbit
Source-ID: 169752
Research output: Research › Journal article – Annual report year: 1997

Kompleksering af tungmetaller med opløst organisk stof

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, J., Christensen, T.
Publication date: 1997

Host publication information
Title of host publication: Kompleksering af tungmetaller med opløst organisk stof
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 169727
Research output: Research › Article in proceedings – Annual report year: 1997

Microbial processes in a leachate contaminated aquifer

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ludvigsen, L., Albrechtsen, H., Bjerg, P. L., Christensen, T. H.
Publication date: 1997
Natural attenuation of xenobiotic compounds at the Grindsted old landfill

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Rügge, K., Bjerg, P., Mosbæk, H., Christensen, T.
Publication date: 1997

Natural biological attenuation: Integrative transition zones. Chapter 20

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Lyngkilde, J., Nielsen, P., Albrechtsen, H., Heron, G.
Publication date: 1997

Naturlig selvrensning som alternativ afværgeteknologi

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T.
Publication date: 1997

Solid phase cadmium and reactions of aqueous cadmium with soil surfaces

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Christensen, T. H., Huang, M.
Number of pages: 661
Solid phase cadmium and reactions of aqueous cadmium with soil surfaces

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T.
Number of pages: 661
Publication date: 1997

Host publication information
Title of host publication: Proceedings of the extended abstracts from the fourth international conference on the biogeochemistry of trace elements
Source: orbit
Source-ID: 318496
Research output: Research › Article in proceedings – Annual report year: 1997

Sorption of Heavy Metals

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Holm, P. E.
Number of pages: 18
Publication date: 1997

Publication information
Original language: English
Research output: Research › Book chapter – Annual report year: 1997

Speciation of heavy metals in landfill leachate

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Jensen, D., Christensen, T.
Publication date: 1997

Host publication information
Title of host publication: Speciation of heavy metals in landfill leachate
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 169693
Research output: Research › Article in proceedings – Annual report year: 1997

Uorganiske stoffluxe i grundvandsopløbet omkring Vejen Losseplads

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resources
Contributors: Bjerg, P., Nielsen, M., Carlson, B., Pedersen, J. K., Christensen, T. H.
Publication date: 1997
Vurdering af lossepladserns overgang fra aktiv til passiv miljøbeskyttelse. Teknis vurdering af eksisterende og nedlagte lossepladser

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christiansen, C., Grevy, I., Johannessen, L., Clausen, S., Winther, P., Christensen, T., Bjerg, P.
Publication date: 1997

Publication information
Original language: Danish
Source: orbit
Source-ID: 169769
Research output: Research - peer-review › Report – Annual report year: 1997

Application of a model accounting for kinetic sorption and degradation to in situ microcosm observations on the fate of aromatic hydrocarbons in an aerobic aquifer

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resources
Contributors: Bjerg, P., Brun, A., Nielsen, P., Christensen, T.
Pages: 1831-1841
Publication date: Jun 1996
Peer-reviewed: Yes

Publication information
Journal: Water Resources Research
Volume: 32
Issue number: 6
ISSN (Print): 0043-1397
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.39 SJR 2.296 SNIP 1.555
Web of Science (2017): Impact factor 4.361
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.1 SJR 2.615 SNIP 1.633
Web of Science (2016): Impact factor 4.397
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.06 SJR 2.525 SNIP 1.593
Web of Science (2015): Impact factor 3.792
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.75 SJR 2.442 SNIP 1.668
Web of Science (2014): Impact factor 3.549
Afdampning og transport af flygtige stoffer i jord

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lindhardt, B., Christensen, T. H.
Pages: 117-130
Publication date: 1996
Application of a microbiology-geochemistry transport model for saturated groundwater flow to a municipal landfill plume (Vejen Landfill, Denmark)

General information
State: Published
Organisations: Department of Hydrodynamics and Water Resources, Department of Environmental Science and Engineering
Contributors: Brun, A., Engesgaard, P. K., Christensen, T. H.
Pages: 109-116
Publication date: 1996

Host publication information
Title of host publication: IAHS-publication no. 227
Source: orbit
Source-ID: 165892
Research output: Research - peer-review » Book chapter – Annual report year: 1996

Cadmium and nickel distribution coefficients for sandy aquifer materials

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Lehmann, N., Jackson, T., Holm, P.
Pages: 75 - 84
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 24
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Cadmium solubility in aerobic soils

General information
Composition and distribution of biomass in a landfill contaminated aquifer (Grindsted, Denmark). Abstract No. 46

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ludvigsen, L., Albrechtsen, H., Christensen, T.
Pages: 82
Publication date: 1996

Host publication information
Title of host publication: Composition and distribution of biomass in a landfill contaminated aquifer
Volume: Abstract No. 46
Place of publication: Grindsted, Denmark
Publisher: Institute of Plant Biology, University of Zürich,
Source: orbit
Source-ID: 169578
Research output: Research › Article in proceedings – Annual report year: 1996

Degradation of organic chemicals in landfills and their attenuation zones

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Albrechtsen, H., Bjerg, P. L., Rügge, K., Kromann, A.
Number of pages: 8
Publication date: 1996
Peer-reviewed: No
Event: Paper presented at 7th International Congress on Solid Waste, Yokohama, Japan.
Research output: Research › Paper – Annual report year: 1996

Effect of dissolved organic carbon on the mobility of cadmium, nickel and zinc in leachate polluted groundwater

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, J., Jensen, D., Christensen, T.
Pages: 3037 - 3049
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 30
Issue number: 12
ISSN (Print): 0043-1354
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.209 SNIP 2.108
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.702 SNIP 1.908
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.568 SNIP 1.757
Web of Science (2002): Indexed yes
Effect of geochemical conditions on fate of organic compounds in groundwater

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Higgo, J., Nielsen, P., Bannon, M., Harrison, I., Christensen, T.
Pages: 335 - 346
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Environmental Geology
Volume: 27
Issue number: 4
ISSN (Print): 0943-0105
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.59 SJR 0.552 SNIP 0.801
Web of Science (2017): Impact factor 1.435
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 1.73 SJR 0.591 SNIP 0.978
Web of Science (2016): Impact factor 1.569
Web of Science (2016): Indexed yes
Scopus rating (2015): CiteScore 1.84 SJR 0.732 SNIP 1.042
Scopus rating (2014): CiteScore 1.83 SJR 0.703 SNIP 1.239
Web of Science (2014): Impact factor 1.765
Scopus rating (2013): CiteScore 1.64 SJR 0.719 SNIP 1.136
Web of Science (2013): Impact factor 1.572
ISI indexed (2013): ISI indexed yes
Scopus rating (2012): CiteScore 1.36 SJR 0.627 SNIP 1.024
Web of Science (2012): Impact factor 1.445
ISI indexed (2012): ISI indexed yes
Scopus rating (2011): CiteScore 1.01 SJR 0.705 SNIP 1.172
Web of Science (2011): Impact factor 1.127
ISI indexed (2011): ISI indexed no
Scopus rating (2010): SJR 0.592 SNIP 0.982
Web of Science (2010): Impact factor 1.07
Scopus rating (2009): SJR 0.633 SNIP 1.11
Scopus rating (2008): SJR 0.633 SNIP 1.217
Scopus rating (2007): SJR 0.502 SNIP 0.865
Scopus rating (2006): SJR 0.487 SNIP 0.777
Scopus rating (2005): SJR 0.522 SNIP 0.875
Effects of Landfill Gas Vegetation

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Neumann, U., Christensen, T. H.
Pages: 155-162
Publication date: 1996

Host publication information
Title of host publication: Landfilling of Waste: Biogas
Place of publication: London
Publisher: E & FN Spon
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
ISBN (Print): 0-419-19400-2
Research output: Research › Book chapter – Annual report year: 1996

Factors controlling the migration and attenuation of priority pollutants in landfill pollution plumes

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Bjerg, P., Heron, G., Williams, G., Higgo, J., Bourg, A., Altmann, R.
Publication date: 1996

Publication information
Place of publication: Brussels
Publisher: European Commission
Original language: English
Source: orbit
Source-ID: 169595
Research output: Research › Book – Annual report year: 1996

Forureningsspredning i grundvandsmagasiner - dispersionsforhold og deres betydning for moniteringsprogrammer og afværgeforanstaltninger

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resources
Contributors: Bjerg, P., Kjeldsen, P., Christensen, T., Pedersen, J. K.
Pages: 21-32
Publication date: 1996

Host publication information
Title of host publication: Forureningsspredning i grundvandsmagasiner - dispersionsforhold og deres betydning for moniteringsprogrammer og afværgeforanstaltninger
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 169551
Research output: Research › Article in proceedings – Annual report year: 1996
Gas-generating processes in landfills

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Kjeldsen, P., Lindhardt, B.
Pages: 27-50
Publication date: 1996

Host publication information
Title of host publication: Landfilling of waste: Biogas
Place of publication: London, GB
Publisher: E & FN Spon
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
ISBN (Print): 0-419-19400-2
Source: orbit
Source-ID: 169517
Research output: Research - peer-review › Book chapter – Annual report year: 1996

Gas issues in landfill management

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T., Cossu, R., Stegmann, R.
Pages: 3-7
Publication date: 1996

Host publication information
Title of host publication: Landfilling of waste: Biogas. (eds. Christensen,T.H., Cossu,R., Stegmann,R.)
Place of publication: London, GB
Publisher: E & FN Spon
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
ISBN (Print): 0-419-19400-2
Source: orbit
Source-ID: 169518
Research output: Research - peer-review › Article in proceedings – Annual report year: 1996

In situ and laboratory determined first-order degradation rate constants of specific organic compounds in an aerobic aquifer

In situ microcosms (ISM) and laboratory batch microcosms (LBM) were used for determination of the first-order degradation rate constants of benzene, toluene, o-xylene, nitrobenzene, naphthalene, biphenyl, o- and p-dichlorobenzene, 1,1,1 -trichloroethane, tetrachlorometane, trichloroethene, tetrachloroethene, phenol, o-cresol, 2,4- and 2,6- dichlorophenol, 4,6-o-dichlorocresol, and o- and p-nitrophenol in an aerobic aquifer. All aromatic hydrocarbons were degraded in ISM and LBM experiments. The phenolic hydrocarbons were all degraded in ISM experiments, but some failed to degrade in LBM experiments. Chlorinated aliphatic hydrocarbons were degraded neither in ISM nor LBM experiments. Degradation rate constants were determined by a model accounting for kinetic sorption (bicontinuum model), lag phases, and first-order degradation. With a few exceptions, lag phases were less than 2 weeks in both ISM and LBM experiments. First-order degradation rate constants for aromatic and phenolic hydrocarbons ranged between 0.01 and 0.9 day(-1). Local variations in first-order degradation rates and variations between rate constants determined by ISM and LBM were generally within a factor of 5, but no systematic differences were observed between rate constants determined in situ and in the laboratory.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Nielsen, P., Bjerg, P., Nielsen, P., Smith, P., Christensen, T.
Pages: 31-37
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology
"Intrinsic bioremediation" eller "intern rensning" - en alternativ afværgeteknologi i Danmark?

**General information**
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T.
Publication date: 1996

**Host publication information**
Title of host publication: "Intrinsic bioremediation" eller "intern rensning" - en alternativ afværgeteknologi i Danmark?
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 169556
Research output: Research › Article in proceedings – Annual report year: 1996

Kemiske stoffers opførsel i jord og grundvand - en oversigt.

**General information**
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kjeldsen, P., Christensen, T. H.
Pages: 17-79
Publication date: 1996

**Host publication information**
Title of host publication: Kemiske stoffers opførsel i jord og grundvand
Volume: 1
Place of publication: København
Publisher: Miljøstyrelsen
Editors: Kjeldsen, P., Christensen, T. H.
(Projekt om jord og grundvand fra Miljøstyrelsen; No. 20).
Electronic versions: int1995_152_2.pdf
Source: orbit
Source-ID: 169563
Research output: Research › Article in proceedings – Annual report year: 1996

Landfilling of waste: Biogas

**General information**
State: Published

Performance of the In Situ Microcosm Technique for Measuring the Degradation of Organic Chemicals in Aquifers

An in situ microcosm (ISM) consists of a stainless steel cylinder isolating about 2 L of the aquifer and is equipped with valves allowing for loading and sampling from the ground surface. During the last five years, this technique has been used frequently to study the degradation of organic chemicals in polluted and pristine aquifers representing different redox environments. The ISM technique has great potential for providing field-relevant degradation potentials and rate constants, but care must be taken in using the equipment and interpreting the results. This paper provides details concerning the installation and operation of an ISM and presents experiences concerning data interpretation and monitoring of redox conditions.
Significance of biomass support particles in laboratory studies on microbial degradation of organic chemicals in aquifers

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Sorption af tungmetaller

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Holm, P. E.
Pages: 235-254
Publication date: 1996

Host publication information
Title of host publication: Kemiske stoffers opførsel i jord og grundvand
Volume: 1
Place of publication: København
Publisher: Miljøstyrelsen
Editors: Kjeldsen, P., Christensen, T. H.
(Project om jord og grundvand fra Miljøstyrelsen; No. 20).
Electronic versions:
imt1995_152_8.pdf
Source: orbit
Source-ID: 169557
Research output: Research › Article in proceedings – Annual report year: 1996

Tungmetaller

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Holm, P. E., Christensen, T. H.
Pages: 451-490
Publication date: 1996

Host publication information
Title of host publication: Kemiske stoffers opførsel i jord og grundvand
Volume: 2
Publisher: Miljøstyrelsen
Editors: Kjeldsen, P., Christensen, T. H.
(Project om jord og grundvand fra Miljøstyrelsen; No. 20).
Volatilisation of aromatic hydrocarbons from soil: Part I, Fluxes from coal tar contaminated surface soils

The non-steady-state fluxes of aromatic hydrocarbons were measured in the laboratory from the surface of soils contaminated with coal tar. Four soil samples from a former gasworks site were used for the experiments. The fluxes were quantified for 11 selected compounds, 4 mono- and 7 polycyclic aromatic hydrocarbons, for a period of up to 8 or 16 days. The concentrations of the selected compounds in the soils were between 0.2 and 3,100 μg/g. The study included the experimental determination of the distribution coefficient of the aromatic hydrocarbons between the sorbed phase and the water under saturated conditions. The determined distribution coefficients showed that the aromatic hydrocarbons were more strongly sorbed to the total organic carbon including the coal tar pitch - by a factor of 8 to 25 - than expected for natural organic matter. The fluxes were also estimated using an analytical solution of the Fick's diffusion equation and assuming that the compounds diffused independently of each other and that instant equilibrium existed between the air, water and sorbed phases. A relatively good agreement was found between the predicted and the measured flux. The predicted fluxes were between 0.11 and 7.5 times the measured fluxes. The fluxes were overestimated for the monocyclic aromatic hydrocarbons and underestimated for 3-rings-PAHs.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lindhardt, B., Christensen, T.
Pages: 129-146
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 89
Issue number: 1-2
ISSN (Print): 0049-6979
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.9
Web of Science (2017): Impact factor 1.769
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.77
Web of Science (2016): Impact factor 1.702
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.7
Web of Science (2015): Impact factor 1.551
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8
Web of Science (2014): Impact factor 1.554
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.8
Web of Science (2013): Impact factor 1.685
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.81
Web of Science (2012): Impact factor 1.748
Volatilisation of aromatic hydrocarbons from soil: Part II, Fluxes from coal tar contaminated soils residing below the soil surface

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Lindhardt, B., Christensen, T.
Pages: 375-389
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 92
ISSN (Print): 0049-6979
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.9
Web of Science (2017): Impact factor 1.769
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.77
Web of Science (2016): Impact factor 1.702
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.7
Web of Science (2015): Impact factor 1.551
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Assessment of the Spatial Variability in Leachate Migration from an Old Landfill Site

Investigations of the pollution of groundwater from old landfills have in most cases focused on delineating the pollution plume and only in very few cases on the landfill as a source to groundwater pollution. Landfills often cover large areas. Spatial variations in leachate composition may have great impact on the location of the main pollution plume in the downstream aquifer. Grindsted landfill in Denmark was investigated by sampling leachate beneath the landfill and in groundwater at the borders of the landfill. A pronounced variability in leachate quality and leakage patterns from the landfill was observed. Also variations in local groundwater flow directions were found. These observations are very important for delineation of the groundwater pollution and for proper choice of remedial action activities, related both to the plume and to the landfill.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Number of pages: 512
Pages: 365-373
Publication date: 1995

Host publication information
Title of host publication: Groundwater Quality: Remediation and Protection (GQ'95) : Proceedings of an international conference held at Prague, Czech Republic, from 15 to 18 May 1995
Place of publication: UK
Publisher: IAHS Press
Editors: Kovar, K., Krásný, J.
ISBN (Print): 978-0947571290
Changes in Trace Metal Species and Other Components of the Rhizosphere During Growth of Radish

Changes in the properties of soil solution in the rhizosphere of developing radish plants were investigated. Variations in these properties were expected to affect the distribution and speciation of metals in the soil and soil solution. Applications of essential nutrients were linked to plant transpiration rates and prevented excess addition of nutrient ions, so that subtle changes in soil solution composition would not be obscured. Soil solution pH, the concentration of dissolved organic carbon (DOC) and the concentrations of major and trace elements in solution were found to vary over time. Strict control of fertilizer additions led to the maintenance of a relatively low ionic strength in the soil solution, and under such conditions trace metal solubility appeared to be highly influenced by the concentration of DOC. A chemical speciation analysis was performed which showed that, while dissolved Cd and Zn were largely uncomplexed in unplanted soil, Cd and Zn in the rhizosphere existed mainly as complexed forms. It is hypothesized that this is partly a result of Ca-metal-ligand equilibrium in solution, with higher Ca concentrations in unplanted soil leading to more of the Cd and Zn in solution existing in the uncomplexed state. Changes in the concentrations of uncomplexed Cd and Zn with time gave the best correlations with changes in plant uptake of these metals over time, supporting the hypothesis that plants mainly absorb the free metal ion from soil solution.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Rothamsted Research
Contributors: Hamon, R. E., Lorenz, S. E., Holm, P. E., Christensen, T. H., McGrath, S. P.
Pages: 749-756
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Plant, Cell and Environment
Volume: 18
Issue number: 7
ISSN (Print): 0140-7791
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 5.48 SJR 2.671 SNIP 1.716
Web of Science (2017): Impact factor 5.415
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 5.89 SJR 2.757 SNIP 1.718
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.28 SJR 2.955 SNIP 1.897
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.95 SJR 2.823 SNIP 1.876
Web of Science (2014): Impact factor 6.96
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.25 SJR 2.883 SNIP 2.008
Web of Science (2013): Impact factor 5.906
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.46 SJR 2.576 SNIP 1.763
Composition and Management of Leachate from Landfills Within the Eu

General information
State: Published
Organisations: Department of Environmental Engineering, Water Quality Institute, Denmark, Science Park Aarhus, Sweco Danmark A/S, Knox Associates, University of Wuppertal
Contributors: Hjelmar, O., Johannessen, L., Knox, K., Ehrig, H., Flyvbjerg, J., Winther, P., Christensen, T. H.
Pages: 243-262
Publication date: 1995

Host publication information
Title of host publication: Proceedings of Sardinia 95: Fifth International Landfill Symposium
Volume: 1
Place of publication: Cagliari
Publisher: CISA, Environmental Sanitary Engineering Centre
Research output: Research - peer-review; Article in proceedings – Annual report year: 1995

Degradability of Chlorinated Organic Compounds in Landfills

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kromann, A., Ludvigsen, L., Christensen, T. H.
Pages: 135-142
Degradation of Organic Chemicals in a Leachate Pollution Plume: An In-Situ Experiment

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Nielsen, P. H., Bjerg, P. L.
Pages: 621-628
Publication date: 1995

Host publication information
Title of host publication: Proceedings of Sardinia 95 - Fifth International Landfill Symposium
Volume: 3
Place of publication: Cagliari
Publisher: CISA, Environmental Sanitary Engineering Centre
Editor: Christensen, T. H.
Source: orbit
Source-ID: 318909
Research output: Research - peer-review › Article in proceedings – Annual report year: 1995

Distribution of Organic Compounds from Municipal Solid Waste in the Groundwater Downgradient of a Landfill (Grindsted, Denmark)
The distribution of organic compounds in the leachate plume downgradient of the Grindsted Landfill was mapped along two 300 m long transects (285 groundwater samples). At the border of the landfill, elevated concentrations of dissolved organic matter 30-1 10 mg of C L⁻¹ (measured as nonvolatile organic carbon, NVOC) were found. In a distance of 130 m downgradient of the landfill, the NVOC had decreased to background level, which is 1-3 mg of C L⁻¹. More than 15 organic compounds were identified in the groundwater at the downgradient border of the landfill with benzene, toluene, ethylbenzene, and xylenes as dominating. No pesticides were identified, but some phenoxy acids, which could be metabolites of known pesticides, were found. In a distance of approximately 60 m from the landfill, most of the specific organic compounds were no longer detectable. Since dilution and sorption apparently cannot account for the disappearance of the specific organic compounds within the first 60 m of the plume, it is proposed that the majority of the specific organic compounds were degraded in the anaerobic plume under methanogenic/iron-reducing conditions. The investigation indicates that the aquifer has a substantial natural attenuation capacity.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Rügge, K., Bjerg, P. L., Christensen, T. H.
Pages: 1395-1400
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 29
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Distribution of Redox-Sensitive Groundwater Quality Parameters Downgradient of a Landfill (Grindsted, Denmark)

The leachate plume stretching 300 m downgradient from the Grindsted Landfill (Denmark) has been characterized in terms of redox-sensitive groundwater quality parameters along two longitudinal transects (285 samples). Variations in the levels of methane, sulfide, iron(II), manganese(II), ammonium, dinitrogen oxide, nitrite, nitrate, and oxygen in the groundwater samples indicate that methane production, sulfate reduction, iron reduction, manganese reduction, and nitrate reduction take place in the plume. Adjacent to the landfill, methanogenic and sulfatereducing zones were identified, while aerobic environments were identified furthest away from the landfill. In between, different redox environments, including apparent transition zones, were identified in a sequence in accordance with the thermodynamic principles. The redox zones are believed to constitute an important chemical framework for the attenuation processes in the plume.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Bjerg, P. L., Rügge, K., Pedersen, J. K., Christensen, T. H.
Pages: 1387-1394
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 29
Issue number: 5
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Web of Science (2012): Impact factor 5.257
Geomicrobial and Geochemical Redox Processes in a Landfill Polluted Aquifer

**General information**
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ludvigsen, L., Heron, G., Albrechtsen, H., Christensen, T. H.
Pages: 11-19
Publication date: 1995

**Host publication information**
Title of host publication: ATV Møde : Biologiske processer i jord og grundvand
Place of publication: Jærgersborg
Publisher: Akademiet for de Tekniske Videnskaber, ATV

**Bibliographical note**
Artiklen trykkes i "In-Situ and On-Site Bioreclamation". The Third Symposium, April 24-27, 1995, San Diego, California
Geomicrobial and Geochemical Redox Processes in a Landfill-Polluted Aquifer

The distribution of different dominant microbial-mediated redox processes in a landfill leachate-polluted aquifer (Grindsted, Denmark) was investigated. The most probable number method was utilized for detecting bacteria able to use each of the electron acceptors, and unamended incubations were utilized to detect the activity of the redox processes using the investigated electron acceptors. The redox processes investigated were methane production and reduction of sulfate, Fe(III), Mn(IV), and nitrate. The presence of methanogenic bacteria and methanogenic activity were observed close to the landfill. Sulfate-reducing bacteria and sulfate reduction were observed in the area where methanogenesis took place, but were also observed further downgradient in the leachate plume. Fe(III)-reducing bacteria were found in almost all samples from the entire anaerobic leachate plume, but no ongoing Fe(III)-reduction was observed. Sediment analysis with respect to iron species supports these findings, because no clear zone of Fe(III) depletion has been found in the leachate plume. Nitrate-reducers were found in a large section of the plume, but denitrification was observed only in the outskirts of the plume where nitrate was present.

Impact of Sediment-Bound Iron on Redox Buffering in a Landfill Leachate Polluted Aquifer (Vejen, Denmark)

Sediments sampled along a central flow line of the leachate pollution plume at the Vejen Landfill, Denmark, were characterized in detail with respect to the forms and pools of Fe(II) and Fe(III). After 15 yr of leaching, redox reactions had diminished the pool of iron(II) oxides and hydroxides in the reduced zones close to the landfill, and the aquifer oxidation capacity (OXC) related to iron oxides was depleted. Less than 2% of the total Fe(II) was recovered as dissolved Fe(II), whereas 1-20% was ion-exchangeable on the sediments. The majority of the Fe(II) was in the solid state either as pyrite or in the ill-defined fraction extractable by 5 M HCl. The total reduction capacities (TRC) of these anaerobic sediments were significantly elevated relative to the unpolluted sediments. Samples from the oxidized, weakly polluted part of the plume contained Fe(III) minerals and insignificant amounts of Fe(II). This study presents evidence of substantial iron reduction buffering the reducing power of landfill leachate entering a shallow aquifer. It is also proposed that reduced sediment-bound iron species form in the plume, thereby increasing the need for oxygen if the aquifer was to be remediated.
In situ and Laboratory Determined First-Order Degradation Rate Constants of Specific Organic Compounds in an Aerobic Aquifer

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Nielsen, P. H., Bjerg, P. L., Nielsen, P., Smith, P., Christensen, T. H.
Pages: 31-44
Publication date: 1995

Host publication information
Title of host publication: ATV Møde: Biologiske processer i jord og grundvand
Place of publication: Jægersborg
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 318628
Research output: Research - peer-review › Article in proceedings – Annual report year: 1995

In Situ and Laboratory Studies on the Fate of Specific Organic Compounds in an Anerobic Landfill Leachate Plume, 1. Experimental Conditions and Fate of Phenolic Compounds

The transformation of specific organic compounds was investigated by in situ and laboratory experiments in an anaerobic landfill leachate pollution plume at four different distances from the landfill. This paper presents the experimental conditions in the in situ microcosm and laboratory batch microcosm experiments performed and the results on the fate of 7 phenolic compounds. Part 2 of this series of papers, also published in this issue, presents the results on the fate of 8 aromatic compounds and 4 chlorinated aliphatic compounds. The redox conditions in the plume were characterized as methanogenic, Fe(III)-reducing and NO~--reducing by the redox sensitive species present in groundwater and sediment and by bioassays. With a few exceptions the aquifer redox conditions were maintained throughout the experiments as monitored by redox sensitive species present in groundwater during the experiments, by redox sensitive species present in the sediment after the experiments and by bioassays performed after the experiments. Transformation of nitrophenol was very fast close to the landfill in strongly reducing conditions, while transformation was slower in the more oxidized part of the plume. Lag phases for the nitrophenols were short (maximum 10 days). Phenol was only transformed in the more distant part of the plume in experiments where NO−, Fe(III) and Mn(IV) reduction was dominant. Lag phases for phenol were either absent or lasted up to 2 months. Dichlorophenols were only transformed in experiments representing strongly reducing, presumably methanogenic, redox conditions close to the landfill after lag phases of up to 3 months. Transformation of o-cresol was not observed in any of the experiments throughout the plume. Generally, there was good accordance between the results obtained by in situ and laboratory experiments, both concerning redox conditions and the fate of the phenolic compounds. However, for phenol and 2,4-dichlorophenol, transformation was observed in some in situ experiments but not in the corresponding laboratory experiments. In some experiments, this could be explained by differences in the redox conditions developing during the experiments. Nitrophenols were apparently transformed abiotically in the most reduced part of the plume, at 2 m from the landfill.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Nielsen, P. H., Albrechtsen, H., Heron, G., Christensen, T. H.
Pages: 27-50
Publication date: 1995
Peer-reviewed: Yes
In Situ and Laboratory Studies on the Fate of Specific Organic Compounds in an Anaerobic Landfill Leachate Plume, 2. Fate of Aromatic and Chlorinated Aliphatic Compounds

The transformation of specific organic compounds was investigated by in situ and laboratory experiments in an anaerobic landfill leachate pollution plume at four different distances from the landfill. In a previous paper (Part 1, also published in this issue) we described the in situ microcosm and laboratory batch microcosm experiments performed focusing on redox conditions, microbiology and the fate of 7 phenolic compounds. In this paper we present the results on the fate of 8 aromatic compounds and 4 chlorinated aliphatic compounds. Nitrobenzene was transformed at all distances from the landfill in methanogenic, and Fe(III)- and NO3-reducing conditions. Toluene was transformed slowly in one out of three in situ experiments at the distance of 250 m from the landfill in the Fe(III)-reducing part of the plume after a lag phase of ~3 months. Benzene, o-xylene, p-dichlorobenzene, o-dichlorobenzene, naphthalene and biphenyl were not transformed at any of the investigated distances from the landfill, neither in situ nor in laboratory experiments. In the methanogenic part of the aquifer 2 m from the landfill, 1,1,1-trichloroethane, tetrachloromethane and tetrachloroethene were transformed in situ experiments while trichloroethene was not. Lag phase periods were up to 40 days for 1,1,1-trichloroethane and up to 100 days for tetrachloroethene. No or only short lag phases (<10 days) were observed for tetrachloromethane. Tetrachloromethane was furthermore transformed at distances of up to 250 m from the landfill in Fe(III)-reducing conditions but not in NO3-reducing conditions at 350 m from the landfill. Abiotic processes apparently contributed to the transformation of tetrachloromethane. A local variation in the transformation of the chlorinated aliphatic hydrocarbons was observed at 2 m from the landfill. In general, good accordance with respect to compound transformation was observed between in situ and laboratory experiments, but in a few cases more compounds were transformed in in situ experiments than in the corresponding laboratory experiments.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Nielsen, P. H., Bjarnadóttir, H., Winter, P. L., Christensen, T. H.
Pages: 51-66
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 20
ISSN (Print): 0169-7722
Ratings:

BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Web of Science (2011): Impact factor 2.324
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.363 SNIP 1.194
Web of Science (2010): Impact factor 2.124
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.335 SNIP 1.4
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.442 SNIP 1.525
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.546 SNIP 1.361
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.428 SNIP 1.48
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.416 SNIP 1.309
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.386 SNIP 1.395
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.33 SNIP 1.465
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.807 SNIP 1.669
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.557 SNIP 1.091
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.383 SNIP 1.036
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.45 SNIP 0.936
Original language: English
Source: orbit
Source-ID: 317690
Laboratory Evaluation of Biomass Support Particles for Microbial Degradation of Organic Chemicals in Water Treatment

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Albrechtsen, H., Smith, P. M., Nielsen, P., Christensen, T. H.
Number of pages: 3
Publication date: 1995
Peer-reviewed: Yes
Event: Poster session presented at 20th International Water Supply Congress and Exhibition, Durban, South Africa.

Landfill Emissions and Environmental Impact: An Introduction

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Kjeldsen, P.
Pages: 3-12
Publication date: 1995
Host publication information
Title of host publication: Proceedings of Sardinia 95 - Fifth International Landfill Symposium
Volume: 3
Place of publication: Cagliari
Publisher: Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 318914
Research output: Research - peer-review → Article in proceedings – Annual report year: 1995

Limiting Factors for Microbial Fe(III)-Reduction In a Landfill Leachate Polluted Aquifer (Vejen, Denmark)

Aquifer sediment samples from two locations within the anaerobic leachate plume of a municipal landfill were compared with respect to microbiology (especially Fe(III)-reduction) and geochemistry. The samples close to the landfill were characterized by low contents of Fe(III), whereas samples from the more distant cluster were rich in Fe(III)-oxides. The active microbial population seemed to be less dense in samples more distant from the landfill (measured by ATP and phospholipid fatty acids (PLFA)), but the microbial communities were very similar in the two sample clusters according to the composition of PLFA. Very little, if any, Fe(III)-reduction was observed close to the landfill, but all the more distant samples showed evident microbiologically mediated Fe(III)-reduction. After amendment with both acetate and Fe(III), all the samples showed a potential for Fe(III)-reduction, and the in situ Fe(III)-reduction seemed to be limited by the lack of Fe(III)-availability. It was suggested, that Fe(III)-reducing populations might be facultative, surviving by use of other electron-acceptors than Fe(III), when Fe(III) is not available for reduction.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Heron, G., Christensen, T. H.
Pages: 233-248
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: FEMS Microbiology Ecology
Volume: 16
Issue number: 3
ISSN (Print): 0168-6496
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.87 SJR 1.492 SNIP 1.052
Web of Science (2017): Impact factor 11.392
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.85 SJR 1.474 SNIP 1.171
Web of Science (2016): Impact factor 12.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.77 SJR 1.698 SNIP 1.128
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.8 SJR 1.573 SNIP 1.235
Web of Science (2014): Impact factor 13.244
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.15 SJR 1.673 SNIP 1.29
Web of Science (2013): Impact factor 13.806
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.78 SJR 1.682 SNIP 1.217
Web of Science (2012): Impact factor 13.231
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 3.63 SJR 1.692 SNIP 1.184
Web of Science (2011): Impact factor 10.96
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.735 SNIP 1.244
Web of Science (2010): Impact factor 11.796
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.727 SNIP 1.172
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.769 SNIP 1.279
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.473 SNIP 1.436
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.791 SNIP 1.51
Scopus rating (2005): SJR 1.578 SNIP 1.263
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.731 SNIP 1.044
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.597 SNIP 1.248
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.352 SNIP 1.013
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.564 SNIP 1.17
Web of Science (2001): Indexed yes
Microbial Fe(III) Reduction - A Process Resulting in Transport of Iron in Aquifers

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Albrechtsen, H., Ludvigsen, L., Heron, G., Hart, S. D., Christensen, T. H.
Number of pages: 50
Publication date: 1995

Host publication information
Title of host publication: Proceedings of GIAM X: Tenth International Conference on Global Impacts of Applied Microbiology and Biotechnology
Place of publication: Elsinore
Publisher: Danish National Commission for UNESCO
Source-ID: 318934
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 1995

Natural Attenuation of Xenobiotic Compounds: Anaerobic Field Injection Experiment

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Rügge, K., Bjerg, P. L., Mosbæk, H., Christensen, T. H.
Number of pages: 8
Publication date: 1995
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1995

Natural Attenuation of Xenobiotic Compounds: Anaerobic Field Injection Experiment

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Water Resources Engineering, Residual Resource Engineering
Contributors: Rügge, K., Bjerg, P. L., Mosbæk, H., Christensen, T. H.
Number of pages: 278
Pages: 127-133
Publication date: 1995

Host publication information
Title of host publication: Intrinsic Bioremediation - Bioremediation 3 (1)
Place of publication: Columbus, Ohio
Publisher: Battelle Memorial Institute
Editors: Hinchee, R. E., Wilson, J. T., Downey, D. C.
ISBN (Print): 978-1574770025
(Bioremediation Series; No. 3 (1)).
Source-ID: 317820
Research output: Research - peer-review › Article in proceedings – Annual report year: 1995

Occurrence and Distribution of Pharmaceutical Organic Compounds in the Groundwater Downgradient of a Landfill (Grindsted, Denmark)
Usually landfill leachates contain specific organic compounds as BTEXs (benzene, toluene, ethylbenzene, and xylenes), chlorinated aliphatic hydrocarbons and chlorobenzenes originating from household chemicals and waste from small businesses (1). However, where industrial waste has been landfilled, the leachate may contain many other organic compounds (2). Another paper of ours (3) described the distribution of commonly found organic compounds in the leachate plume downgradient of the Grindsted Landfill and discussed the fate of the organic compounds in view of the redox environments determined in the plume (4). In this paper, we describe the occurrence and distribution of organic compounds originating from waste from the pharmaceutical industry in the groundwater downgradient of the same landfill. According to our knowledge, this is the first report on pharmaceutical compounds in a leachate plume.

**General information**
State: Published
Organisations: Department of Environmental Science and Engineering, Grindsted Products A/S
Contributors: Holm, J. V., Rügge, K., Bjerg, P. L., Christensen, T. H.
Pages: 1415-1420
Publication date: 1995
Peer-reviewed: Yes

**Publication information**
Journal: Environmental Science & Technology (Washington)
Volume: 29
Issue number: 5
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Web of Science (2012): Impact factor 5.257
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.16 SJR 3.18 SNIP 1.945
Web of Science (2011): Impact factor 5.228
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Redox Buffering in Shallow Aquifers Contaminated by Leachate

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Heron, G., Bjerg, P. L., Christensen, T. H.
Number of pages: 278
Pages: 143-151
Publication date: 1995

Host publication information
Title of host publication: Intrinsic Bioremediation - Bioremediation 3 (1)
Place of publication: Columbus, Ohio
Publisher: Battelle Memorial Institute
Editors: Hinchee, R. E., Wilson, J. T., Downey, D. C.
ISBN (Print): 978-1574770025
(Bioremediation Series; No. 3 (1)).
Source: orbit
Source-ID: 317838
Research output: Research - peer-review › Article in proceedings – Annual report year: 1995

Redox Buffering in Shallow Aquifers Contaminated by Leachate and Implications for the Development of Reduced Plumes and In Situ Remediation

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Heron, G., Bjerg, P. L.
Redox Buffering in Shallow Aquifers Contaminated by Leachate and Implications for the Development of Reduced Plumes and In-Situ Remediation

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Bjerg, P. L., Heron, G.
Number of pages: 1,662
Pages: 911-919
Publication date: 1995

Host publication information
Title of host publication: Contaminated Soil '95
Volume: 2
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editors: van den Brink, W., Bosman, R., Arendt, F.
ISBN (Print): 0-7923-3820-0
Source: orbit
Source-ID: 318497
Research output: Research › Book chapter – Annual report year: 1995

Response to Comment on "Occurrence and Distribution of Pharmaceutical Organic Compounds in the Groundwater Downgradient of a Landfill (Grindsted, Denmark)"

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Grindsted Products A/S
Contributors: Holm, J. V., Bjerg, P. L., Rügge, K., Christensen, T. H.
Pages: 3074-3074
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 29
ISSN (Print): 0013-936X
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 6.58 SJR 2.535 SNIP 1.941
Web of Science (2017): Impact factor 6.653
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Speciation of Dissolved Cadmium: Interpretation of Dialysis, Ion Exchange and Computer (Geochem) Methods

Equilibrium dialysis and ion exchange methods, as well as computer calculations (GEOCHEM), were applied for speciation of dissolved cadmium (Cd) in test solutions and leachate samples. The leachate samples originated from soil, compost, landfill waste and industrial waste. The ion exchange (IE) method separates dissolved Cd into free divalent Cd (Cd 2+) and complexed Cd and furthermore separates the latter into the operationally defined forms: labile, slowly labile and stable complexes. The dialysis (ED) method determines high molecular weight Cd complexes (above 1000mol. wt). For both methods the reproducibility was good. By combining the results of the GEOCHEM calculations in terms of the inorganic complexes, and the IE results, the fractions of free and inorganically complexed Cd were estimated. The IE and ED results furthermore provided information about the organic complexes. Selected environmental leachates showed different Cd speciation patterns as expected. Some leachates were dominated by free divalent Cd (1-70%), some by inorganic complexes (1-87%), and some by organic complexes (7-98%).

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Centre for Soil and Environmental Research
Contributors: Holm, P. E., Andersen, S., Christensen, T. H.
Pages: 803-809
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 29
Issue number: 3
ISSN (Print): 0043-1354
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.15 SJR 2.914 SNIP 2.442
Web of Science (2012): Impact factor 4.655
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.43 SJR 2.862 SNIP 2.355
Web of Science (2011): Impact factor 4.865
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.592 SNIP 2.192
Web of Science (2010): Impact factor 4.546
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.319 SNIP 2.224
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.073 SNIP 2.178
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.94 SNIP 2.184
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.902 SNIP 2.233
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.113 SNIP 2.334
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.209 SNIP 2.108
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.702 SNIP 1.908
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.568 SNIP 1.757
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.319 SNIP 1.69
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.399 SNIP 1.662
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.432 SNIP 1.55

Original language: English
Research output: Research - peer-review › Journal article – Annual report year: 1995
Applications of Fertilizer Cations Affect Cadmium and Zinc Concentrations in Soil Solutions and Uptake by Plants

A pot experiment was conducted to study changes over time of Cd and Zn in soil solution and in plants. Radish was grown in a soil which had been contaminated with heavy metals prior to 1961. Constant amounts of a fertilizer solution (NH4NO3, KN03) were added daily. Soil solution was obtained at intervals by displacement with water. The cumulative additions of small amounts of fertilizers were made equal to the plants' requirements at the final harvest but were found to exceed them during most of the experiment. Excess fertilizers caused substantial increases of major (K, Ca, Mg) and heavy-metal (Cd, Zn) ions in soil solutions and a decrease in soil pH, probably due to ion-exchange mechanisms and the dissolution of carbonates. Uptake of Cd and Zn into leaves was correlated with the mass flow of Cd (adjusted r2 = 0.798) and Zn (adjusted r2=0.859). Uptake of K, Ca and Mg by the plants was independent of their concentrations in solution. It is concluded that, in order to study effects of plants on heavy-metal availability and obtain soil solution that has not been altered by fertilizer ions, nutrients must be added according to the needs and growth of the plants. This could be achieved by linking fertilizer additions to the rate of transpiration, as nutrient uptake and transpiration were closely correlated in this experiment.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Rothamsted Research
Contributors: Lorenz, S. E., Hamon, R. E., McGrath, S. P., Holm, P. E., Christensen, T. H.
Pages: 159-165
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: European Journal of Soil Science
Volume: 45
Issue number: 2
ISSN (Print): 1351-0754
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.34 SJR 1.44 SNIP 1.316
Web of Science (2017): Impact factor 2.644
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.44 SJR 1.426 SNIP 1.502
Web of Science (2016): Impact factor 3.475
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.1 SJR 1.61 SNIP 1.466
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.18 SJR 1.393 SNIP 1.586
Web of Science (2014): Impact factor 2.649
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.03 SJR 1.558 SNIP 1.559
Web of Science (2013): Impact factor 2.387
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3 SJR 1.746 SNIP 1.509
Web of Science (2012): Impact factor 2.651
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 2.44 SJR 1.471 SNIP 1.299
Web of Science (2011): Impact factor 2.34
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.23 SNIP 1.087
Web of Science (2010): Impact factor 1.932
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.482 SNIP 1.354
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.713 SNIP 1.443
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.838 SNIP 1.792
Scopus rating (2006): SJR 1.804 SNIP 1.719
Scopus rating (2005): SJR 1.921 SNIP 1.56
Scopus rating (2004): SJR 1.569 SNIP 1.479
Scopus rating (2003): SJR 1.201 SNIP 1.475
Scopus rating (2002): SJR 1.298 SNIP 1.379
Scopus rating (2001): SJR 1.48 SNIP 1.596
Scopus rating (2000): SJR 2.03 SNIP 1.563
Scopus rating (1999): SJR 2.023 SNIP 1.867
Original language: English
Source: orbit
Source-ID: 317004
Research output: Research - peer-review › Journal article – Annual report year: 1994
Comparison of Soxhlet and Shake Extraction of Polycyclic Aromatic Hydrocarbons from Coal Tar Polluted Soils Sampled in the Field

This study compares three extraction methods for PAHs in coal tar polluted soil: 3-times repeated shaking of the soil with dichloromethane-methanol (1:1), Soxhlet extraction with dichloromethane, and Soxhlet extraction with dichloromethane followed by Soxhlet extraction with methanol. The extraction efficiencies were determined for ten selected PAHs in triplicate samples of six soils sampled at former gasworks sites. The samples covered a wide range of PAH concentrations, from 0.6 to 397 mg/kg soil. Soxhlet extraction with dichloromethane followed by Soxhlet extraction with methanol, in general, was the most efficient method yielding 30 to 50 % higher concentrations than the other methods.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Informatics and Mathematical Modeling
Contributors: Lindhardt, B., Holst, H., Christensen, T. H.
Pages: 9-19
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: International Journal of Environmental Analytical Chemistry
Volume: 57
Issue number: 1
ISSN (Print): 0306-7319
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.32 SJR 0.361 SNIP 0.489
Web of Science (2017): Impact factor 1.372
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.28 SJR 0.368 SNIP 0.514
Web of Science (2016): Impact factor 1.208
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.27 SJR 0.422 SNIP 0.539
Web of Science (2015): Impact factor 1.411
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.17 SJR 0.435 SNIP 0.576
Web of Science (2014): Impact factor 1.295
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.35 SJR 0.403 SNIP 0.557
Web of Science (2013): Impact factor 1.321
Evidence for Microbial Iron Reduction in a Landfill Leachate-Polluted Aquifer (Vejen, Denmark)

Aquifer sediment samples obtained from the anaerobic part of a landfill leachate plume in Vejen, Denmark, were suspended in groundwater or in an artificial medium and incubated. The strictly anaerobic suspensions were tested for reduction of ferric iron (Fe(III)) oxides, which was measured as an increase in the concentration of dissolved Fe(II). Iron reduction did not occur when the medium was inoculated with inactive sediment and when the organisms in the inoculated
medium were killed by formaldehyde, by chloroform, or by pasteurization, whereas the level of iron reduction was significant when living bacteria were present. Mixed cultures were obtained from the sediment samples, and differences in apparent iron reduction rates among the different cultures were maintained during several transfers. In addition, iron reduction was observed in unamended incubation mixtures containing whole sediment and groundwater. Synthetic amorphous Fe(III) oxides, as well as naturally occurring sediment-bound Fe(III) oxides, could be reduced by the cultures. Together, our results provide evidence that iron-reducing bacteria are present and microbial iron reduction occurs in the polluted aquifer sediments which we studied.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Christensen, T. H.
Pages: 3920-3925
Publication date: 1994
Peer-reviewed: Yes
Grindsted Landfill Site: Attenuation of Leachate Pollutants

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Bjerg, P. L., Rügge, K., Christensen, T. H.
Number of pages: 249
Pages: H31E-8 1055h
Publication date: 1994

Host publication information
Title of host publication: AGU 1994 Fall Meeting
Place of publication: Washington
Publisher: American Geophysical Union
Source: orbit
Source-ID: 317440
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 1994

Injektionsforsøg i forureningsfanen ved Grindsted Gl. Losseplads

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Water Resources Engineering, Department of Hydrodynamics and Water Resources, Technical University of Denmark
In Situ Measurement of Degradation of Specific Organic Compounds Under Aerobic, Dentrifying, Iron(III)-Reducing, and Methanogenic Groundwater Conditions

Kompleksering og mobilitet af tungmetaller

Landfill Leachate-Polluted Groundwater Evaluated as Sustrate for Microbial Degradation Under Different Redox Conditions
Measured and Estimated Volatilisation of Naphthalene from a Sandy Soil

The non-steady-state fluxes of naphthalene from an artificially contaminated sandy soil at different water contents were measured in the laboratory, at 10°C. The soil contained 1.1% of organic carbon and the water content varied between 2.8 and 14% w/w. The diffusive flux of naphthalene from the soil was modelled by the numerical code RIOCATS assuming instantaneous equilibrium of naphthalene between soil air, soil water and soil solids. The latter equilibrium was described by a linear or a Freundlich isotherm experimentally determined for the actual soil. The model generally overestimated the fluxes by a factor of 1.5 to 6.4. The largest deviation between predicted and observed dynamic fluxes was found at high water contents. For the cover soil, half-life times of 1 to 2 days were estimated by the model for naphthalene degradation.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering
Contributors: Lindhardt, B., Christensen, T. H.
Pages: 1407-1419
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 29
Issue number: 7
ISSN (Print): 0045-6535
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.62 SJR 1.435 SNIP 1.448
Web of Science (2017): Impact factor 4.427
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.39 SJR 1.447 SNIP 1.625
Web of Science (2016): Impact factor 4.208
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.04 SJR 1.497 SNIP 1.567
Web of Science (2015): Impact factor 3.698
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.76 SJR 1.59 SNIP 1.639
Web of Science (2014): Impact factor 3.34
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.92 SJR 1.721 SNIP 1.751
Web of Science (2013): Impact factor 3.499
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.5 SJR 1.794 SNIP 1.618

General information
State: Published
Contributors: Christensen, T. H., Albrechtsen, H., Bjerg, P. L., Higgo, J., Williams, G.
Number of pages: 13
Pages: EC5
Publication date: 1994

Host publication information
Title of host publication: Towards Sustainable Environmental Management
Place of publication: Brussels
Publisher: Society of Environmental Toxicology and Chemistry
Source: orbit
Source-ID: 317633
Modelling the Fate of Organic Compounds in In Situ Microcosm Experiments

General information
State: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Hydrodynamics and Water Resources
Contributors: Bjerg, P. L., Nielsen, P. H., Christensen, T. H., Brun, A.
Pages: 131-136
Publication date: 1994

Host publication information
Place of publication: Balkema, Rotterdam
Publisher: CRC Press/Balkema
Editors: Dracos, T., Stauffer, F.
ISBN (Print): 905410368X
Source: orbit
ISBN-ID: 317494
Research output: Research - peer-review: Conference abstract in proceedings – Annual report year: 1994

Nødbrudd og sorption i kaalkafjæring

General information
State: Published
Organisations: Urban Water Engineering, Department of Environmental Science and Engineering, Residual Resource Engineering, Technical University of Denmark
Contributors: Jørgensen, M., Albrechtsen, H., Christensen, T. H.
Pages: 177-182
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: Vand & Jord
Volume: 1
Issue number: 4
ISSN (Print): 0908-7761
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
ISBN-ID: 317002
Research output: Research - peer-review: Article in proceedings – Annual report year: 1994

Opløste humuslignende stoffers betydning for tungmetallers opløselighed og mobilitet

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Technical University of Denmark
Contributors: Christensen, J. B., Jensen, D. L., Holm, P. E., Christensen, T. H.
Pages: 61-74
Publication date: 1994

Host publication information
Title of host publication: ATV Møde: Forskningsprojekter vedrørende grundvandsforurening
Place of publication: Danmark
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Speciation of Fe(II) and Fe(III) in Contaminated Aquifer Sediments Using Chemical Extraction Techniques

The iron mineralogy of aquifer sediments was described by chemical extraction techniques. Single-step extractions including 1 M CaCl₂, NaAc, oxalate, dithionite, Ti(II)-EDTA, 0.5 M HCl, 1 M HCl, hot 6 M HCl, and a sequential extraction by HI and Cr(II)HCl were tested on standard iron minerals and nine aquifer sediments from different redox environments sampled in a landfill leachate plume. Ion-exchangeable Fe(II) is easily quantified by anaerobic CaCl₂ extraction. A rapid indication of the redox status of a sediment sample can be achieved by a 0.5 M HCl extraction. This extraction gives an indication of the content of amorphous Fe(II) and reduced Fe(II) species such as FeS and FeCO₃, though the fractions are not quantified. A good estimate of the iron(II) oxide content contributing to the oxidation capacity (OXC) of the sediment is given by the Ti(II)-EDTA extraction. The iron(II) sulfide species are distinguished as AVS (acid volatile sulfide, hot 6 M HCl extraction) and pyrite (sequential HI and Cr(II)HCl extraction). By including a cold 5 M HCl extraction, the total distribution of the major reactive Fe(II) and Fe(II) fractions in aquifer sediments can be assessed.
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.26 SJR 2.559 SNIP 1.902
Web of Science (2016): Impact factor 6.198
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.61 SJR 2.546 SNIP 1.838
Web of Science (2015): Impact factor 5.393
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 5.5 SJR 2.777 SNIP 2.003
Web of Science (2014): Impact factor 5.33
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 5.52 SJR 2.952 SNIP 2.102
Web of Science (2013): Impact factor 5.481
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 5.17 SJR 3.115 SNIP 2.043
Web of Science (2012): Impact factor 5.257
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 5.16 SJR 3.18 SNIP 1.945
Web of Science (2011): Impact factor 5.228
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 2.979 SNIP 1.726
Web of Science (2010): Impact factor 4.827
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 2.86 SNIP 1.809
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 2.96 SNIP 1.935
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 2.774 SNIP 1.914
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 2.55 SNIP 1.893
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 2.608 SNIP 1.999
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.86 SNIP 2.046
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 2.54 SNIP 2.065
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.392 SNIP 1.949
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 2.387 SNIP 1.968
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 3.03 SNIP 2.315
Web of Science (2000): Indexed yes
The Role of Aquifer Sediment in Controlling Redox Conditions in Polluted Groundwater

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Heron, G., Christensen, T. H.
Pages: 73-78
Publication date: 1994

Host publication information
Place of publication: Balkema, Rotterdam
Publisher: CRC Press/Balkema
Editors: Dracos, T., Stauffer, F.
ISBN (Print): 905410368X
Source: orbit
Source-ID: 317584
Research output: Research › Article in proceedings – Annual report year: 1994

Udvaskning af metaller fra metalgevindingspladser

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Technical University of Denmark
Contributors: Jensen, D. L., Holm, P. E., Futtrup, J., Christensen, T. H.
Pages: 49-59
Publication date: 1994

Host publication information
Title of host publication: ATV Møde: Forskningsprojekter vedrørende grundvandsforurening
Place of publication: Danmark
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 317241
Research output: Research › Article in proceedings – Annual report year: 1994

Variabilitet i biologisk nedbrydning af specifikke organiske stoffer i en aerob akvifer målt ved laboratorie batch eksperimenter

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Nielsen, P., Foverskov, A., Christensen, T. H.
Pages: 167-178
Publication date: 1994

Host publication information
Title of host publication: ATV Møde: Vintermøde om grundvandsforurening
Place of publication: Bredsten
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 317629
Research output: Research › Article in proceedings – Annual report year: 1994
Variability of Biological Degradation of Aromatic Hydrocarbons in an Aerobic Aquifer Determined by Laboratory Batch Experiments

The biological aerobic degradation of 7 aromatic hydrocarbons (benzene, toluene, o-xylene, p-dichlorobenzene, o-dichlorobenzene, naphthalene and biphenyl) was studied for 149 days in replicate laboratory batch experiments with groundwater and sediment from 8 localities representing a 15 m × 30 m section of an aerobic aquifer. Compared to biologically deactivated control experiments all compounds were biologically degraded. Degradation curves were very reproducible for some compounds (benzene, toluene, o-xylene, o-dichlorobenzene and p-dichlorobenzene) and less reproducible for other (naphthalene and biphenyl). Based on observed length of lag phases, length of the degradation periods and percent degradation, the variation among the 8 localities appears to be modest. However, detailed examination of the degradation rates revealed statistically significant variation among localities for benzene, toluene, naphthalene and biphenyl, but not for o-xylene, o-dichlorobenzene, and p-dichlorobenzene. The maximum variation in degradation rates was 15 times in the case of biphenyl. Significant co-variation in degradation rates was found between benzene and toluene, and between p- and o-dichlorobenzene.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Nielsen, P. H., Christensen, T. H.
Pages: 305-320
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 15
Issue number: 4
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Variability of Biological Degradation of Phenolic Hydrocarbons in an Aerobic Aquifer Determined by Laboratory Batch Experiments

The biological aerobic degradation of 7 phenolic hydrocarbons (phenol, o-cresol, o-nitrophenol, p-nitrophenol, 2,6-dichlorophenol, 2,4-dichlorophenol, 4,6-o-dichlorocresol) and 1 aromatic hydrocarbon (nitrobenzene) was studied for 149 days in replicate laboratory batch microcosms with sediment and groundwater from 8 localities representing a 15 m × 30 m section of an aerobic aquifer. Three patterns of variation were found: (1) phenol, o-cresol and in most cases p-nitrophenol showed very fast degradation with no or only short lag phases and with very little variation among localities; (2) 2,4-dichlorophenol was degraded in all localities and showed large variability among localities with respect to lag phases (0–50 days) and some variation with respect to degradation periods (20–40 days); and (3) nitrobenzene, o-nitrophenol, 2,6-dichlorophenol and 4,6-o-dichlorocresol showed very large variability among localities ranging from no degradation within 149 days in some localities to degradation within 2 days in other localities. The degradation patterns were highly sequential, indicating a general sequence, for those compounds degradable, valid in all localities. The results are of importance in designing experimental determination of degradation rates and in assigning degradation parameters for use in solute transport models.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Nielsen, P. H., Christensen, T. H.
Vejen Landfill Site: In Situ Injection Studies in the Leachate Plume

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Nielsen, P. H., Albrechtsen, H., Heron, G., Bjerg, P. L.
Number of pages: 249
Pages: H31E-7 1Ø35h
Publication date: 1994

Host publication information
Title of host publication: Proceedings of AGU 1994 Fall Meeting
Place of publication: Washington
Publisher: American Geophysical Union
Source: orbit
Source-ID: 317439
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 1994

Vi ved nok til at gå i gang

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Science and Engineering
Contributors: Christensen, T. H.
Number of pages: 130
Pages: 52-58
Publication date: 1994

Host publication information
Title of host publication: Der mangler en plan! - En debatbog om forurenet jord
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
ISBN (Print): 87-7836-008-0
Source: orbit
Source-ID: 317290
Research output: Research › Book chapter – Annual report year: 1994

Volatilisation of o-Xylene from Sandy Soil
The diffusive release of o-xylene from two soils with different contents of organic carbon (1.1 % and 0.11 % TOC) and with two different water contents (app. 5 % w/w and 15 % w/w was studied in the laboratory. The soils were spiked with o-
xylene in the laboratory. The fluxes were measured over a period of 24 hours. The measured fluxes were compared to
predictions by two models. Model I, which is an analytical model, assumed instant local equilibrium between soil air, water
and solids. The distribution coefficients were measured for the two soils, and Henry's constant and the diffusion coefficient
in air were taken from the literature. This model overestimated the flux for o-xylene for all the tested combinations. The
ratios between estimated and observed fluxes at 1 h were between 1.7 and 7.3. Model II assumed that the mass transfer
of o-xylene between the solids and the water phase was kinetically controlled and was solved numerically. However, the
predictions by the more advanced model were not significantly better than the prediction by the simple analytical model.
The results indicate that prediction of o-xylene volatilisation from unsaturated soil is associated with substantial
uncertainty.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Department of Hydrodynamics
and Water Resources
Contributors: Lindhardt, B., Christensen, T. H., Brun, A.
Pages: 2625-2637
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 29
Issue number: 12
ISSN (Print): 0045-6535
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.62 SJR 1.435 SNIP 1.448
Web of Science (2017): Impact factor 4.427
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.39 SJR 1.447 SNIP 1.625
Web of Science (2016): Impact factor 4.208
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.04 SJR 1.497 SNIP 1.567
Web of Science (2015): Impact factor 3.698
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.76 SJR 1.59 SNIP 1.639
Web of Science (2014): Impact factor 3.34
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.92 SJR 1.721 SNIP 1.751
Web of Science (2013): Impact factor 3.499
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.5 SJR 1.794 SNIP 1.618
Web of Science (2012): Impact factor 3.137
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 3.61 SJR 1.962 SNIP 1.508
Web of Science (2011): Impact factor 3.206
A Field Experiment on Cation Exchanged-affected Multicomponent Solute Transport in a Sandy Aquifer

General information
State: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Residual Resource Engineering
Contributors: Bjerg, P. L., Christensen, T. H.
Pages: 269-290
Publication date: 1993
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 12
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Web of Science (2011): Impact factor 2.324
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.363 SNIP 1.194
Web of Science (2010): Impact factor 2.124
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.335 SNIP 1.4
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.442 SNIP 1.525
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.546 SNIP 1.361
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.428 SNIP 1.48
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.416 SNIP 1.309
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.386 SNIP 1.395
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.33 SNIP 1.465
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.807 SNIP 1.669
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.557 SNIP 1.091
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.383 SNIP 1.036
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.45 SNIP 0.936
Assessing the Variability in Leachate Migration from an Old Municipal Landfill

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Water Resources Engineering, Department of Environmental Science and Engineering, Technical University of Denmark
Pages: 1519-1531
Publication date: 1993

Host publication information
Title of host publication: Proceedings of Sardinia 93: Fourth International Landfill Symposium
Place of publication: Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 314614
Research output: Research - peer-review › Article in proceedings – Annual report year: 1993

Attenuation of Organic Leachate Pollutants in Groundwater

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Water Resources Engineering, Department of Environmental Science and Engineering, Urban Water Engineering, Technical University of Denmark
Contributors: Christensen, T. H., Bjerg, P. L., Rügge, K., Albrechtsen, H., Heron, G., Pedersen, J., Foverskov, A., Skov, B., Würtz, S., Refstrup, M.
Pages: 1105-1116
Publication date: 1993

Host publication information
Title of host publication: Proceedings of Sardinia 93: Fourth International Landfill Symposium
Place of publication: Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 314616
Research output: Research - peer-review › Article in proceedings – Annual report year: 1993

Attenuation of Organic Pollutants in Redox Zones of Landfill Leachate Plumes

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Water Resources Engineering, Department of Environmental Science and Engineering, Urban Water Engineering
Contributors: Christensen, T. H., Bjerg, P. L., Lyngkilde, J., Albrechtsen, H., Heron, G., Rügge, K.
Number of pages: 1,685
Pages: 153-162
Publication date: 1993

Host publication information
Title of host publication: Contaminated Soil '93: Fourth International Kfk/Tno Conference on Contaminated Soil
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editors: Arendt, F., Annokkée, G., Bosman, R., van den Brink, W.
ISBN (Print): 0-7923-2326-2
Source: orbit
Source-ID: 314020
Research output: Research › Book chapter – Annual report year: 1993
Different Abilities of Eight Mixed Cultures of Methane-oxidizing Bacteria to Degrade TCE

The ability of eight mixed cultures of methane-oxidizing bacteria to degrade trichloroethylene (TCE) was examined in laboratory batch experiments. This is one of the first reported works studying TCE degradation by mixed cultures of methane-oxidizing bacteria at 10°C, a common temperature for soils and groundwaters. Only three of the eight mixed cultures were able to degrade TCE, or to degrade TCE fast enough to result in a significant removal of TCE within the experimental time, when the cultures used methane as growth substrate. The same three mixed cultures were able to degrade TCE when they oxidized methanol, but only for a limited time period of about 5 days. Several explanations for the discontinued degradation of TCE are given. An experiment carried out to re-activate the methane-oxidizing bacteria after 8 days of growth on methanol by adding methane did not immediately result in degradation of methane and TCE. During the first 10–15 days after the addition of methane a significant degradation of methane and a minor degradation of TCE were observed. This experiment revealed that the ability of mixed cultures of methane-oxidizing bacteria to degrade TCE varied significantly even though the cultures were grown under the same conditions.
Experimental Determination of Organic Vapour Fluxes from Coal Tar Polluted Soil

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, COWI AS
Contributors: Lindhardt, B., Andersen, L., Christensen, T. H.
Number of pages: 1,685
Pages: 247-254
Publication date: 1993

Host publication information
Title of host publication: Contaminated Soil '93 : Fourth International KfK/TNO Conference on Contaminated Soil
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editors: Arendt, F., Annokkée, G., Bosman, R., van den Brink, W.
ISBN (Print): 0-7923-2326-2
Source: orbit
Source-ID: 313953
Research output: Research › Book chapter – Annual report year: 1993

Experimentelle bestimmung von dampfflüssen organischer substanzen aus mit kohlenteer verunreinigten böden

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, COWI AS
Contributors: Lindhardt, B., Andersen, L., Christensen, T. H.
Number of pages: 1,018
Pages: 235-243
Publication date: 1993

Host publication information
Title of host publication: Altlastensanierung '93
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editor: Arendt, F.
ISBN (Print): 0-7923-2329-7
Source: orbit
Source-ID: 313960
Research output: Research › Book chapter – Annual report year: 1993
Fluxen af automatiske kulbrinter fra tjæreforurenede jord: Laboratorieforsøg

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, COWI AS
Contributors: Lindhardt, B., Christensen, T. H., Andersen, L.
Pages: 53-64
Publication date: 1993

Host publication information
Title of host publication: ATV Møde: Vurdering af inde- og udeklima på grunde forurenet med flygtige organiske kemikalier
Place of publication: Danmark
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 314741
Research output: Research - peer-review › Article in proceedings – Annual report year: 1993

Fluxen af o-xylen og naphthalen fra forurenede sandjord: Laboratorieforsøg

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Lindhardt, B., Christensen, T. H.
Pages: 11-26
Publication date: 1993

Host publication information
Title of host publication: ATV Møde: Vurdering af inde- og udeklima på grunde forurenet med flygtige organiske kemikalier
Place of publication: Danmark
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 314738
Research output: Research - peer-review › Article in proceedings – Annual report year: 1993

Grundvandets selvrensningsevne ved forurening fra lossepladser

General information
State: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering, Urban Water Engineering, Residual Resource Engineering
Contributors: Bjerg, P. L., Nielsen, P. H., Rügge, K., Heron, G., Albrechtsen, H., Christensen, T. H.
Publication date: 1993
Peer-reviewed: Yes

Publication information
Journal: GeologiskNyt
Volume: 3
Original language: Danish
Source: orbit
Source-ID: 314686
Research output: Research - peer-review › Journal article – Annual report year: 1993

In Situ Measurement of Organic Pollutant Degradation in a Leachate Plume

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Nielsen, P. H., Christensen, T. H.
Number of pages: 1,685
Pages: 531-538
Publication date: 1993
In-situ-messung des abbaus organischer schadstoffe in einer sickerwasser-fahne

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Nielsen, P. H., Christensen, T. H.
Number of pages: 1,018
Pages: 519-525
Publication date: 1993

Kationenwanderung/ausbreitung in grundwasser: Ein feldversuch

General information
State: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Residual Resource Engineering
Contributors: Bjerg, P. L., Christensen, T. H.
Number of pages: 1,018
Pages: 467-469
Publication date: 1993

Laboratory Measurements of Non-Steady-State diffusion of O-ylene and Naphthalene from a Sandy Soil

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Lindhardt, B., Christensen, T. H.
Publication date: 1993

Host publication information
Title of host publication: Contaminated Soil '93 : Fourth International Kfk/Tno Conference on Contaminated Soil
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editors: Arendt, F., Annokkée, G., Bosman, R., van den Brink, W.
ISBN (Print): 0-7923-2326-2
Source: orbit
Source-ID: 313964
Research output: Research › Book chapter – Annual report year: 1993

Host publication information
Title of host publication: Altlastensanierung '93
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editor: Arendt, F.
ISBN (Print): 0-7923-2329-7
Source: orbit
Source-ID: 313978
Research output: Research › Book chapter – Annual report year: 1993

Host publication information
Title of host publication: Altlastensanierung '93
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editor: Arendt, F.
ISBN (Print): 0-7923-2329-7
Source: orbit
Source-ID: 313998
Research output: Research › Book chapter – Annual report year: 1993

Host publication information
Löslichkeit von cadmium in verunreinigtem boden

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Andersen, B. B., Christensen, T. H., Holm, P. E.
Number of pages: 1,018
Pages: 489-491
Publication date: 1993

Host publication information
Title of host publication: Altlastensanierung ’93
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editor: Arendt, F.
ISBN (Print): 0-7923-2329-7
Source: orbit
Source-ID: 314008
Research output: Research › Book chapter – Annual report year: 1993

Microbial Activity and Degradation Processes in a Landfill Leachate Polluted Aquifer

General information
State: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering, Residual Resource Engineering
Contributors: Albrechtsen, H., Nielsen, P. H., Lyngkilde, J., Christensen, T. H.
Publication date: 1993

Host publication information
Title of host publication: Proceedings of International Symposium on Subsurface Microbiology
Place of publication: Bath
Source: orbit
Source-ID: 315772
Research output: Research › Conference abstract in proceedings – Annual report year: 1993

Mobilitet og tilgængelighed af cadmium og zink i jord

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering, Technical University of Denmark
Contributors: Holm, P. E., Christensen, T. H., Futtrup, J.
Pages: 97-105
Publication date: 1993

Host publication information
Title of host publication: ATV Møde : Forskningsprojekter vedrørende grundvandsforurening
Place of publication: Danmark
Publisher: Danmarks Tekniske Højskole
Source: orbit
Source-ID: 314894
Research output: Research › Article in proceedings – Annual report year: 1993

Model Simulations of a Field Experiment on Cation Exchange-affected Multicomponent Solute Transport in a Sandy Aquifer

A large-scale and long-term field experiment on cation exchange in a sandy aquifer has been modelled by a three-dimensional geochemical transport model. The geochemical model includes cation-exchange processes using a Gaines-
Thomas expression, the closed carbonate system and the effects of ionic strength. Information on geology, hydrogeology and the transient conservative solute transport behaviour was obtained from a dispersion study in the same aquifer. The geochemical input parameters were carefully examined. CEC and selectivity coefficients were determined on the actual aquifer material by batch experiments and by the composition of the cations on the exchange complex. Potassium showed a non-ideal exchange behaviour with K\&lt;sup\>+:Ca\relax\end{sup\} selectivity coefficients indicating dependency on equivalent fraction and K\+ concentration in the aqueous phase. The model simulations over a distance of 35 m and a period of 250 days described accurately the observed attenuation of Na and the expelled amounts of Ca and Mg. Also, model predictions of plateau zones, formed by interaction with the background groundwater, in general agreed satisfactorily with the observations. Transport of K was simulated over a period of 800 days due to a substantially attenuation in the aquifer. The observed and the predicted breakthrough curves showed a reasonable accordance taking the duration of the experiment into account. However, some discrepancies were observed probably caused by the revealed non-ideal exchange behaviour of K\+.

**General information**

State: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Residual Resource Engineering
Contributors: Bjerg, P. L., Ammentorp, H. C., Christensen, T. H.
Pages: 291-311
Publication date: 1993
Peer-reviewed: Yes

**Publication information**

Journal: Journal of Contaminant Hydrology
Volume: 12
Issue number: 4
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Principles of Landfill Barrier Systems

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, University of Cagliari, Hamburg University of Technology
Contributors: Christensen, T. H., Cossu, R., Stegmann, R.
Number of pages: 656
Pages: 3-10
Publication date: 1993

Host publication information
Title of host publication: Landfilling of Waste: Barriers
Place of publication: London
Publisher: E & FN Spon (Taylor & Francis)
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 317583
Research output: Research - book chapter – Annual report year: 1993

Redox Buffering Capacity of Aquifer Sediment
General information
State: Published
Organisations: Department of Environmental Science and Engineering, Department of Hydrodynamics and Water Resources, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Heron, G., Pedersen, J. K., Tjell, J. C., Christensen, T. H.
Number of pages: 1,685
Pages: 937-938
Publication date: 1993

Host publication information
Title of host publication: Contaminated Soil '93 : Fourth International Kfk/Tno Conference on Contaminated Soil
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editors: Arendt, F., Annokkée, G., Bosman, R., van den Brink, W.
ISBN (Print): 0-7923-2326-2
Source: orbit
Source-ID: 314000
Research output: Research › Book chapter – Annual report year: 1993

Solubility of Cadmium in Polluted Soil

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Andersen, B. B., Christensen, T. H., Holm, P. E.
Number of pages: 1,685
Pages: 503-504
Publication date: 1993

Host publication information
Title of host publication: Contaminated Soil '93 : Fourth International Kfk/Tno Conference on Contaminated Soil
Volume: 1
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editors: Arendt, F., Annokkée, G., Bosman, R., van den Brink, W.
ISBN (Print): 0-7923-2326-2
Source: orbit
Source-ID: 314005
Research output: Research › Book chapter – Annual report year: 1993

Substratwert von durch deponiesickerwasser verunreinigtem grundwasser für den mikrobiellen abbau unter verschiedenen redoxbedingungen

General information
State: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering, Risø National Laboratory for Sustainable Energy, Residual Resource Engineering
Contributors: Albrechtsen, H., Lyngkilde, J., Grøn, C., Christensen, T. H.
Number of pages: 1,018
Pages: 453-454
Publication date: 1993

Host publication information
Title of host publication: Altlastensanierung '93
Place of publication: The Netherlands
Publisher: Kluwer Academic Publishers
Editor: Arendt, F.
ISBN (Print): 0-7923-2329-7
Source: orbit
Source-ID: 313985
Research output: Research › Book chapter – Annual report year: 1993
The Degradation of Chlorinated Aliphatic Compounds in a Sanitary Landfill

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Urban Water Engineering, Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Christensen, T. H., Albrechtsen, H., Kromann, A., Ludvigsen, L., Skov, B.
Pages: 1087-1092
Publication date: 1993

Host publication information
Title of host publication: Proceedings of Sardinia 93 - Fourth International Landfill Symposium
Place of publication: Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source-ID: 314620
Research output: Research - peer-review › Article in proceedings – Annual report year: 1993

The Effect of Fertilizer Applications on the Bio-Availability of the CD and ZN

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Rothamsted Research, Technical University of Denmark
Contributors: Lorenz, S., Hamon, R., McGrath, S., Holm, P., Christensen, T. H.
Publication date: 1993

Host publication information
Title of host publication: Proceedings of 4th Conference on Current Research Developments in Soil and Related Sciences
Place of publication: London
Publisher: British Soil Science Society
Source-ID: 314671
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 1993

The Influence of Dissolved Humic Like Materials on the Solubility and Mobility of Heavy Metals

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Christensen, J. B., Jensen, D. L., Christensen, T. H., Holm, P. E.
Pages: 34-40
Publication date: 1993

Host publication information
Title of host publication: Proceedings of Meeting on Danish Soil Organic Matter Research at Research Centre Foulum
Place of publication: Tjele
Publisher: Danish Society of Soil Science & Research Centre Foulum
Source-ID: 315619
Research output: Research - peer-review › Article in proceedings – Annual report year: 1993

Verringerung von organischen schadstoffen in redoxzonen von deponiensickerwasserfahnen

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Water Resources Engineering, Department of Environmental Science and Engineering, Urban Water Engineering
Contributors: Christensen, T. H., Bjerg, P. L., Lyngkilde, J., Albrechtsen, H., Heron, G., Rügge, K.
Number of pages: 1,018
Pages: 147-158
A Field Method For Determination of Groundwater and Groundwater-sediment Associated Potentials for Degradation of Xenobiotic Organic Compounds

Determination of the degradation potentials for a mixture of eight organic trace contaminants (benzene, toluene, o-xylene, naphthalene, tetrachloromethane, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene) has been made by specially developed in situ microcosms under aerobic and anaerobic aquifer conditions. The developed in situ microcosms allowed for determination of the degradation potentials in the aquifer as represented by the combined groundwater and sediment and by the groundwater only. Six out of eight microcosms functioned hydraulically well as determined by means of a hydraulic tracer. Control experiments showed that the in situ microcosms were not subject to unaccounted losses of the contaminants except from sorption to sediment in the beginning of the experiments. All compounds were studied at initial concentrations of approximately 120 μg/l for a 90 days period. In all experiments the groundwater alone exhibited a degradation potential for the same compounds as those in the case of groundwater plus sediment. These results may have implications for the use of groundwater test systems as means for an evaluation of biodegradation potentials in aquifers.

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Nielsen, P. H., Christensen, T. H., Holm, P. E.
Pages: 449-462
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 25
Issue number: 4
ISSN (Print): 0045-6535
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.62 SJR 1.435 SNIP 1.448
Web of Science (2017): Impact factor 4.427
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.39 SJR 1.447 SNIP 1.625
Web of Science (2016): Impact factor 4.208
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.04 SJR 1.497 SNIP 1.567
Web of Science (2015): Impact factor 3.698
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.76 SJR 1.59 SNIP 1.639
Web of Science (2014): Impact factor 3.34
Web of Science (2014): Indexed yes
Attenuation of Leachate Pollutants in Groundwater

**General information**
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 441-483
Publication date: 1992
Correlation of Benzene, 1,1,1-Trichloroethane, and Naphthalene Distribution Coefficients to the Characteristics of Aquifer Materials With Low Organic Carbon Content

Laboratory batch experiments on benzene, 1,1,1-trichloroethane (TCA), and naphthalene (concentration: 100–1600 μg/l) sorption onto 20 aquifer materials of low organic carbon content (0.006–0.21 %) showed that the equilibrium distribution between solute and aquifer material could be expressed by the distribution coefficient, Kd, since the isotherms were linear: Kd(benzene): 0.05–0.65, Kd(TCA): 0.04–0.55, and Kd(naphthalene): 0.1–15.7 ml/g. Correlating observed Kd values to the organic carbon content of the aquifer materials explained only 52–65 % of the variance in Kd. Introducing the specific surface area of the aquifer materials as a second regression parameter did not significantly improve the correlation. Estimated Koc values were up to 3 times higher than those predicted from regression equations based on the octanol-water partition coefficient. The reason for this is not known, but may be attributed to unknown differences in organic matter composition or to the presence of other sorbing components in the aquifer materials. Fair correlations between Kd values for the studied compounds were observed for the individual aquifer materials.
Degradation of Specific Organic Compounds in Leachate-Polluted Groundwater

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering, University of Waterloo
Pages: 485-495
Publication date: 1992

Host publication information
Degradation of the herbicide mecoprop in an aerobic aquifer determined by laboratory batch studies
The potential of a shallow aerobic aquifer to degrade the herbicide Mecoprop (2-(2-methyl-4-chlorophenoxy)propionic acid) was evaluated in the laboratory using groundwater and sediment suspension batches. Mecoprop was added to the batches to obtain concentrations of 65, 140, 400 and 1400 μg/l. Mecoprop was degraded at 10°C at all concentration levels during the 200 days experimental period. Acclimation periods varied from 20 to 110 days. Initial degradation of approximately 50 % of the added Mecoprop was followed by a second lag period. In most batches, complete degradation was observed after the second lag period. The natural degradation potential for mecoprop varied among locations within a distance of few metres and was affected by different mecoprop concentrations. The observed stepwise degradation was supposedly due to different populations or different microbial mechanisms involved in the degradation of the two stereochemical forms of Mecoprop.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Heron, G., Christensen, T. H.
Pages: 547-557
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 24
Issue number: 5
ISSN (Print): 0045-6535
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.62 SJR 1.435 SNIP 1.448
Web of Science (2017): Impact factor 4.427
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.39 SJR 1.447 SNIP 1.625
Web of Science (2016): Impact factor 4.208
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.04 SJR 1.497 SNIP 1.567
Web of Science (2015): Impact factor 3.698
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.76 SJR 1.59 SNIP 1.639
Web of Science (2014): Impact factor 3.34
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.92 SJR 1.721 SNIP 1.751
Web of Science (2013): Impact factor 3.499
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Effects of Landfill Management Procedures on Landfill Stabilization and Leachate and Gas Quality

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Hamburg University of Technology
Contributors: Christensen, T. H., Kjeldsen, P., Stegmann, R.
Pages: 119-137
Publication date: 1992

Host publication information
Title of host publication: Landfilling of Waste: Leachate
Place of publication: London and New York
Publisher: Elsevier Applied Science Publishers
Fate of Landfill Leachate Pollutants in Groundwater: A Field Study of the Old Vejen Landfill (Denmark)

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Lyngkilde, J., Kjeldsen, P.
Publication date: 1992

Host publication information
Title of host publication: Proceedings of 6th International Congress on Solid Wastes
Place of publication: Spain
Source: orbit
Source-ID: 312873
Research output: Research › Article in proceedings – Annual report year: 1992

Fate of organic contaminants in the redox zones of a landfill leachate pollution plume (Vejen, Denmark)
Samples from 75 sample locations in a landfill leachate pollution plume reveal a significant disappearance of specific organic compounds (SOC's) within the first 100 m of the plume. Only the herbicide Mecoprop® (MCPP) migrates further. Since sorption and dilution cannot account for the decreasing concentrations, degradation is considered to be the governing process. Non-volatile organic carbon shows a corresponding fate probably acting as a substrate for the microbial processes. The first 20 m of the plume are methanogenic/sulfidogenic, judged on the chemistry of the groundwater, followed by a significant ferrogenic zone exhibiting a substantial capacity to degrade the SOC's. The presence of intermediary products (here an oxidized camphor compound) supports the concept of degradation within the ferrogenic zone. This investigation draws the attention to the significant natural attenuation of organic contaminants and to the so far neglected ferrogenic zone in controlling the fate of organic contaminants in leachate plumes.

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Residual Resource Engineering, Department of Environmental Engineering
Contributors: Lyngkilde, J., Christensen, T. H.
Pages: 291-307
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 10
Issue number: 4
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Groundwater Control Monitoring at Sanitary Landfills
Importance of Unattached Bacteria and Bacteria Attached to Sediment in Determining Potentials for Degradation of Xenobiotic Organic Contaminants in an Aerobic Aquifer

The bacterial abundance, distribution, and degradation potential (in terms of degradation versus lack of degradation) for four xenobiotic compounds in an aerobic aquifer sediment have been examined in laboratory and field experiments. The xenobiotic compounds studied were benzene, toluene, o-xylene, and naphthalene (all at concentrations of approximately 120 pg/liter). The aerobic degradation experiments ran for approximately 90 days at 10°C, which corresponded to the groundwater temperature. At the end of the experiment, the major part of the microbial biomass, quantified as acridine orange direct counts, was attached to the groundwater sediment (18 x 10^6 to 25 x 10^6 cells per g [dry weight]), and only a minor part was unattached in the groundwater (0.6 x 10^6 to 5.5 x 10^6 cells per ml). Experiments involving aquifer sediment suspensions showed identical degradation potentials in the laboratory and in the field. However, laboratory experiments involving only groundwater (excluding aquifer sediment) showed less degradation potential than in situ experiments involving only groundwater, indicating that the manipulation or approach of the laboratory experiments could affect the determination of the degradation potentials. No differences were observed between the groundwater-only and the sediment compartments in the in situ experiments in the ability to degrade the compounds, but the maximum degradation rates were substantially lower in the groundwater-only compartment. Preparations used in laboratory experiments for studying the degradation potential for xenobiotic organic contaminants should contain sediment to obtain the highest numbers of bacteria as well as the broadest and most stable degradation. When only the fine (silt- and clay-size) particles of the sediment were used, nearly the same advantages were gained without seriously complicating the sampling procedures by the occurrence of sand and gravel fractions.
Kære politikere...: Åben henvendelse vedrørende styrelsesloven

General information
State: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Residual Resource Engineering, Innovation and Sustainability, Department of Management Engineering, Technical University of Denmark
Contributors: Albrechtsen, H., Christensen, T. H., Godskesen, M. I., Hansen, G., Skov, B., Tjell, J. C.
Publication date: 1992
Peer-reviewed: Unknown

Publication information
Journal: Information
Issue number: 21.10
Original language: Danish
Source: orbit
Source-ID: 313840
Research output: Communication › Contribution to newspaper - Newspaper article – Annual report year: 1992

Landfill Leachate: An Introduction

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, University of Cagliari, Hamburg University of Technology
Contributors: Christensen, T. H., Cossu, R., Stegmann, R.
Pages: 3-14
Publication date: 1992

Host publication information
Title of host publication: Landfilling of Waste : Leachate
Place of publication: London and New York
Publisher: Elsevier Applied Science Publishers
Editors: Christensen, T. H., Cossu, R., Stegmann, R.
Source: orbit
Source-ID: 313214
Research output: Research › Book chapter – Annual report year: 1992

Landfill leachate effects on sorption of organic micropollutants onto aquifer materials
The effect of dissolved organic carbon as present in landfill leachate, on the sorption of organic micropollutants in aquifer materials was studied by laboratory batch and column experiments involving 15 non-polar organic chemicals, 5 landfill leachates and 4 aquifer materials of low organic carbon content. The experiments showed that hydrophobic organic micropollutants do partition into dissolved organic carbon found in landfill leachate potentially increasing their mobility. However, landfill leachate interacted with aquifer materials apparently increases the sorbent affinity for the hydrophobic micropollutants. The combination of these two mechanisms affected the observed distribution coefficients within a factor of two, in some cases increasing and in other cases decreasing the sorption of the chemicals. No means for prediction of the effect is currently available, but from a practical point of view, the effect of landfill leachate on retardation of organic micropollutants in aquifer material seems limited.

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Technical University of Denmark, United States Environmental Protection Agency
Contributors: Larsen, T., Christensen, T. H., Pfeffer, F. M., Enfield, C. G.
Pages: 307-324
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 9
Issue number: 4
ISSN (Print): 0169-7722
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.97 SJR 1.582 SNIP 1.663
Web of Science (2012): Impact factor 2.885
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.49 SJR 1.401 SNIP 1.566
Web of Science (2011): Impact factor 2.324
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.363 SNIP 1.194
Web of Science (2010): Impact factor 2.124
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.335 SNIP 1.4
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.442 SNIP 1.525
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.546 SNIP 1.361
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.428 SNIP 1.48
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.416 SNIP 1.309
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.386 SNIP 1.395
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.33 SNIP 1.465
Modelling TCE degradation by a mixed culture of methane-oxidizing bacteria

A model describing the growth of bacteria and the degradation of methane and trichloroethylene (TCE) based on the concept of competitive inhibition is proposed. The model has been applied to laboratory batch experiments representing different initial TCE concentrations (50–4300 μg/l) and initial methane concentrations (0.53–3.2 mg/l). The proposed model simulated successfully the data obtained for initial methane concentration (less than 1.8 mg/l), causing constant experimental growth conditions during the experiments. This indicates that the interactions between methane and TCE degradation can be explained as competitive inhibition. The model simulations of the results from the experiments with the highest initial methane concentration of 3.2 mg/l failed, supposedly because the growth conditions changed during the experiments. The proposed model is a useful engineering tool for design of treatment processes and in situ bioremediation schemes for degradation of TCE by methane-oxidizing bacteria.
Predicting nonequilibrium transport of naphthalene through aquifer materials using batch determined sorption parameters

Batch experiments with naphthalene sorption onto three aquifer materials with low organic carbon contents (≤ 0.025%) yielded kinetic parameters in accordance with the bicontinuum nonequilibrium model (Kd, F, k2). About half of the sorption was instantaneous while the complementary sorptive fraction developed over 20 to 200 hours depending on the aquifer material. The equilibrium distribution (Kd) was linear as assumed by both the equilibrium and the bicontinuum nonequilibrium solute transport model. The batch determined kinetic parameters were successfully employed in predicting the breakthrough curves for the laboratory columns exposed to constant influent concentration of naphthalene. For two of the aquifer materials showing very little retardation of naphthalene (Kd ≈ 0.15 ml/g) the equilibrium and the bicontinuum nonequilibrium model gave comparable results, while the nonequilibrium model, using batch determined parameters, was superior to the equilibrium model in the case of the aquifer material showing Kd values of the order of 1 ml/g and a flow velocity of 75 m/y.

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering, Technical University of Denmark, University of Arizona
Contributors: Larsen, T., Christensen, T. H., Brusseau, M.
Pages: 141-153
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 24
Issue number: 2
ISSN (Print): 0045-6535
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.62 SJR 1.435 SNIP 1.448
Web of Science (2017): Impact factor 4.427
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.39 SJR 1.447 SNIP 1.625
Redox zones of a landfill leachate pollution plume (Vejen, Denmark)
Downgradient from an old municipal landfill allowing leachate, rich in dissolved organic carbon, to enter a shallow sandy aerobic aquifer, a sequence of redoxe zones is identified from groundwater chemical analysis. Below the landfill, methanogenic conditions prevail, followed by sulfidogenic, ferrogenic, nitrate-reducing and aerobic environments over a distance of 370 m. This redox zone sequence is consistent with thermodynamical principles and is closely matched by the leachate plume determined by the chloride plume distribution. The redox zone sequence is believed to be key in controlling the fate of reactive pollutants leached from the landfill.
Spatial and temporal small-scale variation in groundwater quality of a shallow sandy aquifer

The groundwater quality of a shallow unconfined sandy aquifer has been characterized for pH, alkalinity, chloride, nitrate, sulfate, calcium, magnesium, sodium and potassium in terms of vertical and horizontal variations (350 groundwater samples). The test area is located within a farmland lot. The geology of the area described on the basis of 31 sediment cores appears relatively homogeneous. Large vertical and horizontal variations were observed. The vertical variations are...
strongly affected by the deviating composition of the agricultural infiltration water. The horizontal variations show very limited correlation ranges (less than 10m) and large variations are found over a few metres. The temporal variations observed over a period of 15 months were modest. The observed large variations should be taken into account when designing groundwater sampling and monitoring.
Spatial variability of hydraulic conductivity of an unconfined sandy aquifer determined by a mini slug test

The spatial variability of the hydraulic conductivity in a sandy aquifer has been determined by a mini slug test method. The hydraulic conductivity (K) of the aquifer has a geometric mean of $5.05 \times 10^{-4}$ m s$^{-1}$, and an overall variance of $\ln K$ equal to 0.37 which corresponds quite well to the results obtained by two large scale tracer experiments performed in the aquifer. A geological model of the aquifer based on 31 sediment cores, proposed three hydrogeological layers in the aquifer concurrent with the vertical variations observed with respect to hydraulic conductivity. The horizontal correlation length of the hydraulic conductivity has been determined for each of the three hydrogeological layers and is found to be small (1–2.5 m). The asymptotic longitudinal dispersivity of the aquifer has been estimated from the variance in hydraulic conductivity and the horizontal correlation length, to be in the range of 0.3–0.5 m compared with a value of 0.42 m obtained in one of the tracer tests performed.

General information
State: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Residual Resource Engineering, Geological Survey of Denmark
Contributors: Bjerg, P. L., Hinsby, K., Christensen, T. H., Gravesen, P.
Pages: 107-122
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Journal of Hydrology
Volume: 136
Issue number: 1-4
ISSN (Print): 0022-1694
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Sustainable Management of Cadmium in Danish Agriculture

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Tjell, J. C., Christensen, T. H.
Pages: 273-286
Publication date: 1992

Host publication information
Title of host publication: Trace Metals in the Environment 2: Impact of Heavy Metals on the Environment
Place of publication: Amsterdam
Publisher: Elsevier
Editor: Vernet, J.
Source: orbit
Source-ID: 313064
Research output: Research › Book chapter – Annual report year: 1992

The Use of Soil Solution Parameters to Predict Uptake of Cd and Zn by Radish

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Rothamsted Research
Contributors: Harmon, R., Lorenz, S., McGrath, S., Christensen, T. H., Holm, P. E.
Publication date: 1992
Peer-reviewed: No
Event: Abstract from International Conference European Science Foundation, Scheyern, Germany
Source: orbit
Source-ID: 312484
Research output: Research › Conference abstract for conference – Annual report year: 1992

Vejen injektionsfelt: Uorganisk stoftransport

General information
State: Published
Organisations: Department of Environmental Science and Engineering, Dansk Hydraulisk Institut, Technical University of Denmark
Contributors: Bjerg, P. L., Christensen, T. H., Ammentorp, H. C., Refstrup, M., Skov, B.
Number of pages: 121
Publication date: 1992

Publication information
Original language: Danish
(Lossepladsprojektet. Rapport; No. P4).
Electronic versions:
P4.pdf
Research output: Research › peer-review › Report – Annual report year: 1992

Leaching Tests to Evaluate Pollution Potential of Combustion Residues From an Iron Recycling Industry

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Kjeldsen, P., Christensen, T. H.
Pages: 277-292
Publication date: 1990
Sorption and Degradation of Chlorophenols, Nitrophenols and Organophorus Pesticides in the Subsoil Under Landfills: Laboratory Studies

General information
State: Published
Organisations: Department of Environmental Engineering, Danish Centre for Environment and Energy
Contributors: Kjeldsen, P., Kjølholt, J., Schultz, B., Christensen, T. H., Tjell, J. C.
Pages: 165-184
Publication date: 1990
Peer-reviewed: No

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 6
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.36 SJR 0.891 SNIP 1.003
Web of Science (2017): Impact factor 2.284
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.26 SJR 1.037 SNIP 1.077
Web of Science (2016): Impact factor 2.009
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.12 SJR 0.941 SNIP 1.073
Web of Science (2015): Impact factor 2.063
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.4 SJR 1.293 SNIP 1.516
Web of Science (2014): Impact factor 2.204
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.04 SJR 1.51 SNIP 1.457
Web of Science (2013): Impact factor 2.702
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
A method for determination of cadmium species in solid waste leachates

A procedure has been developed for determination of cadmium (Cd) species in solid waste leachates employing a cation exchange resin (Chelex 100) in a batch-column-batch sequence. The procedure allows for determination of free divalent Cd (Cd\(^{2+}\)), labile Cd complexes, slowly labile Cd complexes and stable Cd complexes. The effects of equilibration time, pH, calcium activity and ratio of sample volume to amount of resin have been examined. The method has been tested on standardized chloride and EDTA solutions containing Cd and on two actual leachates. The Cd species determined in the chloride solutions were in accordance with theoretical calculations of Cd chloride complexes, and Cd in the EDTA solution was identified as stable Cd complexes. The two polluted samples included in the test showed only a small percentage of free divalent Cd and a high degree of labile complexes.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Christensen, T. H., Xu Ze Lun
Pages: 73-80
Publication date: 1989
Cadmium complexation by solid waste leachates

A previously reported method for determination of Cd species in solid waste leachates has been applied to ten leachate samples representing five different types of solid waste: refuse compost, flyash from coal combustion, sewage sludge, refuse incineration residues and landfilled municipal waste. The leachates were spiked with Cd (<100 μg Cd 1−1) to obtain comparable concentrations in the investigated samples. For each sample, at two different Cd concentrations, free divalent Cd and complexed Cd were determined. Furthermore, the complexed fraction was operationally separated into labile complexes, slowly labile complexes and stable complexes. Leachates originating from the same type of solid waste showed different fractions of Cd, in particular with respect to free divalent Cd and stable Cd complexes. Only coal flyash showed almost identical fractions of Cd in the two leachates. The latter is due to the predominant hydroxy complex formation. In all leachates, the labile and slowly labile Cd complexes were predominant, accounting for a total of 69–100% of the leachate Cd concentrations. The fractions of free divalent Cd and stable Cd complexes varied highly.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Xu Ze Lun, Christensen, T. H.
Pages: 81-84
Publication date: 1989
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 23
Issue number: 1
ISSN (Print): 0043-1354
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
Cadmium soil sorption at low concentrations: VIII.: Correlation with soil parameters

General information
State: Published
Organisations: Residual Resource Engineering, Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 71-82
Publication date: 1989
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 44
Issue number: 1-2
ISSN (Print): 0049-6979
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.9
Web of Science (2017): Impact factor 1.769
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.77
Web of Science (2016): Impact factor 1.702
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.7
Web of Science (2015): Impact factor 1.551
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8
Web of Science (2014): Impact factor 1.554
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.8
Web of Science (2013): Impact factor 1.685
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.81
Web of Science (2012): Impact factor 1.748
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.72
A Review of Chemical Solute Transport Models

**General information**

State: Published  
Organisations: Department of Environmental Science and Engineering  
Contributors: Engesgaard, P. K., Christensen, T. H.  
Pages: 183-216  
Publication date: 1988  
Peer-reviewed: No

**Publication information**

Journal: Nordic Hydrology  
Volume: 19  
ISSN (Print): 0029-1277  
Ratings:  
BFI (2019): BFI-level 1  
Web of Science (2019): Indexed yes  
BFI (2018): BFI-level 1  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 1  
Scopus rating (2017): CiteScore 1.57 SJR 0.655 SNIP 0.62  
Web of Science (2017): Impact factor 1.801  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 1  
Scopus rating (2016): CiteScore 1.66 SJR 0.684 SNIP 0.716  
Web of Science (2016): Impact factor 1.754  
BFI (2015): BFI-level 1  
Scopus rating (2015): CiteScore 1.57 SJR 1.018 SNIP 0.811  
Web of Science (2015): Impact factor 1.779  
BFI (2014): BFI-level 1  
Scopus rating (2014): CiteScore 1.78 SJR 0.94 SNIP 1.036  
Web of Science (2014): Impact factor 1.555  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): CiteScore 1.91 SJR 1.205 SNIP 1.099  
Web of Science (2013): Impact factor 1.944  
ISI indexed (2013): ISI indexed yes
Distribution coefficients of Cd, Co, Ni, and Zn in soils

**General information**

State: Published
Organisations: Department of Environmental Engineering, Technical University of Denmark
Contributors: Anderson, P. R., Christensen, T. H.
Pages: 15-22
Publication date: 1988
Peer-reviewed: Yes

**Publication information**

Journal: European Journal of Soil Science
Volume: 39
Issue number: 1
ISSN (Print): 1351-0754
Ratings:

BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Sorption of specific organics in low concentrations on aquifer materials of low organic carbon content: Laboratory experiments

General information
State: Published
Organisations: Department of Environmental Engineering, Technical University of Denmark
Contributors: Larsen, T., Kjeldsen, P., Christensen, T. H., Skov, B. H., Refstrup, M.
Number of pages: 9
Sorption of specific organics on aquifer materials of low organic carbon content

General information
State: Published
Organisations: Department of Environmental Engineering, Technical University of Denmark
Contributors: Larsen, T., Kjeldsen, P., Christensen, T. H., Skov, B. H., Refstrup, M.
Pages: 1155-1157
Publication date: 1988

Host publication information
Title of host publication: Contaminated Soil '88
Publisher: Kluwer Academic Publishers
Editors: Wolf, K., van den Brink, W. J., Colon, F. J.
Research output: Research › Book chapter – Annual report year: 1988

Behaviour of leachate pollutants in groundwater

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Kjeldsen, P., Lyngkilde, J., Tjell, J. C.
Number of pages: 17
Publication date: 1987
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1987

Bly og grundvandsforurening

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Nielsen, B. G., Christensen, T. H.
Pages: 61-65
Publication date: 1987
Peer-reviewed: No

Publication information
Journal: Miljø og Teknologi
Volume: 2
Original language: Danish
Research output: Research › Journal article – Annual report year: 1987

Cadmium soil sorption at low concentrations: V. Evidence of competition by other heavy metals

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 293-303
Publication date: 1987
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 34
ISSN (Print): 0049-6979
Cadmium soil sorption at low concentrations: VI. A model for zinc competition

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 305-314
Retardation of lead in soils

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Nielsen, B. G.
Number of pages: 3
Publication date: 1987
Peer-reviewed: No
Research output: Research - peer-review → Journal article – Annual report year: 1987

Affald og jordforurening - Flere problemer dukker frem de kommende år

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H.
Pages: 9-10
Publication date: 31 May 1986
Peer-reviewed: No

Publication information
Journal: Jord
Issue number: 19/11
Original language: Danish
Research output: Research → Journal article – Annual report year: 1986

A proposal for an unsaturated zone oxygen transport and consumption model

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Refsgaard, J. C., Christensen, T. H., Ammentorp, H. C.
Kontrollerede lossepladser - et påtrængende problem uden lette løsninger

**General information**
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H.
Pages: 2-7
Publication date: 1986
Peer-reviewed: No

Publication information
Journal: Vand og Miljø
Volume: 1
Issue number: s
Original language: Danish
Research output: Research › Journal article – Annual report year: 1986

Solute transport and chemical processes: The present state of the unsaturated zone component of the she modelling system

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Ammentorp, H. C., Jensen, K. H., Christensen, T. H., Refsgaard, J. C.
Number of pages: 12
Publication date: 1986
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1986

Udvaskningstest af industriaffald: Eksempel: Kupolovnsslam

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Kjeldsen, P., Christensen, T. H.
Pages: 14-20
Publication date: 1986
Peer-reviewed: No

Publication information
Journal: Miljø og Teknologi
Volume: 1
Original language: Danish
Research output: Research › Journal article – Annual report year: 1986

Cadmium soil sorption at low concentrations: III. Prediction and observation of mobility

**General information**
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 255-264
Publication date: 1985
Peer-reviewed: Yes
Cadmium soil sorption at low concentrations: IV. Effect of waste leachates on distribution coefficients
Evidence of increasing cadmium contents of agricultural soils

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Tjell, J. C., Christensen, T. H.
Number of pages: 3
Publication date: 1985
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1985

Heavy metal competition for soil sorption sites at low concentrations

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Number of pages: 3
Publication date: 1985
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1985

Pilotossepladsundersøgelserne

General information
State: Published
Organisations: Department of Environmental Engineering, Department of Geology and Geotechnical Engineering
Contributors: Christensen, T. H., Jensen, K. H., Villumsen, A.
Number of pages: 26
Publication date: 1985
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1985

Ionbytningsmodeller: En beskrivelse af ionbytningsprocesser i jord og reservoirmaterialer med henblik på indbygning og anvendelse i geohydrologiske stoftransportmodeller

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H.
Number of pages: 30
Publication date: Jan 1984

Publication information
Publisher: Laboratoriet for Teknisk Hygiejne, DTH
Original language: Danish

Bibliographical note
Rapport til Dansk Hydraulisk Institut (DHI)
Research output: Research › Report – Annual report year: 1984

A rationale for selecting chemical parameters for control monitoring of the ground water quality at sanitary landfills

General information
State: Published
Cadmium soil sorption at low concentrations: I. Effect of time, cadmium load, pH, and calcium

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 105-114
Publication date: 1984
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 21
ISSN (Print): 0049-6979
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.9
Web of Science (2017): Impact factor 1.769
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.77
Web of Science (2016): Impact factor 1.702
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.7
Web of Science (2015): Impact factor 1.551
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8
Web of Science (2014): Impact factor 1.554
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.8
Web of Science (2013): Impact factor 1.685
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.81
Web of Science (2012): Impact factor 1.748
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.72
Web of Science (2011): Impact factor 1.625
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Cadmium soil sorption at low concentrations: II. Reversibility, effect of changes in solute composition, and effect of soil aging

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 115-125
Publication date: 1984
Peer-reviewed: Yes

Publication information
Journal: Water, Air and Soil Pollution
Volume: 21
ISSN (Print): 0049-6979
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.9
Web of Science (2017): Impact factor 1.769
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.77
Web of Science (2016): Impact factor 1.702
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.7
Web of Science (2015): Impact factor 1.551
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8
Web of Science (2014): Impact factor 1.554
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.8
Web of Science (2013): Impact factor 1.685
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.81
Kontrol af grundvandet ved lossepladser

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kjeldsen, P., Christensen, T. H.
Pages: 21-27
Publication date: 1984
Peer-reviewed: No

Publication information
Journal: Vand og Miljø
Volume: 4
Original language: Danish
Research output: Research - peer-review > Journal article – Annual report year: 1984

Leaching from land disposed municipal composts: 3. Inorganic ions

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 63-74
Publication date: 1984
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 2
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
Leaching from land disposed municipal composts: 4. Heavy metals

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Tjell, J. C.
Pages: 347-357
Publication date: 1984
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 2
ISSN (Print): 0734-242X
Ratings:
- BFI (2019): BFI-level 1
- Web of Science (2019): Indexed yes
- BFI (2018): BFI-level 1
- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 1
- Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
- Web of Science (2017): Impact factor 1.631
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 1
- Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
- Web of Science (2016): Impact factor 1.803
- BFI (2015): BFI-level 1
- Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
- Web of Science (2015): Impact factor 1.338
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 1
- Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
- Web of Science (2014): Impact factor 1.297
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
- Web of Science (2013): Impact factor 1.114
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
- Web of Science (2012): Impact factor 1.047
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
- Web of Science (2011): Impact factor 1.193
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
Principles of sanitary landfilling

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Number of pages: 13
Publication date: 1984
Peer-reviewed: No

Selection of parameters for groundwater quality monitoring at waste incinerator residue disposal sites

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Kjeldsen, P., Christensen, T. H., Hjelmar, O.
Pages: 333-344
Publication date: 1984
Peer-reviewed: Yes

Publication information
Journal: Environmental Technology Letters
Volume: 5
ISSN (Print): 0143-2060
Original language: English
Research output: Research - peer-review > Journal article – Annual report year: 1984
Soil attenuation of acid phase landfill leachate

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Kjeldsen, P., Christensen, T. H.
Pages: 247-263
Publication date: 1984
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 2
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Cadmium in Soil and Terrestrial Biota, with Emphasis on the Danish Situation

General information
State: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Tjell, J. C., Christensen, T. H., Bro-Rasmussen, F.
Pages: 122-140
Publication date: 1983
Peer-reviewed: Yes

Publication information
Journal: Ecotoxicology and Environmental Safety
Volume: 7
Issue number: 1
ISSN (Print): 0147-6513
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.24 SJR 1.201 SNIP 1.449
Web of Science (2017): Impact factor 3.974
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.99 SJR 1.225 SNIP 1.486
Web of Science (2016): Impact factor 3.743
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.46 SJR 1.197 SNIP 1.402
Interpretation of experimental results on cadmium crop uptake from sewage sludge amended soil

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Tjell, J. C.
Number of pages: 10
Publication date: 1983
Peer-reviewed: No
Research output: Research » Paper – Annual report year: 1983
Leaching from land disposed municipal composts: 1. Nitrogen

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 115-125
Publication date: 1983
Peer-reviewed: Yes

Publication information
Journal: Waste Management and Research
Volume: 1
ISSN (Print): 0734-242X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.78 SJR 0.519 SNIP 0.92
Web of Science (2017): Impact factor 1.631
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.76 SJR 0.673 SNIP 1.091
Web of Science (2016): Impact factor 1.803
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.53 SJR 0.623 SNIP 0.893
Web of Science (2015): Impact factor 1.338
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.28 SJR 0.733 SNIP 1.097
Web of Science (2014): Impact factor 1.297
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
Leaching from land disposed municipal composts: 1. Organic matter

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Nielsen, C. W.
Pages: 83-94
Publication date: 1983
Peer-reviewed: Yes
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.17 SJR 0.58 SNIP 0.925
Web of Science (2013): Impact factor 1.114
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.4 SJR 0.874 SNIP 1.053
Web of Science (2012): Impact factor 1.047
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.33 SJR 1.028 SNIP 0.858
Web of Science (2011): Impact factor 1.193
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.662 SNIP 0.957
Web of Science (2010): Impact factor 1.222
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.869 SNIP 1.251
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.537 SNIP 0.967
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.359 SNIP 0.697
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.317 SNIP 0.759
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.501 SNIP 0.72
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.478 SNIP 0.828
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.613 SNIP 0.822
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.44 SNIP 0.675
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.678 SNIP 1.163
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.517 SNIP 0.897
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.56 SNIP 0.817
Original language: English
Research output: Research - peer-review › Journal article – Annual report year: 1983

Leaching of pollutants from landdisposed municipal compost

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Number of pages: 20
Publication date: 1983
Peer-reviewed: No
**Parameters controlling the distribution of Cd, Co, Ni and Zn in soils**

**General information**
- State: Published
- Organisations: Department of Environmental Engineering, Technical University of Denmark
- Contributors: Anderson, P. R., Christensen, T. H.
- Number of pages: 5
- Publication date: 1983
- Research output: Research › Paper – Annual report year: 1983

**Comparison of Four Methods for Digestion of Sewage Sludge Samples for Analysis of Metals by Atomic Absorption Spectrophotometry**

**General information**
- State: Published
- Organisations: Department of Environmental Engineering, Technical University of Denmark
- Contributors: Christensen, T. H., Pedersen, L. R., Tjell, J. C.
- Pages: 41-50
- Publication date: 1982
- Peer-reviewed: Yes

**Publication information**
- Journal: International Journal of Environmental Analytical Chemistry
- Volume: 12
- ISSN (Print): 0306-7319
- Ratings:
  - BFI (2019): BFI-level 1
  - Web of Science (2019): Indexed yes
  - BFI (2018): BFI-level 1
  - Web of Science (2018): Indexed yes
  - BFI (2017): BFI-level 1
  - Scopus rating (2017): CiteScore 1.32 SJR 0.361 SNIP 0.489
  - Web of Science (2017): Impact factor 1.372
  - Web of Science (2017): Indexed yes
  - BFI (2016): BFI-level 1
  - Scopus rating (2016): CiteScore 1.28 SJR 0.368 SNIP 0.514
  - Web of Science (2016): Impact factor 1.208
  - BFI (2015): BFI-level 1
  - Scopus rating (2015): CiteScore 1.27 SJR 0.422 SNIP 0.539
  - Web of Science (2015): Impact factor 1.411
  - BFI (2014): BFI-level 1
  - Scopus rating (2014): CiteScore 1.17 SJR 0.435 SNIP 0.576
  - Web of Science (2014): Impact factor 1.295
  - BFI (2013): BFI-level 1
  - Scopus rating (2013): CiteScore 1.35 SJR 0.403 SNIP 0.557
  - Web of Science (2013): Impact factor 1.321
  - ISI indexed (2013): ISI indexed yes
  - Web of Science (2013): Indexed yes
  - BFI (2012): BFI-level 1
  - Scopus rating (2012): CiteScore 1.37 SJR 0.564 SNIP 0.688
  - Web of Science (2012): Impact factor 1.24
  - ISI indexed (2012): ISI indexed yes
  - BFI (2011): BFI-level 1
Comparison of Methods for Preparation of Municipal Compost for Analysis of Metals by Atomic Absorption Spectrophotometry

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 211-221
Publication date: 1982
Peer-reviewed: Yes

Publication information
Journal: International Journal of Environmental Analytical Chemistry
Volume: 12
ISSN (Print): 0306-7319
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.32 SJR 0.361 SNIP 0.489
Web of Science (2017): Impact factor 1.372
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.28 SJR 0.368 SNIP 0.514
Web of Science (2016): Impact factor 1.208
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.27 SJR 0.422 SNIP 0.539
Web of Science (2015): Impact factor 1.411
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.17 SJR 0.435 SNIP 0.576
Web of Science (2014): Impact factor 1.295
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.35 SJR 0.403 SNIP 0.557
Web of Science (2013): Impact factor 1.321
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.37 SJR 0.564 SNIP 0.688
Web of Science (2012): Impact factor 1.24
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.3 SJR 0.551 SNIP 0.539
Web of Science (2011): Impact factor 1.162
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.525 SNIP 0.388
Web of Science (2010): Impact factor 1.169
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.596 SNIP 0.632
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.414 SNIP 0.471
Scopus rating (2007): SJR 0.443 SNIP 0.504
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.433 SNIP 0.45
Scopus rating (2005): SJR 0.374 SNIP 0.491
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.42 SNIP 0.526
Scopus rating (2003): SJR 0.35 SNIP 0.439
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.445 SNIP 0.475
Scopus rating (2001): SJR 0.478 SNIP 0.477
Scopus rating (2000): SJR 0.875 SNIP 0.474
Scopus rating (1999): SJR 0.747 SNIP 0.684
Original language: English
Research output: Research - peer-review › Journal article – Annual report year: 1982

Forureningkomponenters bevægelse i grundvand ved lossepladser

General information
State: Published
Organisations: Department of Environmental Engineering, Technical University of Denmark
Contributors: Christensen, T. H., Hansen, P. B., Kjeldsen, P.
Pages: 67-82
Publication date: 1982
Peer-reviewed: No

Publication information
Journal: Avfall
Volume: 8
Issue number: 1
Original language: Danish
Research output: Research › Journal article – Annual report year: 1982

Måleparametre til grundvandskontrol ved kontrollerede lossepladser: Eksperimentelle undersøgelser
A model for low-range cadmium migration in soils: Principles and verification

Ground water protection and use of the land in waste treatment and disposal

Prediction of cadmium concentrations in Danish soils

Fast Affald: En introduktion til litteratur vedrørende fast affald

Fast Affald: En introduktion til litteratur vedrørende fast affald
Sorption of cadmium onto two mineral soils

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H., Carlson, D. A.
Number of pages: 9
Publication date: 1978
Peer-reviewed: No
Research output: Research › Paper – Annual report year: 1978

Terrestrisk spildevandsbehandling

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Christensen, T. H.
Pages: 31-36
Publication date: 1978
Peer-reviewed: No

Publication information
Journal: Stads og havneingeniøren
Issue number: 2
ISSN (Print): 0038-8947
Original language: Danish
Research output: Research › Journal article – Annual report year: 1978

En vurdering af fast affald som kilde til vandforurening

General information
State: Published
Organisations: Department of Environmental Engineering
Contributors: Andersen, L., Christensen, T. H.
Number of pages: 12
Publication date: 1977
Peer-reviewed: No
Event: Paper presented at Nodiska symposiet om vattenforskning, Helsingfors, Finland.

Bibliographical note
Diffuse vannforurensninger
Research output: Research › Paper – Annual report year: 1977

Projects:

Miljøvurdering af indsamling, genanvendelse og bortskaffelse af tøj, og tekstilaffald
Nørup, N., PhD Student, Department of Environmental Engineering
Scheutz, C., Main Supervisor
Damgaard, A., Supervisor
Pihl, K. A., Supervisor
Christensen, T. H., Examiner
Laitala, K., Examiner
Laner, D., Examiner
Industrial PhD
15/01/2015 → 17/02/2019
Award relations: Miljøvurdering af indsamling, genanvendelse og bortskaffelse af tøj, og tekstilaffald
**Miljøoptimering af affaldsforbrændingsanlæg**  
Riber, C., PhD Student, Department of Environmental Engineering  
Christensen, T. H., Main Supervisor  
Kjeldsen, P., Examiner  
Bilitewski, B., Examiner  
Lundtorp, K., Examiner  
Offentlig finansiering  
01/02/2004 → 21/12/2007  
Award relations: Miljøoptimering af affaldsforbrændingsanlæg  
Project: PhD

**Bæredygtig udnyttelse af Grønlands affald**  
Eisted, R., PhD Student, Department of Environmental Engineering  
Christensen, T. H., Main Supervisor  
Kjeldsen, P., Examiner  
Kirkeby, J. S., Examiner  
Persson, K. M., Examiner  
Kahlig, W., Supervisor  
Offentlig finansiering  
01/02/2008 → 22/06/2011  
Award relations: Bæredygtig udnyttelse af Grønlands affald  
Project: PhD

**Miljøvurdering af organisk husholdningsaffald**  
Hansen, T. L., PhD Student, Department of Environmental Engineering  
Christensen, T. H., Main Supervisor  
Angelidaki, I., Supervisor  
Kjeldsen, P., Examiner  
Stentiford, E. I., Examiner  
Magid, J., Examiner  
DTU-lønnet stipendie  
01/01/2002 → 14/11/2005  
Award relations: Miljøvurdering af organisk husholdningsaffald  
Project: PhD

**Miljøvurdering af restprodukters genanvendelse**  
Birgisdottir, H., PhD Student, Department of Environmental Engineering  
Christensen, T. H., Main Supervisor  
Hauschild, M. Z., Supervisor  
Kjeldsen, P., Examiner  
Finnveden, G., Examiner  
Gardner, K. H., Examiner  
DTU-lønnet stipendie  
01/09/2001 → 23/12/2005  
Award relations: Miljøvurdering af restprodukters genanvendelse  
Project: PhD

**Modeller til miljøvurdering af affaldssystemer**  
Kirkeby, J. S., PhD Student, Department of Environmental Engineering  
Christensen, T. H., Main Supervisor  
Hauschild, M. Z., Supervisor  
Mikkelsen, P. S., Examiner  
Bilitewski, B., Examiner  
Nielsen, P. H., Examiner  
DTU-lønnet stipendie  
01/02/2001 → 18/05/2005  
Award relations: Modeller til miljøvurdering af affaldssystemer  
Project: PhD
Kemisk stabilisering af røggasrensningsprodukter
Astrup, T. F., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Hjelmar, O., Supervisor
Kjeldsen, P., Examiner
Johnson, C. A., Examiner
Stipp, S., Examiner
Forskningsrådsfinansiering
01/01/2000 → 14/05/2004
Award relations: Kemisk stabilisering af røggasrensningsprodukter
Project: PhD

Udluftning af flygtige forureningsstoffer i heterogen umættet jord
Høier, C. K., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Jensen, K. H., Supervisor
Sonnenborg, T. O., Supervisor
Brun, A., Examiner
Illangasekare, T. H., Examiner
Larsen, F., Examiner
DTU-lønnet stipendie
01/09/1998 → 31/03/2006
Award relations: Udluftning af flygtige forureningsstoffer i heterogen umættet jord
Project: PhD

Stabilisering af restprodukter fra affaldsforbrænding
Lundtorp, K., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Jensen, D. L., Supervisor
Mogensen, E., Supervisor
Kjeldsen, P., Examiner
Hjelmar, O., Examiner
Johnson, C. A., Examiner
Erhvervsforskerordningen
01/10/1997 → 12/12/2001
Award relations: Stabilisering af restprodukter fra affaldsforbrænding
Project: PhD

Behandling af restprodukter fra affaldsforbrænding med henblik på genanvendelse og/eller bæredygtig depoerening
Sørensen, M. A., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Postma, D. J., Examiner
Hansen, H. C. B., Examiner
Johnson, C. A., Examiner
Bender Koch, C., Supervisor
DTU-Su Stipendium, Eksperiment
01/09/1997 → 26/09/2001
Award relations: Behandling af restprodukter fra affaldsforbrænding med henblik på genanvendelse og/eller bæredygtig depoerening
Project: PhD

Tungmetalkompleksers betydning i miljøet
Hansen, J. B., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Bjerg, P. L., Examiner
Hansen, H. C. B., Examiner
DTU-Su Stipendium, Eksperiment
01/02/1994 → 17/12/1999
Award relations: Tungmetalkompleksers betydning i miljøet
Project: PhD
Deterministisk-stokastisk modellering af transport og omsætning af organisk stof i grundvand
Brun, A., PhD Student, Department of Environmental Engineering
Rosbjerg, D., Main Supervisor
Christensen, T. H., Supervisor
Engesgaard, P. K., Supervisor
Særige grundforskningsfond
01/01/1992 → 12/09/1996
Award relations: Deterministisk-stokastisk modellering af transport og omsætning af organisk stof i grundvand
Project: PhD

Speciering af tungmetaller i affaldsstoffer i relation til deres mobilitet i miljøet
Holm, P. E., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
DTU-stipendium
01/02/1991 → 15/12/1995
Award relations: Speciering af tungmetaller i affaldsstoffer i relation til deres mobilitet i miljøet
Project: PhD

Frigivelse og transport af flygtige tjærekomponenter i jord
Lindhardt, B., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Gammel ordning u/skema-SU
01/10/1990 → 03/11/1994
Award relations: Frigivelse og transport af flygtige tjærekomponenter i jord
Project: PhD

Integration of Environmental Life Cycle Information Into Cad-Systems for Support of Design for Environment
Bhander, G. S., PhD Student, Department of Management Engineering
Hauschild, M. Z., Main Supervisor
Christensen, T. H., Supervisor
Mikkelsen, P. S., Examiner
Finnveden, G., Examiner
Nielsen, P. H., Examiner
Friplads
01/12/2001 → 31/03/2006
Award relations: Integration of Environmental Life Cycle Information Into Cad-Systems for Support of Design for Environment
Project: PhD

Prediction of Leaching from Waste Incineration Residues
Hyks, J., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Astrup, T. F., Supervisor
Jakobsen, R., Examiner
Jensen, D. L., Examiner
Johnson, C. A., Examiner
Eksternt finansieret virksomhed
01/10/2004 → 01/09/2008
Award relations: Prediction of Leaching from Waste Incineration Residues
Project: PhD

Udnyttelse af procesvandkoncentrater og andre restfraktioner
Villanueva, A., PhD Student, Department of Management Engineering
Wenzel, H., Main Supervisor
Nielsen, P. H., Supervisor
Andreasen, P., Examiner
Christensen, T. H., Examiner
Jepsen, S., Examiner
Centerfinansieret
15/11/1999 → 19/10/2004
Award relations: Udnyttelse af procesvandkoncentrater og andre restfraktioner
Project: PhD
Redoxdynamik i affald-jord-vand-systemer
Heron, G., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
DTU-stipendium
01/08/1991 → 16/01/1995
Award relations: Redoxdynamik i affald-jord-vand-systemer
Project: PhD

Nedbrydning af naturfreddede stoffer i forskellige redoxzoner omkring lossepladser
Nielsen, P. H., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Olhoff, N., Examiner
Gammel ordning u/skema-SU
01/10/1990 → 16/01/1995
Award relations: Nedbrydning af naturfreddede stoffer i forskellige redoxzoner omkring lossepladser
Project: PhD

Effects of redox conditions on pesticide degradation in groundwater
Pedersen, P. G., PhD Student, Department of Environmental Engineering
Mosbæk, H., Main Supervisor
Albrechtsen, H., Supervisor
Christensen, T. H., Examiner
Samarbejdsaftale-Finan-SU
01/03/1997 → 30/03/2001
Award relations: Effects of redox conditions on pesticide degradation in groundwater
Project: PhD

Mikrobiel aktivitet i lossepladsforurenet grundvand.
Ludvigsen, L., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Albrechtsen, H., Supervisor
Center-Finansieret-SU
01/10/1993 → 21/10/1997
Award relations: Mikrobiel aktivitet i lossepladsforurenet grundvand.
Project: PhD

Tungmetallers binding i affaldsdeponier
Jensen, D. L., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Bjerg, P. L., Examiner
Hansen, H. C. B., Examiner
DTU-Su Stipendium, Eksperiment
01/08/1994 → 04/09/1998
Award relations: Tungmetallers binding i affaldsdeponier
Project: PhD

Waste Management Strategies of the Future: A Consistent European and National Technology Platform
Gentil, E., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Hauschild, M. Z., Supervisor
Astrup, T., Examiner
Fischer, C., Examiner
Wilson, D. C., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/10/2006 → 02/03/2011
Award relations: Waste Management Strategies of the Future: A Consistent European and National Technology Platform
Project: PhD
Mobilization of Nickel in Aquifers in response to Afforestation
Kjøller, C., PhD Student, Department of Environmental Engineering
Postma, D. J., Main Supervisor
Christensen, T. H., Examiner
Hansen, H. C. B., Examiner
Kinniburgh, D. G., Examiner
DTU-Su Stipendium, Eksperiment
01/10/1997 → 30/11/2001
Award relations: Mobilization of Nickel in Aquifers in response to Afforestation
Project: PhD

Reduktion af gasemission fra lossepladser i reaktive barrierer
Scheutz, C., PhD Student, Department of Environmental Engineering
Kjeldsen, P., Main Supervisor
Christensen, T. H., Examiner
Höhener, P., Examiner
Stegmann, R., Examiner
DTU-lønnet stipendie
01/08/1998 → 10/01/2003
Award relations: Reduktion af gasemission fra lossepladser i reaktive barrierer
Project: PhD

Gas Generation and Emissions from Decomposition of Organic Wastes at Full-Scale Waste Treatment Facilities
Andersen, J. K., PhD Student, Department of Environmental Engineering
Scheutz, C., Main Supervisor
Christensen, T. H., Supervisor
Kjeldsen, P., Examiner
Jönsson, H., Examiner
Kranert, M., Examiner
DTU-lønnet stipendie
01/09/2007 → 21/12/2010
Award relations: Gas Generation and Emissions from Decomposition of Organic Wastes at Full-Scale Waste Treatment Facilities
Project: PhD

Waste Disposa - Getting the "End of Life" right in Life-Cycle-Assessment Modeling of Waste Management Systems
Manfredi, S., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Kjeldsen, P., Examiner
Kirkby, J. S., Examiner
Lagerkvist, A., Examiner
DTU-lønnet stipendie
01/08/2006 → 01/07/2009
Award relations: Waste Disposa - Getting the "End of Life" right in Life-Cycle-Assessment Modeling of Waste Management Systems
Project: PhD

Fremtidens integrerede indsamlilng af affald
Larsen, A. W., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Scheutz, C., Examiner
Bilitewski, B., Examiner
Björklund, A., Examiner
DTU-lønnet stipendie
01/01/2006 → 11/11/2009
Award relations: Fremtidens integrerede indsamlilng af affald
Project: PhD

Defining Quality Indicators in Waste Management
Merrild, H. K., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Scheutz, C., Examiner

DTU-lønnet stipendie
01/02/2005 → 01/07/2009
Award relations: Defining Quality Indicators in Waste Management
Project: PhD

Reduction of Methane Emissions from Landfills by Use of Engineered Biocovers
Pedersen, G. B., PhD Student, Department of Environmental Engineering
Kjeldsen, P., Main Supervisor
Schuetz, C., Supervisor
Christensen, T. H., Examiner
Gebert, J., Examiner
Rintala, J. A., Examiner
DTU-lønnet stipendie
01/09/2004 → 25/08/2010
Award relations: Reduction of Methane Emissions from Landfills by Use of Engineered Biocovers
Project: PhD

PhD Project 12 - Life cycle assessment of special and hazardous waste types and fractions
Bigum, M. K. K., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Schuetz, C., Supervisor
Kjeldsen, P., Examiner
Olsen, S. I., Examiner
Salhofer, S., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/06/2009 → 26/01/2015
Award relations: PhD Project 12 - Life cycle assessment of special and hazardous waste types and fractions
Project: PhD

Resource and environmental assessment of recycling of construction and demolition waste (C&D waste)
Butera, S., PhD Student, Department of Environmental Engineering
Astrup, T. F., Main Supervisor
Christensen, T. H., Supervisor
Kjeldsen, P., Examiner
Birgisdottir, H., Examiner
Polettini, A., Examiner
Technical University of Denmark
01/09/2010 → 01/04/2015
Award relations: Resource and environmental assessment of recycling of construction and demolition waste (C&D waste)
Project: PhD

LCA model for sewage sludge - an EASEWASTE extension
Yoshida, H., PhD Student, Department of Environmental Engineering
Schuetz, C., Main Supervisor
Christensen, T. H., Supervisor
Damgaard, A., Examiner
Jönsson, H., Examiner
Future Scenario Analysis in Solid Waste Management
Bisinella, V., PhD Student, Department of Environmental Engineering
Astrup, T. F., Main Supervisor
Christensen, T. H., Supervisor
Boldrin, A., Examiner
Guyonnet, D., Examiner
Brandão, M. M. R., Examiner
Technical University of Denmark
01/07/2013 → 05/12/2017
Award relations: Future Scenario Analysis in Solid Waste Management
Project: PhD

Life cycle assessment of waste management: Assessing technical externalities
Brogaard, L. K., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Scheutz, C., Examiner
Eriksson, O. N., Examiner
Olsen, S. I., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/09/2009 → 18/09/2013
Award relations: Life cycle assessment of waste management: Assessing technical externalities
Project: PhD

Flexible model structure for waste-LCA modelling - The next generation of the EASEWASTE model
Clavreul, J., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Baumeister, H., Supervisor
Astrup, T., Examiner
Eriksson, O. N., Examiner
Kirkeby, J. S., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/01/2010 → 18/09/2013
Award relations: Flexible model structure for waste-LCA modelling - The next generation of the EASEWASTE model
Project: PhD

Implementation of LCA-models in Waste Management
Damgaard, A., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Kjeldsen, P., Examiner
Grosso, M., Examiner
Kirkeby, J. S., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/03/2006 → 23/06/2010
Award relations: Implementation of LCA-models in Waste Management
Project: PhD

Environmental Assessment of the Management of Garden and Yard Waste
Boldrin, A., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Angelidaki, I., Examiner
Kranert, M., Examiner
Jensen, L. S., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/03/2006 → 23/09/2009
Award relations: Environmental Assessment of the Management of Garden and Yard Waste
Project: PhD
Environmentally Sustainable Utilization of Waste Resources for Energy Production
Frueergaard, T., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Scheutz, C., Examiner
Olsen, S. I., Examiner
Tillman, A., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/08/2006 → 21/04/2010
Award relations: Environmentally Sustainable Utilization of Waste Resources for Energy Production
Project: PhD

Reduction of Greenhouse Gas Emissions from Landfills by use of Engineered Biocovers: Full Scale Studies
Fredenslund, A. M., PhD Student, Department of Environmental Engineering
Kjeldsen, P., Main Supervisor
Scheutz, C., Supervisor
Christensen, T. H., Examiner
Börjesson, G., Examiner
Poulsen, T., Examiner
DTU, Samfinansiering
01/01/2006 → 26/05/2010
Award relations: Reduction of Greenhouse Gas Emissions from Landfills by use of Engineered Biocovers: Full Scale Studies
Project: PhD

Nedbrydning af organiske stoffer i lossepladser og grundvand.
Rügge, K., PhD Student, Department of Environmental Engineering
Christensen, T. H., Main Supervisor
Gammel Ordnin - Blandet Finan
01/08/1992 → 09/09/1997
Award relations: Nedbrydning af organiske stoffer i lossepladser og grundvand.
Project: PhD

1167: LCA af gipsaffald
"LCA af gipsaffald" er et samarbejdssprojekt med Miljøstyrelsen, som skal danne grundlag for opstilling af behandlingskrav for håndtering af gipsaffald i Danmark. Dette gøres ved at udføre en miljøvurdering af et antal metoder til behandling af gipsaffald vha. LCA-modellen EASEWASTE. Miljøvurderingen indebærer, at der indsamles data for mængder og masseflow for gipsaffald i Danmark, samt at de involverede teknologier beskrives. På det grundlag kan potentielle miljøpåvirkninger fra teknologierne beregnes og de miljømæssigt set mest hensigtmæssige behandlingsmetoder identificeres. lignes og
Christensen, T. H., Project Participant, Department of Environmental Engineering
Møller, J., Project Manager, Department of Environmental Engineering
Project ID: 30787
Ukendt: DKK400,000.00
26/08/2010 → 31/12/2010
Award relations: LCA af gipsaffald
Project: Research

CO2 opgørelse: CO2 opgørelse i affaldssektoren
Affaldssektoren har behov for at opgøre CO2 regnskaber for anlæg, processer, systemer, firmaer osv. Der er behov for at: Udvikle et fælles transparent system for opgørelse af CO2 regnskaber og synliggørelse af sektorens CO2 bidrag. Udvikle fælles data for hvorledes gevinster, der rettelig falder i andre sektorer, kan opgøres og vises i sammenhæng med affaldssektorens egne CO2 bidrag.
Astrup, T. F., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30772
Ukendt: DKK225,000.00
01/06/2010 → 30/11/2010
Award relations: CO2 opgørelse i affaldssektoren
Project: Research
SET 5 PhD: Sustainable Environmental Technology. Application for 5 fellowships

Sustainable Environmental Technology is one of the focus areas in the Danish research strategy FORSK 2015. Sustainable environmental technology is seen as an important research area both for securing continued welfare and for potential development of Danish industry and services useful in a global context. Sustainable environmental technology thus can contribute at the domestic level as well as at the international level. At the domestic level sustainable environmental technology can help develop increased resource efficiency and recovery through improved waste management and help developing intelligent water management in cities under pressure from increased rain and storm intensities, a water resource limited by increasing groundwater pollution and by competition from protection of natural water habitats and wetlands. At the international level similar issues are developing and Danish research within sustainable environmental technology can help Danish technology and service provider to maintain and expand their international activities. The PhD fellowships will be announced within sustainable environmental technology with focus on waste and resource management, and urban water technology, which are among the key research competencies of DTU Environment.

Scheutz, C., Project Participant, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Henze, M., Project Manager, Department of Environmental Engineering
Kjeldsen, P., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Smets, B. F., Project Participant, Department of Environmental Engineering

INTORPS: Integrated organics pre-treatment system for new sludge management systems

INTORPS is a system solution containing equipment for organics treatment with according design rules, rules for process implementation to existing wwtp and SMS, rules for required adjustments at different types of wwtp. LCA, basing on full scale experimental results will show impact of INTORPS on environmental footprint of European SMS including impact on sludge disposal.

Christensen, T. H., Project Manager, Department of Environmental Engineering

Have-park affald: Have-park affald: Sammenlignende vurdering af disponeringsmuligheder. Forprojekt 060609

Affaldsselskaberne står over for fortsat stigende have-affaldsmængder og har behov for gode, billige og fleksible løsninger. Produktion af råkompost og udbringning på dedikerede arealer er en ny og uddokumenteret metode som kan anvendes i stedet for centralkompostering. Problemstillingen belyses og vurderes ud fra en kombination af forsøg og modellering.

Christensen, T. H., Project Manager, Department of Environmental Engineering
Møller, J., Project Participant, Department of Environmental Engineering

935: LCA-screening of 8 European waste management scenarios

Eight waste management scenarios representing various generic European approaches are screened by using EASEWASTE in collaboration with the Sustainable Landfill Foundation. The scenarios involve source separation of recyclables, MBT, incineration, composting, anaerobic digestion, RDF and landfilling.

Astrup, T. F., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Boldrin, A., Project Participant, Department of Environmental Engineering
Manfredi, S., Project Participant, Department of Environmental Engineering
Møller, J., Project Manager, Department of Environmental Engineering
917: Veolia. Literature review on definitions, methodologies, calculations, monitoring and reporting of climate change indicators. Confidential

Collaboration with Veolia Environnement Resherche et Innovations SNC
Christensen, T. H., Project Manager, Department of Environmental Engineering
Gentil, E., Project Participant, Department of Environmental Engineering
Project ID: 30552
Ukendt: DKK438,750.00
18/06/2007 → 30/09/2007
Award relations: Veolia. Literature review on definitions, methodologies, calculations, monitoring and reporting of climate change indicators. Confidential
Project: Research

918: Inventory modelling and documentation of four landfilling technologies for ELCD using EASEWASTE

The objective is to develop inventory modelling (in-put / out-out tables) and documentation for four landfilling technologies for ELCD using EASEWASTE. ELCD is the European database for life-cycle-inventories hosted by the JRC in Ispra. The ELCD datasets will be represented as default technologies in EASEWASTE in the future
Christensen, T. H., Project Manager, Department of Environmental Engineering
Manfredi, S., Project Manager, Department of Environmental Engineering
Project ID: 30727
Ukendt: DKK211,950.00
15/12/2008 → 30/04/2009
Award relations: Inventory modelling and documentation of four landfilling technologies for ELCD using EASEWASTE
Project: Research

819: RiskCycle

Risk-based management of chemicals and products in a circular economy at a global scale (Co-ordination action)
Kusk, K. O., Project Manager, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Project ID: 30737
Ukendt: DKK379,316.00
01/08/2009 → 31/07/2012
Award relations: RiskCycle
Project: Research
HEIMTSA: Health and Environment Integrated Methodology and Toolbox for Scenario Assessment. The contributions of landfills. EU contract GOCE Contract No. 036913

The project is large EU project modelling the health effects of environmental factors in Europe distributed with respect to geographical areas and sources. DTU Environment contributes with the modelling of methane and trace gas emission from landfills.

Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30509
Ukendt: DKK137,180.00
01/01/2007 → 01/02/2012
Award relations: Health and Environment Integrated Methodology and Toolbox for Scenario Assessment. The contributions of landfills. EU contract GOCE Contract No. 036913
Project: Research

782: Århus - Garden Waste
Characterisation of garden waste, description of treatment and use of garden waste and on the basis hereof modelling of the environmental impact (LCA). Experimental investigations also included as a means of obtaining central data for the environmental assessment.

Christensen, T. H., Project Manager, Department of Environmental Engineering
Boldrin, A., Project Participant, Department of Environmental Engineering
Andersen, J. K., Project Participant, Department of Environmental Engineering
Project ID: 30501
Ukendt: DKK610,000.00
01/06/2006 → 31/10/2008
Award relations: Århus - Garden Waste
Project: Research

783: Biogrowth - VF
LCA modelling of a combined anaerobic-aerobic process for treatment of source-sorted organic waste mixed with a quantity of garden waste. Implementation of the model on actual problems in chosen municipalities within 'Vestforbrændings' area.

Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30500
Ukendt: DKK478,000.00
19/10/2006 → 30/04/2007
Award relations: Biogrowth - VF
Project: Research

429: DTUs bidrag til koordinering og udredning.
Formål er at: - sikre DTU en gennemgående rolle i koordineringen af samarbejdsprojekter(Affald Danmark, RGA-samarbejde(ELSAM, AF, VF) - udføre, efter konkret aftale, mindre udrednings-og sammenskrivningsopgaver
Astrup, T. F., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Röttger, U., Project Participant, Affald Danmark
Project ID: 30335
Ukendt: DKK300,000.00
01/04/2004 → 31/03/2007
Collaborators: Affald Danmark
Award relations: DTUs bidrag til koordinering og udredning.
Project: Research

333: Development of leaching tests for organic compounds in contaminated soils.
Inexpensive and fast performing column leaching tests are developed for both volatile and non-volatile organic compounds. The column leaching tests are able to avoid artifacts for non-volatile compounds due to colloids which make more traditionel batch leaching tests difficult to use.

Kjeldsen, P., Project Manager, Department of Environmental Engineering
Kjeldsen, P., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Gamst, J., Project Participant, Department of Environmental Engineering
Project ID: 30247
Ukendt: DKK996,168.00
31/05/2002 → 31/12/2004
Collaborators: DHI Water - Environment - Health
Award relations: Development of leaching tests for organic compounds in contaminated soils.
Project: Research
325: Environmental assessment of organic household waste management in the municipal of Copenhagen
Christensen, T. H., Project Manager, Department of Environmental Engineering
Ukendt: DKK348,000.00
01/11/2000 → 30/09/2002
Award relations: Environmental assessment of organic household waste management in the municipal of Copenhagen
Project: Research

323: Pretreatment of source separated organic household waste prior to biogasification
Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30239
Ukendt: DKK130,000.00
16/01/2002 → 01/10/2002
Award relations: Pretreatment of source separated organic household waste prior to biogasification
Project: Research

240: Biogasification of organic household waste: Waste composition, pretreatment and methane potentials
Projektet vil etablere basisdata for sammensætning og karakteristika af organisk husholdningsaffald i forhold til biogaspotentialt for fraktioner indsamlet separat efter forskellige sorteringskriterier. Projektet indeholder 3 faser: En kritisk gennemgang af det eksisterende datagrundlag Indsamling af nye pålidelige data om sammensætningen af det organiske affald Måling af faktiske biogaspotentialer.
Christensen, T. H., Project Manager, Department of Environmental Engineering
Hansen, T. L., Project Participant, Department of Environmental Engineering
Project ID: 30145
Ukendt: DKK1,440,000.00
01/01/2001 → 30/11/2002
Collaborators: Lund University, Ramboll Group AS, Malmö Kommune/Sysav
Award relations: Biogasification of organic household waste: Waste composition, pretreatment and methane potentials
Project: Research

The new waste chapter in the TGD is expected to provide guidance how to address the potential concerns specifically related to the "rend-of-service-life" waste stage of chemical substances. This means in particular Criteria in which cases a waste scenario should be carried out guidance how to identify the most relevant emission scenarios in these cases recommendations on how to make use of available emission models for certain waste operations and emission scenarios for certain product type guidance on how proceed if no realistic emission scenario is available examples how to formulate the standard conclusions with regard for more information based on waste related releases.
Baun, A., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Ukendt: DKK99,000.00
01/12/2000 → 31/12/2000
Collaborators: Miljøstyrelsen
Award relations: Emission scenarios for the end of service life of substances - waste treatment.
Project: Research

184: Characterization and stabilization of municipal waste incineration residues.
Kjeldsen, P., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Ukendt: DKK0.00
01/09/1999 → 30/03/2003
Award relations: Characterization and stabilization of municipal waste incineration residues.
Project: Research

151: Treatment of residues from solid waste incineration: Pilotscale experiments.
Inhension is the most common waste treatment and disposal method for municipal and industrial solid waste in Denmark. Solid residues are generated in terms of bottom ash and APC (air pollution control) solids (fly ashes and acid flue gas cleaning products). The bottom ashes are primarily used for construction purposes while the APC solids are landfilled or temporarily stored until permanent landfills are approved. All the residues from incineration should be utilized or landfilled by sustainable methods without adverse impacts on the environment. One of the main environmental concerns is the short term (few years) as well as long term (centuries) leaching of salts and heavy metals from construction material containing residues or from waste residue landfills The aim of this project is to develop technologies
for bottom ashes as well as for APC products based on combinations of washing and chemical stabilization. Currently focus is on APC solids and washing followed by stabilization by iron oxides. This leads to a reduction in the leaching of salts by partial removal and a permanent binding of heavy metals in the treated solids.

Lundtorp, K., Project Participant, Department of Environmental Engineering
Sørensen, M. A., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering

Ukendt: DKK 100,000.00
01/03/1999 → 31/12/2000
Collaborators: Vestforbrænding, I/S Amagerforbrænding, AVM Miljø, Miljøstyrelsen
Award relations: Treatment of residues from solid waste incineration: Pilotscale experiments.
Project: Research

93: Natural attenuation as remediation of landfill leachate plumes.
Natural attenuation as a remediation technology is being considered for landfill leachate plumes. The demonstration of mass removal of target pollutants by natural remediation and the evaluation of residual risk is somewhat more complicated than the approaches and protocols used in the context of petroleum hydrocarbons and chlorinated aliphatic compounds. The difference relates to the size of the source term and its influence on local hydrogeology, the mixture of pollutants and general organic matter and the often unidentified toxicity of the leachate. Based on the extensive research results described under "landfills" a conceptual model for natural attenuation at landfills is being developed.

Foerskov, A., Project Participant, Department of Environmental Engineering
Baun, A., Project Participant, Department of Environmental Engineering
Ledin, A., Project Participant, Department of Environmental Engineering
Troelsen, L. B. D., Project Participant, Department of Environmental Engineering
Nyholt, N., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Participant, Department of Environmental Engineering
Kruse, S., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Nilsson, T., Project Participant, Department of Environmental Engineering

Ukendt: DKK 2,152,200.00
01/01/1997 → 31/12/2000
Award relations: Natural attenuation as remediation of landfill leachate plumes.
Project: Research

108: Joule Heating
Heron, G., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
01/06/1996 → 30/12/1998
Project: Research

98: Inorganic fluxes in watersheds hosting old landfills
Natural attenuation by degradation may be substantial for organic pollutants in leachate plumes, but most inorganic species will be subject to only minor attenuation in the aquifer. However inorganic species as chloride, sodium, potassium, calcium, magnesium, sulfate etc. enter the groundwater also from other sources than the landfill. This be precipitation, soil weathering, use of fertilizer and use of road deicing chemicals. The significance of these other sources is being mapped by monitoring of groundwater quality just below different land uses within two watersheds also containing unlined landfills. The contributions from the landfills are also being assessed. The results indicate that deicing chemicals and agriculture contribute significantly to the load of inorganic species on the groundwater.

Skov, B. H., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Manager, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering

01/01/1997 → 31/12/2004
Project: Research

90: Treatment of residues from solid waste incineration
Incineration is the most common waste treatment and disposal method for municipal and industrial solid waste in Denmark. Solid residues are generated in terms of bottom ash and APC (air pollution control) solids (fly ashes and acid flue gas cleaning products). The bottom ashes are primarily used for construction purposes while the APC solids are landfilled or temporarily stored until permanent landfills are approved. All the residues from incineration should be utilized or landfilled by sustainable methods without adverse impacts on the environment. One of the main environmental concerns is the short term (few years) as well as long term (centuries) leaching of salts and heavy metals from construction material containing residues or from waste residue landfills. The aim of this project is to develop technologies for bottom ashes as well as for APC products based on combinations of washing and chemical stabilization. Currently focus is on APC solids and washing followed by stabilization by iron oxides. This leads to a reduction in the leaching of salts by partial removal and a permanent binding of heavy metals in the treated solids. Utilization by incorporation into ceramics
The complexation of heavy metals by dissolved organic carbon from a leachate plume has been measured by means of ion exchange resin techniques. The dissolved organic carbon was studied in its original matrix in order to avoid artifacts by purification and loss of non-purifiable carbon (in some cases up to 30% is lost). Conditional stability constants have been estimated showing much higher complexation for Cu and Pb than for Cd, Ni and Zn. Experiments using aquifer material instead of resin gave comparable results but showed that even in the presence of dissolved organic carbon, the distribution coefficients for the metal sorption onto the aquifer material still was high indicating limited mobility also in the presence of dissolved organic carbon. Traditional purification of the dissolved organic carbon showed that 60% was fulvic-acid-like, 10% was humic-acid-like and 30% belonged to a hydrophilic group somewhat related to fulvic acids. The characteristics of the separated fractions are being studied and complexation modeled by Model V/WHAM and NICA-Donnan/Ecosat.

Eighteen organic chemicals at trace level were injected for six month period into the strongly anaerobic part of the leachate plume downgradient from the Grindsted Landfill. The immigration and fate of the compounds were monitored for nearly three years. Sorption was insignificant in the coarse sandy aquifer, but many of the organic chemicals degraded: Toluene, o-xylene, several nitrobenzenes and maybe naphthalene. Benzene was recalcitrant. The degradation rates were low and in many cases long adaptation periods were observed making short term laboratory degradation studies unsuited for studying degradation of organic chemicals in leachate plumes. However, long term batch degradation experiments and in situ microcosms installed in the plume gave results generally comparable to the observations in the plume. The plume was dominated by iron reduction, but locally methanogenesis and sulfate reduction also took place.

Quality criteria for soils with respect to heavy metals have traditionally focused on the environmental issues related to the land use (ingestion of soil, skin contact, etc.) and very little attention has been given to protection of the groundwater. The complex form of heavy metals in polluted soils makes prediction of leachability difficult and leaching experiments or leaching test are usually the only way to assess the amount of metal to leach from the soil. Model scenarios are being developed to evaluate heavy metal leaching in the context of groundwater protection and allow for simplified methods to account for groundwater quality criteria, depth and location of polluted soil, education in infiltration and leachable amounts determined in leaching test. Experimental studies have been performed at actual sites and leaching experiments are conducted in the laboratory.
9: Distribution coefficients for metals in soils and aquifer materials
Distribution coefficients are useful parameters to describe trace metal distribution between solid phase and solute phase at low trace metal concentration provided that sorption is the controlling process. The database on distribution coefficient determined at low environmentally relevant concentration levels is still very limited and few regression evaluations are available for predicting distribution coefficients from soil and aquifer characteristics. We conduct Batch experiments to measure distribution coefficients on soils and aquifer materials. Most studies are done on samples from our library of soil and aquifer material. In general the distribution coefficients are lower in aquifer materials than in soil, but for both materials pH seems to be the dominating parameter for all the metals studied.

6: Monitoring and interpretation of H2 as a redox indicator in an anaerobic leachate plume
Concentrations of hydrogen (H2) was measured in 52 sampling points in the leachate pollution plume at the Grindsted Landfill. The H2 concentrations indicate that the redox level of the main part of the strongly anaerobic plume is iron-reducing. Calculation of Gibb’s free energy for various redox processes at the actual groundwater temperature of 8 degrees C suggests that sulfate-reduction may also take place, but that methanogenesis must take place in micronicrons or by fermentation since the free energy and the H2 levels are not favorable for carbon dioxide reduction. These results are in accordance with the microbial studies performed in the plume. Prior to the study, testing of well construction and materials was performed to allow for correct measurements to be made.

7: Microbial studies of an anaerobic leachate plume
Microbial studies were performed in 37 locations in the leachate plume at Grindsted Landfill in terms of MPN-counting of methanogens, sulfate-reducers, iron-reducers, manganese-reducers and denitrifiers, ATP levels, PLFA levels and composition and redox activities in unamended bioassays. Volatile fatty acids, H2 concentrations and (no) protozoa were measured as well. Several redox processes were identified in the same samples but usually one process dominated when compared on a carbon conversion basis. The leachate significantly affected the microbial populations, but the distribution of the actual redox activities were not limited by the microbial populations but the availability of electron donors and acceptors.

4: Colloids in landfill leachate
Heavy metal contents of landfill leachate sometimes are unexpectedly high. This may be related to the presence of colloidal matter with high metal contents that, due to lack of strict protocols on sampling and solid separation, some times are found in the sampled leachate.
8: Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills

The complexation of heavy metals by dissolved organic carbon from a leachate plume has been measured by means of ion exchange resin techniques. The dissolved organic carbon was studied in its original matrix in order to avoid artifacts by purification and loss of non-purifiable carbon (in some cases up to 30% is lost). Conditional stability constants have been estimated showing much higher complexation for Cu and Pb than for Cd, Ni and Zn. Experiments using aquifer material instead of resin gave comparable results but showed that even in the presence of dissolved organic carbon, the distribution coefficients for the metal sorption onto the aquifer material still was high indicating limited mobility also in the presence of dissolved organic carbon. Traditional purification of the dissolved organic carbon showed that 60% was fulvic-acid-like, 10% was humic-acid-like and 30% belonged to a hydrophilic group somewhat related to fulvic acids. The characteristics of the separated fractions are being studied and complexation modeled by Model V/WHAM and NICADonnan/Ecosat.

Hansen, J. B., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering

01/02/1994 → 31/03/1999
Project: Research

Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills

The complexation of heavy metals by dissolved organic carbon from a leachate plume has been measured by means of ion exchange resin techniques. The dissolved organic carbon was studied in its original matrix in order to avoid artifacts by purification and loss of non-purifiable carbon (in some cases up to 30% is lost). Conditional stability constants have been estimated showing much higher complexation for Cu and Pb than for Cd, Ni and Zn. Experiments using aquifer material instead of resin gave comparable results but showed that even in the presence of dissolved organic carbon, the distribution coefficients for the metal sorption onto the aquifer material still was high indicating limited mobility also in the presence of dissolved organic carbon. Traditional purification of the dissolved organic carbon showed that 60% was fulvic-acid-like, 10% was humic-acid-like and 30% belonged to a hydrophilic group somewhat related to fulvic acids. The characteristics of the separated fractions are being studied and complexation modeled by Model V/WHAM and NICADonnan/Ecosat.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Hansen, J. B., Project Participant, Department of Environmental Science and Engineering
Grøn, C., Project Participant, Risø National Laboratory for Sustainable Energy
Tipping, E., Project Participant, Freshwater Biological Association
Kinninburgh, D., Project Participant, British Geological Survey
Wabolu, D. Z. F., Project Participant

01/06/1995 → 28/02/1999
Collaborators: Freshwater Biological Association, British Geological Survey
Award relations: Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills, Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills
Project: Research

Treatment of residues from solid waste incineration

Incineration is the most common waste treatment and disposal method for municipal and industrial solid waste in Denmark. Solid residues are generated in terms of bottom ash and APC (air pollution control) solids (fly ashes and acid flue gas cleaning products). The bottom ashes are primarily used for construction purposes while the APC solids are landfilled or temporarily stored until permanent landfills are approved. All the residues from incineration should be utilized or landfilled by sustainable methods without adverse impacts on the environment. One of the main environmental concerns is the short term (few years) as well as long term (centuries) leaching of salts and heavy metals from construction material containing residues or from waste residue landfills. The aim of this project is to develop technologies for bottom ashes as well as for APC products based on combinations of washing and chemical stabilization. Currently focus is on APC solids and washing followed by stabilization by iron oxides. This leads to a reduction in the leaching of salts by partial removal and a permanent binding of heavy metals in the treated solids. Extensive laboratory studies are being carried out and currently a pilot-plant is being constructed.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Jensen, D. L., Project Participant, Department of Environmental Science and Engineering
Sørensen, M. A., Project Participant, Department of Environmental Science and Engineering
Lundtorp, K., Project Participant, Department of Environmental Science and Engineering
Duhring, P. B., Project Participant, Department of Environmental Science and Engineering
Skov, B. H., Project Participant, Department of Environmental Science and Engineering
Mogensen, E., Project Participant, Babcock & Wilcox Velund A/S
Stipp, S., Project Participant, University of Copenhagen
Bender Koch, C., Project Participant, Royal Agricultural and Veterinary University
Bordia, R., Project Participant, University of Washington
Benjamin, M., Project Participant, University of Washington

Ukendt: DKK1,512,000.00
01/09/1997 → 30/08/2000
Project: Research
Collaborators: Royal Agricultural and Veterinary University, University of Washington, University of Copenhagen, Babcock & Wilcox Vølund A/S
Award relations: Treatment of residues from solid waste incineration
Project: Research

432: Kvantificering af miljøeffekter fra RGA.
Projektet forventes at beskæftige sig med stabiliseret, deponeret RGA og en til og genanvendelsesteknologier. De faktiske teknologier udvalgtes af styringsgruppen, idet relevans og tilgængelighed af relevante prøveemner er afgørende. Selve værkøjet, dvs. en sammenhængende procedure for sammenstilling af data, laboratorietestning samt modellering er projektets hovedformål, men værdien heraf er gældende ved at basere sig på relevante RGA-teknologier. Astrup, T. F., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Sloot, H. V. D., Project Participant, Energy research Centre of the Netherlands - ECN
Project ID: 30333
Sam.arb.aftaler - Amter og kommuner: DKK1,965,000.00
01/10/2004 → 30/09/2007
Collaborators: Energy research Centre of the Netherlands - ECN
Award relations: Kvantificering af miljøeffekter fra RGA.
Project: Research

Natural attenuation of landfill leachate plumes
Natural attenuation as a remediation technology is being considered for landfill leachate plumes. The demonstration of mass removal of target pollutants by natural remediation and the evaluation of residual risk is somewhat more complicated than the approaches and protocols used in the context of petroleum hydrocarbons and chlorinated aliphatic compounds. The difference relates to the size of the source term and its influence on local hydrogeology, the mixture of pollutants and general organic matter and the often unidentified toxicity of the leachate. Based on the extensive research results described under "landfills" a conceptual model for natural attenuation at landfills is being developed. Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Bjerg, P. L., Project Participant, Department of Environmental Science and Engineering
Kjeldsen, P., Project Participant, Department of Environmental Science and Engineering
Rokkjær, A., Project Participant, Amternes Videncenter for jordforurening
Ejlskov, P., Project Participant, Ejlskov Consult
Züricho, H., Project Participant, Sønderjyllands Amt
01/01/1997 → 31/12/2000
Collaborators: Ejlskov Consult, Sønderjyllands Amt, Ejlskov A/S, Amternes Videncenter for jordforurening
Project: Research

Characterization and stabilization of Residues.
Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Kjeldsen, P., Project Participant, Department of Environmental Science and Engineering
Hjelmar, O., Project Participant, Unknown Organization
01/09/1999 → 30/08/2002
Collaborators: Unknown Organization
Project: Research

In Situ heat treatment of polluted clayish soils
Laboratory experiments have been performed determining the effects of elevated temperatures on the physico-chemical constants of TCE forming the basis for heating soils as a mean of remediation. Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Heron, G., Project Participant, Department of Environmental Science and Engineering
Enfield, A. C., Project Participant, US.EPA Research Laboratory,
Zupthen, M. V., Project Participant, Netherlands Organisation for Applied Scientific Research - TNO
Ukendt: DKK0.00, Ukendt: DKK1,200,000.00
01/05/1995 → 01/01/9999
Collaborators: Netherlands Organisation for Applied Scientific Research - TNO, EPA National Exposure Research Laboratory, US.EPA Research Laboratory,
Award relations: In Situ heat treatment of polluted clayish soils, In Situ heat treatment of polluted clayish soils
Project: Research

Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills
The complexation of heavy metals by dissolved organic carbon from a leachate plume has been measured by means of ion exchange resin techniques. The dissolved organic carbon was studied in its original matrix in order to avoid artifacts by purification and loss of non-purifiable carbon (in some cases up to 30% is lost). Conditional stability constants have been
estimated showing much higher complexation for Cu and Pb than for Cd, Ni and Zn. Experiments using aquifer material instead of resin gave comparable results but showed that even in the presence of the dissolved organic carbon, the distribution coefficients for the metal sorption onto the aquifer material still were high indicating limited mobility also in the presence of dissolved organic carbon. Traditional purification of the dissolved organic carbon showed that 60% was fulvic-acid-like, 10% was humic-acid-like and 30% belonged to a hydrophilic group somewhat related to fulvic acids. The characteristics of the separated fractions are being studied and complexation modeled by Model VWHAM and NICADonnan/Ecosat.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Hansen, J. B., Project Participant, Department of Environmental Science and Engineering
Grøn, C., Project Participant, Risø National Laboratory
Filip, Z., Project Participant, Verein für Wasser-, Boden- und Lufthygiene e.V.
Tipping, E., Project Participant, Freshwater Biological Association
Kinninburgh, D., Project Participant, British Geological Survey

Collaborators: Freshwater Biological Association, Risø National Laboratory, British Geological Survey, Verein für Wasser-, Boden- und Lufthygiene e.V.
Award relations: Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills, Complexation of Cd, Ni, Zn, Pb and Cu by dissolved organic carbon from landfills
Project: Research

Leaching of heavy metals from soils
Quality criteria for soils with respect to heavy metals have traditionally focused on the environmental issues related to the land use (ingestion of soil, skin contact, etc.) and very little attention has been given to protection of the groundwater. The complex form of heavy metals in polluted soils makes prediction of leachability difficult and leaching experiments or leaching test are usually the only way to assess the amount of metal to leach from the soil. Model scenarios are being developed to evaluate heavy metal leaching in the context of groundwater protection and allow for simplified methods to account for groundwater quality criteria, depth and location of polluted soil, reduction in infiltration and leachable amounts determined in leaching test. Experimental studies have been performed at actual sites and leaching experiments are conducted in the laboratory.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Kjeldsen, P., Project Participant, Department of Environmental Science and Engineering
Astrup, T. F., Project Participant, Department of Environmental Science and Engineering
Boddum, J. K., Project Participant, Department of Environmental Science and Engineering
Astrup, T. F., Project Participant, Department of Environmental Science and Engineering
Jensen, D. L., Project Participant, Department of Environmental Science and Engineering
Foverskov, A., Project Participant, Department of Environmental Science and Engineering
Holm, P., Project Participant, VKI Water Quality Institute
Hjelmar, O., Project Participant, VKI Water Quality Institute

Collaborators: VKI Water Quality Institute
Award relations: Leaching of heavy metals from soils, Leaching of heavy metals from soils
Project: Research

Anaerobic field injection experiment with organic chemicals in a leachate plume
Eighteen organic chemicals at trace level were injected for at six month period into the strongly anaerobic part of the leachate plume downgradient from the Grindsted Landfill. The migration and fate of the compounds were monitored for nearly three years.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Rügge, K., Project Participant, Department of Environmental Science and Engineering
Bjerg, P. L., Project Participant, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Mosbæk, H., Project Participant, Department of Environmental Science and Engineering
Foverskov, A., Project Participant, Department of Environmental Science and Engineering
Skov, B. H., Project Participant, Department of Environmental Science and Engineering
Serensen, J. S., Project Participant, Department of Environmental Science and Engineering
Refstrup, M., Project Participant, Department of Environmental Science and Engineering
Haderlein, S., Project Participant, Swiss Federal Institute of Aquatic Science and Technology

Collaborators: Swiss Federal Institute of Aquatic Science and Technology
Award relations: Anaerobic field injection experiment with organic chemicals in a leachate plume, Anaerobic field injection experiment with organic chemicals in a leachate plume
Project: Research
Microbial studies were performed in 37 locations in the leachate plume at Grindsted Landfill in terms of MPN-counting of methanogens, sulfate-reducers, iron-reducers, manganese-reducers and denitrifiers, ATP levels, PLFA levels and composition and redox activities in unamended bioassays. Valatile fatty acids, H2 concentrations and (no) protozoa were measured as well. Several redox processes were identified in the same samples but usually one process dominated when compared on a carbon conversion basis. The leachate significantly affected the microbial populations, but the distribution of the actual redox activities were not limited by the microbial populations but the availability of electron donors and acceptors.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Ludvigsen, L., Project Participant, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Refstrup, M., Project Participant, Department of Environmental Science and Engineering
Hansen, K., Project Participant, Department of Environmental Science and Engineering
Ringelberg, D., Project Participant, Waterways Experimental Station, Vikcsburg (PLFA)
Holst, H., Project Participant
Ekkelund, F., Project Participant, University of Copenhagen

Ukendt: DKK1,800,000.00
01/01/1994 → 30/03/1997
Collaborators: Waterways Experimental Station, Waterways Experimental Station, Vikcsburg (PLFA), University of Copenhagen
Award relations: Microbial studies of an anaerobic leachate plume
Project: Research

Monitoring and interpretation of H2 as a redox indicator in an anaerobic leachate plume
Concentrations of hydrogen (H2) was measured in 52 sampling points in the leachate pollution plume at the Grindsted Landfill. The H2 concentrations indicate that the redox level of the main part of the strongly anaerobic plume is iron-reducing. Calculation of Gibb's free energy for various redox processes at the actual groundwater temperature of 8 degrees C suggests that sulfate-refuction may also take place, but that methanogenesis must take place in microniches or by fermentation since the free energy and the H2 levels are not favorable for carbondioxide reduction. These results are in accordance with the microbial studies performed in the plume. Prior to the study, testing of well construction and materials was performed to allow for correct measurements to be made.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Bjerg, P. L., Project Participant, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Skov, B. H., Project Participant, Department of Environmental Science and Engineering
Jakobsen, R., Project Participant, Department of Geology and Geotechnical Engineering

Ukendt: DKK200,000.00
01/09/1996 → 30/09/1997
Award relations: Monitoring and interpretation of H2 as a redox indicator in an anaerobic leachate plume
Project: Research

En model opstilles for Århus Forbrændingsanlæg i EASEWASTE, og en vurdering af de miljø- og energimæssige forhold omkring anlægget foretages.

Christensen, T. H., Project Manager, Department of Environmental Engineering
Astrup, T. F., Project Participant, Department of Environmental Engineering
Riber, C., Project Participant, Department of Environmental Engineering

Project ID: 30445
Ukendt: DKK710,000.00
01/12/2005 → 30/11/2006
Project: Research

EASEWASTE RSO: Bevilling fra Rektors Strategiske Omstillingspulje til at fremme innivationsaktiviteter på DTU, in casu EASEWASTE
Bevilling fra Rektors Strategiske Omstillingspulje til at fremme innivationsaktiviteter på DTU, in casu EASEWASTE.

Christensen, T. H., Project Manager, Department of Environmental Engineering

Project ID: 30455
[Ordinær drift UK 10]: DKK1,500,000.00
01/01/2006 → 31/12/2008
Award relations: Bevilling fra Rektors Strategiske Omstillingspulje til at fremme innivationsaktiviteter på DTU, in casu EASEWASTE
NM-model: Beslutningsstøtteværktøj vedrørende indsamling og behandling af kildesorteret dagrenovation
Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30408
Sam.arb.aftaler - Statslige danske: DKK220,000.00
06/08/2005 → 01/12/2005
Award relations: Beslutningsstøtteværktøj vedrørende indsamling og behandling af kildesorteret dagrenovation
Project: Research

591: Miljømæssig vurdering af træaffald i DK
Christensen, T. H., Project Manager, Department of Environmental Engineering
Merrild, H. K., Project Participant, Department of Environmental Engineering
Project ID: 30399
Sam.arb.aftaler - Amter og kommuner: DKK167,000.00
01/06/2005 → 31/10/2005
Award relations: Miljømæssig vurdering af træaffald i DK
Project: Research

588: Miljøvurdering af affaldsbehandling med EASEWASTE modellen
Christensen, T. H., Project Manager, Department of Environmental Engineering
Merrild, H. K., Project Participant, Department of Environmental Engineering
Project ID: 30398
Sam.arb.aftaler - Amter og kommuner: DKK200,000.00
21/06/2005 → 31/12/2006
Award relations: Miljøvurdering af affaldsbehandling med EASEWASTE modellen
Project: Research

559: High temperature slagging gasifier for waste.
The project concerns modification and testing of an existing slagging gasifier developed by TK Energi AS in order to verify the mechanical principle and the quality of the produced slag. Furthermore the project investigates the feasibility of the high temperature slagging gasification plant for waste.
Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30393
Ukendt: DKK500,000.00
30/01/2005 → 31/12/2006
Collaborators: TK Energi ApS
Award relations: High temperature slagging gasifier for waste.
Project: Research

558: Miljøvurdering af genanvendelse og slutdisponering af spildevandsslam
Christensen, T. H., Project Manager, Department of Environmental Engineering
Hansen, T. L., Project Participant, Department of Environmental Engineering
Baun, A., Project Participant, Department of Environmental Engineering
Kirkeby, J. S., Project Participant, Department of Environmental Engineering
Gabriel, S., Project Participant, Department of Environmental Engineering
Project ID: 30392
Sam.arb.aftaler, Private danske - Andre virksomheder: DKK187,000.00
07/04/2005 → 30/08/2005
Collaborators: Hedeselskabet
Award relations: Miljøvurdering af genanvendelse og slutdisponering af spildevandsslam
Project: Research

540: Miljøvurdering af systemer til håndtering af husholdningsaffald i Herning Kommune.
Der opstilles systematiske databaser om affaldssystemets funktion (data fra Herning bruges) med henblik på brug i et dansk miljøvurderingsværktøj og - dette værktøj bruges til en konkret vurdering af de ressource- og miljømæssige forhold omkring affaldshåndtering i Herning.
433: Udvikling af deponeringsanlægget AV-Miljø - Et dynamisk samarbejde mellem AV-Miljø og Miljø & Ressourcer DTU.

Formålet med projektet er: - at undersøge gasemissionen fra AV-Miljø via måling af gassammensætning, gasemission og methanoxidation i afsluttede etaper, samt total gasemission fra AV-Miljø vha. storksaf, - at generere overblik over nuværende perkolatkvalitet og udvaskningsbetingelser - at etablere facilitet til storksafa udvaskningstest med efterfølgende test af én affaldstype.

Scheutz, C., Project Participant, Department of Environmental Engineering
Kjeldsen, P., Project Participant, Department of Environmental Engineering

Project: Research

340: Hvidbog om RGA-teknologier

Projektet udarbejder en teknisk hvidbog over eksisterende teknologier, dvs. en mere miljøorienteret og data-specifik fremstilling end den eksisterende BAT-note. For hver teknologi sammenstilles en standardbeskrivelse på basis af foreliggende materiale. En særlig indsats gøres for at indsamle erfaringer fra de japanske termiske behandlinger.

Christensen, T. H., Project Manager, Department of Environmental Engineering

Project: Research

431: Vurderingsværktøj for RGA-disponering (LCA RGA).

Projektets koncept er at udarbejde et paradigme for hvorledes alternative disponeringer af RGA skal miljøvurderes, således at der i beslutningen omkring den fremtidige disponering af RGA, udover økonomi og politiske aspekter, også indgår en serios opgørelse af miljømæssige fordele og ulemper. Projektet vil tage det livscyklusbaserede paradigme for at indtage miljøekonomi og andre mere bløde vurderingsværktøjer. Der vil blive fokus på det metodemæssige, men vil i det omfang data er tilgængelige for relevante RGA-teknologier (deponering efter stabilisering, gennemførelse konkret vurdering som en erfaringsopbyggende case. Heraf kan uddraget indgå omkring anvendelse af specifikke data versus generelle data, om kritiske komponenter, om væsentlige delbidrag til miljø og evtl. miljøekonomi, samt om vigtige politiske prioriteringsområder.

Christensen, T. H., Project Manager, Department of Environmental Engineering

Project: Research

412: Heavy metals in residential waste and incineration bottom ashes

The project performs five full scale incineration test(300 - 1200 tons) with residential waste of various origin in order to establish the heavy metal content of the waste. By controlling all emissions and determining their compositions the composition of the original waste can be found. In addition, the composition of individual material fractions in the waste are analyzed. The aim is to determine the contribution of residential waste and thereby indirectly the contribution by non-residential waste to the heavy metal burden of incinerator bottom ash as a basis for future improvements in source
controls. The projects is funded by the National Danish EPA and the incinerator plants associated with Affald Danmark
Christensen, T. H., Project Manager, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Hedberg, C. B., Project Participant, Department of Environmental Engineering
Riber, C., Project Participant, Department of Environmental Engineering
Project ID: 30313
Forskningsprojekter - Miljø- og Energiministeriet: DKK900,000.00
19/12/2003 → 31/12/2005
Collaborators: Amagerforbrænding, Aarhus Kommune
Award relations: Heavy metals in residential waste and incineration bottom ashes
Project: Research

410: Mechanical sorting of municipal solid waste for recovery of organic fraction.
Samarbejdsaftale med NML Combineering har til formål at gennemføre: En karakterisering af out-put fra NMLs koncept-
anlæg, opstillet på Fyns Værket, Odense til sortering af dagrenovation, med henblik på dokumentation af anlæggets
funktion.
Christensen, T. H., Project Manager, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Hansen, T. L., Project Participant, Department of Environmental Engineering
Project ID: 30302
Sam.arb.aftaler, Private danske - Andre virksomheder: DKK136,875.00
01/10/2003 → 28/02/2004
Collaborators: NLM Combineering A/S
Award relations: Mechanical sorting of municipal solid waste for recovery of organic fraction.
Project: Research

Århus F2: Kortlægning af kilder til miljøskadelige stoffer i affaldet.
Der udføres en opgørelse af potentielle miljømæssige besparelser ved udsortering af 3 udvalgte affaldstype/fraktioner
tilført Århus Forbrændingsanlæg. De miljø- og energimæssige konsekvenser af udsorteringen modelleres i EASEWASTE
baseret på konkrete målinger ved forbrændingstests.
Christensen, T. H., Project Manager
Astrup, T. F., Project Participant
Riber, C., Project Participant
Project ID: 30446
Ukendt: DKK440,000.00
01/08/2006 → 31/01/2007
Collaborators: Technical University of Denmark
Award relations: Kortlægning af kilder til miljøskadelige stoffer i affaldet.
Project: Research

350: Forbrændingstest med rent dagrenovation.
Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30278
Sam arb.aftaler - Amter og kommuner: DKK540,000.00
01/06/2003 → 30/06/2004
Award relations: Forbrændingstest med rent dagrenovation.
Project: Research

Århus Frem Affald: Fremtidens indsamling og disponering af husholdningsaffald i Århus Kommune: En integreret analyse
af miljø, service og økonomi. Del 2 - det fremtidige affaldssystem.
Del 2 har til formål at give en integreret vurdering af forslag til fremtidige affaldsordninger i århus Kommune
Christensen, T. H., Project Manager
Larsen, A. W., Project Participant
Project ID: 30447
Ukendt: DKK470,000.00
01/04/2006 → 30/09/2007
Collaborators: Technical University of Denmark
Award relations: Fremtidens indsamling og disponering af husholdningsaffald i Århus Kommune: En integreret analyse af
miljø, service og økonomi. Del 2 - det fremtidige affaldssystem.
Project: Research

Del 1 har til formål at opstille en model, der kan beskrive de miljømæssige og økonomiske aspekter af det nuværende affaldssystem for husholdningsaffald i Århus Kommune som et grundlag for udvikling af fremtidige affaldsordninger.

Christensen, T. H., Project Manager
Larsen, A. W., Project Participant
Project ID: 30448
Utendt: DKK470,000.00
01/12/2005 → 30/04/2007
Collaborators: Technical University of Denmark
Award relations: Fremtidens indsamling og disponering af husholdningsaffald i Århus Kommune: En integreret analyse af miljø, service og økonomi. Del 1 - det nuværende affaldssystem.
Project: Research

Life cycle assessment of road construction and reuse of waste incineration residues
The project develops a life-cycle-assesment model for road construction with and without use of incineration residues. The model accounts for all uses and savings in resources and environmental emissions including savings in residue landflling if the residue is use in road construction. A key issue is quantification of the leaching from the materials and test data and sub-models have been developed.

Christensen, T. H., Project Manager
Birgisdottir, H., Project Participant
Christensen, T. H., Project Participant
Project ID: 30224
Sam.arb.aftaler - Amter og kommuner: DKK1,450,000.00
01/10/2001 → 31/05/2005
Collaborators: Vestforbrænding, Amagerforbrænding, Danish Road Directorate, Technical University of Denmark
Award relations: Life cycle assessment of road construction and reuse of waste incineration residues
Project: Research

Environmental assessment of solid waste management in the municipality of Aarhus

Christensen, T. H., Project Manager, Department of Environmental Engineering
Kirkeby, J. S., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Participant, Department of Environmental Engineering
Hansen, T. L., Project Participant, Department of Environmental Engineering
Riber, C., Project Participant, Department of Environmental Engineering
Janniche, G. S., Project Participant, Department of Environmental Engineering
Project ID: 30225
Sam.arb.aftaler - Amter og kommuner: DKK500,000.00
01/04/2002 → 30/06/2004
Collaborators: Municipality of Århus
Award relations: Environmental assessment of solid waste management in the municipality of Aarhus
Project: Research

Methane emissions from organic household waste biogasification.

Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30216
Forskningsprojekter - Miljø- og Energimisteriet: DKK404,000.00
01/01/2002 → 31/10/2002
Award relations: Methane emissions from organic household waste biogasification.
Project: Research

Environmental assessment of solid waste management system with a view to technological innovation

Christensen, T. H., Project Manager, Department of Environmental Engineering
Project ID: 30159
Sam.arb.aftaler, Private danske - Fonde: DKK750,000.00
01/03/2001 → 28/02/2003
Award relations: Environmental assessment of solid waste management system with a view to technological innovation
Project: Research
Statistisk analyse af jordkomponenters betydning for cadmium sorption i jord.

Formålet med projektet er at undersøge om distributionskoefficienten, der udtrykker forholdet mellem komponenten bundet i hhv. jord- og vandfasen kan beskrives ved hjælp af en række jordparametre samt hvilke jordparametre der i denne forbindelse er vigtige. Sekundaert er formålet at optimere bestemmelsen af distributionskoefficienten ud fra sammenhørende værdier af S og C. Projektet udføres i samarbejde med IMT og KVL.

Rootzén, H., Project Manager, Department of Informatics and Mathematical Modeling
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering
01/01/1995 → 31/12/1997

Project: Research

TB2 Anvendelse af RGA i beton : indledende undersøgelser

Geiker, M. R., Project Manager, Department of Civil Engineering, Section for Construction Materials
Kjeldsen, A. M., Project Participant, Department of Civil Engineering, Section for Construction Materials
Christensen, T. H., Project Participant, Department of Environmental Engineering
Astrup, T. F., Project Participant, Department of Environmental Engineering
Project ID: 25699
Sam.arb.aftaler, Private danske - Andre virksomheder: DKK600,000.00
01/08/2005 → 31/03/2006

Award relations: TB2 Anvendelse af RGA i beton : indledende undersøgelser
Project: Research


The new waste chapter in the TGD is expected to provide guidance how to address the potential concerns specifically related to the "end-of-service-life" waste stage of chemical substances. This means in particular Criteria in which cases a waste scenario should be carried out guidance how to identify the most relevant emission scenarios in these cases recommendations on how to make use of available emission models for certain easte operations and emission scenarios for certain product types guidance on how proceed if no realistic emission scenario is available examples how to formulate the standard conclusions with regard for more information based on waste related releases.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Baun, A., Project Participant, Department of Environmental Science and Engineering
01/12/2000 → 31/12/2000

Project: Research

Iron and manganese in an anaerobic leachate plume

In the strongly anaerobic part of the leachate plume at the Grindsted Landfill very high concentrations of dissolved iron and manganese have been observed consistently; for example iron was found in concentrations exceeding 200 mg/l. Samples carefully obtained from the plume have been characterized in terms of colloidal content (cross flow filtration) and free ferro-ion activity (ion exchange resin technique). The results surprisingly suggest that more than 70% of the measured iron concentrations are due to free ferro-ions. This suggests strongly supersaturated conditions in the plume and currently the thermodynamic data for siderite (FeCO3) is being revisited and supplementary measurements made.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
01/02/1997 → 31/12/1998

Project: Research

Iron and manganese in an anaerobic leachate plume

In the strongly anaerobic part of the leachate plume at the Grindsted Landfill very high concentrations of dissolved iron and manganese have been observed consistently; for example iron was found in concentrations exceeding 200 mg/l. Samples carefully obtained from the plume have been characterized in terms of colloidal content (cross flow filtration) and free ferro-ion activity (ion exchange resin technique). The results surprisingly suggest that more than 70% of the measured iron concentrations are due to free ferro-ions. This suggests strongly supersaturated conditions in the plume and currently the thermodynamic data for siderite (FeCO3) is being revisited and supplementary measurements made.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Jensen, D. L., Project Participant, Department of Environmental Science and Engineering
Bodum, J. K., Project Participant, Department of Environmental Science and Engineering
Tjell, J. C., Project Participant, Department of Environmental Science and Engineering
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering
Ukendt: DKK200,000.00
01/02/1997 → 30/03/1998

Award relations: Iron and manganese in an anaerobic leachate plume
Project: Research
Inorganic fluxes in watersheds hosting old landfills

Natural attenuation by degradation may be substantial for organic pollutants in leachate plumes, but most inorganic species will be subject to only minor attenuation in the aquifer. However inorganic species as chloride, sodium, potassium, calcium, magnesium, sulfate etc. enter the groundwater also from other sources than the landfill. This be precipitation, soil weathering, use of fertilizer and use of road deicing chemicals. The significance of these other sources is being mapped by monitoring of groundwater quality just below different land uses within two watersheds also containing unlined landfills. The contributions from the landfills are also being assessed. The preliminary results indicate that deicing chemicals and agriculture contribute significantly to the load of inorganic species on the groundwater. The project will finish the field activities in the Fall of 1997. Two international journal papers are in preparation. The project is funded by the Groundwater Research Centre.

Bjerg, P. L., Project Manager, Department of Environmental Science and Engineering
Skov, B. H., Project Participant, Department of Environmental Science and Engineering
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering
Carlson, B. B., Project Participant, Department of Environmental Science and Engineering
Nielsen, M. Æ., Project Participant, Department of Environmental Science and Engineering
Pedersen, J. K., Project Participant, Department of Hydrodynamics and Water Resources
01/01/1997 → 31/12/2001

Project: Research

Distribution coefficients for metals in soils and aquifer materials

Distribution coefficients are useful parameters to describe trace metal distribution between solid phase and solute phase at low trace metal concentration provided that sorption is the controlling process. The database on distribution coefficient determined at low environmentally relevant concentration levels is still very limited and few regression equations are available for predicting distribution coefficients from soil and aquifer characteristics. We conduct batch experiments to measure distribution coefficients on soils and aquifer material. Most studies are done on samples from our library of soil and aquifer material. In general the distribution coefficients are lower in aquifer materials than in soil, but for both materials pH seems to be the dominating parameter for all the metals studied. Studies have been collected for Cd, Ni, Zn and Cu.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Hansen, J. B., Project Participant, Department of Environmental Science and Engineering
01/01/1995 → 31/12/1999

Project: Research

Colloids in landfill leachate

Heavy metal contents of landfill leachate sometimes are unexpectedly high. This may be related to the presence of colloidal matter with high metal contents that, due to lack of strict protocols on sampling and solid separation, some times are found in the sampled leachate. Leachate has been sampled by special techniques at four Danish full scale landfills and the colloidal content (down to about 1 nm) has been characterized. The four leachates had low contents of heavy metals except high concentrations of zinc in one leachate sample. A substantial part of the heavy metals were associated with the colloidal matter suggesting that the presence of colloidal matter in leachate samples may cause high metal concentrations. Sampling protocols should precisely specify the filtration procedures for leachate sampling.

Christensen, T. H., Project Manager, Department of Environmental Science and Engineering
Jensen, D. L., Project Participant, Department of Environmental Science and Engineering
Ledin, A., Project Participant, Department of Environmental Science and Engineering
Hauritz, A., Project Participant, Department of Environmental Science and Engineering
Ukendt: DKK500,000.00
01/10/1995 → 30/05/1998

Award relations: Colloids in landfill leachate

Project: Research

Cation exchange in an anaerobic leachate plume

Participants: Poul L. Bjerg, Peter Engesgaard (ISVA), Thomas H Christensen. The distribution of cations, including iron and manganese being important in relation to redox processes, in anaerobic leachate plumes is greatly affected by cation exchange although the cation exchange in leachate plumes by determining base saturation, selectivity constants (very few constants are available for Fe2+ and Mn2+) and comparing predictions with actual distribution in the plumes.

Bjerg, P. L., Project Manager, Department of Environmental Science and Engineering
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering
Engesgaard, P. K., Project Participant, Department of Hydrodynamics and Water Resources
01/01/1992 → 31/12/2001

Project: Research
Groundwater source characterization of landfills
Evaluating environmental effect of landfill especially groundwater and surface water pollution, information on the composition of landfill leachate is very important. In 1999 a study of the leachate composition of leachate from old Danish landfills was reported as paper submitted to peer-review journal. A literature review of landfill leachate composition was initiated.

Kjeldsen, P., Project Manager, Department of Environmental Science and Engineering
Bjerg, P. L., Project Participant, Department of Environmental Science and Engineering
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering
Rügge, K., Project Participant, Department of Environmental Science and Engineering
Skov, B. H., Project Participant, Department of Environmental Science and Engineering
01/06/1993 → 31/12/2000
Project: Research

Modelling the fate of organics in landfills
Organic chemicals are disposed of in landfills in terms of industrial waste, small quantities in municipal waste and traces in other waste products. These organic chemicals may sorb onto the solid waste, dissolve into the leachate, volatilize into the gas phase or degrade. Measurements at actual landfills of organic chemicals in leachate and gas are proving the presence of organic chemicals in landfills and suggest that emissions by leachate and gas are substantial fate routes, but in general very little seems to be known about the behaviour of organic chemicals in landfills. Due to lack of actual data on the amount of organic chemicals entering a landfill and on the waste composition and state, a simple model is constructed founded on basic physic-chemical principles, a first order degradation term and bookkeeping of the losses by leachate and gas, all based on average data. The model suggests that especially the degradability of the organic chemicals is a very important factor controlling the fate and emissions of organic chemicals in the landfill environment, a factor which needs much more attention. In 1999 the model was finally reported in a submitted paper. Further work was initiated with the scope of modelling the slow release of organic pollutants from specific waste types (CFCs from insulating foams). Collaboration with an British waste company was continued in order to start up a collaborative project, with one objective of validate the model.

Kjeldsen, P., Project Manager, Department of Environmental Science and Engineering
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering
01/01/1996 → 31/12/2000
Project: Research

Reactive Transport Modelling of Coupled Inorganic and Organic Processes in Groundwater
The aim of the project is to investigate coupled inorganic and organic processes in redox zones downgradient to Vejen Landfill by comparing simulation results with field observations. A Ph.D. study by Adam Brun, ISVA. Funded by the Technical University of Denmark and the Groundwater Research Centre, Technical University of Denmark.

Engesgaard, P. K., Project Manager, Department of Hydrodynamics and Water Resources
Rosbjerg, D., Project Participant, Department of Hydrodynamics and Water Resources
Brun, A., Project Participant, Department of Hydrodynamics and Water Resources
Christensen, T. H., Project Participant, Department of Environmental Science and Engineering

01/01/1992 → 01/07/1996
Award relations: Reactive Transport Modelling of Coupled Inorganic and Organic Processes in Groundwater, Reactive Transport Modelling of Coupled Inorganic and Organic Processes in Groundwater
Project: Research

C-accounting and the role of LCA in waste management
Thomas Højlund Christensen (Keynote speaker)
Department of Environmental Engineering
Atmospheric Environment
Water Technologies
Documents:
16 ICWMT Beijing T H Christensen

Related event
The 11th International Conference on Waste Management and Technology
LCA – Life-Cycle-Assessment - modeling with an industrial waste example
Period: 27 Sep 2016 → 30 Sep 2016
Thomas Højlund Christensen (Invited speaker)
Department of Environmental Engineering
Atmospheric Environment
Water Technologies
Documents:
16 Crete Thomas Christensen Invited lecture

Related event
5th International Conference on Industrial and Hazardous waste management
27/09/2016 → 30/09/2016
Crete, Greece
Activity: Talks and presentations › Conference presentations