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Publication information
Methanotrophic contribution to biodegradation of phenoxy acids in cultures enriched from a groundwater-fed rapid sand filter

Drinking water supply is in many parts of the world based on groundwater. Groundwater often contains methane, which can be oxidized by methanotrophs upon aeration. Sand from rapid sand filters fed with methane-rich groundwater can remove some pesticides (Hedegaard and Albrechtsen in Water Res 48:71-81, 2014). We enriched methanotrophs from filter sand and investigated whether they could drive the degradation of various pesticides. To enrich for methanotrophs, we designed and operated four laboratory-scale, continuously methane-fed column reactors, inoculated with filter sand and one control column fed with tap water. When enrichments were obtained, methane was continuously supplied to three reactors, while the fourth was starved for methane for 1 week, and the reactors were spiked with ten pesticides at groundwater-relevant concentrations (2.1-6.6 μg/L). Removal for most pesticides was not detected at the investigated contact time (1.37 min). However, the degradation of phenoxy acids was observed in the methanotrophic column reactor starved for methane, while it was not detected in the control column indicating the importance of methanotrophs. Phenoxy acid removal, using dichlorprop as a model compound, was further investigated in batch experiments with methanotrophic biomass collected from the enrichment reactors. Phenoxy acid removal (expressed per gram of matrix sand) was substantially improved in the methanotrophic enrichment compared to parent filter sand. The presence of methane did not clearly impact dichlorprop removal but did impact mineralization. We suggest that other heterotrophs are responsible for the first step in dichlorprop degradation, while the subsequent steps including ring-hydroxylation are driven by methanotrophs.

Microbial degradation pathways of the herbicide bentazone in filter sand used for drinking water treatment

The herbicide bentazone is used extensively worldwide, and it is frequently detected in groundwater sources used for drinking water production. Previously, bentazone has been shown to be biodegraded in filter sand from biological rapid sand filters at various waterworks. This untapped potential could be an inexpensive and sustainable alternative for the removal of trace organic contaminants. To study the fate of bentazone in sand filters and to identify associated risks, degradation pathways in filter sand were identified and the toxicity of identified transformation products was evaluated using quantitative structure–activity relationship (QSAR) modelling. Bentazone degradation was investigated in microcosm experiments with filter sand, effluent water and bentazone at elevated (5 mg L−1) and environmentally relevant concentrations (<10 μg L−1). The investigations at elevated concentrations revealed up to 10 transformation products, suggesting three main biotransformation pathways: 1) oxidation of the isopropyl-moiety to the corresponding carboxylic acid, 2) oxidation of the aromatic ring leading to ring cleavage and subsequent decarboxylation reactions, and 3) N-methylation followed by oxidation to a carboxylic acid. At environmentally relevant concentrations, 92% of the initial bentazone was removed within 13 days, and at this point only one transformation product, carboxy-bentazone, could be detected in the water. QSAR-models considering both human and environmentally relevant endpoints showed that degradation in filter sand led to a detoxification of bentazone. Initial oxidation processes followed by further degradation,
and partial mineralization highlights the relevance of both methanotrophs and heterotrophs for the bentazone degradation in rapid sand filters.

Softening of drinking water – are other processes in the treatment affected?

Softening of drinking water by the pellet reactor - Effects of influent water composition on calcium carbonate pellet characteristics

Pellet softening of drinking water can provide aesthetic, socioeconomic and environmental benefits in areas with hard water. Calcium carbonate pellets are the main by-product from pellet softening and their characteristics determine their reuse potentials. We characterized pellets from a pilot-scale pellet reactor treating 16 water types at 8 Danish drinking water treatment plants to investigate the variations in pellet characteristics and how they depend on the influent water composition. The pellets consisted of up to 100% calcium as calcium carbonate, but contained often also impurities such as strontium, magnesium, iron and sodium each contributing with up to 1.3% of the pellet mass. Other elements, including heavy metals, accounted for <0.04% of the pellet mass. The quartz sand seeding material contributed with up to 15% of the pellet mass and can be a barrier for pellet reuse. Therefore, replacing this with calcium carbonate (limestone) seeding material increases the pellet purity. Modelling the chemical speciation indicated that elements not forming carbonates (e.g. potassium and magnesium), are only incorporated into pellets to a limited extent. The concentrations of strontium, magnesium, manganese, iron and nickel in the pellets had a strong positive correlation with the influent water concentration. Consequently, the pellet purity increases if the concentration of these elements is reduced in the water before softening by other treatment technologies. Potassium, arsenic and zinc showed no or only a weak correlation. The pellets precipitated as calcite, and had a reactivity of ≤25.7% and a specific surface area of ≤0.32m2/g, which limits the potential reuse in agriculture. The pellet mineralogy was independent of the investigated range of influent water quality and seeding materials. Including pellet quality when designing the softening process can improve pellet reuse, ultimately leading to a more environmentally sustainable drinking water supply.
ASTA - A method for multi-criteria evaluation of water supply technologies to Assess the most SusTainable Alternative for Copenhagen

Utilities in larger cities have to make complex decisions planning future investments in urban water infrastructure. Changes are driven by physical water stress or political targets for environmental water flows e.g. through the implementation of the European water framework directive. To include these environmental, economic and social sustainability dimensions we introduce a novel multi-criteria assessment method for evaluation of water supply technologies. The method is presented and demonstrated for four alternatives for water supply based on groundwater, rain- & stormwater or seawater developed for augmenting Copenhagen's current groundwater based water supply. To identify the most sustainable technology, we applied rank order distribution weights to a multi-criteria decision analysis to combine the impact assessments of environment, economy and society. The three dimensions were assessed using 1) life-cycle assessment, 2) cost calculations taking operation and maintenance into account and 3) the multi-criteria decision analysis method Analytical hierarchy process. Specialists conducted the life-cycle assessment and cost calculations and the multi-criteria decision analyses were based on a stakeholder workshop gathering stakeholders relevant for the specific case. The workshop reached consensus on three sets of ranked criteria. Each set represented stakeholder perspectives with first priority given to one of the three sustainability dimensions or categories. The workshop reached consensus and when the highest weight was assigned to the environmental dimension of sustainability then the alternative of 'Rain- & stormwater harvesting' was the most sustainable water supply technology; when the highest weight was assigned to the economy or society dimensions then an alternative with 'Groundwater abstraction extended with compensating actions' was considered the most sustainable water supply technology. Across all three sets of ranked weights, the establishment of new well fields is considered the least sustainable alternative.

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Bedre forudsigelse af effekterne fra blødgøring

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**Biological treatment: Optimization of biological rapid sand filters for drinking water production**
Drinking water production from groundwater will often require removal of several compounds such as ammonia, manganese, ferrous iron, methane, sulphides or natural organic matter (NOM). In rapid sand filters this may be mediated through microbial processes. Sometimes the filters unfortunately fail to meet the design criteria, and a deeper insight in the underlying processes would provide a necessary platform to solve the problems. Efficient removal of potential microbial substrates is essential for production of biostable water which is required when the produced drinking water is stored and distributed without a disinfection residual as e.g. in Denmark. We have developed a toolbox including investigations of the presence of required microorganisms. To investigate the presence and density of various microbial fractions, qPCR-methods were established for quantification of ammonium oxidizing (AOB, AOA), nitrite oxidizing (NOB), iron oxidizing (IOB) and methane oxidizing (MeOB) microorganisms. In addition, pyrosequencing of the full microbiome of the sand filters revealed a high diversity, and especially the presence of a very large and dominating population of Nitrospira was surprizing. Nitrification was particularly investigated in full scale filters, and lab-scale CST-columns incubated with depth specific samples of filter material allowed for investigation of the depth specific kinetics and maximum removal capacity. Additionally, pilot scale column experiments allowed for investigation of e.g. increased load of ammonium due to increased hydraulic load versus increased concentration, physical space in the filter material and its surface qualities. A safe operational windows in terms of load was identified during short term up-shifts in the ammonium load to the different columns. This showed the importance of the total load no matter the increase was due to hydraulic load or concentration. Based on the obtained insight the functionality of the filters could be optimized. Addition of limiting micronutrients such as phosphorous or cupper (which specifically stimulating nitrification since cupper is an essential metal in the ammonium mono oxygenase) was able to increase nitrification rate, to overcome incomplete nitrification with accumulation of nitrite, and to reduce the startup time of the microbial processes in new filters. This presentation provides an overview of a number of research projects on biological rapid sand filters conducted during the last 5 years.

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Can pesticide degradation be connected with methane oxidation at waterworks?

Detection of drinking water contamination by an optical real-time bacteria sensor

In a drinking water distribution system, little is known about the characteristics of a microbiological pollution, how it enters the system, and how it can be detected. The drinking water industry has relied on various pollution indicators, through grab sampling and laboratory analyses, revealing results long after the water has been used. To be able to react more proactively to pollution events, many drinking water distributors supplement grab sampling with proportional sampling and/or real-time sensors. We have tested the ability of a new bacteria monitor to detect four different pollution events: wastewater intrusion, rainwater runoff, resuspension of drinking water sediments, and bird droppings entering the distribution system. The monitor response, in terms of bacteria and abiotic particle concentrations, was compared with traditional laboratory methods. The results illustrate the benefits of using such real-time bacteria sensors for monitoring the dynamics of drinking water microbiology and for early warning of potential pollution events.

Although earlier circumstantial observations have suggested the presence of iron oxidizing bacteria (IOB) in groundwater-fed rapid sand filters (RSF), ferrous iron (Fe(II)) oxidation in this environment is often considered a chemical process due to the highly oxic and circumneutral pH conditions. The low water temperature (5-10 degrees C), typical of groundwaters, on the other hand, may reduce the rates of chemical Fe(II) oxidation, which may allow IOB to grow and compete with chemical Fe(II) oxidation. Hence, we hypothesized that IOB are active and abundant in groundwater-fed RSFs. Here, we applied a combination of cultivation and molecular approaches to isolate, quantify, and confirm the growth of IOB from groundwater-fed RSFs, operated at different influent Fe(II) concentrations. Isolates related to Undibacterium and Curvibacter were identified as novel IOB lineages. Gallionella spp. were dominant in all waterworks, whereas Ferriphaselus and Undibacterium were dominant at pre-filters of waterworks receiving groundwaters with high (> 2 mg/l) Fe(II) concentrations. The high density and diversity of IOB in groundwater-fed RSFs suggest that neutrophilic IOB may not be limited to oxic/anoxic interfaces.
Does universal 16S rRNA gene amplicon sequencing of environmental communities provide an accurate description of nitrifying guilds?

Universal (i.e., targeting most bacteria/prokaryotes) 16S rRNA gene based amplicon sequencing is widely used for assessing microbial communities due to its low cost, time efficiency, and ability to provide a full overview of the community. However, it is currently unclear if it can yield reliable information on specific microbial guilds, which can be obtained by using primer sets targeting functional genes or specific 16S rRNA gene sequences. Here, we compared the relative abundance, diversity, richness, and composition of selected guilds (nitrifiers), obtained from universal 16S rRNA gene based amplicon sequencing and from guild targeted approaches. The universal amplicon sequencing provided 1) accurate estimates of nitrifier composition, 2) clustering of the samples based on these compositions consistent with sample origin, 3) estimates of the relative abundance of the guilds correlated with those obtained from the targeted approaches and within ~1.2 orders of magnitude of them, but with measurable bias that should be considered when comparing estimates from both approaches. In contrast, the diversity and richness estimations using the universal 16S rRNA based amplicon sequencing were likely limited by the sequencing depth; therefore, we suggest preferring targeted approaches for assessing nitrifiers diversity and richness or using sequencing depth larger than those currently typically practiced.
Evidence of co-metabolic bentazone transformation by methanotrophic enrichment from a groundwater-fed rapid sand filter

The herbicide bentazone is recalcitrant in aquifers and is therefore frequently detected in wells used for drinking water production. However, bentazone degradation has been observed in filter sand from a rapid sand filter at a waterworks with methane-rich groundwater. Here, the association between methane oxidation and removal of bentazone was investigated with a methanotrophic enrichment culture derived from methane-fed column reactors inoculated with that filter sand.

Several independent lines of evidence obtained from microcosm experiments with the methanotrophic enrichment culture, tap water and bentazone at concentrations below 2 mg/L showed methanotrophic co-metabolic bentazone transformation: The culture removed 53% of the bentazone in 21 days in presence of 5 mg/L of methane, while only 31% was removed in absence of methane. Addition of acetylene inhibited methane oxidation and stopped bentazone removal. The presence of bentazone partly inhibited methane oxidation since the methane consumption rate was significantly lower at high (1 mg/L) than at low (1 μg/L) bentazone concentrations. The transformation yield of methane relative to bentazone normalized by their concentration ratio ranged from 58 to 158, well within the range for methanotrophic co-metabolic degradation of trace contaminants calculated from the literature, with normalized substrate preferences varying from 3 to 400. High-resolution mass spectrometry revealed formation of the transformation products (TPs) 6-OH, 8-OH, isopropyl-OH and di-OH-bentazone, with higher abundances of all TPs in the presence of methane. Overall, we found a suite of evidence all showing that bentazone was co-metabolically transformed to hydroxy-bentazone by a methanotrophic culture enriched from a rapid sand filter at a waterworks.
Holistic design of centralised drinking water softening

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Methane oxidation and the degradation potential of the herbicide bentazone at Danish waterworks

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On-line mikrobiel drikkevandskvalitet - on-site tests

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On-line monitoring of microbial drinking water quality – on site tests
Microbial contamination is a major threat to drinking water quality, and monitoring the microbial water quality is a way to ensure good and safe drinking water. However, grab sampling and long incubation times for growth based methods may lead to late responses (several days) which may be too late to allow for relevant correcting actions. This calls for methods which can provide results rapidly - ideally in nearly real times. Microbial water quality is not restricted to pathogens or indicator organisms, since increased microbial numbers and activity may reflect the management and functionality of
microbial processes in the treatment such as back washing of biological rapid sand filters. Furthermore they may become essential in distribution systems to monitor the efficiency of the disinfection or in cases without disinfection residual where reparations of pipes, stagnant water or ingress of water in case of leakages challenge the water quality.

Several approaches have been taken to monitor the microbial water quality - one is a biochemical parameter Adenosine TriPhosphate (ATP), since it is an energy carrier molecule present in all living cells. Monitoring of ATP in drinking water is a promising technique because firstly, ATP is an indicator of total microbial activity, meaning that only active microorganisms are detected, and the detection is not restricted to a specific microbial type. Secondly, ATP analysis can provide results in few minutes, creating a great potential for real time monitoring. We have successfully demonstrated the use of ATP as a measure for ingress of contaminating water in the drinking water system, and to monitor the effect of backwashing rapid sand filters.

Another approach is to monitor enzyme activity in terms of Alkaline Phosphatase (ALP) which is produced in most microbial cells and which can use 4-Methylumbelliferyl-Phosphate (MUP) which is a Fluorescent substrate. This is measured in a fully automated instrument BACTcontrol (microLAN) with a total measuring time of 40 minutes and where the phosphatase activity was determined by measuring the fluorescence associated with the formation of 4-methylumelliferone (MUF).

We are comparing these two approaches: the BACTcontrol Total Activity online analyzer and ATP analysis as well as other viability assays through simultaneous measurement at two different water companies: Aigües de Barcelona (AB), and Cetaqua, Spain, and Nordvand, Gentofte, Denmark. The eight-month long investigation includes including both the drinking water treatment plant and the distribution network i.e. multi-source chlorinated tap water from Barcelona DN and three types of process water from DWTP (sandfiltered water, GAC-filtered water and treated water) as well as biologically treated ground water.

This project is an ongoing work and further validation and optimization are supported by the EU granted project Aquavalens.

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Optimeret blødgøring med pelletmetoden – kalkfines og CCPP

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Optimizing the benefits from drinking water softening by better calculating the calcium carbonate precipitation potential - CCPP

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Remediation of incomplete nitrification and capacity increase of biofilters at different drinking water treatment plants through copper dosing

Drinking water treatment plants based on groundwater may suffer from incomplete ammonium removal, which deteriorates drinking water quality and constrains water utilities in the operation of their plants. Ammonium is normally removed through nitrification in biological granular media filters, and recent studies have demonstrated that dosing of copper can stimulate the removal of ammonium. Here, we investigated if copper dosing could generically improve ammonium removal of biofilters, at treatment plants with different characteristics. Copper was dosed at ≤1.5μg Cu/L to biofilters at 10 groundwater treatment plants, all of which had displayed several years of incomplete nitrification. Plants exceeded the Danish national water quality standard of 0.05mg NH4+/L by a factor of 2–12. Within only 2-3 weeks of dosing, ammonium removal rates increased significantly (up to 150%). Nitrification was fully established, with ammonium effluent concentrations of <0.01mg NH4+-N/L at most plants, regardless of the differences in raw water chemistry, ammonium
loading rates, filter design and operation, or treatment plant configuration. However, for filters without primary filtration, it took longer time to reach complete ammonium removal than for filters receiving prefiltered water, likely due to sorption of copper to iron oxides, at plants without prefiltration. With complete ammonium removal, we subjected two plants to short-term loading rate upshifts, to examine the filters’ ability to cope with loading rate variations. After 2 months of dosing and an average loading rate of 1.0g NH₄⁺-N/m³ filter material/h, the loading rate was upshifted by 50%. Yet, a filter managed to completely remove all the influent ammonium, showing that with copper dosing the filter had extra capacity to remove ammonium even beyond its normal loading rates. Depth sampling revealed that the ammonium removal rate of the filter’s upper 10cm increased more than 7-fold from 0.67 to 4.90g NH₄⁺-N/m³/h, and that nitrite produced from increased ammonium oxidation was completely oxidized further to nitrate. Hence, no problems with nitrite accumulation or breakthrough occurred. Overall, copper dosing generically enhanced nitrification efficiency and allowed a range of quite different plants to meet water quality standards, even at increased loading rates. The capacity increase is highly relevant in practice, as it makes filters more robust towards sudden ammonium loading rate variations.

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Stochastic processes govern invasion success in microbial communities when the invader is phylogenetically close to resident bacteria
Despite recent efforts in identifying the determinants of invasion in microbial communities, experimental observations across different ecosystems are inconclusive. While relationships between resident community diversity and invasion success are often noted, community diversity says little about community assembly processes. Community assembly processes may provide a more inclusive framework to explain-and potentially prevent or facilitate-invasion. Here we let replicate nitrite-oxidizing bacterial guilds assemble under different conditions from a natural source community and study their compositional patterns to infer the relative importance of the assembly processes. Then, an invader strain from that same guild was introduced at one of three propagule pressures. We found no significant correlation between community diversity and invasion success. Instead, we observed that the effect of selection on invasion success was surpassed by the effect of drift, as inferred from the substantial influence of propagule pressure on invasion success. This dominance of drift can probably be generalized to other invasion cases with high phylogenetic similarity between invader and resident community members. In these situations, our results suggest that attempting to modulate the invasibility of a community by altering its diversity is futile because stochastic processes determine the invasion outcome. Increasing or reducing propagule pressure is then deemed the most efficient avenue to enhance or limit invasion success.

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Aquavalens Project - Report on the selected DWTPs and distribution networks and control points for instrument installation: Deliverable D10.1

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By-product reuse in drinking water softening: influence of operating conditions on calcium carbonate pellet characteristics

Water utilities are becoming increasingly aware of the environmental sustainability of drinking water production and distribution, while still producing water meeting regulatory guidelines in a cost-effective manner. In areas with high water hardness, central drinking water softening can provide both socio-economic and environmental benefits. However, optimal implementation of softening requires a holistic approach including e.g. possibilities for by-product reuse. A pellet reactor is one widely used softening technology that may produce up to 350 kg calcium carbonate pellets per 1000 m3 softened water. As of yet, no overview exists of how the physical and chemical properties of pellets are affected by operating conditions, such as placement in the water treatment train and which seeding material is used (quartz sand or calcium carbonate). The aim of this study was to characterize pellets formed under different operating conditions in pilot scale experiments at 8 Danish water treatment plants softening 16 water types. Results showed that iron concentrations, measured with ICP-MS, varied from 19 to 9,200 mg/kg and manganese varied from 0.5 to 980 mg/kg. The concentrations depended on both the raw water quality and the location of softening in the treatment train. Despite differences in chemical dosage, chemical composition of influent water, and seeding material, XRD analyzes showed that all pellets crystallized as calcite and have a relatively low reactivity of 7.4 to 26 % measured by the Sauerbeck & Rietz method. Our study showed that some pellet characteristics, e.g. the concentrations of iron and manganese, can be controlled in the design of the softening process. This allows for optimization of pellets with respect to environmentally sustainable reuse and ensure a pellet composition with high market value e.g. in markets such as glass or chemical industries. Our results assist the circular economy thinking in drinking water production.

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Challenges in using allylthiourea and chlorate as specific nitrification inhibitors

Allylthiourea (ATU) and chlorate (ClO3-) are often used to selectively inhibit nitrification and nitratation. In this work we identified challenges with use of these compounds in inhibitory assays with filter material from a biological rapid sand filter for groundwater treatment. Inhibition was investigated in continuous-flow lab-scale columns, packed with filter material from a full-scale filter and supplied with NH4+ or NO2-. ATU concentrations of 0.1-0.5 mM interfered with the indophenol
blue method for NH4+ quantification leading to underestimation of the measured NH4+ concentration. Interference was stronger at higher ATU levels and resulted in no NH4+ detection at 0.5 mM ATU. ClO3- at typical concentrations for inhibition assays (1-10 mM) inhibited nitratation by less than 6%, while nitratation was instead inhibited by 91% when NH4+ was supplied. On the other hand, nitratation was inhibited by 67-71% at 10-20 mM ClO3- when NO2- was supplied, suggesting significant nitratation inhibition at higher NO2- concentrations. No chlorite (ClO2-) was detected in the effluent, and thus we could not confirm that nitratation inhibition was caused by ClO3- reduction to ClO2-. In conclusion, ATU and ClO3- should be used with caution in inhibition assays, because analytical interference and poor selectivity for the targeted process may affect the experimental outcome and compromise result interpretation.

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Copper dosing enhances nitrification in biofilters treating groundwater

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Corrigendum to "Microbial pesticide removal in rapid sand filters for drinking water treatment - Potential and kinetics" [Water Res. 48 (2014) 71-81]

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Contributors: Hedegaard, M. J., Albrechtsen, H.
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Publication information
Density and distribution of nitrifying guilds in rapid sand filters for drinking water production: Dominance of Nitrospira spp.

We investigated the density and distribution of total bacteria, canonical Ammonia Oxidizing Bacteria (AOB) (Nitrosomonas plus Nitrosospira), Ammonia Oxidizing Archaea (AOA), as well as Nitrobacter and Nitrospira in rapid sand filters used for groundwater treatment. To investigate the spatial distribution of these guilds, filter material was sampled at four drinking water treatment plants (DWTPs) in parallel filters of the pre- and after-filtration stages at different locations and depths. The target guilds were quantified by qPCR targeting 16S rRNA and amoA genes. Total bacterial densities (ignoring 16S rRNA gene copy number variation) were high and ranged from 10^9 to 10^10 per gram (10^15 to 10^16 per m^3) of filter material. All examined guilds, except AOA, were stratified at only one of the four DWTPs. Densities varied spatially within filter (intra-filter variation) at two of the DWTPs and in parallel filters (inter-filter variation) at one of the DWTPs. Variation analysis revealed random sampling as the most efficient strategy to yield accurate mean density estimates, with collection of at least 7 samples suggested to obtain an acceptable (below half order of magnitude) density precision. Nitrospira was consistently the most dominant guild (5–10% of total community), and was generally up to 4 orders of magnitude more abundant than Nitrobacter and up to 2 orders of magnitude more abundant than canonical AOBs. These results, supplemented with further analysis of the previously reported diversity of Nitrospira in the studied DWTPs based on 16S rRNA and nxrB gene phylogeny (Gülçay et al., 2016; Palomo et al., 2016), indicate that the high Nitrospira abundance is due to their comammox (complete ammonia oxidation) physiology. AOA densities were lower than AOB densities, except in the highly stratified filters, where they were of similar abundance. In conclusion, rapid sand filters are microbially dense, with varying degrees of spatial heterogeneity, which requires replicate sampling for a sufficiently precise determination of total microbial community and specific population densities. A consistently high Nitrospira to bacterial and archaeal AOB density ratio suggests that non-canonical pathways for nitrification may dominate the examined RSFs.
Monitoring water quality in drinking water distribution systems is the basis for proactive approaches to prevent or manage emerging water quality issues, and such a monitoring requires a strategic selection of relevant and representative monitoring sites. GISMOWA is a new GIS and risk-based analysis tool to identify and prioritize pipe segments for water quality monitoring and to comply with existing monitoring and sampling guidelines. The tool was designed to integrate multiple parameters categorized as (1) hydraulic and structural weaknesses in the system, e.g., residence time; (2) external threats, e.g., contaminated sites; and (3) sensitive consumers, e.g., hospitals, in a GIS environment. The tool used a multicriteria decision analysis to evaluate multiple monitoring site parameters and map zones particularly suitable for water quality monitoring. GISMOWA was applied to Danish water distribution systems as a transparent and simple-to-use tool facilitating a complete overview of the distribution system, including sensitive consumers and consumers in general, thus fulfilling a precondition for a HACCP-based monitoring strategy of drinking water. (C) 2017 American Society of Civil Engineers.
Invasion of nitrite oxidizer dominated communities: interactions between propagule pressure and community composition

Managing invasion of microbial communities by new members can be a powerful tool in microbial resource management. Abundant studies have examined how resource availability and resident community diversity affect invasion success. Yet, a more rigorous approach towards studying invasion would consider a broader community ecology framework. For example, the effect of propagule pressure, often studied in macro-ecology, has rarely been examined for microbial communities. Also, the interactions between processes governing community assembly and propagule pressure on invasion success have never been reported.

The objective of this study was to determine the effect of propagule pressure on invasion success in microbial communities, shaped by varying degrees of stochasticity and determinism. The experimental system consisted of nitrite oxidizing bacterial enrichments, developed in replicate flow-through biofilm reactors using drinking water as inoculum and continuous feeding with nitrite as a sole energy source. Different nitrite loading rates were applied, as these were previously shown to influence nitrifying guild composition and stochasticity [1]. After 6 weeks, the reactors were invaded for 24 hours by nitrite oxidizer strain (Candidatus Nitrotoga sp. HW29) at 3 different propagule pressures. The reactors were then operated another 2 weeks before analyzing community composition by targeted qPCRs and 16S rRNA gene amplicon analysis. We successfully assembled resident communities with different ratios of Nitrotoga to Nitrospira as a result of determinism created by different nitrite concentrations: High nitrite loading selected for a diverse and abundant Nitrotoga population while low nitrite loading selected for an abundant Nitrospira population. We noted invasion success only at the highest propagule pressure, and the frequency of establishment was higher under low versus high nitrite loading conditions. Contrary to previous invasion studies, we found no significant correlation between resident community diversity and invasion success. Instead, our results suggest that deterministic processes combined with resident-invader phylogenetic relatedness influence invasion success.

Niche partitioning within genus Nitrospira is affected by environmental copper concentration

Nitrification is a dominant process in groundwater-fed rapid sand filters (RSFs) used for drinking water purification. Near complete removal of ammonium and nitrite is required in the EU and Denmark due to strict regulatory limits that enable high water stability in the distribution system. Previous work has revealed that in poorly functioning filters, the addition of trace copper can increase the rate of nitrification, leading to increased removal of ammonium and nitrite to below regulatory limits. RSFs are a unique environment harboring diverse microbial communities including a range of nitrifying bacteria; Betaproteobacterial ammonia oxidizers (Nitrosomonas, Nitrosospira; AOB), ammonia oxidizing archaea (AOA), diverse heterotrophs potentially capable of ammonia and/or nitrite oxidation and a large fraction of Nitrospira spp., recently shown to comprise both nitrite oxidizers and comammox Nitrospira spp.. This diversity points towards extensive niche partitioning within the nitrifying guild, and particularly within Nitrospira which generally comprises between 10 and 65% of the total filter community. Copper is a co-factor in the ammonia monooxygenase enzyme and is thus an essential and at times limiting nutrient in nitrifying environments. We sought to examine the effects of copper on niche partitioning within the genus Nitrospira in full-scale filters. Sand samples from the top of an after-filter that displayed incomplete ammonium oxidation at Nærum waterworks were taken prior to Cu dosing treatment and 4 months following the commencement of low-level Cu dosing (~ μg Cu L-1). Copper treatment had an immediate effect on nitrification, resulting in removal of...
ammonium and nitrite to below regulatory levels. DNA was extracted from sand samples and was subject to qPCR and amplicon based Illumina sequencing of Nitrospira nxrB (nitrite reductase B-subunit) and amoA genes using newly designed primers targeting clades A and B comammox. Quantitative PCR revealed that Cu addition resulted in a 4-fold increase of total Nitrospira, but a 5-fold decrease in the abundance of comammox Nitrospira. However, further examination of the qPCR melt curves and amoA sequence data revealed that the reduction in comammox Nitrospira resulted from the near complete loss of Clade B comammox, while Clade A comammox were present at similar absolute abundances as in the community prior to copper dosing. The reasons for the loss of Clade B comammox are currently unclear. Higher sensitivity to copper toxicity in Clade B relative to Clade A and nitrite-oxidizing Nitrospira seems unlikely due to the extremely low copper concentrations applied. An overall stimulation of the growth of nitrifying bacteria occurred once copper limitation was removed, likely resulting in the out-competition of Clade B Nitrospira ammonium oxidizers. These results suggest that copper availability plays a role in determining the diversity and distribution of Nitrospira spp. in nitrifying environments.

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Nitrotoga is selected over Nitrospira in newly assembled biofilm communities from a tap water source community at increased nitrite loading
Community assembly is a central topic in microbial ecology: how do assembly processes interact and what is the relative contribution of stochasticity and determinism? Here, we exposed replicate flow-through biofilm systems, fed with nitrite-supplemented tap water, to continuous immigration from a source community, present in the tap water, to determine the extent of selection and neutral processes in newly assembled biofilm communities at both the community and the functional guild (of nitrite-oxidizing bacteria, NOB) levels. The community composition of biofilms assembled under low and high nitrite loading was described after 40 days of complete nitrite removal. The total community assembly, as well as the NOB guild assembly were largely governed by a combination of deterministic and stochastic processes. Furthermore, we observed deterministic enrichment of certain types of NOB in the biofilms. Specifically, elevated nitrite loading selected for a single Nitrotoga representative, while lower nitrite conditions selected for a number of Nitrospira. Therefore, even when focusing on ecologically coherent ensembles, assembly is the result of complex stochastic and deterministic processes that can only be interrogated by observing multiple assemblies under controlled conditions. This article is protected by copyright. All rights reserved.

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Web of Science (2017): Indexed yes
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On the way to on-line monitoring of microbial drinking water quality

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Pellets fra central blødgøring - fra affald til ressource

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Pesticide degradation potential of pesticides in biological rapid sand filters at 10 different waterworks

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Possibilities for reuse of calcium carbonate pellets from drinking water softening
A novel, optical, on-line bacteria sensor for monitoring drinking water quality

Today, microbial drinking water quality is monitored through either time-consuming laboratory methods or indirect on-line measurements. Results are thus either delayed or insufficient to support proactive action. A novel, optical, on-line bacteria sensor with a 10-minute time resolution has been developed. The sensor is based on 3D image recognition, and the obtained pictures are analyzed with algorithms considering 59 quantified image parameters. The sensor counts individual suspended particles and classifies them as either bacteria or abiotic particles. The technology is capable of distinguishing and quantifying bacteria and particles in pure and mixed suspensions, and the quantification correlates with total bacterial counts. Several field applications have demonstrated that the technology can monitor changes in the concentration of bacteria, and is thus well suited for rapid detection of critical conditions such as pollution events in drinking water.

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Copper deficiency can limit nitrification in biological rapid sand filters for drinking water production

Incomplete nitrification in biological filters during drinking water treatment is problematic, as it compromises drinking water quality. Nitrification problems can be caused by a lack of nutrients for the nitrifying microorganisms. Since copper is an important element in one of the essential enzymes in nitrification, we investigated the effect of copper dosing on nitrification in different biological rapid sand filters treating groundwater. A lab-scale column assay with filter material from a water works demonstrated that addition of a trace metal mixture, including copper, increased ammonium removal compared to a control without addition. Subsequently, another water works was investigated in full-scale, where copper influent concentrations were below 0.05 μg Cu L-1 and nitrification was incomplete. Copper dosing of less than 5 μg Cu L-1 to a full-scale filter stimulated ammonium removal within one day, and doubled the filter's removal from 0.22 to 0.46 g NH4-N m-3 filter material h-1 within 20 days. The location of ammonium and nitrite oxidation shifted upwards in the filter, with an almost 14-fold increase in ammonium removal rate in the filter's top 10 cm, within 57 days of dosing. To study the persistence of the stimulation, copper was dosed to another filter at the water works for 42 days. After dosing was stopped, nitrification remained complete for at least 238 days. Filter effluent concentrations of up to 1.3 μg Cu L-1 confirmed that copper fully penetrated the filters, and determination of copper content on filter media revealed a buildup of copper during dosing. The amount of copper stored on filter material gradually decreased after dosing stopped; however at a slower rate than it accumulated. Continuous detection of copper in the filter effluent confirmed a release of copper to the bulk phase. Overall, copper dosing to poorly performing biological rapid sand filters increased ammonium removal rates significantly, achieving effluent concentrations of below 0.01 mg NH4-N L-1, and had a long-term effect on nitrification performance.

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Copper dosing stimulates nitrification in full-scale biological drinking water filters

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Copper dosing to biological rapid sand filters increases nitrifier activity and abundance

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Demonstrationsanlæg til blødgøring af drikkevand: Fyrtårnsprojekt “Fremtidens Drikkevandsforsyning” Arbejdspakke 5

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De novo biofilm community assembly from tap water source communities favors Nitrotoga over Nitrospira under elevated nitrite surface loading

Four main processes are considered to drive microbial community assembly: selection, drift, dispersal and speciation. These processes occur simultaneously, but the extent to which each process contributes to community assembly is unclear in natural communities. We exposed a high-throughput flow-through biofilm system to continuous immigration from a tap water metacommunity while applying different nitrite surface loading rates. After 63 days of operation, we extracted biofilms and analyzed the community composition via Illumina MiSeq targeting the 16S rRNA gene. Previous studies have shown that Nitrospira is the dominant nitrite oxidizing genus in low nitrite environments. Hence, we postulated that by elevating the nitrite surface loading we would select for NOB with lower nitrite affinity than Nitrospira. We observed different dominant NOB species under different loading rates. While in the metacommunity, Nitrotoga and Nitrospira were
found at near equal abundances, in the biofilm community, elevated nitrite loading strongly selected for Nitrotoga over Nitrospira. The biofilms were also significantly different in their alpha-diversity (p<0.001) and beta-diversity, and the evenness and richness of the biofilm community decreased significantly (p=0.004) compared to the metacommunity. These observations indicate that the selection towards Nitrotoga and Nitrospira dominated community assembly under different nitrite loadings. Lastly, we compared our observations of community composition with that predicted by neutral community assembly model. The predictions did not match the community structure observed in the biofilms (p=0.31), providing further evidence of the importance of selection during community assembly.

Depth investigation of rapid sand filters for drinking water production reveals strong stratification in nitrification biokinetic behavior
The biokinetic behavior of NH4 + removal was investigated at different depths of a rapid sand filter treating groundwater for drinking water preparation. Filter materials from the top, middle and bottom layers of a full-scale filter were exposed to various controlled NH4 + loadings in a continuous-flow lab-scale assay. NH4 + removal capacity, estimated from short term loading up-shifts, was at least 10 times higher in the top than in the middle and bottom filter layers, consistent with the stratification of Ammonium Oxidizing Bacteria (AOB). AOB density increased consistently with the NH4 + removal rate, indicating their primarily role in nitrification under the imposed experimental conditions. The maximum AOB cell specific NH4 + removal rate observed at the bottom was at least 3 times lower compared to the top and middle layers. Additionally, a significant up-shift capacity (4.6 and 3.5 times) was displayed from the top and middle layers, but not from the bottom layer at increased loading conditions. Hence, AOB with different physiological responses were active at the different depths. The biokinetic analysis predicted that despite the low NH4 + removal capacity at the bottom layer, the entire filter is able to cope with a 4-fold instantaneous loading increase without compromising the effluent NH4 +. Ultimately, this filter up-shift capacity was limited by the density of AOB and their biokinetic behavior, both of which were strongly stratified.
Ecological patterns, diversity and core taxa of microbial communities in groundwater-fed rapid gravity filters

Here, we document microbial communities in rapid gravity filtration units, specifically serial rapid sand filters (RSFs), termed prefiltration (PFs) and after-filtration (AFs) filters, fed with anoxic groundwaters low in organic carbon to prepare potable waters. A comprehensive 16S rRNA-based amplicon sequencing survey revealed a core RSF microbiome comprising few bacterial taxa (29–30 genera) dominated by Nitrospirae, Proteobacteria and Acidobacteria, with a strikingly high abundance (75–87±18%) across five examined waterworks in Denmark. Lineages within the Nitrospira genus consistently comprised the second most and most abundant fraction in PFs (27±23%) and AFs (45.2±23%), respectively, and were far more abundant than typical proteobacterial ammonium-oxidizing bacteria, suggesting a physiology beyond nitrite oxidation for Nitrospira. Within the core taxa, sequences closely related to types with ability to oxidize ammonium, nitrite, iron, manganese and methane as primary growth substrate were identified and dominated in both PFs (73.6±6%) and AFs (61.4±21%), suggesting their functional importance. Surprisingly, operational taxonomic unit richness correlated strongly and positively with sampling location in the drinking water treatment plant (from PFs to AFs), and a weaker negative correlation held for evenness. Significant spatial heterogeneity in microbial community composition was detected in both PFs and AFs, and was higher in the AFs. This is the first comprehensive documentation of microbial community diversity in RSFs treating oligotrophic groundwaters. We have identified patterns of local spatial heterogeneity and dispersal, documenting surprising energy–diversity relationships, observed a large and diverse Nitrospira fraction and established a core RSF microbiome.

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Ecological patterns of nitrifiers in the urban water cycle

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Establishing drinking water biofilms with varying alpha-diversity?

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Fordel og ulemper ved forskellige blødgøringsteknologier på vandværket

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Linking nitrifiers diversity to the flux of their key resources

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Microbial challenges – contamination and aftergrowth

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Mikrobiologisk risikovurdering af øgede temperaturer i grundvandet ved ATES (Aquifer Thermal Energy Storage)

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Contributors: Tønder, M. M., Christensen, S. C. B., Larsen, S. L., Albrechtsen, H., Boe-Hansen, R., Niemi Sørensen, S.
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New treatment technology to remove worms in biological rapid sand filters

General information
New treatment technology to remove worms in biological sand filter

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Optimized Softening - Note 1: Reuse of Pellets from Central Drinking Water Softening

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Optimized Softening - Note 2: Pellet Characteristics

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Optimized Softening - Note 3: Optimization of Pellets from Drinking Water Softening

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Publication date: 2016
Optimizing nitrification in biological rapid sand filters: Diagnosing and supplementing micronutrients needed for proper filter performance

Nitrification is an important biological process commonly used in biological drinking water filters to remove ammonium from drinking water. Recent research has shown that a lack of micronutrients could be limiting the performance of these filters. Because nitrification is a biological process, carbon, nitrogen, phosphorus and other micronutrients, such as copper, are required to ensure growth and activity. In nitrification, copper is a micronutrient that is needed in the amoA enzyme used by ammonia-oxidizers to oxidize ammonium to nitrite. Increasing nitrification performance is needed in many filters that are unable to meet ammonium guideline values for drinking water, and can also be used to optimize filter performance by increasing water treatment capacity. Although copper supplementation can increase nitrification in some filters with nitrification problems, it does not always work. Therefore, in order to avoid the time, expense, and regulatory hurdles of supplementing a filter with copper, there is a need to accurately diagnose copper limitations in these filters. To determine if copper addition could increase nitrification in filters with nitrification problems, a bench scale batch essay was developed and tested. Initial batch experiments showed that proper mixing was needed to avoid concentration gradients, and that caution should be taken when mixing to avoid damaging the filter coating. Initial experiments were used to determine the proper mixing regime, which was then applied to all further batch tests. A collaboration between DTU Environment, industrial partners, and different water works was established to test the batch essays at two different water works. Both water works had trouble meeting the Danish guideline value for ammonium (0.05 mg NH4/L). At the start of the batch essays, ammonium removal was determined at 3 different ammonium concentrations, both with and without copper addition (for a total of 6 different batch essays). This was done at both water works to determine the initial removal rates. After initial dosing, the ammonium to each batch set up was increased to 10 mg NH4/L to allow for a period of incubation. After a week, the batches were re-spiked to the 3 different ammonium concentrations examined initially. Copper supplementation did not show any observable difference in ammonium removal at the start of the batch essays. After the cultivation period, one of the water works showed increased ammonium removal with copper addition at all examined ammonium concentrations. This was also observed in the corresponding full scale waterworks. The addition of copper yielded no observed difference in ammonium removal at the second water works, which was also observed in the corresponding full scale filter. These findings are important as they show that the batch essays can be used as a diagnostic tool to determine if copper supplementation can increase nitrification performance. The developed batch essays have important practical implications in optimizing nitrification performance. They can not only be used to diagnose and improve nitrification in existing filters, but can also be used to determine if the nitrification capacity of a filter can be increased, which could optimize filter operation. The batch essays have the potential to be an important diagnostic tool that could decrease regulatory hurdles, and save time and money.

Optimizing nitrification in biological rapid sand filters for drinking water production

Addition of phosphate or trace metals or better management e.g. in terms of ammonium load can improve the nitrification rate and efficiency in biological rapid sand filters.
Reductive dechlorination of trichloroethylene (TCE) in competition with Fe and Mn oxides – observed dynamics in H2-dependent terminal electron accepting processes

The determination of hydrogen (H2) concentration together with the products of microbial reduction reactions in a trichloroethylene dechlorinating system is conducted to delineate the ongoing predominant terminal electron accepting processes (TEAP). Formate was used as electron donor and synthetic Fe minerals or environmental samples were used as the substrata. Iron(III) and Mn(IV) reduction limited microbial dechlorination by the mixed anaerobic culture by decreasing the level of H2 in the system. The H2 measurements indicated that the H2 concentration at which different TEAPs occur can overlap and thus these TEAPs can therefore occur concurrently rather than exclusively. Difference in Fe(III) bioavailability and hence, Fe(III) reduction partially explain this wide range. The distinction between dechlorination and other microbial reduction processes based on H2 threshold values is not feasible under such conditions, though there appears to be a relation between the rates of H2 consuming process and the observed H2 level.

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Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Geomicrobiology Journal
Volume: 33
Issue number: 5
ISSN (Print): 0149-0451
Ratings:
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.36 SJR 0.583 SNIP 0.573
Web of Science (2016): Impact factor 1.485
Web of Science (2016): Indexed yes
Original language: English
Electronic versions:
Paul_et_al_UGMB_2014_OA.pdf
DOIs:
10.1080/01490451.2015.1043410
Reduktion af forureningsrisiko fra atmosfærisk luft: Guideline for danske vandværker – Beluftning og trykudligning med atmosfærisk luft i produktion af drikkevand

General information
Publication status: Published
Number of pages: 26
Publication date: 2016

Publication information
Place of publication: København K
Publisher: Miljøstyrelsen
Original language: Danish
Electronic versions:
Reduktion_af_forureningsrisiko_fra_atmosf_risk_luft.pdf
Research output: Book/Report › Report – Annual report year: 2016 › Commissioned

Sammenhæng mellem aktivitet af metanoksiderende bakterier, opformeret fra sandfiltre på danske vandværker, og nedbrydningen af pesticidet bentazon

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Systems, Water Technologies
Contributors: Hedegaard, M. J., Delinere, H., Prasse, C., Dechesne, A., Smets, B. F., Albrechtsen, H.
Publication date: 2016
Media of output: PowerPoint

Event information
Location: Hotel Radisson Blu i Aarhus, Aarhus, Denmark
Electronic versions:
Hedegaard_Mathilde_Dansk_Vand_til_dansk_vand.pdf
Research output: Non-textual form › Sound/Visual production (digital) – Annual report year: 2016 › Research

Sensors for microbial drinking water quality

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Systems
Contributors: Tatari, K., Corfitzen, C. B., Albrechtsen, H., Christensen, S. C. B.
Number of pages: 43
Publication date: 2016

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark, DTU Environment
Original language: English
Electronic versions:
Sensors_for_microbial_drinking_water_quality_2016_w_logo.pdf

Bibliographical note
Karolina Tatari m. fl.
Source: PublicationPreSubmission
Source-ID: 124418385
Research output: Book/Report › Report – Annual report year: 2016 › Commissioned
Stable isotope probing and dynamic loading experiments provide insight into the ecophysiology of novel ammonia oxidizers in rapid gravity sand filters

Nitrification is often the dominant microbial process in rapid gravity sand filters (RSF), used to treat aerated groundwater to produce drinking water. RSFs harbor diverse microbial communities including a range of ammonia oxidizing clades; Betaproteobacteria (Nitrosomonas, Nitrosospira), Archaea, diverse potentially ammonia oxidizing heterotrophs and abundant Nitrospira spp., recently shown to comprise both canonical nitrite oxidizing as well as complete ammonium oxidizing (comammox) types. We examined the contributions of the different ammonia oxidizers to in situ ammonia oxidation, and aimed to elucidate the differences in ecophysiology between the ammonia oxidizing clades that enable them to co-exist in this unique environment. Experiments were conducted using sand columns designed and operated to mimic the conditions in the full-scale parent RSF. RNA and DNA stable isotope probing based on 13C-bicarbonate incorporation during continuous feeding with either ammonium or nitrite as sole energy source implicated Nitrospira spp. and certain ‘heterotrophic’ bacteria in addition to Nitrosomonas spp. in autotrophy during ammonium oxidation in RSFs. Further experimentation aimed to elucidate the ecophysiology of each ammonia oxidizing clade in RSFs, in particular comammox Nitrospira for which little is currently known. Columns were fed with RSF effluent spiked with various concentrations of ammonium ranging from 0.1- 5.0 mg/L delivered at different loading rates to examine the effects of both ammonium loading and oxygen limitation on ammonia oxidizers. Our observations indicate that the native conditions in the RSF used in this study foster the enrichment of comammox Nitrospira, which provides a preliminary step in the description of their ecophysiology.

Submerged Pond Sand Filter-A Novel Approach to Rural Water Supply

This study describes the new design and function of a modified version of a traditional slow sand filter. The Submerged Pond Sand Filter is built inside a pond and has a vertical as well as a horizontal flow of water through a sloped filter opening. The filter provides treated drinking water to a rural Indian village. The filter has functioned with minimal maintenance for five years without being subject to the typical scraping off and changing of sand as needed in traditional slow sand filters every few months. This five-year study showed bacterial removal efficiency of 97% on average with a level of faecal coliforms of 2 +/- 2 colony forming units (CFU)/100 mL measured in the treated water. Turbidity was visibly removed during treatment. When water was retrieved from the filter through a manual pump for long consistent time intervals (60 min), faecal coliform counts increased from four to 10 CFU/100 mL on average compared to shorter pumping intervals (5 min). Though the treated water did not comply with the World Health Organization standards of 0 CFU/100 mL, the filter significantly improved water quality and provided one of the best sources of drinkable water in a water-depleted area, where only surface water was available. Furthermore, it is a sustainable treatment method due to low maintenance requirements.
The impact of backwashing on nitrification in biological rapid sand filters under different ammonium loading conditions

General information
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Publication date: 2016

Host publication information
Title of host publication: 10th annual meeting of DWF16 : Abstracts
Publisher: Danish Water Forum
Electronic versions:
DWF_The_impact_of_backwashing_on_nitrification_in_biological_rapid_sand_filters_under_different_ammonium_loading_conditions.pdf
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2016 › Research › peer-review

Towards the development of an automated ATP measuring platform to monitor microbial quality of drinking water
This work aimed to develop an automated and nearly on-line method to monitor ATP levels in drinking water as an indicator of microbial contamination. The system consists of a microfluidic cartridge installed in a light tight box, where the sample is mixed with the reagents and the emitted light is detected by a photomultiplier. Temperature in the assay box is controlled and set to 25°C. Calibration of the system using ATP standard solutions was successful, both for free and for total ATP. Chemical release of ATP by reagent addition however resulted in the formation of particles that ultimately clogged the microfluidic channels. An alternative thermal lysis step was implemented, by adding a flow-through heating/cooling step to the system. Thermal lysis showed efficient release of ATP from an E. coli dilution, but the releasing efficiency varied according to the type of water. Overall, the developed prototype system proves the concept of a lab-on-a-chip ATP analyzer.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Systems
Number of pages: 3
Publication date: 2016
Peer-reviewed: Yes
Event: Abstract from World Water Congress & Exhibition 2016, Brisbane, Australia.
Electronic versions:
IWA_WWCE16_Tatari_ATP_373969_20161013_Orbit.pdf
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2016 › Research › peer-review

Undersøgelse af kilde til mikrobiel forurening: Lyngbyværket, Aarhus Vand

General information
A comprehensive 454 survey provides insights into microbial diversity and community structure in rapid sand filters

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Water Technologies, Urban Water Systems
Contributors: Gülay, A., Musovic, S., Albrechtsen, H., Smets, B. F.
Pages: 79-83
Publication date: 2015

Host publication information
Title of host publication: IWA Specialized Conference biofilms in drinking water systems from treatment to tap
Place of publication: Arosa, Switzerland
Publisher: IWA Publishing
Keywords: Rapid sand filters, Pyrosequencing, Core taxa, Drinking water, Groundwater
Source: PublicationPreSubmission
Source-ID: 116644585
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2015 › Research › peer-review

A novel high-throughput drip-flow system to grow autotrophic biofilms of contrasting diversities

The impact of community diversity on the functioning and assembly of microbial systems remains a central questions in microbial ecology. This question is often addressed by either combining a few cultures without necessarily a history of coexistence, or by using environmental communities, which are often ill controlled and thus likely to be poorly reproducible. The purpose of this work is to develop a high-throughput continuous-flow system for growing replicate microbial biofilms of varying, but controlled, average thickness and associated community diversity. With these replicate biofilms, the effect of community composition and diversity on various ecological processes can then be rigorously examined. We hypothesize that the increased loading, resulting in thicker biofilms, will decrease the drift in the community and impose limited environmental filtering by providing more diverse niches. Thus, thicker biofilms are likely to host greater diversity. A system with 40 replicates has been constructed using flow-through polypropylene columns housing a defined number of single-sized glass beads supported by a stainless steel mesh. Biofilms consisting primarily of ammonia oxidizing and nitrite oxidizing bacteria are cultivated on the beads using a drip-flow assembly by feeding a mineral medium...
containing ammonium-N as sole energy source. Biofilm thickness is controlled by setting the surficial loading rate to 0.168 g NH₄-N/m²/day or 1.678 g NH₄-N/m²/day, which should theoretically result in biofilms with average thickness of 100 or 1000 μm. We will present the differences observed in community composition between systems run at high and low loading rates for 60 days. We will also evaluate community activity by measuring nitrification efficiency and correlate that to microbial diversity. In conclusion, we hope to demonstrate a high-replicate biofilm cultivation systems that allow us, by altering the loading rate, to engineer biofilms towards prescribed differences in composition, opening new opportunities to explore community assembly processes and their link to ecosystem function.

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Kinnunen, M., Dechesne, A., Albrechtsen, H., Smets, B. F.
Publication date: 2015
Peer-reviewed: Yes
Event: Abstract from 13th Symposium on Bacterial Genetics and Ecology, Milan, Italy.
Source: PublicationPreSubmission
Source-ID: 114850398
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2015 › Research › peer-review

**Apparatus comprising trace element dosage and method for treating raw water in biofilter**
Apparatus for treating raw water in a biofilter. The present invention relates to an apparatus in which raw water is treated through microbial activity where microbial activity is controlled by nutrients and other parameters. Some of the nutrients controlling the microbial activity are trace elements such as certain metals (Cu, Co, Cr, Mo, Ni, W, Zn or a mixture thereof). The apparatus comprises: a volume provided with an inlet (2) for raw water and an outlet (3) for water having been subjected to microbial activity, a filter and a trace element dosage device (13) are placed in this volume: - the filter comprises a filter material (4) including a porous filter material and a microbial biomass, the filter material (4) is either stationary relative to the volume or comprises a particulate material, the filter material (4) is inserted in a fluid flow path generated by water flowing in direction from the inlet (2) to the outlet (3) or in the reverse direction, - the trace element dosage device (13) is positioned upstream of the porous filter material and microbial biomass and is configured to dose trace element(s) to the water flowing through the filter. A method for treating raw water by microbial activity whereby trace elements are dosed upstream of the raw water is also claimed.

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Technical University of Denmark, Krüger Veolia Water Technologies
Contributors: Albrechtsen, H., Wagner, F. B., Borch Nielsen, P., Boe-Hansen, R., Vincentz Fischer, E.
Publication date: 2015

**Biodegradation: Updating the Concepts of Control for Microbial Cleanup in Contaminated Aquifers**
Biodegradation is one of the most favored and sustainable means of removing organic pollutants from contaminated aquifers but the major steering factors are still surprisingly poorly understood. Growing evidence questions some of the established concepts for control of biodegradation. Here, we critically discuss classical concepts such as the thermodynamic redox zonation, or the use of steady state transport scenarios for assessing biodegradation rates. Furthermore, we discuss if the absence of specific degrader populations can explain poor biodegradation. We propose updated perspectives on the controls of biodegradation in contaminant plumes. These include the plume fringe concept, transport limitations, and transient conditions as currently underestimated processes affecting biodegradation.

**General information**
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Department of Environmental Engineering, Urban Water Engineering, Water Resources Engineering, Helmholtz Zentrum München, Geological Survey of Denmark and Greenland, Flemish Institute for Technological Research, Ghent University, University of Oxford, University of Birmingham, KU Leuven, Vrije Universiteit Amsterdam, Université Catholique de Louvain, University of Duisburg-Essen
Degradation of specific aromatic compounds migrating from PEX pipes into drinking water

Nine specific compounds identified to migrate from polyethylene (PE) and cross-linked polyethylene (PEX) to drinking water were investigated for their degradation in drinking water. Three sample types were studied: field samples (collected at consumer taps), PEX pipe water extractions, and water samples spiked with target compounds. Four compounds were quantified in field samples at concentrations of 0.15 ± 0.0 mg/L. During PEX pipe water extraction 0.42 ± 0.20 mg NVOC/L was released and five compounds quantified (0.5e6.1 mg/L). The degradation of these compounds was evaluated in PEX-pipe water extractions and spiked samples. 4-ethylphenol was degraded within 22 days. Eight compounds were, however, only partially degradable under abiotic and biotic conditions within the timeframe of the experiments (2-4 weeks). Neither inhibition nor co-metabolism was observed in the presence of acetate or PEX pipe derived NVOC. Furthermore, the degradation in drinking water from four different locations with three different water works was similar. In conclusion, eight out of the nine compounds studied would e if being released from the pipes - reach consumers with only minor concentration decrease during water distribution.
Modeling the Factors Impacting Pesticide Concentrations in Groundwater Wells
This study examines the effect of pumping, hydrogeology, and pesticide characteristics on pesticide concentrations in production wells using a reactive transport model in two conceptual hydrogeologic systems; a layered aquifer with and without a stream present. The pumping rate can significantly affect the pesticide breakthrough time and maximum concentration at the well. The effect of the pumping rate on the pesticide concentration depends on the hydrogeology of the aquifer; in a layered aquifer, a high pumping rate resulted in a considerably different breakthrough than a low pumping rate, while in an aquifer with a stream the effect of the pumping rate was insignificant. Pesticide application history and properties have also a great impact on the effect of the pumping rate on the concentration at the well. The findings of the study show that variable pumping rates can generate temporal variability in the concentration at the well, which helps understanding the results of groundwater monitoring programs. The results are used to provide guidance on the design of pumping and regulatory changes for the long-term supply of safe groundwater. The fate of selected pesticides is examined, for example, if the application of bentazone in a region with a layered aquifer stops today, the concentration at the well can continue to increase for 20 years if a low pumping rate is applied. This study concludes that because of the rapid response of the pesticide concentration at the drinking water well due to changes in pumping, wellhead management is important for managing pesticide concentrations.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Water Resources Engineering, Urban Water Engineering
Contributors: Aisopou, A., Binning, P. J., Albrechtsen, H., Bjerg, P. L.
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Peer-reviewed: Yes
Early online date: 2014

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Scopus rating (2015): CiteScore 1.6 SJR 1.111 SNIP 1.118
Web of Science (2015): Impact factor 1.947
Web of Science (2015): Indexed yes
Original language: English
Electronic versions:
Post_print_4623_2_merged_1405709332.pdf
DOIs:
10.1111/gwat.12264
Source: FindIt
Source-ID: 271187776
Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research › peer-review

Monitoring microbial water quality in Nordhavn

General information
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Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Lee, C. O., Tatari, K., Albrechtsen, H.
Number of pages: 33
Publication date: 2015

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark, DTU Environment
Original language: English
Electronic versions:
Optimering af vandforsyningens moniteringsstrategi ved hjælp af GIS-analyse

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Department of Systems Biology
Contributors: Albrechtsen, H., Christensen, S. C. B., Grønkjær, T., Kirstein, J., Larsen, S. L., Rygaard, M.
Publication date: 2015
Media of output: PowerPoint

Ormebekæmpelse i vandværksfiltre

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Christensen, S. C. B., Boe-Hansen, R., Albrechtsen, H.
Publication date: 2015
Media of output: PowerPoint

Overlevelse af coliforme bakterier i drikkevand

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Christensen, S. C. B., Albrechtsen, H.
Number of pages: 14
Publication date: 2015

Publication information
Place of publication: Kgs. Lyngby
Publisher: DTU Miljø
Original language: Danish
Electronic versions:
Overlevelse_af_coliforme_bakterier_i_drikkevand_090915.pdf
Source: PublicationPreSubmission
Source-ID: 115503957
Research output: Book/Report › Report – Annual report year: 2015 › Research

Phosphorus addition can increase nitrification in biological rapid sand filters for drinking water treatment

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Water Resources Engineering, Krüger Veolia Water Technologies
Number of pages: 1
Produktionspris: tre alternative drikkevandsressourcer

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Hedegaard, M. J., Rygaard, M., Albrechtsen, H.
Number of pages: 19
Publication date: 2015

Removal of pesticides with filter sand from biological rapid sand filters

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Hedegaard, M. J., Albrechtsen, H.
Number of pages: 1
Publication date: 2015
Peer-reviewed: Yes
Event: Poster session presented at IWA Specialized Conference: Biofilms in Drinking Water Systems: from Treatment to Tap, Arosa, Switzerland.
Electronic versions:
Mathilde_Hedegaard_130815.pdf
Source: PublicationPreSubmission
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Research output: Contribution to conference › Poster – Annual report year: 2015 › Research › peer-review

Removal of pesticides with filter sand from biological rapid sand filters

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Hedegaard, M. J., Albrechtsen, H.
Number of pages: 2
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Title of host publication: IWA Specialized Conference Biofilms in drinking water systems from treatment to tap
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Electronic versions:
Removal_of_pesticides_with_filter_sand_from_biological_rapid_sand_filters.pdf
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2015 › Research › peer-review
Renset regnvand som drikkevandsressource: 10 spørgsmål og svar i tilæg til 'Renset spildevand som drikkevandsressource (2014)'

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Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Hedegaard, M. J., Albrechtsen, H., Rygaard, M.
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Publisher: DTU Miljø
Original language: Danish
Source: PublicationPreSubmission
Source-ID: 106970747
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RiskStyr - Sammenfatning: RiskStyr Sammenfatning IP04 - Fra kontrol til styring - Risikovurdering i vandforsyningen

General information
Publication status: Published
Organisations: Department of Systems Biology, Department of Environmental Engineering, Urban Water Engineering
Contributors: Larsen, S. L., Christensen, S. C. B., Rygaard, M., Albrechtsen, H.
Number of pages: 7
Publication date: 2015

Publication information
Place of publication: Kgs. Lyngby
Publisher: Danmarks Tekniske Universitet (DTU)
Original language: Danish
Electronic versions:
RiskStyrSammenfatning_Endelig.pdf
Source: PublicationPreSubmission
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Research output: Book/Report › Report – Annual report year: 2015 › Commissioned

Stimulation of Nitrification in Biological Rapid Sand Filters by Addition of Phosphorus and Trace Metals

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Krüger Veolia Water Technologies
Contributors: Wagner, F. B., Lee, C. O., Nielsen, P. B., Albrechtsen, H.
Pages: 252-253
Publication date: 2015

Host publication information
Title of host publication: IWA Specialized Conference biofilms in drinking water systems from treatment to tap
Place of publication: Arosa, Switzerland
Publisher: IWA Publishing
Keywords: Biological drinking water treatment, Nitrification, Nutrient limitations, Rapid sand filtration
Source: PublicationPreSubmission
Source-ID: 116644580
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2015 › Research › peer-review

Styr moniteringsstrategien med GISMOVA

General information
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Organisations: Department of Environmental Engineering, Urban Water Engineering, Aarhus Water, VandCenter Syd A/S
Pages: 54-55
Publication date: 2015
Tilsætning af spormetaller stimulerer nitrifikation i sandfiltre

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Krüger Veolia Water Technologies
Contributors: Albrechtsen, H., Wagner, F. B., Borch Nielsen, P., Boe-Hansen, R., Fischer, E. V.
Pages: 21-22
Publication date: 2015

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Place of publication: Aarhus
Publisher: Dansk Vand- og Spildevandsforening - DANVA
Electronic versions:
Tilsætning_af_spormetaller_stimulerer_nitrifikation_i_sandfiltre.pdf
Source: PublicationPreSubmission
Source-ID: 118081672
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2015 › Research › peer-review

Topological clustering as a tool for planning water quality monitoring in water distribution networks

Topological clustering was explored as a tool for water supply utilities in preparation of monitoring and contamination contingency plans. A complex water distribution network model of Copenhagen, Denmark, was simplified by topological clustering into recognizable water movement patterns to: (1) identify steady clusters for a part of the network where an actual contamination has occurred; (2) analyze this event by the use of mesh diagrams; and (3) analyze the use of mesh diagrams as a decision support tool for planning water quality monitoring. Initially, the network model was divided into strongly and weakly connected clusters for selected time periods and mesh diagrams were used for analysing cluster connections in the Nørrebro district. Here, areas of particular interest for water quality monitoring were identified by including user-information about consumption rates and consumers particular sensitive towards water quality deterioration. The analysis revealed sampling locations within steady clusters, which increased samples' comparability over time. Furthermore, the method provided a simplified overview of water movement in complex distribution networks, and could assist identification of potential contamination and affected consumers in contamination cases. Although still in development, the method shows potential for assisting utilities during planning of monitoring programs and as decision support tool during emergency contingency situations.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Kirstein, J. K., Albrechtsen, H., Rygaard, M.
Number of pages: 8
Pages: 1011-1018
Publication date: 2015
Peer-reviewed: Yes

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Journal: Water Science and Technology: Water Supply
Volume: 15
Issue number: 5
ISSN (Print): 1606-9749
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Scopus rating (2015): CiteScore 0.64 SJR 0.315 SNIP 0.462
Web of Science (2015): Impact factor 0.532
Web of Science (2015): Indexed yes
Assessment of the drinking water quality sensor prototype "Zebra"

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Christensen, S. C. B., Kornholt, S., Vang, Ó. K., Albrechtsen, H.
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Place of publication: Kgs. Lyngby
Publisher: DTU Environment
Original language: English
Source: PublicationPreSubmission
Source-ID: 103567332
Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research › peer-review

Diagnostics in biological rapid sand filters treating groundwater – governing factors for nitrification
To improve the insight in the processes in biological rapid sand filters a range of methods were developed to diagnose the microbial mediated processes – particularly nitrification.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Water Resources Engineering, Krüger Veolia Water Technologies
Number of pages: 6
Publication date: 2014
Peer-reviewed: Yes
Research output: Contribution to conference › Paper – Annual report year: 2014 › Research › peer-review

Effects of dynamic operating conditions on nitrification in biological rapid sand filters for drinking water treatment
Biological rapid sand filters are often used to remove ammonium from groundwater for drinking water supply. They often operate under dynamic substrate and hydraulic loading conditions, which can lead to increased levels of ammonium and nitrite in the effluent. To determine the maximum nitrification rates and safe operating windows of rapid sand filters, a pilot scale rapid sand filter was used to test short-term increased ammonium loads, set by varying either influent ammonium concentrations or hydraulic loading rates. Ammonium and iron (flock) removal were consistent between the pilot and the full-scale filter. Nitrification rates and ammonia-oxidizing bacteria and archaea were quantified throughout the depth of the filter. The ammonium removal capacity of the filter was determined to be 3.4 g NH₄-N m⁻³ h⁻¹, which was 5 times greater than the average ammonium loading rate under reference operating conditions. The ammonium removal rate of the filter was determined by the ammonium loading rate, but was independent of both the flow and influent ammonium concentration individually. Ammonia-oxidizing bacteria and archaea were almost equally abundant in the filter. Both ammonium removal and ammonia-oxidizing bacteria density were strongly stratified, with the highest removal and ammonia-oxidizing bacteria densities at the top of the filter. Cell specific ammonium oxidation rates were on average 0.6 × 10⁻² ± 0.2 × 10⁻² fg NH₄-N h⁻¹ cell⁻¹. Our findings indicate that these rapid sand filters can safely remove both nitrite and ammonium over a larger range of loading rates than previously assumed.
Estimating risks from urban sewer flooding's -Combining quantitative microbial data with hydrological software to improve quantitative microbial risk assessment of urban sewer flooding's

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Evaluation of ATP measurements to detect microbial ingress by wastewater and surface water in drinking water.

Fast and reliable methods are required for monitoring of microbial drinking water quality in order to protect public health. Adenosine triphosphate (ATP) was investigated as a potential real-time parameter for detecting microbial ingress in drinking water contaminated with wastewater or surface water. To investigate the ability of the ATP assay in detecting different contamination types, the contaminant was diluted with non-chlorinated drinking water. Wastewater, diluted at 10^4 in drinking water, was detected with the ATP assay, as well as 10^2 to 10^3 times diluted surface water. To improve the performance of the ATP assay in detecting microbial ingress in drinking water, different approaches were investigated, i.e. quantifying microbial ATP or applying reagents of different sensitivities to reduce measurement variations; however, none of these approaches contributed significantly in this respect. Compared to traditional microbiological methods, the ATP assay could detect wastewater and surface water in drinking water to a higher degree than total direct counts (TDCs), while both heterotrophic plate counts (HPC 22 °C and HPC 37 °C) and Colilert-18 (Escherichia coli and coliforms) were more sensitive than the ATP measurements, though with much longer response times. Continuous sampling combined with ATP measurements displays definite monitoring potential for microbial drinking water quality, since microbial ingress in drinking water can be detected in real-time with ATP measurements. The ability of the ATP assay to detect microbial ingress is influenced by both the ATP load from the contaminant itself and the ATP concentration in the specific drinking water. Consequently, a low ATP concentration of the specific drinking water facilitates a better detection of a potential contamination of the water supply with the ATP assay.
Internal Porosity of Mineral Coating Supports Microbial Activity in Rapid Sand Filters for Groundwater Treatment

A mineral coating develops on the filter grain surface when groundwater is treated via rapid sand filtration in drinking water production. The coating changes the physical and chemical properties of the filter material, but little is known about its effect on the activity, colonization, diversity, and abundance of microbiota. This study reveals that a mineral coating can positively affect the colonization and activity of microbial communities in rapid sand filters. To understand this effect, we investigated the abundance, spatial distribution, colonization, and diversity of all and of nitrifying prokaryotes in filter material with various degrees of mineral coating. We also examined the physical and chemical characteristics of the mineral coating. The amount of mineral coating correlated positively with the internal porosity, the packed bulk density, and the biologically available surface area of the filter material. The volumetric NH₄⁺ removal rate also increased with the degree of mineral coating. Consistently, bacterial 16S rRNA and amoA abundances positively correlated with increased mineral coating levels. Microbial colonization could be visualized mainly within the outer periphery (60.6 ± 35.6 μm) of the mineral coating, which had a thickness of up to 600 ± 51 μm. Environmental scanning electron microscopic (E-SEM) observations suggested an extracellular polymeric substance-rich matrix and submicron-sized bacterial cells. Nitrifier diversity profiles were similar irrespective of the degree of mineral coating, as indicated by pyrosequencing analysis. Overall, our results demonstrate that mineral coating positively affects microbial colonization and activity in rapid sand filters, most likely due to increased volumetric cell abundances facilitated by the large surface area of internal mineral porosity accessible for microbial colonization.

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Mecoprop (MCPP) removal in full-scale rapid sand filters at a groundwater-based waterworks

Contamination by the herbicide mecoprop (MCPP) was detected in groundwater abstraction wells at Kerteminde Waterworks. MCPP was removed to below detection limit in a simple treatment line where anaerobic groundwater was aerated and subsequently filtered by primary and secondary rapid sand filters. Water quality parameters were measured throughout the waterworks, and they behaved as designed for. MCPP was removed in secondary rapid sand filters — removal was the greatest in the sand filters in the filter line with the highest contact time (63min). In these secondary sand filters, MCPP concentration decreased from 0.037μg/L to below the detection limit of 0.01μg/L. MCPP was removed continuously at different filter depths (0.80m). Additionally, biodegradation, mineralisation and adsorption were investigated in the laboratory in order to elucidate removal mechanisms in the full-scale system. Therefore, microcosms were set up with filter sand, water and 14C-labelled MCPP at an initial concentration of 0.2μg/L. After 24h, 79–86% of the initial concentration of MCPP was removed. Sorption removed 11–15%, while the remaining part was removed by microbial processes, leading to a complete mineralisation of 13–18%. Microbial removal in the filter sand was similar at different depths of the rapid sand filter, while the amount of MCPP which adsorbed to the filter sand after 48h decreased with depth from 21% of the initial MCPP in the top layer to 7% in the bottom layer. It was concluded that MCPP was removed in secondary rapid sand filters at Kerteminde Waterworks, to which both adsorption and microbial
Microbial degradation of pesticides in rapid sand filters for treatment of drinking water

In Denmark drinking water supply is based on groundwater which is treated by aeration followed by filtration in rapid sand filters. Unfortunately pesticide contamination of the groundwater poses a threat to the water supply, since the simple treatment process at the waterworks is not considered to remove pesticides from the water phase and pesticides are detected in 24% of the active Danish waterworks wells. This study aimed at investigating the potential of microbial pesticide removal in rapid sand filters for drinking water treatment. Removal of the pesticides MCP, bentazone, glyphosate and the degradation compound p-nitrophenol was investigated in the rapid sand filters at Islevbro and Sjælsø waterworks plant I and II. Microcosms were set up with sand from rapid sand filters, water and an initial pesticide concentration of 0.03-0.38 μg/L. In all the investigated waterworks the concentration of pesticides in the water decreased – MCP decreased to 42-85%, bentazone to 15-35%, glyphosate to 7-14% and p-nitrophenol 1-3% – from the initial concentration over a period of 6-13 days. The largest microbial removal was observed at Sjælsø waterworks Plant II, where the pesticides were partially mineralised – up to 43% of the initial glyphosate was found as CO₂ after 6 days. At Sjælsø waterworks Plant II the contact time in the primary rapid sand filter was 43 minutes. It was found that less than 20 minutes was needed to biologically remove more than 50% of the initial bentazone (concentration 0.1 μg/L). It is therefore certain that there is a potential for microbial removal of pesticides from contaminated groundwater in Danish waterworks.
Microbial diversity and identification of core taxa in rapid sand filters treating groundwaters

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Microbial pesticide degradation processes in rapid sand filters for treatment of groundwater for drinking water production

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Microbial pesticide removal in rapid sand filters for drinking water treatment – Potential and kinetics

Filter sand samples, taken from aerobic rapid sand filters used for treating groundwater at three Danish waterworks, were investigated for their pesticide removal potential and to assess the kinetics of the removal process. Microcosms were set up with filter sand, treated water, and the pesticides or metabolites mecoprop (MCPP), bentazone, glyphosate and p-nitrophenol were applied in initial concentrations of 0.03–2.4 μg/L. In all the investigated waterworks the concentration of pesticides in the water decreased – MCPP decreased to 42–85%, bentazone to 15–35%, glyphosate to 7–14% and p-nitrophenol 1–3% – from the initial concentration over a period of 6–13 days. Mineralisation of three out of four investigated pesticides was observed at Sjælsø waterworks Plant II – up to 43% of the initial glyphosate was mineralised within six days. At Sjælsø waterworks Plant II the removal kinetics of bentazone revealed that less than 30 min was needed to remove 50% of the bentazone at all the tested initial concentrations (0.1–2.4 μg/L). Increased oxygen availability led to greater and faster removal of bentazone in the microcosms. After 1 h, bentazone removal (an initial bentazone concentration of 0.1 μg/L) increased from 0.21%/g filter sand to 0.75%/g filter sand, when oxygen availability was increased from 0.28 mg O₂/g filter sand to 1.09 mg O₂/g filter sand. Bentazone was initially cleaved in the removal process. A metabolite, which contained the carbonyl group, was removed rapidly from the water phase and slowly mineralised after 24 h, while a metabolite which contained the benzene-ring was still present in the water phase. However, the microbial removal of this metabolite was initiated over seven days.

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Contributors: Hedegaard, M. J., Albrechtsen, H.
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Microbial water quality in clean water tanks following inspection and cleaning

Increased bacterial counts are often registered in drinking water leaving clean water tanks after the tanks have been emptied, inspected and cleaned by flushing. To investigate the reason for the increased bacterial concentrations and consequently limit it, samples from two clean water tanks before, during and after cleaning of the tanks were analysed. Bacteria were quantified, the dominating bacterial groups were identified and re-growth potential in the water was estimated. Bacterial counts did not exceed drinking water guideline values but ATP concentrations in the water were high right after start-up of the tanks, which may indicate that a substantial part of the bacteria in the drinking water leaving the tanks originated from the sand filter. This was supported by 16S DNA analyses.
Microbial water quality in clean water tanks following inspection and cleaning

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Microbial water quality in clean water tanks following inspection and cleaning

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Mikrobiel vandkvalitet i rentvandsbeholdere efter inspektion og rensning

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Mineral coating creates internal porosity and supports microbial activity in rapid sand filters treating groundwaters

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Mineral coating supports microbial activity in rapid sand filters for drinking water production

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Nitrification in biological rapid sand filters treating drinking water: monitoring governing factors

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Ormebekæmpelse i vandværksfiltrer

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Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Krüger Veolia Water Technologies
Contributors: Christensen, S. C. B., Boe-Hansen, R., Albrechtsen, H.
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Pesticide degradation in rapid sand filters

General information
Processes of microbial pesticide degradation in rapid sand filters for treatment of drinking water
Aerobic rapid sand filters for treatment of groundwater at waterworks were investigated for the ability to remove pesticides. The potential, kinetics and mechanisms of microbial pesticide removal was investigated in microcosms consisting of filter sand, treated water and pesticides in initial concentrations of 0.04-2.4 μg/L. The pesticides were removed from the water in microcosms with filter sand from all three investigated sand filters. Within the experimental period of six to 13 days, 65-85% of the bentazone, 86-93% of the glyphosate, 97-99% of the p-nitrophenol was removed from the water phase. Investigations of the removal kinetics of bentazone at Sjælsø waterworks Plant II revealed that more than 50% of bentazone was removed within 30 minutes (initial concentrations 0.1-2.4 μg/L). Ammonium and methane is oxidized by bacteria in rapid sand filters, and these are known to degrade xenobiotics by cometabolic processes. It was investigated if addition of ammonium affected bentazone removal or if removal was affected by addition of allylthiourea, which inhibits ammonium oxidizing bacteria. Preliminary results indicated that addition of ammonium as well as allylthiourea affected the removal of bentazone.
Simplification of Water Distribution Network Simulation by Topological Clustering – Investigation of its Potential Use in Copenhagen's Water Supply Monitoring and Contamination Contingency Plans

Topological clustering was investigated to simplify a complex water distribution network of Copenhagen, Denmark, into recognizable water movement patterns. This made it possible to assess the general transport of the water and to suggest strategic sampling locations. Through a topological analysis, the network model was divided into strongly and weakly connected clusters within selected time periods. Steady connected clusters were found by conducting a cluster analysis over all chosen selected time periods. We identified sampling locations with steady hydraulic conditions, increasing the samples' comparability over time, and locations, where samples represent the distributed and consumed water in the Nørrebro district.

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Stimulation of aerobic degradation of bentazone, mecoprop and dichlorprop by oxygen addition to aquifer sediment

In order to investigate aerobic degradation potential for the herbicides bentazone, mecoprop and dichlorprop, anaerobic groundwater samples from two monitoring and three drinking water wells near a drinking water abstraction field in Nybølle, Denmark, were screened for their degradation potential for the herbicides. In the presence of oxygen 14C-labelled bentazone and mecoprop were removed significantly from the two monitoring wells' groundwater samples. Oxygen was added to microcosms in order to investigate whether different oxygen concentrations stimulate the biodegradation of the three herbicides in microcosms using groundwater and sandy aquifer materials. To maintain a certain oxygen concentration this level was measured from the outside of the bottles with a fibre oxygen meter using oxygen-sensitive luminescent sensor foil mounted inside the microcosm, to which supplementary oxygen was added. The highest oxygen concentrations (corresponding to 4-11mgL-1) stimulated degradation (a 14-27% increase for mecoprop, 3-9% for dichlorprop and 15-20% for bentazone) over an experimental period of 200 days. Oxygen was required to biodegrade the herbicides, since no degradation was observed under anaerobic conditions. This is the first time bentazone degradation has been observed in aquifer material at low oxygen concentrations (2mgL-1). The sediment had substantial oxygen consumption (0.92-1.45O2g-1dw over 200days) and oxygen was depleted rapidly in most incubations soon after its addition, which might be due to the oxidation of organic matter and other reduced species such as Fe2+, S2- and Mn in sediment before the biodegradation of herbicides takes place. This study suggests that oxygen enhancement around a drinking water abstraction field could stimulate the bioremediation of diffuse source contamination. © 2013.

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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.

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**Contributors:** Bjerg, P. L., Albrechtsen, H., Kjeldsen, P., Christensen, T. H., Cozzarelli, I. M.  
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### Treatment of worm infested biological rapid sand filters

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**Contributors:** Christensen, S. C. B., Albrechtsen, H.  
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### A novel bench-scale column assay to investigate site-specific nitrification biokinetics in biological rapid sand filters

A bench-scale assay was developed to obtain site-specific nitrification biokinetic information from biological rapid sand filters employed in groundwater treatment. The experimental set-up uses granular material subsampled from a full-scale filter, packed in a column, and operated with controlled and continuous hydraulic and ammonium loading. Flowrates and flow recirculation around the column are chosen to mimic full-scale hydrodynamic conditions, and minimize axial gradients. A reference ammonium loading rate is calculated based on the average loading experienced in the active zone of the full-scale filter. Effluent concentrations of ammonium are analyzed when the bench-scale column is subject to reference loading, from which removal rates are calculated. Subsequently, removal rates above the reference loading are measured by imposing short-term loading variations. A critical loading rate corresponding to the maximum removal rate can be inferred. The assay was successfully applied to characterize biokinetic behavior from a test rapid sand filter; removal rates at reference loading matched those observed from full-scale observations, while a maximum removal capacity of 6.9 g NH4+-N/m3 packed sand/h could easily be determined at 7.5 g NH4+-N/m3 packed sand/h. This assay, with conditions reflecting full-scale observations, and where the biological activity is subject to minimal physical disturbance, provides a simple and fast, yet powerful tool to gain insight in nitrification kinetics in rapid sand filters.

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**Volume:** 47
Asellus aquaticus as a potential carrier of Escherichia coli and other coliform bacteria into drinking water distribution systems

Individuals of the water louse, Asellus aquaticus, enter drinking water distribution systems in temperate parts of the world, where they establish breeding populations. Populations of A. aquaticus in surface water from 2 ponds were analysed for associated faecal indicator bacteria and the risk of A. aquaticus transporting bacteria into distribution systems was assessed. Conc. of ≤2 Escherichia coli and 5 total coliforms ml-1 were measured in the water and 200 E. coli and >240 total coliforms ml-1 in the sediments of the investigated ponds. Conc. of A. aquaticus associated bacteria never exceeded 3 E. coli and 6 total coliforms A. aquaticus-1. During exposure to high concn. of coliforms, concn. reached 350 coliforms A. aquaticus-1. A. aquaticus associated E. coli were only detected as long as E. coli were present in the water and sediment. The calculated probability of exceeding drinking water guideline values in non-disinfected systems by intrusion of A. aquaticus was low. Only in scenarios with narrow pipes and low flows, did total coliforms exceed guideline values, implying that the probability of detection by routine monitoring is also low. The study may expand the knowledge base for evaluating incidents with the presence of coliform indicators in drinking water by showing that intruding A. aquaticus are not important carriers of E. coli or other coliform bacteria even when emerging from faecally contaminated waters.
Assessment of the contamination of drinking water supply wells by pesticides from surface water resources using a finite element reactive transport model and global sensitivity analysis techniques

A reactive transport model is employed to evaluate the potential for contamination of drinking water wells by surface water pollution. The model considers various geologic settings, includes sorption and degradation processes and is tested by comparison with data from a tracer experiment where fluorescein dye injected in a river is monitored at nearby drinking water wells. Three compounds were considered: an older pesticide MCPP (Mecoprop) which is mobile and relatively persistent, glyphosate (Roundup), a newer biodegradable and strongly sorbing pesticide, and its degradation product AMPA. Global sensitivity analysis using the Morris method is employed to identify the dominant model parameters. Results show that the characteristics of clay aquitards (degree of fracturing and thickness), pollutant properties and well depths are crucial factors when evaluating the risk of drinking water well contamination from surface water. This study suggests that it is unlikely that glyphosate in streams can pose a threat to drinking water wells, while MCPP in surface water can represent a risk: MCPP concentration at the drinking water well can be up to 7% of surface water concentration in confined aquifers and up to 10% in unconfined aquifers. Thus, the presence of confining clay aquitards may not prevent contamination of drinking water wells by persistent compounds in surface water. Results are consistent with data on pesticide occurrence in Denmark where pesticides are found at higher concentrations at shallow depths and close to streams.

Begrebsafklaring og oplæg til kvalitetskriterier for sekundavand

Begrebsafklaring og oplæg til kvalitetskriterier for sekundavand
Biostimulation of pesticide degradation in groundwater aquifers with addition of oxygen at different concentrations

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Combined isotope and enantiomer analysis to assess the fate of phenoxy acids in a heterogeneous geologic setting at an old landfill
Phenoxy acid herbicides and their potential metabolites represent industrial or agricultural waste that impacts groundwater and surface waters through leaching from old landfills throughout the world. Fate assessment of dichlorprop and its putative metabolite 4-CPP (2-(4-chlorophenoxy)propionic acid) is frequently obstructed by inconclusive evidence from redox conditions, heterogeneous geologic settings (e.g. clay till) and ambiguous parent-daughter relationships (i.e. 4-CPP may be daughter product or impurity of dichlorprop). For the first time, a combination of four methods was tested to assess transformation of phenoxy acids at a contaminated landfill (Risby site): analysis of (i) parent and daughter compound concentrations, (ii) enantiomer ratios (iii) compound-specific isotope analysis and (iv) enantiomer-specific isotope analysis. Additionally, water isotopes and chloride were used as conservative tracers to delineate two distinct groundwater flow paths in the clay till. Metabolite concentrations and isotope ratios of chlorinated ethenes demonstrated dechlorination activity in the area with highest leachate concentrations (hotspot) indicating favorable conditions also for dechlorination of dichlorprop to 4-CPP and further to phenoxypropionic acid. Combined evidence from concentrations, enantiomer ratios and isotope ratios of dichlorprop and 4-CPP confirmed their dechlorination in the hotspot and gave evidence for further degradation of 4-CPP downgradient of the hotspot. A combination of 4-CPP enantiomer and isotope analysis indicated different enantioselectivity and isotope fractionation, i.e. different modes of 4-CPP degradation, at different locations. This combined information was beyond the reach of any of the methods applied alone demonstrating the power of the new combined approach.

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ISI indexed (2013): ISI indexed yes
Comparing Metabolic Functionalities, Community Structures, and Dynamics of Herbicide-Degrading Communities Cultivated with Different Substrate Concentrations

Two 4-chloro-2-methylphenoxyacetic acid (MCPA)-degrading enrichment cultures selected from an aquifer on low (0.1 mg liter\(^{-1}\)) or high (25 mg liter\(^{-1}\)) MCPA concentrations were compared in terms of metabolic activity, community composition, population growth, and single cell physiology. Different community compositions and major shifts in community structure following exposure to different MCPA concentrations were observed using both 16S rRNA gene denaturing gradient gel electrophoresis fingerprinting and pyrosequencing. The communities also differed in their MCPA-mineralizing activities. The enrichments selected on low concentrations mineralized MCPA with shorter lag phases than those selected on high concentrations. Flow cytometry measurements revealed that mineralization led to cell growth. The presence of low-nucleic acid-content bacteria (LNA bacteria) was correlated with mineralization activity in cultures selected on low herbicide concentrations. This suggests that LNA bacteria may play a role in degradation of low herbicide concentrations in aquifers impacted by agriculture. This study shows that subpopulations of herbicide-degrading bacteria that are adapted to different pesticide concentrations can coexist in the same environment and that using a low herbicide concentration enables enrichment of apparently oligotrophic subpopulations.

Discharge of landfill leachate to streambed sediments impacts the mineralization potential of phenoxy acid herbicides depending on the initial abundance of tfdA gene classes

To understand the role of abundance of tfdA gene classes belonging to β- and γ-proteobacteria on phenoxy acid herbicide degradation, streambed sediments were sampled around three seepage meters (SMs) installed in a landfill-impacted groundwater–surface water interface. Highest herbicide mass discharge to SM3, and lower herbicide mass discharges to SM1 and SM2 were determined due to groundwater discharge rates and herbicide concentrations. SM1-sediment with the lowest abundance of tfdA gene classes had the slowest mineralization, whereas SM2- and SM3-sediments with more abundant tfdA genes had faster mineralization. The observed difference in mineralization rates between discharge zones was simulated by a Monod-based kinetic model, which confirmed the role of abundance of tfdA gene classes. This study suggests presence of specific degraders adapted to slow growth rate and high yield strategy due to long-term herbicide exposure; and thus groundwater–surface water interface could act as a natural biological filter and protect stream water quality.
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Publication date: 2013
Peer-reviewed: Yes

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Scopus rating (2013): CiteScore 4.35 SJR 1.985 SNIP 1.951
Web of Science (2013): Impact factor 3.902
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
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Source: dtu
Source-ID: u::7253
Research output: Contribution to journal › Journal article – Annual report year: 2013 › Research › peer-review

Drinking water: Risks, solutions, and monitoring. Case: Nørrebro

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Albrechtsen, H.
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Pages: 14
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Place of publication: Kgs. Lyngby
Publisher: The Danish Water Research and Innovation Platform
Editors: Jensen, B. K., Levysohn, N.
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Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2013 › Research › peer-review

DW BIOFILTERS: Hvordan fungerer de mikrobiologiske processer i sandfiltre i drikkevandsbehandling

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Albrechtsen, H.
Number of pages: 1
Pages: 20
Publication date: 2013

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Title of host publication: Dansk vand konference 2013
Place of publication: Aarhus
Publisher: Dansk Vand- og Spildevandsforening - DANVA
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Effect of Pumping Strategies on Pesticide Concentrations in Water Abstraction Wells
Pesticide use in agriculture is one of the main sources of groundwater contamination and poses an important threat to groundwater abstraction. Pesticides have been detected in 37% of Danish monitoring wells sampled, with 12 % exceeding drinking water guidelines. Field data captured in monitoring and pumping wells show that pesticide concentrations vary greatly in both time and space. This study aimed to use models to determine how pumping affects pesticide concentrations in drinking water wells placed in two hypothetical aquifer systems; a homogeneous layered aquifer and a layered aquifer with a stream. Two pesticides with different application histories, chemical structure and properties were considered; an old pesticide, MCPP (Mecoprop) which is mobile and relatively persistent; and a new pesticide, bentazone, which is persistent and low-sorbing.

Numerical models of contaminant transport in a pumping well capture zone were constructed using COMSOL Multiphysics. A series of simulations were conducted to examine the effect of pumping strategies (constant versus varying pumping rate), pesticide properties and aquifer hydrogeology on the concentration in drinking water wells. The results of the simulations show that the pumping rate can significantly affect the pesticide breakthrough time and maximum concentration at a drinking water well. The effect of the pumping rate on the pesticide concentration depends on the hydrogeology of the aquifer. For example, in a layered aquifer a high pumping rate results in a considerably different breakthrough than a low pumping rate, while in an aquifer with a stream the pumping rate has an insignificant effect on the breakthrough at the well. The pesticide properties and application history have a great impact on the observed pesticide concentrations. For example, for a sorbing and non-degradable pesticide (e.g., bentazone), the pumping rate is insignificant, while for a sorbing and degradable pesticide (e.g., MCPP) the pumping rate can affect both the maximum concentration and the breakthrough time at the well. The findings of the study show that variable pumping rates can generate temporal variability in the concentration at the well, similar to that observed in groundwater monitoring programmes. The results are also used to provide guidance on the design of pumping and remediation strategies for the long-term supply of safe potable groundwater. For example, if application of bentazone in a layered aquifer stops today, the concentration at the well will continue to grow for 20 years if a low pumping rate is applied, while the decay will be immediate for a high pumping rate. However, for both pumping rates it will take more than 50 years for the pesticide to be flushed out of the aquifer. This study concludes that well head management of pumping strategies is as important as catchment management for controlling pesticide concentrations in water supply wells and that the approach developed can guide the selection of pesticide monitoring well locations for the protection of drinking water wells.

Effects of a 20 year rain event: a quantitative microbial risk assessment of a case of contaminated bathing water in Copenhagen, Denmark
Quantitative microbial risk assessments (QMRAs) often lack data on water quality leading to great uncertainty in the QMRA because of the many assumptions. The quantity of waste water contamination was estimated and included in a QMRA on an extreme rain event leading to combined sewer overflow (CSO) to bathing water where an ironman competition later took place. Two dynamic models, (1) a drainage model and (2) a 3D hydrodynamic model, estimated the dilution of waste water from source to recipient. The drainage model estimated that 2.6% of waste water was left in the system before CSO and the hydrodynamic model estimated that 4.8% of the recipient bathing water came from the CSO, so on average there was 0.13% of waste water in the bathing water during the ironman competition. The total estimated incidence rate from a conservative estimate of the pathogenic load of five reference pathogens was 42%, comparable to 55% in an epidemiological study of the case. The combination of applying dynamic models and exposure data led to an improved QMRA that included an estimate of the dilution factor. This approach has not been described previously.
Examining biological sand filters for drinking water treatment as biofilm reactors: experimental and modeling approach

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Krüger Veolia Water Technologies
Contributors: Tatari, K., Smets, B. F., Lee, C. O., Nielsen, P. B., Albrechtsen, H.
Number of pages: 2
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prod2138366918205.Biofilm_13_proceedings_abstract.pdf
Source: du
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Influence of the Water Louse, Asellus Aquaticus, on Bacterial Survival in Drinking Water Systems

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, VCS Denmark
Contributors: Christensen, S. C. B., Albrechtsen, H., Arvin, E., Nissen, E.
Publication date: 2013
Interactions between microbial activity and distribution and mineral coatings on sand grains from rapid sand filters treating groundwater

Rapid sand filtration is a traditional and widespread technology for drinking water purification which combines biological, chemical and physical processes together. Granular media, especially sand, is a common filter material that allows several oxidized compounds to accumulate on its surface. Preliminarily, we detected a strong relation between the amount of DNA and mineral coating mass. We hypothesized that the accumulated mineral coatings have a positive effect on amount of bacterial biomass, its spatial distribution and substrate removal rates. In this study, we combined molecular, microscopic, physico-chemical and biokinetic techniques to determine the interaction between attached bacteria and attached minerals in rapid sand filters as well as the causality of the relation. Strong pairwise correlations revealed the strong relation between mineral physical properties and bacterial activity and abundance indicated that attached minerals are an important factor controlling bacterial colonization, growth, distribution and substrate utilization in these systems.

Life-cycle and freshwater withdrawal impact assessment of water supply technologies

Four alternative cases for water supply were environmentally evaluated and compared based on the standard environmental impact categories from the life-cycle assessment (LCA) methodology extended with a freshwater withdrawal category (FWI). The cases were designed for Copenhagen, a part of Denmark with high population density and relatively low available water resources. FWI was applied at local groundwater catchments based on data from the national implementation of the EU Water Framework Directive. The base case of the study was the current practice of groundwater abstraction from well fields situated near Copenhagen. The 4 cases studied were: Rain & stormwater harvesting from several blocks in the city; Today's groundwater abstraction with compensating actions applied in the affected freshwater environments to ensure sufficient water flow in water courses; Establishment of well fields further away from the city; And seawater desalination. The standard LCA showed that the Rain & stormwater harvesting case had the lowest overall environmental impact (81.9 μPET/m³) followed by the cases relying on groundwater abstraction (123.5–137.8 μPET/m³), and that desalination had a markedly lower environmental impact compared to the base case, due to the reduced water hardness leading to e.g. a decrease in electricity consumption in households. For a relevant comparison, it is therefore essential to include the effects of water hardness when comparing the environmental impacts of water systems of different hardness. This study also emphasizes the necessity of including freshwater withdrawal respecting the relevant affected geographical scale, i.e. by focusing the assessment on the local groundwater catchments rather than on the regional catchments. Our work shows that freshwater withdrawal methods previously used on a regional level can also be applied to local groundwater catchments and integrated into the standard LCA as an impact category. When standard LCA is extended to include impacts of freshwater withdrawal, rain & stormwater and seawater (0.09–0.18 compared to 11.45–17.16 mPET/m³) were the resources resulting in least overall environmental impact.
Microbial community structure and a core microbiome in biological rapid sand filters at Danish waterworks
Rapid sand filtration is a traditional and common technology for drinking water purification from groundwater. Despite its wide scale and long-term use, the diversity and characterization of microbial communities in these engineered systems have remained unexplored and their roles in removal performances yet to be discovered. In order to explore the microbial ecology of these systems, we conducted 16S rRNA gene (rDNA) based 454 pyrosequencing as a deep sequencing approach to 94 sample cores retrieved from 5 different waterworks including proper biological replication. This comprehensive sampling of replicate rapid sand filters across many waterworks together with high-throughput sequencing provides a first glimpse into the microbial communities in rapid sand filters and their potential roles in the treatment process.

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Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Gülay, A., Musovic, S., Albrechtsen, H., Smets, B. F.
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Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2013 › Research › peer-review

Neutrophilic iron-oxidizing bacteria: occurrence and relevance in biological drinking water treatment
Rapid sand filtration (RSF) is an economical way to treat anoxic groundwater around the world. It consists of groundwater aeration followed by passage through a sand filter. The oxidation and removal of ferrous iron, which is commonly found in anoxic groundwaters, is often believed to be a fully physicochemical process. However, persistently low temperatures in RSF across Denmark may negatively affect the kinetics of chemical oxidation. The slower chemical oxidation of ferrous iron may increase the chances for iron bioconversion by neutrophilic iron-oxidizing bacteria (FeOB), which are found naturally in many environments. In this study, we used a combination of a cultivation-based opposing gradient enrichment
technique and 16S rRNA gene targeted molecular tools to isolate, quantify and identify FeOB from RSF. Themicroscopic quantification of selectively enriched FeOB cells revealed that in RSF, neutrophilic iron oxidizers were present at the level of up to $7 \times 10^5$ cells g$^{-1}$ sediment. The spatial abundance and diversity of FeOB inferred by denaturing gradient gel electrophoresis fingerprinting differed greatly both between and within individual sand filters. The results suggest a larger than assumed role of FeOB in iron removal at waterworks using RSF technologies.

**General information**

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Organisations: Department of Environmental Engineering, Residual Resource Engineering, Urban Water Engineering
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**Nitrification activity stratifies in a rapid sand filter for drinking water treatment - A study in two Danish waterworks**

**General information**

Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Environmental Chemistry, Technical University of Denmark, Krüger Veolia Water Technologies, Københavns Energi A/S
Contributors: Tatari, K., Smets, B. F., Gudbrand, T., Nielsen, P. B., Lind, S., Albrechtsen, H.
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**Optimal pH in chlorinated swimming pools - balancing formation of by-products**

In order to identify the optimal pH range for chlorinated swimming pools the formation of trihalomethanes, haloacetonitriles and trichloramine was investigated in the pH-range 6.5–7.5 in batch experiments. An artificial body fluid analogue was used to simulate bather load as the precursor for by-products. The chlorine-to-precursor ratio used in the batch experiments influenced the amounts of by-products formed, but regardless of the ratio the same trends in the effect of pH were observed. Trihalomethane formation was reduced by decreasing pH but haloacetonitrile and trichloramine formation increased. To evaluate the significance of the increase and decrease of the investigated organic by-products at the different pH values, the genotoxicity was calculated based on literature values. The calculated genotoxicity was approximately at the same level in the pH range 6.8–7.5 and increased when pH was 6.7 or lower. An optimal pH range
for by-products formation in swimming pools was identified at pH 7.0–7.2. In the wider pH range (pH 6.8–7.5) the effect on by-product formation was negligible. Swimming pools should never be maintained at lower pH than 6.8 since formation of both haloacetonitriles and trichloramine increase significantly below this value.

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Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Hansen, K. M. S., Albrechtsen, H., Andersen, H. R.
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Scopus rating (2013): CiteScore 1.45 SJR 0.535 SNIP 0.739
Web of Science (2013): Impact factor 1.172
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Web of Science (2013): Indexed yes
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Past, present and future: sources, transport and fate of pesticides in surface water and groundwater

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Electronic versions:
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Phosphate limitation in biological rapid sand filters used to remove ammonium from drinking water
Removing ammonium from drinking water is important for maintaining biological stability in distribution systems. This is especially important in regions that do not use disinfectants in the treatment process or keep a disinfectant residual in the distribution system. Problems with nitrification can occur with increased ammonium loads caused by seasonal or operational changes and can lead to extensive periods of elevated ammonium and nitrite concentrations in the effluent. One possible cause of nitrification problems in these filters maybe due to phosphate limitation. This was investigated using a pilot scale sand column which initial analysis confirmed performed similarly to the full scale filters. Long term increased ammonium loads were applied to the pilot filter both with and without phosphate addition. Phosphate was added at a concentration of 0.5 mg PO4-P/L to ensure that it was not the limiting substrate. Preliminary results showed an increased nitrification capacity both with and without phosphate addition although the addition of phosphate doubled the ammonium and nitrite removal capacity of the filter compared to non-phosphate dosing conditions. Phosphate addition also increased the total number of ammonium oxidizing bacteria in the column. © 2013 American Water Works Association AWWA WQTC Conference Proceedings All Rights Reserved.
Relating dynamic conditions to the performance of biological rapid sand filters used to remove ammonium, iron, and manganese from drinking water

Rengøring på slagterier og mejerier i Danmark: Udvikling af fremtidens effektive, ressourcebesparende teknologier

Rengøring på slagterier og mejerier i Danmark: Udvikling af fremtidens effektive, ressourcebesparende teknologier
Stratification of nitrification activity in rapid sand filters for drinking water treatment

Rapid sand filters used in groundwater treatment remove ammonium, iron and manganese from the water. Ammonium is removed biologically by nitrifying microorganisms attached on the sand surface. Nitrification kinetics and activity is strongly affected by filter design and operation, which are the key parameters in process optimization. Nitrification optimization needs a detailed insight of the process and the way it takes place in the filter. Filters are often considered in a “black box” approach, where data are only available for influent and effluent and the entire filter is assumed homogenous. The aim of this study is to investigate nitrification activity in a rapid sand filter, with focus on its homogeneity and how it relates to filter performance.

Two groundwater treatment plants in Denmark were selected for the experimental investigations. Plant 1 operates a single line of pre and after filters and has been well performing over the last years. Plant 2 consists of two separate lines, each one with pre and after filtration steps. Plant 2 has experienced challenges in removing ammonium below the 0.05 mg/L regulatory limit especially in one of the two lines. Sand core samples were taken from the after filter in Plant 1 and the after filters in both lines of plant 2. Core samples were divided according to depth and nitrification activity was measured in a lab scale assay. The method consists in a continuous flow mini-column where influent and effluent are monitored for all nitrogen species. Kinetics and maximum nitrification capacity are derived and used to quantify nitrification activity.

Nitrification activity was concentrated at the top 10 cm of filter depth, and maximum nitrification capacity was 7 g NH₄⁺-N/ m³ sand/h compared with 0.8-0.4 g NH₄⁺-N/ m³ sand/h in the middle and bottom layers. A water sampler was installed in the full scale filter of plant 1 to observe the ammonium profile with depth. Ammonium was removed within the upper 15 cm with a removal rate ranging of 3.6- 7.7 g NH₄⁺-N/ m³ sand/h. Full scale observations fit with the lab scale activity measurements showing that the upper layer of the filter is where nitrification mostly happens. Deeper layers that are less active, provide extra nitrifying capacity in case ammonium is not removed within the top 15 cm. qPCR counts for ammonium oxidizing bacteria showed a decrease from 5*10⁷ cells /gr sand at the top of the filter to 2*10⁵ cells /gr sand in the lowest 20 cm. From this study results that rapid sand filters are not homogenous in terms of biological activity. This can be an important consideration when modeling these units and as a basis for process optimization.

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The use of models to determine the impact of pumping on pesticide contamination of groundwater

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Contributors: Aisopou, A., Bjerg, P. L., Albrechtsen, H., Binning, P. J.
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Vandteknologi

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Contributors: Albrechtsen, H., Brandt Sørensen, T., Kristensen, G. K., Christiansen, A., Krarup, L., Nielsen, H., Thy, C.
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Biological Removal of Manganese and Iron in Rapid Sand Filters

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Organisations: Department of Environmental Engineering, Urban Water Engineering, Environmental Chemistry, Københavns Energi A/S
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Centimetre-scale vertical variability of phenoxy acid herbicide mineralization potential in aquifer sediment relates to the abundance of tfdA genes
Centimetre-scale vertical distribution of mineralization potential was determined for 2,4-dichlorophenoxyacetic acid (2,4-D), 4-chloro-2-methylphenoxyacetic acid (MCPA) and 2-(4-chloro-2-methylphenoxy)propanoic acid (MCPP) by 96-well microplate radiorespirometric analysis in aquifer sediment sampled just below the groundwater table. Mineralization of 2,4-D and MCPA was fastest in sediment samples taken close to the groundwater table, whereas only minor mineralization of MCPP was seen. Considerable variability was exhibited at increasing aquifer depth, more so with 2,4-D than with MCPA. This suggests that the abundance of MCPA degraders was greater than that of 2,4-D degraders, possibly due to the fact that the overlying agricultural soil had long been treated with MCPA. Mineralization of 2,4-D and MCPA was followed by increased abundance of tfdA class I and class III catabolic genes, which are known to be involved in the metabolism of phenoxy acid herbicides. tfdA class III gene copy number was approximately 100-fold greater in samples able to mineralize MCPA than in samples able to mineralize 2,4-D, suggesting that tfdA class III gene plays a greater role in the metabolism of MCPA than of 2,4-D. Degradation rate was found to correlate positively with tfdA gene copy number, as well as with the total organic carbon content of the sediment.

General information
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Publication information
Journal: F E M S Microbiology Ecology
Volume: 80
Issue number: 2
Effect of pH on the formation of disinfection byproducts in swimming pool water – Is less THM better?

This study investigated the formation and predicted toxicity of different groups of disinfection byproducts (DBPs) from human exudates in relation to chlorination of pool water at different pH values. Specifically, the formation of the DBP groups trihalomethanes (THMs), haloacetic acids (HAAs), haloacetonitriles (HANs) and trichloramine (NCI3), resulting from the chlorination of body fluid analog, were investigated at 6.0 ≤ pH ≤ 8.0. Either the initial concentration of active chorine or free chlorine was kept constant in the tested pH range. THM formation was reduced by decreasing pH but HAN, and NCI3 formation increased at decreasing pH whereas the formation of HAAs remained constant. Under our experimental conditions, the formation of NCI3 (suspected asthma inducing compound) at pH = 6.0 was an order of magnitude higher than at pH = 7.5. Furthermore, the effect of the presence of bromide on DBP formation was investigated and found to follow the same pH dependency as without bromide present, with the overall DBP formation increasing, except for HAAs. Estimation of genotoxicity and cytotoxicity of the chlorinated human exudates showed that among the quantified DBP groups, HAN formation were responsible for the majority of the toxicity from the measured DBPs in both absence and presence of bromide.

Effect of surface loading fluctuations in rapid sand-filters used to remove ammonium from drinking water

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Contributors: Hansen, K. M. S., Willach, S., Antoniou, M., Mosbæk, H., Albrechtsen, H., Andersen, H. R.
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Source-ID: n::oai:DTIC-ART:elsevier/373334757::20841
Research output: Contribution to journal › Journal article – Annual report year: 2012 › Research › peer-review
Effect of surface loading fluctuations on ammonium removal during rapid sand filtration

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Enrichment and characterization of high- and low-affinity herbicide-degrading bacteria from a groundwater aquifer

General information
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Contributors: Gozdereliler, E., Boon, N., Aamand, J., De Roy, K., Granitsiotis, M., Albrechtsen, H., Reinhold Sørensen, S.
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Publication date: 2012
Peer-reviewed: Yes
Event: Abstract from 14th International Symposium on Microbial Ecology, Copenhagen, Denmark.
Electronic versions: 283B Gozdereliler et 2012 poster.pdf

Identification of discharge zones and quantification of contaminant mass discharges into a local stream from a landfill in a heterogeneous geologic setting

Contaminants from Risby Landfill (Denmark) are expected to leach through the underlying geologic strata and eventually reach the local Risby Stream. Identification of the groundwater discharge zone was conducted systematically by an array of methods including studies on site geology and hydrogeology, ground- and surface water flows and landfill leachate tracing from April 2009 to December 2010. Chemical profiling by driven wells and gradients in streambed temperatures was an efficient method to identify the contaminant discharge area. A considerable variation of leachate indicators, redox parameters and xenobiotic organic compounds were revealed in this area because of a complex geological setting with clay till (interbedded sand lenses) and deposits of sand and peat. Concentrations of leachate indicators decreased from the landfill to the stream, implying attenuation processes. Xenobiotic organic compounds were mainly phenoxy acid herbicides, while petroleum hydrocarbons and chlorinated solvents were found at very few boreholes. Findings of putative metabolites of phenoxy acid herbicides suggest degradation under the anaerobic conditions, which dominated inside and beneath the landfill. The groundwater discharge was quantified by two methods: direct collection of discharged
groundwater by seepage meters and calculations from measurement of streambed temperature gradients. The landfill impacted the stream seasonally during dry periods when concentrations in the stream reached groundwater concentration levels. A comparison between mass balance for selected stream stretches and upscaled measurements of the contaminant discharge from groundwater into the stream indicated that only a small part of the actual contaminant discharge of the stream could be explained by the inflowing contaminant discharge from groundwater. Surface runoff and seepage from ponds along the stream impacted by landfill interflow may be important pathways as well. The placement of Risby Landfill near a stream and the complex source and geology causing a large spatial variability of leachate compounds are typical for landfill sites so the approaches and findings from Risby Landfill can be applied to other landfill sites. The study highlights that landfills may pose a risk to surface waters and future studies should be directed towards evaluation of both chemical and ecological risk.

**General information**

Publication status: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Urban Water Engineering, Geological Survey of Denmark and Greenland
Contributors: Milosevic, N., Thomsen, N. I., Juhler, R., Albrechtsen, H., Bjerg, P. L.
Pages: 13-23
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Peer-reviewed: Yes

**Publication information**

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Volume: 446-447
ISSN (Print): 0022-1694
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BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.38 SJR 1.902 SNIP 2.014
Web of Science (2012): Impact factor 2.964
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
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Keywords: Landfill leachate, Phenoxy acid herbicides, Mass discharge, Clay till, Stream, Groundwater/surface water interaction
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Source: dtu
Source-ID: n::oai:DTIC-ART:elsevier/365342928::16735
Research output: Contribution to journal › Journal article – Annual report year: 2012 › Research › peer-review

Identity and biodegradability of organic compounds migrating from PEX pipes used in water installations in buildings

Migration of organic compounds from PEX pipes used in water installations in buildings was investigated by batch set ups. Several compounds were identified and quantified. The organic compounds released to the water phase could support microbial growth and a few of the identified compounds decreased in concentration while the microbial number increased.

**General information**

Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Technical University of Denmark
Number of pages: 3
Pages: 173-175
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**Bibliographical note**

Kilde: CD 2-1
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2012 › Research › peer-review
Influence of Asellus aquaticus on Escherichia coli, Klebsiella pneumoniae, Campylobacter jejuni and naturally occurring heterotrophic bacteria in drinking water

Water lice, Asellus aquaticus (isopoda), frequently occur in drinking water distribution systems where they are a nuisance to consumers and water utilities. Whether they are solely an aesthetic problem or also affect the microbial water quality is a matter of interest. We studied the influence of A. aquaticus on microbial water quality in non-chlorinated drinking water in controlled laboratory experiments. Pure cultures of the indicator organisms Escherichia coli and Klebsiella pneumoniae and the pathogen Campylobacter jejuni as well as naturally occurring heterotrophic drinking water bacteria (measured as heterotrophic plate counts, HPC) were investigated in microcosms at 7 °C, containing non-sterilised drinking water, drinking water sediment and A. aquaticus collected from a non-chlorinated ground water based drinking water supply system. Concentrations of E. coli, K. pneumoniae and C. jejuni decreased over time, following a first order decay with half lives of 5.3, 18.4 and 1.3 days, respectively. A. aquaticus did not affect survival of indicators and pathogens substantially whereas HPC were influenced by presence of dead A. aquaticus. Growth rates increased with an average of 48% for bacteria grown on R-2A agar and an average of 83% for bacteria grown on yeast extract agar when dead A. aquaticus were present compared to no and living A. aquaticus present. A. aquaticus associated E. coli, K. pneumoniae and C. jejuni were measured (up to 25 per living and 500 per dead A. aquaticus) and so were A. aquaticus associated heterotrophic bacteria (>1.8*10^4 CFU per living and >6*10^4 CFU per dead A. aquaticus). A. aquaticus did not serve as an optimised habitat that increased survival of indicators and pathogens, since A. aquaticus associated E. coli, K. pneumoniae and C. jejuni were only measured as long as the bacteria were also present in the water and sediment. A. aquaticus did not affect survival of indicators and pathogens substantially.
Isolation of 2-methyl-4-chlorophenoxyacetic acid degrading bacteria from groundwater sediments using a novel low substrate flux approach

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Environmental Chemistry, Geological Survey of Denmark and Greenland, University of Copenhagen
Contributors: Gozdereliler, E., Dechesne, A., Haubjerg Nicolaisen, M., Sharp, R. E., Aamand, J., Albrechtsen, H., Smets, B. F., Reinhold Sørensen, S.
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Event: Abstract from 14th International Symposium on Microbial Ecology, Copenhagen, Denmark.
Electronic versions:
239B Gozdereliler et al 2012 poster.pdf

Bibliographical note
239B
Source: dtu
Source-ID: u::7171
Research output: Contribution to conference > Conference abstract for conference – Annual report year: 2012 > Research > peer-review

Life cycle assessment of 3 alternatives for stormwater management

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Godskesen, B., Zambrano, K., Albrechtsen, H.
Number of pages: 14
Publication date: 2012

Host publication information
Title of host publication: 6th Annual Meeting of DWRP - Abstracts
Place of publication: Copenhagen
Electronic versions:
abstract_conference.pdf
Source: orbit
Source-ID: 317703
Research output: Chapter in Book/Report/Conference proceeding > Conference abstract in proceedings – Annual report year: 2012 > Research > peer-review
Life cycle assessment of central softening of very hard drinking water

Many consumers prefer softened water due to convenience issues such as avoidance of removing limescale deposits from household appliances and surfaces, and to reduce consumption of cleaning agents and laundry detergents leading to lower household expenses. Even though central softening of drinking water entailed an increased use of energy, sand and chemicals at the waterworks, the distributed and softened drinking water supported a decrease in consumption of energy and chemical agents in the households along with a prolonged service life of household appliances which heat water. This study used Life Cycle Assessment (LCA) to quantify the environmental impacts of central softening of drinking water considering both the negative effects at the waterworks and the positive effects imposed by the changed water quality in the households. The LCA modeling considered central softening of drinking water from the initial hardness of the region of study (Copenhagen, Denmark) which is 362 mg/L as CaCO₃ to a final hardness as CaCO₃ of 254 (a softening depth of 108) mg/L or 145 (a softening depth of 217) mg/L. Our study showed that the consumer preference can be met together with reducing the impact on the environment and the resource consumption. Environmental impacts decreased by up to 3 mPET (milli Personal Equivalent Targeted) and the break-even point from where central softening becomes environmentally beneficial was reached at a softening depth of only 22 mg/L as CaCO₃. Both energy-related and chemically related environmental impacts were reduced as well as the consumption of resources. Based on scarcity criteria, nickel was identified as the most problematic non-renewable resource in the system, and savings of up to 8 mPR (milli Person Reserve) were found.

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Quantitative Sustainability Assessment, Department of Management Engineering, Københavns Energi A/S
Contributors: Godskesen, B., Hauschild, M. Z., Rygaard, M., Zambrano, K., Albrechtsen, H.
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Peer-reviewed: Yes

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Scopus rating (2012): CiteScore 4.01 SJR 1.381 SNIP 2.51
Web of Science (2012): Impact factor 3.057
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Original language: English
DOI:
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Source: dtu
Source-ID: n::oai:DTIC-ART:pubmed/365184536::16651
Research output: Contribution to journal › Journal article – Annual report year: 2012 › Research › peer-review

Microbial Abundance, Distribution and Diversity in Rapid Sand Filters

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Environmental Chemistry
Contributors: Musovic, S., Gülay, A., Albrechtsen, H., Smets, B. F.
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Event: Abstract from 2012 Water Quality Technology Conference and Exposition (WQTC), Toronto, Ontario, Canada.
Electronic versions:
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Source: dtu
Source-ID: u::6475
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2012 › Research › peer-review

Microbial Community-Level Physiological Profiles (CLPP) and herbicide mineralization potential in groundwater affected by agricultural land use

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Godskesen, B., Hauschild, M. Z., Rygaard, M., Zambrano, K., Albrechtsen, H.
Number of pages: 1
Publication date: 2012
Peer-reviewed: Yes
Diffuse groundwater pollution from agricultural land use may impact the microbial groundwater community, which was investigated as Community-Level Physiological Profiles (CLPP) using EcoPlate™. Water was sampled from seven piezometers and a spring in a small agricultural catchment with diffuse herbicide and nitrate pollution. Based on the Shannon–Wiener and Simpson's diversity indices the diversity in the microbial communities was high. The response from the EcoPlates™ showed which substrates support groundwater bacteria, and all 31 carbon sources were utilized by organisms from at least one water sample. However, only nine carbon sources were utilized by all water samples: d-Mannitol, N-acetyl-d-glucosamine, putrescine, d-galacturonic acid, itaconic acid, 4-hydroxy benzoic acid, tween 40, tween 80, and l-asparagine. In all water samples the microorganisms preferred d-mannitol, d-galacturonic acid, tween 40, and 4-hydroxy benzoic acid as substrates, whereas none preferred 2-hydroxy benzoic acid, α-d-lactose, d,l-α-glycerol phosphate, α-ketobutyric acid, l-threonine and glycyl-l-glutamic acid. Principal Component Analysis of the CLPP's clustered the most agriculturally affected groundwater samples, indicating that the agricultural land use affects the groundwater microbial communities. Furthermore, the ability to mineralize atrazine and isoproturon, which have been used in the catchment, was also associated with this cluster.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Water Resources Engineering, Department of Informatics and Mathematical Modeling, DTU Data Analysis, Mathematical Statistics, Urban Water Engineering
Contributors: Janniche, G. S., Spliid, H., Albrechtsen, H.
Pages: 45-55
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Web of Science (2012): Impact factor 2.885
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Research output: Contribution to journal › Journal article – Annual report year: 2012 › Research › peer-review

Modeling the Performance of Biological Rapid Sand Filters Used to Remove Ammonium, Iron, and Manganese From Drinking Water
Although biological rapid sand filters are a well established technology for treating drinking water, there is still a lack of scientific understanding of the processes controlling their performance. For example, the distribution and role of microorganisms in contaminant removal in the filter has not been described. As a result, the design and operation of these filters is based on rules of thumb rather than firm scientific understanding. The goal of this research is to characterize the underlying processes that control the biological performance of biological rapid sand filters in order to link filter management to performance.

Biological rapid sand filters are used for the dual purpose of particle removal (including microorganisms) and contaminant removal through biological activity on the filter media. For drinking water treatment in the United States, biological filters use granular activated carbon and are often used following ozonation to remove additional biodegradable organics created during ozonation. In Europe, biological filters are also used to remove ammonium and reduced forms of iron and manganese. These compounds can cause biological instability in the distribution system and can lead to many problems including the growth of pathogens and aesthetic problems (taste, odor, and color). All of these compounds can be removed through chemical oxidation with oxidants such as chlorine, but biological filters can be used to remove these compounds and thereby reduce the need for chlorine addition following treatment. Under the normal conditions found in many water treatment plants, reduced iron can be oxidized through aeration and the precipitates can be captured by the filter media. Ammonium and manganese can be removed biologically.

This research uses both pilot and full scale studies to determine how operating conditions affect the performance of the filters. Substrate concentrations, particle/precipitate accumulation, and biomass kinetics are monitored throughout the depth of the filter and over the operational cycle of the filter. Tracer tests, using a conservative salt tracer, are performed during an operational cycle of a filter to examine how the filter flow changes with time. The data is used to validate a mathematical model that can both predict process performance and to gain an understanding of how dynamic conditions can influence filter performance. The mathematical model developed is intended to assist in the design of new filters, set
up of pilot plant studies, and as a tool to troubleshoot existing problems in full scale filters. Unlike previous models, the model developed accounts for the effects of particle/precipitate accumulation and its effects on the biological performance of the filter.

Neutrophilic iron oxidizers adapted to highly oxic environments
Rapid sand filtration is an economical way to treat anoxic groundwaters and involves aeration followed by particulate and soluble substrate removal via deep bed filtration. The anoxic source groundwater can contain several potential electron donors (CH4, Fe2+, Mn2+, NH4+ and assimilable organic carbon) while oxygen (O2) is the electron acceptor provided during the aeration process. Numerous previous studies have described neutrophilic iron oxidizers as a bacterial guild with a special niche preference, especially the transition zone between aerobic and anoxic regions, where abiotic chemical oxidation of iron would be retarded. For that reason, no attempts have been documented to describe the density and diversity of iron oxidizing bacteria (FeOB) in oxic neutrophilic environments. Under low temperatures (5 to 10°C) conditions, as typically found in groundwater, extremely low rates of chemical iron oxidation (t1/2: 315min.) have been documented. This assumed slow chemical oxidation of Fe2+ in rapid sand filters may allow certain bacteria to oxidize iron concurrently with the ongoing slow chemical oxidation. Hence, we aimed to investigate the abundance, diversity, and spatial distribution of iron oxidizing bacterial in the highly oxic environments found in typical rapid sand filters. The neutrophilic FeOB were enriched by the Fe2+/O2 opposing gradient technique and quantified by MPN methodology. Diversity fingerprints of the enrichment cultures were obtained with a 16S rRNA targeted DGGE technique, and dominant bands were isolated and sequenced for identification of dominant enrichment members. Enrichment were microscopically examined via CSLM in combination with FeOB specific or generic cytostains to verify enrichments, check cell morphologies and quantify cell densities. Our results indicate that neutrophilic iron oxidizers in highly oxic environments like drinking water treatment systems can be abundant (5 E+04 to 7 E+05 cells per gram of wet sand material). It was furthermore observed that the diversity of the cultivated dominant iron oxidizers differs substantially from those typically observed in aerobic/anoxic transition zones.

Neutrophilic Iron Oxidizing Bacteria: Occurrence and Relevance in Biological Drinking Water Treatment
Rapid sand filtration (RSF) is an economical way to treat anoxic groundwater around the world. It consists of groundwater aeration followed by passage through a sand filter. The oxidation and removal of ferrous iron, which is commonly found in anoxic groundwaters, is often believed to be a fully physicochemical process. However, persistently low temperatures in RSF across Denmark may negatively affect the kinetics of chemical oxidation. The slower chemical oxidation of ferrous iron may increase the chances for iron bioconversion by neutrophilic iron-oxidizing bacteria (FeOB), which are found naturally in many environments.
In this study, we used a combination of a cultivation-based opposing gradient enrichment technique and 16S rRNA gene targeted molecular tools to isolate, quantify and identify FeOB from a RSF. The microscopic quantification of selectively
enriched FeOB cell revealed that in RSF, neutrophilic iron oxidizers were present at the level of up to 7 105 cells per gram sediment. The spatial abundance and diversity of FeOB inferred by DGGE fingerprinting differed greatly both between and within individual sand filters. The results suggest a larger than assumed role of FeOB in iron removal at waterworks using RSF technologies.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Environmental Chemistry, Urban Water Engineering
Contributors: Gülay, A., Musovic, S., Albrechtsen, H., Smets, B. F.
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Research output: Contribution to conference › Paper – Annual report year: 2012 › Research › peer-review

Pesticides in groundwater: modelling and data analysis of the past, present and future
Pesticides are the most frequently detected groundwater contaminants in Denmark. However, there is still a great deal of debate about the fate of pesticides and their future occurrence in our environment. We do not really understand the link between past usage and current observations, and are not well equipped to predict future trends in pesticide concentrations in groundwater. For example, we do not understand the difference between the loads from point and diffuse sources, or the impact of impurities and degradation products. We must also face the challenge that arises from the need to jointly manage our groundwater and surface water resources. Here, observed pesticide data is analyzed and combined with models to address these questions and needs. Groundwater and surface water pesticide observations reflect the fact that these two hydrological components have a strong interaction. For example, many older and banned pesticides are detected in streams and reflect the groundwater baseflow contribution to stream flow. Models of groundwater age and pesticide transport demonstrate the importance of geology and pumping regime in determining observed groundwater concentrations. Finally, management issues are addressed, eg. it is shown that it is important for pesticide management to consider both pumping strategies and manage surface application.

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Research output: Contribution to conference › Paper – Annual report year: 2012 › Research › peer-review

Pesticides in water supply wells in Zealand, Denmark: A statistical analysis
Data from the Danish National Borehole Database are used to predict drinking water well vulnerability to contamination by pesticides, and to identify the dominant mechanisms leading to well pollution in Zealand, Denmark. The frequency of detection and concentrations of 4 herbicides and 3 herbicide metabolites are related to factors accounting for geology (thicknesses of sand, clay and chalk layers), geographical location (distance to surface water and distance to contaminated sites), redox conditions and well depth using logistic regression, the binomial test and Spearman correlation techniques. Results show that drinking water wells located in urban areas are more vulnerable to BAM and phenoxy acids contamination, while non-urban area wells are more subject to bentazone contamination. Parameters accounting for the hydraulic connection between the well and the surface (well depth and thickness of the clay confining layer) are often strongly related to well vulnerability. Results also show that wells close to surface water are more vulnerable to contamination, and that sandy layers provide better protection against the leaching of oxidizable pesticides than clay aquifers, because they are more likely to be aerobic. 4-CPP is observed more often at greater well depth, perhaps because of anaerobic dechlorination of dichlorprop. The field data are used to create a set of probabilistic models to predict well vulnerability to contamination by pesticides.

General information
Publication status: Published
Quantitative potential for rainwater use

General information
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Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Sørup, H. J. D., Ambjerg-Nielsen, K., Mikkelsen, P. S., Albrechtsen, H., Rygaard, M.
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Redegørelse om sundhedseffekter af blødgøring i København specielt med fokus på caries

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Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Rygaard, M., Albrechtsen, H.
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Source: orbit
Relating dynamic conditions to the performance of biological rapid sand filters used to remove ammonium, iron, and manganese from drinking water

Biological rapid sand filters are used throughout the world to remove both particulates and dissolved compounds from drinking water and is a proven and effective treatment technique for providing safe and secure drinking water. However, experience has shown that some filters have problems consistently meeting regulatory guidelines for compounds like ammonium and reduced forms of iron and manganese. These compounds can cause biological instability in the distribution system and can lead to many problems including the growth of pathogens and aesthetic problems (taste, odor, and color). When problems occur in these filters, current solutions are often based on rules of thumb and guess work rather than on firm scientific principle. The goal of this research is to characterize the underlying processes that control the biological performance of biological rapid sand filters in order to link filter management to performance.

This research uses both pilot and full scale studies conducted at Islevbro water works, a drinking water plant in west Copenhagen, to determine how operating conditions and substrate loading affect the performance of the biological rapid sand filters. The pilot columns consist of two columns that are run in parallel and fed with influent water from the water works. The sand in the pilot columns was taken from one of the full scale filters and matches the depth profile of the full scale filter. The pilot columns were initially operated for approximately 2 and a half months at similar operating conditions as the full scale filter to validate the performance of the pilot columns. After this, the pilot columns were fed with varying loading rates of iron, ammonium, and manganese. To fully examine the changes in filter performance several parameters were analyzed. Water and media samples were collected throughout the depth of the column and over the operational cycle of the columns. Substrate analysis included ammonium, nitrite, nitrate, iron, and manganese. Qpcr analysis were also performed to quantify ammonium oxidizing bacteria (AOBs), ammonium oxidizing archea (AOAs), nitrite oxidizing bacteria (NOBs), and total bacteria with both depth and time. Similar analyses were performed in the full scale filters. The data is used to validate a mathematical model that can both predict process performance and is used to gain an understanding of how dynamic conditions can influence filter performance. The results presented will show how these varying conditions affect both the biological distribution and performance of these filters and will increase the understanding of biological rapid sand filters used to treat drinking water. This research helps to extend the knowledge on the roles of both Ammonium oxidizing bacteria (AOBs) and Ammonium oxidizing archea (AOAs) in the biological removal of ammonium in rapid sand filters and how varying substrate loadings and operating conditions can affect the biological performance of these filters.

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Contributors: Lee, C., Albrechtsen, H., Smets, B. F., Binning, P. J.
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Peer-reviewed: Yes
Event: Abstract from AWWA Water Quality Technology Conference (WQTC), Toronto, Canada.
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Lee_AWWA-WQTC12_Toronto.pdf
Source: dtu
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Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2012 › Research › peer-review

Risikostyring i vandforsyningen
Drinking water in Denmark is distributed with only few or no hygienic barriers between catchment and consumer, and it is therefore essential to monitor the drinking water quality. Traditionally, drinking water monitoring has been performed as a control of the delivered water quality rather than as a risk management, allowing to react timely on quality changes to prevent distribution of a deteriorated water quality. ‘From risk monitoring to risk management – risk assessment in water supply’ is a 3-year (2011-2013) innovation project under the strategic partnership ‘Water in Urban Areas’ (www.vandibyer.dk) carried out by the knowledge institutions DTU Environment, DHI, the water utilities Copenhagen Energy, Aarhus Water, VCS Denmark and the public authorities Odense municipality and the Danish Nature Agency. The purpose of the project is to develop and implement risk management as a part of the climate adaptation measures in the water supply. The risk management will be based on the development of a new and improved monitoring strategy from catchment to consumer - taking into consideration the possibilities and limitations of analytical methods and sensors - and the development and implementation of advanced quantitative risk analysis and management systems. The project work includes: a) Identification of focus areas based on experiences gathered from contamination cases in the involved water supplies; b) Identification of additional demand for management systems for monitoring based on experiences from the processes of implementing Water Safety Plans; c) Development of a new monitoring strategy; d) Development of
quantitative risk assessment in water supply; e) Development of strategies for implementing extra hygienic barriers e.g. UV; f) Development of new software to cover identified demands for monitoring and management; g) Implementing and evaluating developed tools in demonstration projects, hereby ensuring further dissemination. The first part of the project has been a knowledge gathering based on the water utilities experiences from implementation of Water Safety Plans and from contamination cases. The knowledge gathering will be used to define monitoring strategies for the three scenarios a) the normal situation; b) a contamination situation; c) source tracking situation.

General information
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Publisher: Svenskt Vatten - NORDIWA

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Source: dtu
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Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2012 › Research › peer-review

Sustainability assessment of water supply in Copenhagen: Alternatives fulfilling the EU-Water Framework Directive

General information
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Organisations: Department of Environmental Engineering, Urban Water Engineering, Department of Management Engineering, Quantitative Sustainability Assessment, Københavns Energi A/S
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Publication date: 2012
Peer-reviewed: Yes
Event: Poster session presented at 2012 Water Quality Technology Conference and Exposition (WQTC), Toronto, Ontario, Canada.
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Bibliographical note
Poster presentation
Research output: Contribution to conference › Poster – Annual report year: 2012 › Research › peer-review

Sustainability assessment of water supply in Copenhagen - what is the impact of freshwater withdrawal?

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Department of Management Engineering, Quantitative Sustainability Assessment, Ørsted Bioenergy & Thermal Power
Number of pages: 1
Pages: 59
Publication date: 2012

Host publication information
Title of host publication: Book of abstracts - SETAC 18th LCA Case Study Symposium and 4th NorLCA Symposium : Sustainability Assessment in the 21st century - Tools, Trends and Applications

Bibliographical note
TORS04-04
Adenosine triphosphate measurements for real-time monitoring of microbial drinking water quality

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Vang, Ø. K., Corfitzen, C. B., Albrechtsen, H.
Number of pages: 1
Publication date: 2011

Aerobic degradation potential of the herbicides mecoprop, dichlorprop and bentazone in groundwater from chalk aquifers

The aerobic degradation potential of mecoprop, dichlorprop and bentazone was studied at concentration of 1 μg/L in laboratory batch experiments with groundwater from chalk aquifers. Within the incubation period of 129 days, 14C-mecoprop concentration decreased to 60-80% in the microcosms with groundwater collected from two monitoring wells (Well 1 and 2). Dichlorprop degradation was neither observed under aerobic nor anaerobic conditions, while 17-27% of the initial concentration of 14C-bentazone was removed. The results indicated a degradation potential of mecoprop and bentazone under aerobic conditions.

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Water Resources Engineering, Technical University of Denmark
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Publication date: 2011

Assessing the most Sustainable Alternative for Production of drinking water - ASTA a decision support system

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Quantitative Sustainability Assessment, Department of Management Engineering, Urban Water Engineering, Københavns Energi A/S
Assessing the most sustainable alternative for production of drinking water – ASTA a decision support system Alternatives fulfilling the EU-Water Framework Directive

Bakteriesensor til on-line identifikation/bestemmelse af mikrobiel drikkevandskvalitet

Betydningen af grundvand-overfladevandsinteraktion for vandkvaliteten i et vandløb beliggende nedstrøms for Risby losseplads
Cluster of Legionnaires’ disease in a newly built block of flats, Denmark, December 2008-January 2009
During December 2008 to January 2009, two persons contracted Legionnaires’ disease in a newly built block of flats in a suburb of Copenhagen in Denmark. Polymerase chain reaction and culture was used to diagnose Legionnaires’ disease in this cluster. Isolates from both patients tested positive for Legionella pneumophila serogroup 1 subgroup Philadelphia sequence type 1 and the same strain was detected in hot water samples taken from the residential area indicating that the hot water supply system was the most likely source of infection. Legionella was not detected in the cold water. Two interventions were conducted to limit the Legionella colonisation of the piping and storage tanks and the effect was monitored by investigating water samples from various sites in the block of flats. Only the second intervention had a sufficient effect on the Legionella colonisation. The cluster described here points to several risk factors regarding growth of Legionella in hot water systems: (i) stagnancy of water from when the building is constructed and piping installed and until residents move in, (ii) stagnancy and low temperature (from room temperature to approximately 38 degrees C) of water in shower hoses and (iii) failure in operation of and control measures for the hot water system.
Conceptualization of natural attenuation processes at a complex contaminated site based on hydrogeological chemical and microbial data

General information
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Organisations: Water Resources Engineering, Department of Environmental Engineering, Urban Water Engineering, Geological Survey of Denmark and Greenland
Number of pages: 78
Publication date: 2011

Detection of Legionella by quantitative-polymerase chain reaction (qPCR) for monitoring and risk assessment

Background: Culture and quantitative polymerase chain reaction (qPCR) assays for the detection of Legionella were compared on samples from a residential area before and after two interventions. A total of 84 samples were collected from shower hoses and taps as first flush samples and at constant temperature. Samples were grouped according to the origin of the sample, a) circulation water b) water from empty apartments c) water from shower hoses. The aims were to investigate the usefulness of qPCR compared to culture for monitoring remedial actions for elimination of Legionella bacteria and as a tool for risk assessment. Results: In water collected from the apartments Legionella spp were detected by qPCR in the concentration range from LOQ to 9.6* 10^5 GU/L while L. pneumophila were detected in a range from LOQ to 6.8*10^5 GU/L. By culturing, the legionellae were detected in the range from below detection limit (> 10 CFU/L) to 1.6*10^6 CFU/L. In circulating water and in first flush water from shower hoses, culture and qPCR showed the same tendencies. The overall correlation between the bacteria number detected by culture and the two developed qPCR assays (L. spp and L. pneumophila) was relatively poor (r(2) = 0.31 for culture and Legionella spp. assay, r(2) = 0.20 for culture and L. pneumophila assay). Conclusion: Detection by qPCR was suitable for monitoring changes in the concentration of Legionella but the precise determination of bacteria is difficult. Risk assessment by qPCR only on samples without any background information regarding treatment, timing, etc is dubious. However, the rapid detection by qPCR of high concentrations of Legionella - especially Legionella pneumophila - is valuable as an indicator of risk, although it may be false positive compared to culture results. On the other hand, the detection of a low number of bacteria by qPCR is a strong indication for the absence of risk.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, Statens Serum Institut
Detection of microbial contaminations in drinking water using ATP measurements – evaluating potential for online monitoring

There is an increasing call for fast and reliable methods for continuous monitoring of microbial drinking water quality in order to protect public health. The potential for Adenosine triphosphate (ATP) measurements as a real-time analysis for continuous monitoring of microbial drinking water quality was investigated through simulation of two contamination scenarios, i.e. drinking water contaminated with waste water and surface water at various concentrations. With ATP measurements it was possible to detect waste water diluted 1000-10,000 times in drinking water depending on sensitivity of reagent kit. Surface water diluted 100-1000 times was detected in drinking water with ATP measurements. ATP has the potential as an early warning tool, especially in the period when the contamination concentration is high. 2011 © American Water Works Association AWWA WQTC Conference Proceedings All Rights Reserved.

Distribution of Asellus aquaticus and microinvertebrates in a non-chlorinated drinking water supply system – Effects of pipe material and sedimentation

Danish drinking water supplies based on ground water without chlorination were investigated for the presence of the water louse, Asellus aquaticus, microinvertebrates (}
Effect of selection of pH in swimming pool on formation of chlorination by-products

Chlorine is used as disinfection agent in public swimming pools, but also reacts with organic matter in the water forming chlorinated disinfection by-products. In order to evaluate the effect of choice of pH setpoint in the pool we investigated the effect of chlorination of artificial body fluid analogue at different pH-values between 6 and 8. The formation of trihalomethans, haloacetic acids and haloacetonitriles was measured. It was found that the formation of trihalomethans decreased with decreased pH. Haloacetic acid formation remained almost constant over the pH-range and haloacetonitrile formation increased with decreasing pH. As haloacetonitriles contributes the most to the genotoxicity of the water the predicted genotoxicity of the water was highest at the lowest pH value in the range tested. Adding bromine in the experiments resulted in decreased haloacetic acids formation and increased formation of haloacetonitriles and trihalomethans. Addition of bromide in the experiments resulted in a shift in the formation of DBP to more brominated DBPs which contributed to that the predicted genotoxicity of the water increased significantly regardless of the pH-level.
in aquifers. The aim of the current study was to investigate the stimulation of pesticides biodegradation by adding oxygen concentration range 0.0-11mg/L. We have studied effects of oxygen addition to anaerobic sediment on biodegradation of 1 μg/L mecoprop, dichlorprop and bentazone by microcosm experiments in 48 incubations for 130 days. A significant increase of mecoprop degradation was obtained (18-20%) at high oxygen concentrations of 9-11mg/L where 8.5% of mineralized at 2mg/L. Dichlorprop was mineralized to some extent (4-5%) at 9-11mg/L oxygen concentration. 10-15% of bentazone degradation was observed at high oxygen concentrations (8-11mg/L) and 3-5% mineralized at relatively low concentrations (0.5-2mg/L). To our knowledge, this is the first observation of bentazone degradation with aquifer. Optimization of redox conditions from anaerobic to aerobic by adding oxygen stimulated the biodegradation of three pesticides.

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Organisations: Urban Water Engineering, Department of Enviromental Engineering, Water Resources Engineering
Contributors: Levi, S., Bjerg, P. L., Albrechtsen, H.
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Publication date: 2011

Effects of herbicide contaminated groundwater discharges on mineralizations of phenoxy acids in a streambed

General information
Publication status: Published
Contributors: Pazarbasi, M. B., Milosevic, N., Albrechtsen, H., Bjerg, P. L., Aamand, J.
Number of pages: 41
Publication date: 2011

Effects of pumping strategies on pesticide concentration of a drinking water well

Groundwater is an important source of drinking water production in many countries including Denmark. This requires high quality groundwater that meets the standards of the European Water Framework Directive. Yet as a result of agricultural activity, deposition and previous handling, pesticides are frequently found in groundwater and can raise a substantial problem for ground water abstraction. The concentration of this contamination may vary between different layers. The heterogeneity of the subsurface geology and the depth of the drinking water well’s screen are important parameters that affect the resulting contamination of the abstracted groundwater. The pesticide concentration in wells may also be affected by the pumping strategy because pumping can alter the structure of the flow field, the flowpath of water going to the well and subsequently the age of water at the well. The purpose of this study was to examine numerically the effects of pumping on pesticide contamination of drinking water wells using a reactive transport model in a hypothetical aquifer system resembling a typical Danish well field. The application history of the pesticides is crucial. This can be taken into account by assessing the effects of pumping on water age distribution along the well. Three compounds with different application histories were considered: an old banned pesticide MCPP (Mecoprop) which is mobile and relatively persistent in deeper aquifers, and a highly applied, biodegradable and strongly sorbing pesticide glyphosate, and its degradation product AMPA. A steady state flow field was first computed. A well field was then introduced and different pumping regimes were applied for a period of 180 years; a low-rate pumping, a high-rate pumping and a varying pumping regime. A constant application rate at the surface was assumed for the application period of each pesticide. The pre-abstraction age distribution of the water in the system was first estimated using a steady-state flow and transport simulation. These water
ages were then used as the initial conditions for the transient simulations. The results of the simulations showed that the range of water ages contributing to the well increased during pumping and was substantially affected by the pumping rate. High pesticide concentrations were persistent in the well 40 to 100 years after they were banned, due to the high residence times in the aquifer. Large changes in simulated pesticides concentrations at the well occurred during pumping. The pesticide concentration reaching the well was affected by the pumping regime and the pesticide application history and properties. A higher pumping rate induced a higher pesticide concentration peak at the well of shorter duration, while a lower pumping rate induced a lower concentration peak of longer duration. The long term scenarios revealed that at high pumping rates MCPP would disappear 40 years after its application end year, while glyphosate concentrations increase and reach a plateau, which is highly dependent on the pumping rate. The findings of the study help understand the results of groundwater monitoring programmes and can be used for the quantitative evaluation of management and pumping strategies for the long-term supply of safe potable groundwater.

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- **Contributors:** Aisopou, A., Binning, P. J., Bjerg, P. L., Albrechtsen, H.
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**Forekomst af småorganismer i drikkevandssystemer**

**General information**
- **Publication status:** Published
- **Organisations:** Urban Water Engineering, Department of Environmental Engineering, VandCenter Syd A/S
- **Contributors:** Christensen, S. C., Nissen, E., Arvin, E., Albrechtsen, H.
- **Pages:** 27-28
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- **Issue number:** 5
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- **Ratings:**
- **ISI indexed (2011):** ISI indexed no
- **Original language:** Danish
- **Source:** orbit
- **Source-ID:** 286562
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**Gastroenteritis: A waterborne outbreak affected 430 triathletes in an ironman competition - Could this be avoided?**

**General information**
- **Publication status:** Published
- **Organisations:** Department of Environmental Engineering, Department of Environmental Science and Engineering, Urban Water Engineering
- **Contributors:** Andersen, S. T., Erichsen, A. C., Mark, O., Albrechtsen, H.
- **Publication date:** 2011
- **Peer-reviewed:** Yes
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- **Electronic versions:** A0.pdf
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Herbicide mineralizations relate to the appearances of tfdA genes

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Organisations: Department of Environmental Engineering, Urban Water Engineering, Geological Survey of Denmark and Greenland
Number of pages: 141
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Hvordan minimeres forureninger ved ledningsarbejder – og hvorfor er det vigtigt?

General information
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Contributors: Albrechtsen, H., Corfitzen, C. B., Vang, Ó. K., Lindhardt, B.
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Increasing urban water self-sufficiency: New era, new challenges
Urban water supplies are traditionally based on limited freshwater resources located outside the cities. However, a range of concepts and techniques to exploit alternative water resources has gained ground as water demands begin to exceed the freshwater available to cities. Based on 113 cases and 15 in-depth case studies, solutions used to increase water self-sufficiency in urban areas are analyzed. The main drivers for increased self-sufficiency were identified to be direct and indirect lack of water, constrained infrastructure, high quality water demands and commercial and institutional pressures. Case studies demonstrate increases in self-sufficiency ratios to as much as 80% with contributions from recycled water, seawater desalination and rainwater collection. The introduction of alternative water resources raises several challenges: energy requirements vary by more than a factor of ten amongst the alternative techniques, wastewater reclamation can lead to the appearance of trace contaminants in drinking water, and changes to the drinking water system can meet tough resistance from the public. Public water-supply managers aim to achieve a high level of reliability and stability. We conclude that despite the challenges, self-sufficiency concepts in combination with conventional water resources are already helping to reach this goal.

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Contributors: Rygaard, M., Binning, P. J., Albrechtsen, H.
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Inherent mineralization of 2,6-dichlorobenzamide (BAM) in unsaturated zone and aquifers – Effect of initial concentrations and adaptation

The dichlobenil metabolite BAM (2,6-dichlorobenzamide) is frequently detected in aquifers e.g. in Denmark despite the mother compound dichlobenil was banned here since 1997. BAM mineralization was investigated at environmentally relevant concentrations in sediment samples. Undisturbed sediment cores with known dichlobenil application were collected from topsoil to 8.5 m below surface resulting in 57 samples hereof 4 aquifer samples. Mineralization was only substantial (>10%) in the uppermost meter of the unsaturated zone. Microbial adaptation, observed as faster mineralization in pre-exposed than in pristine sediments from the same location, was only evident in sandy sediment where dichlobenil was still present, but not in clayey sediments. Higher initial concentrations (1–5000 μg/kg) did not stimulate mineralization in pristine clayey or sandy sediments, or in pre-exposed sand. However, in pre-exposed clay mineralization was stimulated at high concentrations. Furthermore BAM was for the first time mineralized in aerobic aquifer sediments from different BAM-contaminated groundwater locations. BAM mineralization in subsurface and groundwater was demonstrated.
Life cycle assessment of three water systems in Copenhagen-a management tool of the future.

Environmental life-cycle assessment (LCA) was applied to evaluate three different water systems of the water sector in Copenhagen, Denmark, including technologies within water supply, facilities recycling water and treatment of sewer overflow. In these three water systems LCA was used to evaluate the environmental impacts of each of the processes involved. The overall conclusion was that LCA is suitable as a decision support tool in the water sector as it provides a holistic evaluation platform of the considered alternatives categorised in environmental impact categories. The use of LCA in the water sector of this region has limitations since it does not yet consider impact categories assessing freshwater scarcity and ecological sustainability.

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Natural attenuation processes in landfill leachate plumes at three Danish sites.

This article provides an overview of comprehensive core and fringe field studies at three Danish landfill sites. The goal of the research activities is to provide a holistic description of core and fringe attenuation processes for xenobiotic organic compounds in landfill leachate plumes. The approach used is cross-disciplinary, encompassing integration of field-scale observations at different scales, field injection experiments, laboratory experiments, and reactive solute transport modeling. This is illustrated in examples from the most recently investigated site-the Sjoelund Landfill. The research performed serves as good case studies to conceptualize natural attenuation processes in landfill leachate plumes and also supports the notion that monitored natural attenuation (MNA) may be a possible remediation strategy at landfills. However, landfill leachate plumes challenge traditional approaches and tools used in the application of MNA. In particular, the use of in situ indicators to document mass removal in landfill leachate plumes is emphasized. In this article, we advocate the application of conceptual and numerical models as tools for the integration of data and testing of hypotheses.

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Contributors: Corfitzen, C. B., Albrechtsen, H.
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Source: orbit
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Research output: Book/Report › Report – Annual report year: 2011 › Research

Overlevelse af indikatororganismer og patogener i ledningsnet

Following several of the larger contamination incidents in drinking water supplies, indicator organisms (coliforms, E. coli, enterococci) have been present in the distribution network for a long time even after extensive flushing. For example E. coli and coliforms were present in the distribution system of Aarhus for 5 to 6 weeks (2002), without the source being identified. Numerous observations regarding the presence of indicator organisms in drinking water distribution systems cannot be explained by the current knowledge. In order to evaluate the significance of such presence of coliforms, it is necessary to gain further knowledge on which circumstances they can survive - or maybe even grow - in distribution systems. The purpose of this project was to investigate the survival of selected indicator organisms and pathogens in contact with different types of pipe material and in pipes collected from distribution systems with special focus on the interaction between water phase and biofilm. Furthermore the purpose was, to investigate the influence of working procedures when replacing distribution pipes, including whether renovation of pipes represents a risk for the microbial drinking water quality. Firstly, the working procedures during renovation work were mapped. An assessment of the working procedures at Nordvand A/S identified a series of risks for the microbial drinking water quality before, during and after the renovation work. Based on the identified risks a number of recommendations for the water supplies were prepared – including storage of new pipe preventing the inner surfaces to get in contact with the environment, the renovation work should be performed as controlled as possible, the staff should be trained in hygiene, defined procedures for the renovation work etc. Microbial analysis of the water from renovation dig-outs revealed high bacterial counts and a significant level of indicator organisms (coliforms, E. coli, enterococci). This water can cause problems in the distribution network if it gets in contact with the inner surfaces of the new water pipes. Therefore the working procedure during renovation should always include removal of water from the digouts. This project has lead to Nordvand A/S having more structured work procedures for pipe renovation. After the implementation of the new procedures, Nordvand A/S has only experienced few occurrences of high bacterial counts in relation to pipe renovation. Thus the project demonstrated that high bacterial counts following pipe renovation can be prevented by good hygiene and standardised working procedures. To evaluate the risk of a microbial contamination in relation with renovation work, the survival of a number of bacteria was investigated. This work included seven strains of Escherichia coli, seven strains of Klebsiella pneumoniae and six strains of Campylobacter jejuni, isolated from both clinical patients and the environment. Initial concentrations of E. coli and K. pneumoniae were 100-200 cells/ml and of C. jejuni 1000 celler/ml, which are low concentrations close to realistic levels.
All strains of the indicators E. coli and K. pneumoniae survived for more than four weeks in drinking water, which is a relative long time considering that the residence time of drinking water in distribution networks usually is shorter than one week. Strains of the pathogen C. jejuni were only detected in the water phase for two to five days by the applied analysis method. In general strains of K. pneumoniae (T½: 11-42 days) survived better than strains of E. coli (T½: 6-18 days). All strains of K. pneumoniae and E. coli could also be detected in the biofilm on PE-pipes, while none of the C. jejuni could be detected in biofilms. Generally K. pneumoniae colonised the biofilm of the pipe surfaces to a higher degree than E. coli. However, the water phase concentration of K. pneumoniae and E. coli was always higher than the biofilm concentration. K. pneumoniae and E. coli always decayed significantly in the water phase during the four weeks investigated, while the biofilm concentration was relatively stable. This indicated a better survival in the biofilm. The survival of E. coli and K. pneumonia in drinking water was inhibited by the presence of plastic materials (PE (polyethylene), PEX (cross-linked polyethylene) and silicone) and the degree of the effect depended on material type. Silicone had the strongest inhibition on the survival in the water phase followed by PE and PEX (silicone >> PE > PEX). Both indicator organisms were detected in the biofilm on all three materials during the four weeks investigated. Contact with plastic pipes had no effect on the survival of C. jejuni in drinking water and C. jejuni was not detected in biofilms on any of the materials. There was no clear distinction between the colonisation of the biofilm on the three materials, though the biofilm density was higher on silicone than on PE and PEX. It was investigated how indicator organisms and pathogens survived under realistic conditions, i.e. in pipes collected from a real distribution system, with scalings and mature biofilms. Both indicator organisms - E. coli and K. pneumoniae – were detected both in the water phase and in the biofilm for more than four weeks in PE pipes, but only for two weeks in cast iron pipes. C. jejuni was detected in the pipes for up to three days by the applied analysis method, and only in the water phase. C. jejuni might be present in a viable-but-not-culturale state, but it is unknown whether the cells are infectious in this state. There were significantly more bacteria (total ATP) in the water phase of cast iron pipes than in the investigated PE pipes, and the biofilm density on cast iron pipes was larger than on PE pipes. The older the PE pipe was the higher the biofilm density and the higher degree of colonisation of the biofilm with indicator organisms. The project has demonstrated that high bacterial counts following pipe renovation can be prevented by good hygiene and standardised working procedures. It is important that water from the renovation dig-outs do not get in contact with the inner surfaces of the new water pipes, since this can affect the microbial drinking water quality. Laboratory investigations with new and old pipes collected from real distribution systems demonstrated that indicator organisms can colonise the surfaces of pipes and survive for more than four weeks. Laboratory investigations demonstrated that pipe material influenced the survival of indicator organisms and most likely also the survival of pathogens, with indicator organisms surviving in drinking water for two weeks in cast iron pipes and four weeks in plastic pipes (PE, PEX).
Sustainable drinking water treatment - biological filters (DW BIOFILTERS)

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Two cases of legionnaires’ disease associated with a newly build residential area - risk factors and remedial actions

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UrbanWaterTech: Et forskeruddannelsesprogram for urban vandteknologi

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Vertical small scale variations of sorption and mineralization of three herbicides in subsurface limestone and sandy aquifer

Vertical variation in sorption and mineralization potential of mecoprop (MCPP), isoproturon and acetochlor was investigated at low concentrations (μg-range) at the cm-scale in unsaturated sub-surface limestone samples and saturated sandy aquifer samples from an agricultural catchment in Brévilles, France. From two intact core drills, four heterogenic limestone sections were collected from 4.50-26.40 m below surface (mbs) and divided into 12 sub-samples of 8-25 cm length, and one sandy aquifer section from 19.20-19.53 m depth divided into 7 sub-samples of 4-5 cm length. In the sandy aquifer section acetochlor and isoproturon sorption increased substantially with depth; in average 78% (acetochlor) and 61% (isoproturon) per 5 cm. Also the number of acetochlor and isoproturon degraders (mostprobable-number) was higher in the bottom half of the aquifer section (93->16 000 /g) than in the upper half (4-71 /g). One 50 cm long limestone section with a distinct shift in color showed a clear shift in mineralization, number of degraders and sorption: In the two brown, uppermost samples, up to 31% mecoprop and up to 9% isoproturon was mineralized during 231 days, the numbers of mecoprop and isoproturon degraders were 1 300 to >16 000 /g, and the sorption of both isoproturon and acetochlor was more than three times higher, compared to the two deeper, grayish samples just below where mineralization (≤4 %) and numbers of degraders (1-520 /g) were low for all three herbicides. In both unsaturated limestone and sandy aquifer, variations and even distinct shifts in both mineralization, number of specific degraders and sorption were seen within just 4-15 cm of vertical distance. A simple conceptual model of herbicides leaching to groundwater through a 10 m unsaturated limestone was established, and calculations showed that a 30 cm active layer with the measured sorption and mineralization values hardly impacted the fate of the investigated herbicides, whereas a total thickness of layers of 1 m would substantially increase natural attenuation.

General information
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Contributors: Janniche, G. S., Mouvet, C., Albrechtsen, H.
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Web of Science (2011): Indexed yes
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Vurdering af risici ved anvendelser af sekundavand generelt samt konkret vurdering af sekundavandet fra de nye vandkiosker

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Acetochlor sorption and degradation in limestone subsurface and aquifers

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Development and sensitivity analysis of a fullykinetic model of sequential reductive dechlorination in subsurface

Chlorinated hydrocarbons originating from point sources are amongst the most prevalent contaminants of ground water and often represent a serious threat to groundwater-based drinking water resources. Natural attenuation of contaminant plumes can play a major role in contaminated site management and natural degradation of chlorinated solvents frequently occurs in the subsurface through sequential reductive dechlorination. However, the occurrence and the performance of natural sequential reductive dechlorination strongly depends on environmental factor such as redox conditions, presence of fermenting organic matter / electron donors, presence of specific biomass, etc. Here we develop a new fully-kinetic biogeochemical reactive model able to simulate chlorinated solvents degradation as well as production and consumption
of molecular hydrogen. The model is validated using batch experiment data and global sensitivity analysis is performed.

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Source-ID: 265060
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2010 › Research peer-review

**Effect of pH on formation of chlorinated by-products in swimming pool water**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Hansen, K. M. S., Mosbæk, H., Albrechtsen, H., Andersen, H. R.
Publication date: 2010
Peer-reviewed: No
Event:
Research output: Contribution to conference › Paper – Annual report year: 2010 › Research

**Estimation of critical indicator level in drinking water for infection with specific pathogens**

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H., Corfitzen, C. B., Vang, Ø. K.
Publication date: 2010

**Host publication information**
Title of host publication: 2010 AWWA International Symposium on Waterborne Pathogens, Manhattan Beach, California, May 2-4, 2010
Publisher: American Water Works Association (AWWA)
URLs:
http://www.acumen-va-online.com/awwaWP2010/
Source: orbit
Source-ID: 274397
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2010 › Research

**Fjernelse af pesticidet MCCP (mecoprop) ved traditionel vandbehandling**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Arvin, E., Albrechtsen, H., Corfitzen, C. B., Ferguson, C.
Publication date: 2010

**Host publication information**
Title of host publication: Dansk Vand Konference 2010 : Orientering om foredrag
Publisher: Dansk Vand- og Spildevandsforening - DANVA

**Bibliographical note**
Projektet er afrapporteret i vinter – har været kort præsenteret på et IDA miljømøde
Source: orbit
Source-ID: 268133
Infiltration of pesticides in surface water into nearby drinking water supply wells

Drinking water wells are often placed near streams because streams often overly permeable sediments and the water table is near the surface in valleys, and so pumping costs are reduced. The lowering of the water table by pumping wells can reverse the natural flow from the groundwater to the stream, inducing infiltration of surface water to groundwater and consequently to the drinking water well. Many attenuation processes can take place in the riparian zone, mainly due to mixing, biodegradation and sorption. However, if the water travel time from the surface water to the pumping well is too short, or if the compounds are poorly degradable, contaminants can reach the drinking water well at high concentrations, jeopardizing drinking water quality. Here we developed a reactive transport model to evaluate the risk of contamination of drinking water wells by surface water pollution. The model was validated using data of a tracer experiment in a riparian zone. Three compounds were considered: an older pesticide MCPP (Mecoprop) which is mobile and persistent, glyphosate (Roundup), a new biodegradable and strongly sorbed pesticide, and its degradation product AMPA. Global sensitivity analysis using the method of Morris was employed to identify the dominant model parameters. Results showed that the presence of an aquitard and its characteristics (degree of fracturing and thickness), pollutant properties and well depth are the crucial factors affecting the risk of drinking water well contamination from surface water. Global sensitivity analysis results were compared with rank correlation statistics between pesticide concentrations and geological parameters derived from a comprehensive database of Danish drinking water wells. Aquitard thickness and well depth are the most critical parameters in both the model and observed data.
Invertebrate animals in Danish drinking water distribution networks

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Christensen, S. C., Nissen, E., Arvin, E., Albrechtsen, H.
Publication date: 2010

Host publication information
Title of host publication: The 7th Nordic Drinking Water Conference, Copenhagen June 7-9, 2010: Abstracts
Place of publication: Skanderborg
Publisher: Dansk Vand- og Spildevandsforening - DANVA
Source: orbit
Source-ID: 274160
Research output: Chapter in Book/Report/Conference proceeding → Conference abstract in proceedings – Annual report year: 2010 → Research → peer-review

Life Cycle Assessment and evaluation of environmental benefits of softening water

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Københavns Energi A/S
Contributors: Godskesen, B., Zambrano, K. C., Albrechtsen, H.
Publication date: 2010

Host publication information
Title of host publication: Proceedings of the World Water Congress and Exhibition
Volume: IWA-3306
Publisher: International Water Association
Source: orbit
Source-ID: 267603
Research output: Chapter in Book/Report/Conference proceeding → Conference abstract in proceedings – Annual report year: 2010 → Research → peer-review

Life Cycle Assessment of Central Softening of drinking water in Copenhagen

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Godskesen, B., Zambrano, K., Albrechtsen, H.
Publication date: 2010
Peer-reviewed: No
Source: orbit
Source-ID: 267565
Research output: Contribution to conference → Poster – Annual report year: 2010 → Research

Life cycle assessment of three water systems in Copenhagen - A management tool of the future

Environmental life-cycle assessment (LCA) was applied to evaluate three different water systems of the water sector in Copenhagen, Denmark, including technologies within water supply, facilities recycling water and treatment of sewer
overflow. In these three water systems LCA was used to evaluate the environmental impacts of each of the processes involved. The overall conclusion was that LCA is suitable as a decision support tool in the water sector as it provides a holistic evaluation platform of the considered alternatives categorized in environmental impact categories. The use of LCA in the water sector of this region has limitation since it not yet considers impact categories assessing freshwater scarcity and ecological sustainability.
Mineralization of isoproturon, mecoprop and acetochlor in a deep unsaturated limestone and sandy aquifer

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Lindberg, I. E., Mouvet, C., Albrechtsen, H.
Pages: 823-831
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 81
ISSN (Print): 0045-6535
Ratings:
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.893 SNIP 1.426
Web of Science (2010): Impact factor 3.155
Web of Science (2010): Indexed yes
Original language: English
DOIs: 10.1016/j.chemosphere.2010.08.023

Monitoring microbial processes and quality in drinking water production - application of near-continuous ATP-measurements

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 11-12
Publication date: 2010

Host publication information
Title of host publication: Proceedings of the 1st Sino-Danish Joint Conference on Sustainable Environmental Engineering, Shanghai, May 20-21, 2010
Place of publication: Shanghai
Publisher: Tongji University
Source: orbit
Source-ID: 264720
Research output: Contribution to journal > Journal article – Annual report year: 2010 > Research > peer-review

Notat om foreløbig risikovurdering ved anvendelse af sekundavand – grundvand indvundet i Københavns kommune – til toletskyl og tøjvask.

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Number of pages: 17
Publication date: 2010

Publication information
Risk assessment and monitoring of Legionella by culture and q-PCR in a newly built block of flats associated with a small outbreak of legionnaires’ disease

During the investigation of a small outbreak of legionnaires’ disease in a newly built block of flats, several risk factors were uncovered. The outbreak encompassed two men (age 44 and 65) of which the oldest one died. Two interventions (heat treatments of 70ºC for 12 and 24 hours respectively) and permanent changes of the flow and temperature were conducted to overcome the high concentrations of Legionella in the water. Water samples (104 in total, both cold and warm water) from taps and shower hoses were collected and cultivated. The samples consisted of: A samples: the first one litre, B samples: one litre collected after flushing until constant temperature and water from shower hoses at a temperature of 38ºC. The survey pointed at important risk factors 1) low temperature of the hot water in some of the most distant taps 2) low flow of the water circulating system because of too small pipe dimensions and too low pump capacity 3) high numbers of Legionella in the shower hoses 4) stagnancy of water before residents move in and in unoccupied apartments and 5) lack of or inappropriate control measures. Following cultivation, DNA from all water samples was extracted by a simple method with Chelex-100. The samples will be investigated by an in-house q-PCR (Quantitative Real Time PCR). The q-PCR is a Taq-Man based assay with 5S primers detecting Legionella spp and mip primers detecting Legionella pneumophila. The two Legionella q-PCR assays have been validated according to the Afnor standard (T90 471) with standards calibrated according to the international standard from Legionelles centre National de Référence (SRM_LEGDNA_01 and CQE_LEGDNA_01). The results from culture (CFU/L) and PCR (GU/L) will be compared, and on this background it will be evaluated if q-PCR could have been used for fast risk assessment in the initial phase of the investigation and to follow the effect of the interventions in the later phase of the investigation.
Risk assessment of intrusion of Campylobacter jejuni and indicator organisms in drinking water distribution networks

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Vang, O. K., Corfitzen, C. B., Albrechtsen, H.
Publication date: 2010

Host publication information
Title of host publication: 2010 AWWA International Symposium on Waterborne Pathogens, Manhattan Beach, California, May 2-4, 2010
Publisher: American Water Works Association (AWWA)

Bibliographical note
Power Point presentation.
Source: orbit
Source-ID: 274399
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2010 › Research

UV-belysnings effekt på vandkvaliteten i ledningsnettet VandCenter Syd

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Mollerup, F., Albrechtsen, H.
Publication date: 2010

Host publication information
Publisher: Dansk Vand- og Spildevandsforening - DANVA
Source: orbit
Source-ID: 268131
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2010 › Research


General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Rygaard, M., Albrechtsen, H., Arvin, E., Binning, P. J.
Number of pages: 42
Publication date: 2009

Publication information
Place of publication: Lyngby
Publisher: DTU Miljø
Original language: Danish

Bibliographical note
Juli 2009
Source: orbit
Source-ID: 275229
Research output: Book/Report › Report – Annual report year: 2009 › Research

A biogeochemical transport model to simulate the attenuation of chlorinated hydrocarbon contaminant fluxes across the groundwater-surface water interface
Chlorinated hydrocarbons originating from point sources are amongst the most prevalent contaminants of ground water and surface water resources. Riparian zones may play an important role in the attenuation of contaminant concentrations when contaminant plumes flow from groundwater to surface water because of the occurrence of redox gradients, strongly
reductive conditions and high biological activity. In order to meet the expectations of the EU Water Framework Directive, an evaluation of the impact of such plumes on surface water is needed. The aim of this work is to develop a groundwater transport and biogeochemical transformation model of the discharge of a TCE plume into a stream, and to determine which parameters most strongly affect pollutant discharge concentrations. Here biological kinetics and the interaction with the soil matrix are implemented in PHREEQC. The ability of PHREEQC to deal with a large number of geochemical processes, allows the simulation of soil geochemical transformations when microbial by-products are released to surface water, and the consideration of non-linear feedbacks on bacterial growth and pollutant transformations. Sensitivity analysis is performed through Monte Carlo simulations to identify the dominant parameters influencing chlorinated solvents degradation.

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Malaguerra, F., Binning, P. J., Albrechtsen, H.
Pages: 389-392
Publication date: 2009

**Host publication information**
Title of host publication: ModelCARE 2009. 7th International Conference on Calibration and Reliability in Groundwater Modelling: Managing Groundwater and the Environment
Volume: Section 4
Publisher: Riskpoint
Source: orbit
Source-ID: 253540
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 2009 > Research > peer-review

**Acetochlors skæbne fra topjord, gennem kalk til grundvandsmagasin: undersøgelser af et nyt herbicid**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Albrechtsen, H.
Pages: 131-138
Publication date: 2009

**Host publication information**
Title of host publication: Vintermøde om jord- og grundvandsforurening, Vingstedcentret 10.-11. marts 2009
Volume: Bind 1
Place of publication: Kgs. Lyngby
Publisher: ATV Jord og Grundvand
Source: orbit
Source-ID: 240186
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 2009 > Research

**Alternative water management and self-sufficient water supplies**

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Rygaard, M., Albrechtsen, H., Binning, P. J.
Publication date: 2009

**Publication information**
Place of publication: London, UK
Publisher: IWA Publishing
ISBN (Print): 9781843392279
Original language: English
Source: orbit
Source-ID: 253525
Research output: Book/Report > Book – Annual report year: 2009 > Research > peer-review
Anvendelighed af ATP som hurtigmetode til proces- og kvalitetskontrol

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Schnipper, G., Henriques, A., Corfitzen, C. B.
Number of pages: 1
Publication date: 2009
Peer-reviewed: No
Source: orbit
Source-ID: 253836
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2009 › Research

Drinking water distribution - effects on water quality

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 103-111
Publication date: 2009

Host publication information
Title of host publication: Drinking water - sources, sanitation and safeguarding
Place of publication: Stockholm
Publisher: Formas - The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
ISBN (Print): 978-91-540-6034-4
Source: orbit
Source-ID: 250541
Research output: Chapter in Book/Report/Conference proceeding › Book chapter – Annual report year: 2009 › Research

Economic assessment of water quality

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Røgaard, M., Albrechtsen, H., Arvin, E., Binning, P. J.
Pages: 11-12
Publication date: 2009

Host publication information
Title of host publication: 3rd annual meeting of the Danish Water Research Platform DWRP - (Forskningsplatformen Vand), 29 January 2009
Volume: Abstracts
Source: orbit
Source-ID: 237976
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2009 › Research

Fate of herbicides in Brévilles catchment from topsoil through aquifer to spring

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Janniche, G. S., Baran, N., Gutierrez, A., Mouvet, C., Albrechtsen, H.
Number of pages: 23
Publication date: 2009

Host publication information
Title of host publication: AquaTerra. Final conference - Processes - data - models - future scenarios. Scientific fundamentals for river basin management, 25th to 27th March 2009, Tübingen, Germany
Volume: Conference programme & proceedings
Full scale test of UV-based water treatment technologies at Gladsaxe Sportcentre - with and without advanced oxidation mechanisms

Invertebrate animals in a Danish drinking water distribution network: Poster B27

Legionnaires’ disease associated with a new residential area - risk factors and remedial actions
Removal of the phenoxyacid herbicide Mecoprop (MCP) in water works rapid sandfilters

Rensning af grundvand for BAM og atrazin med aktivt kul

Risikovurdering af forhøjede værdier af coliforme bakterier
Risikovurdering og risikoprofil af forekomst af coliforme bakterier i drikkevand

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Vang, Ó. K., Albrechtsen, H.
Publication date: 2009

**Publication information**
Place of publication: København
Publisher: By- og Landskabsstyrelsen, Miljøministeriet
Original language: Danish
URLs:
http://www.blst.dk/NR/rdonlyres/417080E2-C1A5-4E5B-9097-4A47D62F471D/0/Risikovurdering_og_risikoprofil_ColiRisk.pdf
Source: orbit
Source-ID: 257600
Research output: Book/Report › Report – Annual report year: 2009 › Research

Small animals in water distribution networks

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Christensen, S. C., Arvin, E., Albrechtsen, H.
Pages: 14-15
Publication date: 2009

**Host publication information**
Title of host publication: 3rd annual meeting of the Danish Water Research Platform DWRP - (Forskningsplatformen Vand), 29 January 2009
Volume: Abstracts
Source: orbit
Source-ID: 238009
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2009 › Research

Strategier for at sikre tilstrækkeligt vand til storbyer, set i et internationalt perspektiv

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Rygaard, M., Binning, P. J., Albrechtsen, H.
Publication date: 2009
Peer-reviewed: No
Source: orbit
Source-ID: 252684
Research output: Contribution to conference › Poster – Annual report year: 2009 › Research

Survival of E. coli, coliform bacteria (K. pneumoniae) and the pathogen C. jejuni in drinking water distribution networks: Oral 45

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Vang, Ó. K., Corfitzen, C. B., Albrechtsen, H.
Number of pages: 96
Survival of indicator organisms and pathogens in drinking water distribution networks

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Vang, Ø. K., Corfitzen, C. B., Lindhardt, B., Albrechtsen, H.
Number of pages: 9
Publication date: 2009

Host publication information
Title of host publication: 15th Health Related Water Microbiology Symposium, 31.05 - 05.06 2009, Naxos, Greece
Place of publication: Naxos, Greece
Publisher: IWA
Source-ID: 244652
Research output: Chapter in Book/Report/Conference proceeding > Conference abstract in proceedings – Annual report year: 2009 > Research > peer-review

Undersøgelse af: Mikrobiologiske drikkevandsforureninger 2000-2002 omfang, årsager, aktion og sygdom

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Engelsborg, C. C., Andersen, U. T., Albrechtsen, H., Ethelberg, S., Bagge, L.
Publication date: 2009

Undersøgelse af pesticidfjernelsen i Kerteminde Vandværk med henblik på procesoptimering: Rapport udarbejdet for Fyn Amt

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Ferguson, C., Corfitzen, C. B., Albrechtsen, H., Arvin, E.
Publication date: 2009

Undersøgelse af pesticidfjernelsen i Kerteminde Vandværk med henblik på procesoptimering: Rapport udarbejdet for Fyn Amt

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Ferguson, C., Corfitzen, C. B., Albrechtsen, H., Arvin, E.
Publication date: 2009

Publication information
Place of publication: Kgs. LyngbyDTU Miljø, Danmarks Tekniske Universitet
Original language: Danish
Electronic versions:
ENV2009-285.pdf
URLs:
Water quality and energy considerations in water supply

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Rygaard, M., Albrechtsen, H., Arvin, E., Binning, P. J.
Publication date: 2009

**Host publication information**
Title of host publication: Water & Energy 2009 - mitigation in the water sector & potential synergies with the energy sector
29.-31. October 2009, Copenhagen Denmark
Volume: USB key
Place of publication: London, UK
Publisher: International Water Association
Source: orbit
Source-ID: 252681

Water quality and energy considerations - the costs and benefits of purity

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Rygaard, M., Albrechtsen, H., Arvin, E., Binning, P. J.
Publication date: 2009
Peer-reviewed: Yes
Event: Poster session presented at Water & Energy: Mitigation in the water sector & potential synergies with the energy sector, Copenhagen Denmark, 29.-31. October, .
Source: orbit
Source-ID: 252679
Research output: Contribution to conference – Poster – Annual report year: 2009 – Research – peer-review

Analysis of microbial contaminations and risk of outbreaks in Danish drinking water supplies

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H., Engelsborg, C. C., Andersen, U. T., Bagge, L., Ethelberg, S.
Pages: 173-180
Publication date: 2008

**Host publication information**
Title of host publication: NVK 2008. 6. nordiska drikkevannskonferansen, Oslo, 9-11 juni 2008
Volume: Foredrag
Place of publication: Hamar, Norge
Publisher: Norsk Vann BA
Source: orbit
Source-ID: 222354
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 2008 – Research

Benchmark for kundeoplevet forsyning af drikkevand

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Schow, C., Albrechtsen, H., Arvin, E., Raben, A.
Pages: 27-36
Benchmarking customer-experienced supply of water

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Schow, C., Albrechtsen, H., Arvin, E., Raben, A.
Publication date: 2008

Host publication information
Title of host publication: IWA World Water Congress and Exhibition, 7-12 September 2008, Vienna. Proceedings
Volume: CD-ROM
Place of publication: London, UK
Publisher: International Water Association
Source-ID: 224620
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2008 › Research

Giver mikrobiologiske drikkevandsforureninger sygdom?

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Engelsborg, C., Ethelberg, S., Bagge, L.
Pages: 105-120
Publication date: 2008

Host publication information
Title of host publication: Vandforsyningsteknik 57
Place of publication: Skanderborg
Publisher: Dansk Vand- og Spildevandsforening - DANVA
Source-ID: 223812
Research output: Chapter in Book/Report/Conference proceeding › Book chapter – Annual report year: 2008 › Research

How long can E. coli and coliform bacteria (K. pneumoniae strains) survive in drinking water in contact with plastic pipes?

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Vang, Ó. K., Corfitzen, C. B., Albrechtsen, H.
Publication date: 2008

Host publication information
Title of host publication: NVK 2008. 6. nordiska drikkevannskonferansen, Oslo, 9-11 juni 2008
Volume: CD-ROM
Place of publication: Hamar, Norge
Publisher: Norsk Vann BA
Source-ID: 222355
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2008 › Research
SENSOWAQ - Sensors for monitoring and control of water quality

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H., Corfitzen, C. B.
Publication date: 2008
Peer-reviewed: No
Event: Poster session presented at 6. nordiska drikkevannskonferansen, Oslo, Norway.

URLs:
Source: orbit
Source-ID: 222493
Research output: Contribution to conference › Poster – Annual report year: 2008 › Research

Alternativer til klor som desinfektionsmiddel i offentlige svømmebade

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Kristensen, G., Klausen, M., Arvin, E., Albrechtsen, H., Bisted, O., Hansen, B., Frederiksen, E., Kaas, P.
Number of pages: 124
Publication date: 2007

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 1153).

URLs:
Source: orbit
Source-ID: 197472
Research output: Book/Report › Report – Annual report year: 2007 › Research

Analyse af AOC og metan Stege vandværk: Udført for Vordingborg Vand A/S

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Publication date: 2007

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Danish
Source: orbit
Source-ID: 219836
Research output: Book/Report › Report – Annual report year: 2007 › Research

A New Approach for Biologically-Inhibiting Surfaces
A biologically-inhibiting surface based on electrochemical principles has been shown to have a reducing effect on the formation of biofilms in drinking water. The coating consists of silver and another precious metal, which is applied to the surface in small areas with a thickness measured in nanometers. Due to the difference in potentials, the biologically-inhibiting material will act as a galvanic element in contact with an electrolyte. The electrochemical processes taking place at the metal surface seem to exhibit a catalytic oxidation character more than an oligomeric effect from the silver.
Bakteriers vækst og overlevelse i drikkevandssystemer - samspil med materialer

Bakteriologi. Hvad er det for mikroorganismer, der er i drikkevandet - og hvad betyder de?

Dechlorination after thermal treatment of a TCE-contaminated aquifer: Laboratory experiments
Degradation of the herbicide dichlobenil and its metabolite BAM in soils and subsurface sediments

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Arildskov, N. P., Larsen, F., Aamand, J., Albrechtsen, H.
Pages: 157-173
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 89
ISSN (Print): 0169-7722
Ratings:
Scopus rating (2007): SJR 1.623 SNIP 1.361
Web of Science (2007): Indexed yes
Original language: English
DOIs:
10.1016/j.jconhyd.2006.04.004
Source: orbit
Source-ID: 193526
Research output: Contribution to journal › Journal article – Annual report year: 2007 › Research › peer-review

Deposition, persistence and turnover of pollutants: first results from the EU project AquaTerra for selected river basins and aquifers

Deposition, turnover and movement of persistent organic pollutants (POP) were investigated in the EU integrated project "AquaTerra", which is among the first funded environmental projects within the 6th Framework Program by the European Commission. Project work integrates across various disciplines that range from biogeochemistry, environmental engineering, computer modelling and chemistry to socio-economic sciences. Field study areas are the river basins of the Ebro, the Meuse, the Elbe and the Danube as well as the 3-km(2) French catchment of the Brevilles Spring. Within the first 2 years of the project more than 1700 samples of atmospherically deposited particles, sediments, and water have been collected in the above-mentioned systems. Results show clear spatial patterns of deposition of polyaromatic hydrocarbons (PAHs) with the highest rates in the Meuse Basin. For local inputs, in the Brevilles sandy aquifer, the contamination of the groundwater by the pesticides atrazine (AT) and deethylatrazine did not decrease even 5 years after their agricultural inputs were stopped. On the other hand, herbicides such as mecroprop (MCPP), and PAHs, were at least partially degraded microbiologically in laboratory studies with soils and aquifer material from selected sites. For sediment transport of contaminants, new flood sampling techniques revealed highest deposition rates of beta-hexachlorocyclohexane (beta-HCH) in river sediments at hotspot areas on the Mulde River in the Bitterfeld region (Elbe Basin, Germany). These selected preliminary results of AquaTerra help to improve fundamental understanding of persistent organic pollutants (POP) in the environment. (c) 2007 Elsevier B.V. All rights reserved.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Barth, J., Steidle, D., Kuntz, D., Gocht, T., Mouvet, C., von Tümpling, W., Lobe, I., Langenhoff, A., Albrechtsen, H., Janniche, G. S., Morasch, B., Hunkeler, D., Grathwohl, P.
Pages: 40-50
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Science of the Total Environment
Volume: 376
ISSN (Print): 0048-9697
Ratings:
Scopus rating (2007): SJR 1.42 SNIP 1.49
Effect of biofilm on the survival of indicator organisms, e.g. E. coli in drinking water pipes

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Silhan, J., Corfitzen, C. B.
Number of pages: 102
Pages: 44-45
Publication date: 2007

Host publication information
Title of host publication: SWAP 2007: The European symposium on waterborne pathogens in surface and drinking waters Luxembourg, April 19-20, 2007. Programme - Abstracts - List of participants
Volume: Abstract book
Place of publication: Luxembourg
Publisher: Centre de Recherche Public Gabriel Lippmann
Source: orbit
Source-ID: 198836
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2007 – Research

Effect of nutrient amendments and sterilization on mineralization and/or biodegradation of 14C-labeled MCPP by soil bacteria under aerobic conditions

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: El-Bestawy, E., Albrechtsen, H.
Pages: 193-201
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: International Biodeterioration & Biodegradation
Volume: 59
ISSN (Print): 0964-8305
Ratings:
Scopus rating (2007): SJR 0.659 SNIP 1.027
Web of Science (2007): Indexed yes
Original language: English
DOIs:
10.1016/j.ibiod.2006.12.001
Source: orbit
Source-ID: 199173

Electrochemical properties and effects of new bacterial inhibiting surfaces in water

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Chiang, W., Hilbert, L., Corfitzen, C. B., Albrechtsen, H., Møller, P.
Publication date: 2007
Inhibition of real-time PCR in DNA extracts from aquifer sediment

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Lindberg, I. E., Albrechtsen, H., Jacobsen, C.
Pages: 343-352
Publication date: 2007
Peer-reviewed: Yes

Publication Information
Journal: Geomicrobiology Journal
Volume: 24
ISSN (Print): 0149-0451
Ratings:
Scopus rating (2007): SJR 0.786 SNIP 0.792
Web of Science (2007): Indexed yes
Original language: English
DOIs:
10.1080/01490450701456701
Source: orbit
Source-ID: 206577
Research output: Contribution to journal › Journal article – Annual report year: 2007 › Research › peer-review

Integriert håndtering af vand og spildevand i København: Projekt A3 - Alternativ vandhåndtering og selvforsyning - international erfaringssamling

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Rygaard, M., Albrechtsen, H., Binning, P. J.
Publication date: 2007

Publication Information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Danish
Electronic versions:
MR2007-113.pdf
Source: orbit
Source-ID: 199301
Research output: Book/Report › Report – Annual report year: 2007 › Research


General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering, CU-Test
Contributors: Ursin, C., Corfitzen, C. B., Albrechtsen, H., Arvin, E.
Number of pages: 42
Publication date: 2007

Publication Information
Publisher: DTU Miljø
Microcosm evaluation of bioaugmentation after field-scale thermal treatment of a TCE-contaminated aquifer

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Friis, A. K., Kofoed, J. L. L., Heron, G., Albrechtsen, H., Bjerg, P. L.
Pages: 661-674
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Biodegradation
Volume: 18
ISSN (Print): 0923-9820
Ratings:
Scopus rating (2007): SJR 0.876 SNIP 1.106
Web of Science (2007): Indexed yes
Original language: English
DOIs:
10.1007/s10532-006-9098-y
Source: orbit
Source-ID: 205959
Research output: Contribution to journal › Journal article – Annual report year: 2007 › Research › peer-review

Small-scale variation in degradation of pesticides (acetochlor, isoproturon and MCPP) in unsaturated and aquifer environments

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Publication date: 2007

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Danish
Electronic versions:
MR2007_234.pdf
Source: orbit
Source-ID: 208166
Research output: Book/Report › Report – Annual report year: 2007 › Research
General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Lindberg, E., Mouvet, C., Albrechtsen, H.
Number of pages: 15
Publication date: 2007

Host publication information
Title of host publication: AquA Terra Subproject Meeting BIOGEOCHEMC Combined with KNOWMAN course on Brévilles: Long-term fate of pollutants in soils: Mobility, stability, and transformation 15-16 March, 2007
Place of publication: Tübingen
Publisher: Eberhard Karls University of Tübingen
Source: orbit
Source-ID: 197333
Research output: Chapter in Book/Report/Conference proceeding » Conference abstract in proceedings – Annual report
year: 2007 » Research

Småskala-variation i nedbrydning af pesticider (acetochlor, isoproturon og MCPP)

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Lindberg, E., Albrechtsen, H.
Number of pages: 215-225
Publication date: 2007

Host publication information
Title of host publication: Wintermøde om jord- og grundvandsforurening, Vingstedcentret 6.-7. marts 2007
Volume: Bind 2
Place of publication: Kgs. Lyngby
Publisher: ATV Jord og Grundvand
Source: orbit
Source-ID: 197302
Research output: Chapter in Book/Report/Conference proceeding » Article in proceedings – Annual report
year: 2007 » Research

Spatial small-scale variation in degradation of pesticides (acetochlor, isoproturon MCPP) in limestone and sand from Brévilles, France

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Lindberg, I. E., Mouvet, C., Albrechtsen, H.
Publication date: 2007

Host publication information
Title of host publication: International workshop on "Biogeochemical processes in groundwater systems", GSF Campus, Munich, Germany 10-11 September 2007
Place of publication: Neuherberg
Publisher: GSF - National Research Center for Environmental and Health in the Helmholtz Association
Source: orbit
Source-ID: 202855
Research output: Chapter in Book/Report/Conference proceeding » Article in proceedings – Annual report
year: 2007 » Research

Temperature dependence of anaerobic TCE-dechlorination in a highly enriched Dehalococcoides-containing culture

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Friis, A. K., Heimann, A. C., Jakobsen, R., Albrechtsen, H., Cox, E., Bjerg, P. L.
Number of pages: 355-364
Publication date: 2007
Peer-reviewed: Yes
Anaerobic dechlorination and redox activities after full-scale electrical resistance heating (ERH) of a TCE-contaminated aquifer

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Friis, A. K., Heron, G., Albrechtsen, H., Udell, K., Bjerg, P. L.
Pages: 219-234
Publication date: 2006
Peer-reviewed: Yes

Aqua Terra: Monitoring activities in selected river basins

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 1-3
Publication date: 2006

Biofilmdannelse i ledningsnet: populationssammensætning i vand- og biofilmprøver

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Department of Systems Biology
Contributors: Albrechtsen, H., Martiny, A. C., Arvin, E., Molin, S.
Controlling parameters for microbial pesticide degradation in subsurface and aquifers

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Clausen, L., Pedersen, P. G., Toräng, L., Tuxen, N., Nyholm, N., Bjerg, P. L.
Publication date: 2006

Host publication information
Title of host publication: Vandforsyningsteknik 55
Place of publication: Skanderborg
Publisher: Dansk Vand- og Spildevandsforening - DANVA
ISBN (Print): 87-90455-63-0
Source: orbit
Source-ID: 191848
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2006 – Research

Controls on atrazine leaching through a soil-unsaturated fractured limestone sequence at Brévilles, France

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Roulier, S., Baran, N., Mouvet, C., Stenemo, F., Morvan, X., Albrechtsen, H., Clausen, L., Jarvis, N.
Pages: 81-105
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 84
Ratings:
Scopus rating (2006): SJR 1.475 SNIP 1.525
Web of Science (2006): Indexed yes
Original language: English
Source: orbit
Source-ID: 188778
Research output: Contribution to journal – Journal article – Annual report year: 2006 – Research – peer-review

Degradation and sorption in subsurface and aquifers of the herbicide metabolite BAM after non-point contamination

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Clausen, L., Nygaard, B., Albrechtsen, H.
Publication date: 2006

Host publication information
Title of host publication: Pesticide behaviour in soils, water and air : Oral and poster abstracts, University of Warwick, UK, 27-29 March 2006
Place of publication: London, UK
Publisher: SCI Pest Management Group
Effect of temperature and pipe material on biofilm formation and survival of Escherichia coli in used drinking water pipes: a laboratory-based study

Segments of used drinking water pipes of galvanised steel (GS), cross-linked polyethylene (PEX), copper pipes (Cu) or new medium-density polyethylene (PE) were investigated for the formation of biofilm and survival of E coli in biofilm and in the water phase. Pipes were filled with water and incubated at 15 degrees C or 35 degrees C under static conditions. Biofilm formation was followed during 32, 40 and 56 (58) d. The most dense biofilm was formed on GS, reaching approximately 4.7 x 10(5) CFU/cm(2) measured as heterotrophic plate count (HPC), and at the other materials the density reached 3 x 10(3) CFU/cm(2) on PE and PEX and 5 x 10(1) and 5 x 10(2) CFU/cm(2) on Cu pipes after 58 d at 15 degrees C. Biofilm HPC values were higher at 35 degrees C than at 15 degrees C, with only slightly higher values on the metals, but 100-fold higher on PE and PEX. Adenosine triphosphate (ATP) measurements confirmed the general trends observed by HPC. Higher temperature was seen to be an important factor reducing E coli survival in the water phase in drinking water pipes. At 1 VC E coli survived more than 4 d in GS and Cu pipes and 8 d in PE-pipes, but was not detected after 48 h at 35 degrees C. The E coli survived longer at both temperatures in the glass control bottles than in the drinking water pipes. Despite the obvious biofilm formation, E coli was not detected in the biofilm at any of the investigated surfaces.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Silhan, J., Corfitzen, C. B., Albrechtsen, H.
Pages: 49-56
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Water Science and Technology
Volume: 54
Issue number: 3
ISSN (Print): 0273-1223
Ratings:
Scopus rating (2006): SJR 0.696 SNIP 0.789
Web of Science (2006): Indexed yes
Original language: English
DOIs:
10.2166/wst.2006.447
Source: orbit
Source-ID: 192849
Research output: Contribution to journal > Journal article – Annual report year: 2006 > Research > peer-review

Future trends in transport and fate of diffuse contaminants in catchments, with special emphasis on stable isotope applications

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 205-213
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Hydrological Processes
Volume: 20
Ratings:
Scopus rating (2006): SJR 1.391 SNIP 1.434
Web of Science (2006): Indexed yes
Original language: English
Source: orbit
Groundwater ecology as a necessary link to the EU water framework directive

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 94-99
Publication date: 2006

Host publication information
Title of host publication: Proceedings of the European Groundwater Conference 2006
Place of publication: Vienna
Publisher: Umweltbundesamt
URLs:
http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/wasser/Grundwasser/conference/Abstracts_Presentations/3_5_Danielopol_et_al.pdf
Source: orbit
Source-ID: 190763
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2006 › Research

Identification of a reactive degradation zone at a landfill leachate plume fringe using high resolution sampling and incubation techniques

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., Albrechtsen, H., Bjerg, P. L.
Pages: 179-194
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 85
Ratings:
Scopus rating (2006): SJR 1.475 SNIP 1.525
Web of Science (2006): Indexed yes
Original language: English
Source: orbit
Source-ID: 189223
Research output: Contribution to journal – Journal article – Annual report year: 2006 › Research › peer-review

Integriert håndtering af vand og spildevand i København: Projekt A2 - Opstilling og analyse af 9 scenarier for fremtidens vand- og spildevandshåndtering i København. Samarbejdsprojekt med Københavns Energi. Endelig udgave

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Rygaard, M., Hauger, M. B., Eilersen, A. M., Albrechtsen, H., Binning, P. J.
Publication date: 2006

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Danish
Electronic versions:
MR2006-131.pdf
Mikrobiologiske undersøgelser af effekten af UV-belysning i Odense Vandselskabs ledningsnet: fase 1

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H., Arvin, E.
Publication date: 2006

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Chinese
Electronic versions:
MR2006-276.pdf
Source: orbit
Source-ID: 208163
Research output: Book/Report › Report – Annual report year: 2006 › Research

Oxygen-enhanced biodegradation of phenoxy acids in ground water at contaminated sites

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., Reitzel, L., Albrechtsen, H., Bjerg, P. L.
Pages: 256-265
Publication date: 2006
Peer-reviewed: Yes

Publication Information
Journal: Ground Water
Volume: 44
Ratings:
Scopus rating (2006): SJR 1.014 SNIP 1.228
Web of Science (2006): Indexed yes
Original language: English
Source: orbit
Source-ID: 188669
Research output: Contribution to journal › Journal article – Annual report year: 2006 › Research › peer-review

Quantification of phenoxytakanoic acid degraders and investigation of PCR inhibiting effects in aquifer sediment by real-time PCR

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Geological Survey of Denmark and Greenland, Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek
Contributors: Lindberg, E., Jacobsen, C., Tuxen, N., Luijten, M., Albrechtsen, H.
Publication date: 2006
Peer-reviewed: No
Electronic versions:
MR2006-086.pdf

Bibliographical note
Oral and poster abstracts
Source: orbit
Source-ID: 189462
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2006 › Research
Rapid methods for detection of bacteria

Traditional methods for detection of bacteria in drinking water e.g. Heterotrophic Plate Counts (HPC) or Most Probable Number (MPN) take 48-72 hours to give the result. New rapid methods for detection of bacteria are needed to protect the consumers against contaminations. Two rapid methods: Measurements of Adosine Triphosphate and BactiQuantTM have shown promising results as new monitoring tools, which gives the result within minutes/hours.

Real-time PCR: Anvendelse ved kvantificering af phenoxyeyre-nedbrydere i grundvandssediment

Rethinking the urban water management of Copenhagen
Rethinking the urban water management of Copenhagen

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Binning, P. J., Hauger, M. B., Rygaard, M., Eilersen, A. M., Albrechtsen, H.
Publication date: 2006

Host publication information
Title of host publication: IWA World Water Congress and Exhibition, 10-14 September 2006, Beijing, China: Proceedings
Volume: CD-ROM
Place of publication: London, UK
Publisher: International Water Association
Source: orbit
Source-ID: 191254
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2006 – Research peer-review

Risikovurdering af Giardia og Cryptosporidium i vand

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Publication date: 2006

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
ISBN (Print): 87-7614-987-0
Original language: Danish
(Miljøprojekt, No. 1070).
URLs:
Source: orbit
Source-ID: 188834

Risk assessment of Giardia duodenalis and Cryptosporidium parvum in Danish drinking water

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Adaptive Immunology & Parasitology, Division of Veterinary Diagnostics and Research, National Veterinary Institute
Number of pages: 170
Publication date: 2006

Publication information
Place of publication: Copenhagen
Publisher: Danish Environmental Protection Agency
Edition: Environmental Report No. 1070
Original language: English
Source: orbit
Source-ID: 241083

Standardising the biomass production potential method for determining the enhancement of microbial growth of construction products in contact with drinking water: Inter-laboratory testing
Survival of indicator organisms, e.g. E. coli in drinking water pipes
The survival of E. coli was investigated in used drinking water pipes from households. The investigation showed that E. coli survived longer in plastic pipes than in copper pipes and galvanized steel pipes. The investigation also showed longer survival at cold water temperatures (15°C) than at hot water temperatures (35°C).

The need for bioaugmentation after thermal treatment of TCE-contaminated aquifer: Laboratory experiments
The potential for bioaugmentation after a full-scale thermal treatment
Host publication information
Title of host publication: Remediation of Chlorinated and Recalcitrant Compounds, The 5th International Conference, Monterey, May 22-25, 2006 : Platform Abstracts
Volume: E6. Activation of In Situ Degradation by Thermal/Vacuum Treatments
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 189426
Research output: Chapter in Book/Report/Conference proceeding » Conference abstract in proceedings – Annual report year: 2006 » Research

Afgivelse af organiske stoffer fra PE-rør til drikkevand

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Nielsen, L., Heyer, E., Arvin, E., Albrechtsen, H., Mosbæk, H.
Pages: 336-341
Publication date: 2005
Peer-reviewed: No

Publication information
Journal: DanskVand
Volume: 73
Issue number: 5
ISSN (Print): 1602-3609
Original language: Danish
Source: orbit
Source-ID: 190001
Research output: Contribution to journal » Journal article – Annual report year: 2005 » Research

Anaerobic dechlorination after thermal treatment

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Friis, A. K., Albrechtsen, H., Bjerg, P. L., Duhamel, M., Udell, K., Heron, G.
Publication date: 2005
Peer-reviewed: Yes
Event: Poster session presented at 8th International In Situ and On-Site Bioremediation Symposium, Baltimore, MD, United States.
Source: orbit
Source-ID: 184634
Research output: Contribution to conference » Poster – Annual report year: 2005 » Research » peer-review

Bakterievækst og tilsætningsstoffer

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Wessels, S., Corfitzen, C. B., Albrechtsen, H.
Publication date: 2005

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 991).
URLs:
Source: orbit
Source-ID: 181177
BAM's skæbne i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Publication date: 2005

Host publication information
Title of host publication: Vintermøde om jord- og grundvandsforurening, Vingstedcentret 8.-9. marts 2005
Volume: bind 1
Place of publication: Kgs. Lyngby
Publisher: ATV Jord og Grundvand
ISBN (Print): 87-91313-03-1
Source: orbit
Source-ID: 181170
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 2005 – Research

Biodegradation of organic pollutants and molecular identification of the responsible micro-organisms in several European river basins

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 2937-2938
Publication date: 2005

Host publication information
Title of host publication: ConSoil 2005 : Proceedings of the 9th International FZK/TNO Conference on Soil-Water Systems in cooperation with BRGM, 3-7 October 2005, Bordeaux Convention Centre, France
Volume: CD-ROM
Place of publication: Karlsruhe
Publisher: Forschungszentrum Karlsruhe
Source: orbit
Source-ID: 182782
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 2005 – Research
Degradation and sorption of the herbicide metabolite BAM (dichlobenzamid) in subsurface and aquifers after non-point contamination

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Janniche, G. S., Clausen, L., Nygaard, B., Albrechtsen, H.
Number of pages: 48
Publication date: 2005

Host publication information
Place of publication: Washington, D.C.
Publisher: American Society for Microbiology
Source: orbit
Source-ID: 182145
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2005 › Research

Delanalyse om arbejdsmiljø og teknisk hygiejne

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Bagge, I., Christensen, A.
Number of pages: 20
Publication date: 2005

Host publication information
Title of host publication: Teknologisk fremsyn om hygiejne. Forskningspolitisk handlingsplan 2004
Place of publication: København
Publisher: Ministeriet for Videnskab, Teknologi og Udvikling
Source: orbit
Source-ID: 154229
Research output: Chapter in Book/Report/Conference proceeding › Book chapter – Annual report year: 2005 › Research

Factors controlling biomass production on polymers: Paper 75

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Number of pages: 66
Publication date: 2005

Host publication information
Title of host publication: Water Micro 05 : International symposium on health-related water microbiology, 5-9 September 2005, University of Swansea, UK
Place of publication: London, UK
Publisher: IWA Publishing
Source: orbit
Source-ID: 189458
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2005 › Research

Fringe processes control natural attenuation of herbicides in a landfill leachate plume

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Identification of bacteria in biofilm and bulk water samples from a nonchlorinated model drinking water distribution system: Detection of a large nitrite-oxidizing population associated with Nitrospira spp.

General information
Publication status: Published
Organisations: Department of Systems Biology, Department of Environmental Engineering
Contributors: Martiny, A. C., Albrechtsen, H., Arvin, E., Molin, S.
Pages: 8611-8617
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Applied and Environmental Microbiology
Volume: 71
Issue number: 12
ISSN (Print): 0099-2240
Ratings:
Scopus rating (2005): SJR 2.074 SNIP 1.653
Web of Science (2005): Indexed yes
Original language: English
Source: orbit
Source-ID: 183555
Research output: Contribution to journal › Journal article – Annual report year: 2005 › Research › peer-review

Identification of controlling parameters for microbial pesticide degradation in non-point contaminated subsurface

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Number of pages: 127
Publication date: 2005

Host publication information
Place of publication: Washington, D.C.
Publisher: American Society for Microbiology
Source: orbit
Source-ID: 182148
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2005 › Research

Implementation of real-time PCR for detection and quantification of phenoxyalkanoic acid degradaders in aquifer sediment
**Long-term biofilm formation in a model drinking water distribution system - beyond culturability: structure and diversity:**

**Paper 33**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering, Department of Systems Biology
Contributors: Albrechtsen, H., Martiny, A. C., Arvin, E., Molin, S.
Number of pages: 3
Publication date: 2005

**Host publication information**
Title of host publication: Water Micro 05: International symposium on health-related water microbiology, 5-9 September 2005, University of Swansea, UK
Place of publication: London, UK
Publisher: IWA Publishing
Source: orbit
Source-ID: 189460
Research output: Chapter in Book/Report/Conference proceeding ➔ Conference abstract in proceedings – Annual report year: 2005 ➔ Research

**Natural attenuation of herbicides in a landfill leachate plume: The role of fringe processes**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Bjerg, P. L., Tuxen, N., Ask Reitzel, L., Albrechtsen, H.
Number of pages: 3
Publication date: 2005

**Host publication information**
Title of host publication: 2nd European conference on natural attenuation, soil and groundwater risk management, May 18-20, 2005, DECHEMA-House, Frankfurt am Main: Book of abstracts
Place of publication: Frankfurt am Main
Publisher: DECHEMA
Source: orbit
Source-ID: 181266
Research output: Chapter in Book/Report/Conference proceeding ➔ Conference abstract in proceedings – Annual report year: 2005 ➔ Research

**Nedbrydning og sorption af herbicider (atrazine, isoproturon, MCPP og acetochlor) i umættet zone og i grundvandsmagasiner**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Clausen, L., Pedersen, P.
Pages: 1-9
Ny viden om BAM reducerer varigheden af forureninger i grundvandet

Quantitative risk assessment for human infection by the protozoans Giardia and Cryptosporidium related to different water uses in Denmark: Paper 73

Redox processes and release of organic matter after thermal treatment of TCE-contaminated aquifer
Rensning af miljøfremmede stoffer i vandværksfiltre

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Publication date: 2005

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
Source: orbit
Source-ID: 199382

The potential for biological dechlorination after a thermal treatment

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Friis, A. K., Udell, K., Heron, G., Edwards, E., Duhamel, M., Cox, E., Albrechtsen, H., Bjerg, P. L.
Publication date: 2005

Host publication information
Title of host publication: ConSoil 2005. Proceedings of the 9th International FZK/TNO Conference on Soil-Water Systems in cooperation with BRGM, 3-7 October 2005, Bordeaux Convention Centre, France
Volume: CD-ROM
Place of publication: Karlsruhe
Publisher: Forschungszentrum Karlsruhe
Source: orbit
Source-ID: 182781
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2005 – Research

Aktivt kul renser grundvand for BAM

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Kagstrup, T., Christensen, T., Corfitzen, C. B., Albrechtsen, H., Arvin, E.
Publication date: 2004
Peer-reviewed: Unknown

Publication information
Journal: MiljøNyt
Issue number: 2
Original language: Danish
URLs:
Bacterial diversity and community structure of a sub-surface aquifer exposed to realistic low herbicide concentrations

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: de Lipthay, J., Johnsen, K., Albrechtsen, H., Rosenberg, P., Aamand, J.
Pages: 59-69
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: F E M S Microbiology Ecology
Volume: 49
ISSN (Print): 0168-6496
Scopus rating (2004): SJR 1.672 SNIP 1.003
Web of Science (2004): Indexed yes
Original language: English
Source: orbit
Source-ID: 43476
Research output: Contribution to journal › Journal article – Annual report year: 2004 › Research › peer-review

Brug af regnvand opsamlet fra tage og befæstede arealer - Udpegning af relevante måleparametre

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Number of pages: 121
Publication date: 2004

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Økologisk Byfornyelse og spildevandsrensning; No. 48).
Source: orbit
Source-ID: 43749
Research output: Book/Report › Report – Annual report year: 2004 › Research

Development of a continuous flow model system for studies of biofilm formation on polymers and its application on PVC-C and PVC-P: Article prepared for submission

Migration of bioavailable compounds from polymeric pipe materials in drinking water distribution systems may cause bacterial aftergrowth. Present methods for microbial testing of polymeric materials are based on batch or semi-batch tests, but a continuous flow model system may provide a better test system. In this study, a continuous flow model system was developed, for investigating biofilm formation on polymers, simulating conditions in the distribution system. Commercially available pipes were used for exchangeable test pieces, which allowed for testing over prolonged time periods. Test pieces could be harvested from three different combinations of flow velocity and residence time. Biofilm formation was followed by ATP analysis on test material (chlorinated polyvinylchloride, PVC-C), negative control (stainless steel) and positive control (plasticized polyvinylchloride, PVC-P) incubated in separate flow model systems. Results show a good agreement between biofilm densities on test pieces from the developed flow model system and batch-incubated test pieces during 16 weeks of incubation; average values during 8 to 16 weeks of operation were 40 pg ATP/cm² for steel, 60 pg ATP/cm² for PVC-C, while most of the very deviating values for PVC-P were between 2-13,000 pg ATP/cm². During 43 weeks of operation of the continuous flow model systems the biofilm formation increased on all three materials, with biofilm formation on PVC-C at the same level as on the negative steel control (values of 75-200 pg ATP/cm²), but at a level one hundred times higher on the positive PVC-P control. With the materials tested no specific effects of varying flow velocities and residence times in the flow model systems were observed.
Development of a flow model system for investigating biofilm formation on polymers in drinking water and its application on PVC-C and PVC-P

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Publication date: 2004
Peer-reviewed: Yes
Source: orbit
Source-ID: 154467
Research output: Contribution to conference → Poster – Annual report year: 2004 → Research → peer-review

Distribution of bacteria in a domestic hot water system in a Danish apartment building

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Bagh, L., Albrechtsen, H., Arvin, E., Ovesen, K.
Pages: 225-235
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 38
ISSN (Print): 0043-1354
Ratings:
Scopus rating (2004): SJR 2.233 SNIP 2.116
Web of Science (2004): Indexed yes
Original language: English
Source: orbit
Source-ID: 43319
Research output: Contribution to journal → Journal article – Annual report year: 2004 → Research → peer-review

Environmental conditions following a thermal treatment

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Friis, A. K., Bjerg, P. L., Albrechtsen, H., Udell, K., Larsen, T.
Publication date: 2004

Host publication information
Title of host publication: Remediation of Chlorinated and Recalcitrant Compounds: The 4th International Conference, Monterey, May 24-27, 2004
Volume: D4. Impacts of Aggressive Remedial Measures on Indigenous Microbial Populations, Battelle Press, Columbus, OH
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Fringe processes control natural attenuation of herbicides landfill leachate plumes

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., Albrechtsen, H., Bjerg, P. L.
Publication date: 2004

Host publication information
Title of host publication: Remediation of Chlorinated and Recalcitrant Compounds: The 4th International Conference, Monterey, May 24-27, 2004
Volume: Platform Abstracts, A5. Remediation of Pesticides and Intermediates
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 135555

Hvad sker der, når vi ingenting gør - bliver jord og vand rent af sig selv?

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 11-16
Publication date: 2004

Host publication information
Title of host publication: Er jord og grundvand blevet renere de sidste 25 år, Schæffergården 21. oktober 2004
Place of publication: Kgs. Lyngby
Publisher: ATV-fonden for Jord og Grundvand
Source: orbit
Source-ID: 135646

Integration into effective models of process knowledge gained on the unsaturated and saturated zones: results from the PEGASE project

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 211-226
Publication date: 2004

Host publication information
Title of host publication: Proceedings of the international workshop: Saturated and unsaturated zone workshop. Integration of process knowledge into effective models, 5-7 May, 2004, Rome, Italy
Place of publication: Pavia, Italy
Publisher: La Goliardica Pavese s.r.l.
Editor: Aagaard, P.
Source: orbit
Source-ID: 154266
Investigating aftergrowth potential of polymers in drinking water – the effect of water replacement and temperature: Manuscript

The aftergrowth potential of polymers used in drinking water distribution was investigated by a batch set-up, where test pieces were incubated in biostable, inorganic nutrient amended drinking water inoculated with surface water. Biomass production was measured as ATP and followed over 16 weeks in the water phase and on the material surface. Supplementary measurements of HPC and NVOC were applied when investigating the biostability within the test system, and the effect of water replacement and temperature. Addition of inorganic nutrients and inoculum to the biostable drinking water had no significant effect on the aftergrowth potential of the water. The background biomass production could be affected by the choice of caps for the test bottles, since ‘blue caps’ of polyethylene leached significant amounts of AOCP17 compared to ‘red caps’ containing teflon inlayers. There was no or only slightly difference on the biomass production of no replacement of the test water, replacement once a week or every second week. Periodical water replacement could nevertheless be considered beneficial, since a substantial NVOC migration occurred within the first six weeks of incubation, which potentially could affect the bacterial growth. Temperatures of 10ºC and 25ºC had no significant effect on the migration of bioavailable organic compounds, but there were a tendency for higher migration at 10ºC than at 25ºC.

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Number of pages: 12
Publication date: 2004

Investigation of microbial quality of drinking water without disinfection produced from groundwater

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Number of pages: 27,152
Publication date: 2004

Host publication information
Volume: CD-ROM
Place of publication: London
Publisher: IWA Publishing
Source: orbit
Source-ID: 135647
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2004 › Research › peer-review

Langsomfiltres effekt på drikkevands biostabilitet - Litteraturudredning: Udført for Københavns Energi

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Boe-Hansen, R., Albrechtsen, H., Bennedsen, L.
Number of pages: 23
Publication date: 2004

Publication information
Place of publication: Kgs. Lyngby
Publisher: Institut for Miljø & Ressourcer, Danmarks Tekniske Universitet
Original language: Danish
Microbial activity - geochemistry distribution patterns at the Brabant and Sjoelund site: EU-CORONA D21

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Luijten, M., Hoekstra, N., Slenders, H., Tuxen, N., Albrechtsen, H., Bjerg, P. L., Gerritse, J.
Publication date: 2004

Publication information
Place of publication: Alpendoorn, NL
Publisher: TNO Environment, Energy and Process Innovation
Original language: English
(TNO-report; No. R 2004/467).
Source: orbit
Source-ID: 135854
Research output: Book/Report › Report – Annual report year: 2004 › Research

Microbial pesticide degradation in non-point contaminated subsurface: The challenge of detecting low rates at low concentrations

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Clausen, L., Pedersen, P., Toräng, L., Tuxen, N., Nyholm, N., Bjerg, P. L.
Publication date: 2004

Host publication information
Title of host publication: UNESCO Workshop on transport and fate of diffuse contaminants in catchments with special emphasis on stable isotope applications: GSF, Munich, Germany, 30 November-2 December 2004
Place of publication: Neuherberg
Publisher: GSF
Source: orbit
Source-ID: 154475
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2003 › Research

MTBE removal by biofiltration in a water works

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Arvin, E., Nielsen, L., Tully, A., Albrechtsen, H., Mosbæk, H.
Pages: 120-121
Publication date: 2004

Host publication information
Title of host publication: The 2nd Leading-Edge Conference on Water and Wastewater Treatment Technologies, 1-4 June 2004, Prague, Czech Republic: Final programme and abstract book
Place of publication: London, UK
Publisher: IWA Publishing
ISBN (Print): 1-84339-508-8
URLs:
Source: orbit
Source-ID: 178160
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2004 › Research › peer-review
NAPL plumes and in situ remediation: Future challenges?

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Urban Water Engineering
Number of pages: 16
Publication date: 2004

Host publication information
Publisher: IAHS Press
Source: orbit
Source-ID: 135566
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2004 › Research

Natural attenuation of dichlobenil and its metabolite 2,6-dichlorobenzamide (BAM), effects of redox conditions

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Larsen, F., Albrechtsen, H.
Publication date: 2004

Host publication information
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 135530
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2004 › Research

Natural attenuation of herbicides (atrazine, isoproturon, MCPP) in the subsurface

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Albrechtsen, H., Pedersen, P.
Publication date: 2004

Host publication information
Title of host publication: Remediation of Chlorinated and Recalcitrant Compounds : The 4th International Conference, Monterey, May 24-27, 2004
Volume: Platform Abstracts. A5. Remediation of Pesticides and Intermediates
Place of publication: Columbus, OH
Publisher: Battelle Memorial Institute
Source: orbit
Source-ID: 135529
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 2004 › Research

Optimisation of ATP determination in drinking water: Manuscript

Adenosine Triphosphate (ATP) can be used as a relative measure of cell activity, and is measured by the light output from the reaction between luciferin and ATP catalyzed by firefly luciferase. The measurement has potential as a monitoring and surveillance tool within drinking water distribution, since the method is very sensitive (detects 0.5 ng ATP/L) and results are obtained within minutes. When calculating the ATP value a number of parameters need to be considered. These were investigate by use of two different reagent kits (PCP-kit and Lumin(ATE)/Lumin(EX)-kit), internal standard and an Advance Coupe luminometer. The investigations showed a 60 times higher response of the PCP-kit, making it more suitable for measurement of samples
with low ATP content. ATP-standard dilutions prepared in tap water were stable for at least 15 months when stored frozen at -80ºC, and storage of large aliquots of standards increase quality control and ease daily operation. The medium (Lumin(PM) buffer, tap water or MilliQ water) for preparation of ATP-standard dilution significantly affected the rlu response of the ATP-standard dilutions (20% difference). The effect of dilution media and of sample characteristics can be eliminated by use of internal standard. In strongly coloured biofilm samples the measuring efficiency can be reduced with up to 85%. Extra cellular ATP made up a significant part of the total ATP (>50%) in some samples, so when only intra cellular ATP is of interest the cells need be separated from the water phase by filtration.

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H.
Number of pages: 10
Publication date: 2004

Pesticides in European groundwaters: Detailed study of representative aquifers and simulation of possible evolution scenarios PEGASE: Final report

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Publication date: 2004

Processes influencing migration of bioavailable organic compounds from polymers - investigated during biotic and abiotic testing under static and non-static conditions with varying S/V-ratios: Article prepared for submission
The migration of bioavailable organic compounds ('bioavailable migration') from polymeric materials used for drinking water distribution was investigated by an abiotic test: Extracting materials under sterile conditions, and a biotic test: Extracting materials in presence of bacteria. Both tests showed elevated bioavailable migration during the first two weeks of incubation followed by a lower constant level, which was maintained during the test period of 16 weeks.
Problems with aftergrowth due to bioavailable migration from polymeric materials are therefore not solved by initial flushing. The bioavailable migration from the polymer surface was influence by diffusion over the solid-liquid boundary layer under sterile conditions, which resulted in an inversely proportionally relationship between bioavailable migration expressed per unit surface area of material and the surface to volume ratio (S/V-ratio), corresponding to lower bioavailable migration at smaller pipe diameters. Under sterile conditions gentle shaking of the water phase reduced the thickness of the boundary layer resulting in an increased bioavailable migration from the surfaces. The presence of bacteria together with the material overruled the effect of the boundary layer, since bioavailable migration was continuously consumed by the bacteria. Thus the driving force for the diffusion process was maintained at a maximum, thereby enhancing the bioavailable migration from the material surfaces. Thus neither non-static conditions nor varying S/V-ratios had any effect on the bioavailable migration in the biotic tests. Not to underestimate growth potential of polymers, investigations should thus be performed in the presence of a diverse microbial population with paired measurements of biomass in the water phase and on the material surfaces.

General information
Publication status: Published
Rensning af MTBE forurenset grundvand i bioreaktor med MTBE som primært substrat

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Number of pages: 95
Publication date: 2004

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 880).
URLs:
Source: orbit
Source-ID: 43309
Research output: Book/Report › Report – Annual report year: 2004 › Research

Smittefare ved spildevand på afveje

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 7-10
Publication date: 2004
Peer-reviewed: Unknown

Publication information
Journal: EVA : Erfaringsudveksling i vandmiljøteknikken
Volume: 17
Issue number: 3
ISSN (Print): 1901-3663
Original language: Danish
Source: orbit
Source-ID: 181064
Research output: Contribution to journal › Journal article – Annual report year: 2004 › Communication

Sorption of the herbicide dichlobenil and the metabolite 2,6-dichlorobenzamide on soils and aquifer sediments

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Larsen, F., Albrechtsen, H.
Pages: 4510-4518
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Environmental Science & Technology (Washington)
Volume: 38
Subsurface microbiology - from exploration to working tools. Editorial

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Aamand, J.
Pages: 1-2
Publication date: 2004
Peer-reviewed: Unknown

Publication information
Journal: F E M S Microbiology Ecology
Volume: 49
ISSN (Print): 0168-6496
Ratings:
Scopus rating (2004): SJR 2.871 SNIP 2.079
Web of Science (2004): Indexed yes
Original language: English
Source: orbit
Source-ID: 90517
Research output: Contribution to journal › Journal article – Annual report year: 2004 › Research › peer-review

Vurdering af naturlig nedbrydning af herbicider ved Sjølund Losseplads

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., Albrechtsen, H., Bjerg, P. L.
Pages: 345-354
Publication date: 2004

Host publication information
Title of host publication: Vintermøde om jord- og grundvandsforurening, Vingstedcentret 9.-10. marts
Volume: bind 2
Place of publication: Kgs. Lyngby
Publisher: ATV Jord og Grundvand
Source: orbit
Source-ID: 135680
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2004 › Research

Application of natural attenuation to ground water contaminated by phenoxy acid herbicides at an old landfill in Sjøeland

Investigations of geology, hydrogeology, and ground water chemistry in the aquifer downgradient from Sjøeland Landfill, Denmark, formed the basis for an evaluation of natural attenuation as a remediation technology for phenoxy acid herbicides at the site. Concentrations of phenoxy acids were up to 65 µg/L in the ground water, primarily 4-chlor-2-methylphenoxypropionic acid (MCPP) and 2,4-dichlorophenoxypropionic acid (dichlorprop). Mass removal of the phenoxy acids was shown within 50 to 100 m of the landfill by calculation of contaminant fluxes passing transects at three distances. There was accordance between increasing oxygen concentrations and decreasing phenoxy acid concentrations with distance from the landfill, indicating that aerobic degradation was a major mass removal process. Presence of high concentrations of putative anaerobic phenoxy acid metabolites suggested that anaerobic degradation was also occurring. Laboratory degradation experiments using sediment and ground water from the aquifer supported aerobic and anaerobic degradability of MCPP at the site. It was concluded that natural attenuation may be applicable as a
remedy for the phenoxy acids at the Sjoelund Landfill site, although uncertainties related to calculations of chloride and phenoxy acid fluxes at a complex site and identification of specific in situ indicators were encountered. Thus, there is a pronounced need for development and broader experience with evaluation tools for natural attenuation of phenoxy acids, such as specific metabolites, changes in enantiomeric fractions, compound-specific stable carbon isotope ratios, or microbial fingerprints.

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 48-58
Publication date: 2003
Peer-reviewed: Yes

**Publication information**
Journal: Ground Water Monitoring & Remediation
Volume: 23
Issue number: 4
ISSN (Print): 1069-3629
Ratings:
Scopus rating (2003): SJR 0.496 SNIP 0.681
Web of Science (2003): Indexed yes
Original language: English
DOIs:
10.1111/j.1745-6592.2003.tb00694.x
Source: orbit
Source-ID: 44001
Research output: Contribution to journal › Journal article – Annual report year: 2003 › Research › peer-review

**Assessment of the microbial growth support potential of products in contact with drinking water (CPDW): Development of a harmonised test to be used in the European Acceptance Scheme concerning CPDW**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering
Publication date: 2003

**Publication information**
Place of publication: Brussels
Publisher: European Commission
Original language: English
(EUR; No. 20832 EN).
Source: orbit
Source-ID: 202036
Research output: Book/Report › Report – Annual report year: 2003 › Research

**BAM-forurening af grundvandet - et varigt problem?**

**General information**
Publication status: Published
Organisations: Department of Environmental Engineering, Technical University of Denmark
Contributors: Clausen, L., Ludvigsen, L., Albrechtsen, H., Elkjaer, L., Jorgensen, P. R.
Pages: 636-639
Publication date: 2003
Peer-reviewed: Unknown

**Publication information**
Journal: DanskVand
Volume: 71
Issue number: 10
ISSN (Print): 1602-3609
Original language: Danish
Degradation of a mixture of phenoxy acids, related chlorophenols and other herbicides at a former machine pool

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Number of pages: 61
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
Publisher: The Royal Veterinary and Agricultural University
Source-ID: 135564
Research output: Chapter in Book/Report/Conference proceeding > Conference abstract in proceedings – Annual report year: 2003 > Research

Degradation of the herbicides atrazine, isoproturon and MCPP in the subsurface at four European sites

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H., Clausen, L., Pedersen, P.
Pages: 43-44
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, 2003. Abstracts
Place of publication: Copenhagen
Publisher: The Royal Veterinary and Agricultural University
Source-ID: 135560
Research output: Chapter in Book/Report/Conference proceeding > Conference abstract in proceedings – Annual report year: 2003 > Research

Denitrifikation i en kystnær akvifer

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Friis, A. K., Bjerg, P. L., Pedersen, B., Postma, D. J., Jakobsen, R., Albrechtsen, H., Andersen, M. S.
Pages: 263-273
Publication date: 2003

Host publication information
Title of host publication: Vintermøde om jord- og grundvandsforurening, Vingstedcentret 4.-5. marts
Volume: bd. 1
Place of publication: Kgs. Lyngby
Publisher: ATV Jord og Grundvand
Source-ID: 135704
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 2003 > Research

Experimental systems for studying biofilm growth in drinking water
Fate of phenoxy acid herbicides in a landfill leachate plume

The aim of this study was to evaluate how the in situ exposure of a Danish subsurface aquifer to phenoxy acid herbicides at low concentrations (<40 μg l⁻¹) changes the microbial community composition. Sediment and groundwater samples were collected inside and outside the herbicide-exposed area and were analyzed for the presence of general microbial populations, Pseudomonas bacteria, and specific phenoxy acid degraders. Both culture-dependent and culture-independent methods were applied. The abundance of microbial phenoxy acid degraders (10⁰ to 10⁴ g⁻¹ sediment) was determined by most probable number assays, and their presence was only detected in herbicide-exposed sediments. Similarly, PCR analysis showed that the 2,4-dichlorophenoxyacetic acid degradation pathway genes tfdA and tfdB (10² to 10³ gene copies g⁻¹ sediment) were only detected in sediments from contaminated areas of the aquifer. PCR-restriction fragment length polymorphism measurements demonstrated the presence of different populations of tfd genes, suggesting that the in situ herbicide degradation was caused by the activity of a heterogeneous population of phenoxy acid degraders. The number of Pseudomonas bacteria measured by either PCR or plating on selective agar media was higher in sediments subjected to high levels of phenoxy acid. Furthermore, high numbers of CFU compared to direct counting of 4',6-diamidino-2-phenylindole-stained cells in the microscope suggested an increased culturability of the indigenous microbial communities from acclimated sediments. The findings of this study demonstrate that continuous exposure to low herbicide concentrations can markedly change the bacterial community composition of a subsurface aquifer.

In situ exposure to low herbicide concentrations affects microbial population composition and catabolic gene frequency in an aerobic shallow aquifer

The aim of this study was to evaluate how the in situ exposure of a Danish subsurface aquifer to phenoxy acid herbicides at low concentrations (<40 μg l⁻¹) changes the microbial community composition. Sediment and groundwater samples were collected inside and outside the herbicide-exposed area and were analyzed for the presence of general microbial populations, Pseudomonas bacteria, and specific phenoxy acid degraders. Both culture-dependent and culture-independent methods were applied. The abundance of microbial phenoxy acid degraders (10⁰ to 10⁴ g⁻¹ sediment) was determined by most probable number assays, and their presence was only detected in herbicide-exposed sediments. Similarly, PCR analysis showed that the 2,4-dichlorophenoxyacetic acid degradation pathway genes tfdA and tfdB (10² to 10³ gene copies g⁻¹ sediment) were only detected in sediments from contaminated areas of the aquifer. PCR-restriction fragment length polymorphism measurements demonstrated the presence of different populations of tfd genes, suggesting that the in situ herbicide degradation was caused by the activity of a heterogeneous population of phenoxy acid degraders. The number of Pseudomonas bacteria measured by either PCR or plating on selective agar media was higher in sediments subjected to high levels of phenoxy acid. Furthermore, high numbers of CFU compared to direct counting of 4',6-diamidino-2-phenylindole-stained cells in the microscope suggested an increased culturability of the indigenous microbial communities from acclimated sediments. The findings of this study demonstrate that continuous exposure to low herbicide concentrations can markedly change the bacterial community composition of a subsurface aquifer.
Long-term succession of structure and diversity of a biofilm formed in a model drinking water distribution system

In this study, we examined the long-term development of the overall structural morphology and community composition of a biofilm formed in a model drinking water distribution system with biofilms from 1 day to 3 years old. Visualization and subsequent quantification showed how the biofilm developed from an initial attachment of single cells through the formation of independent microcolonies reaching 30 μm in thickness to a final looser structure with an average thickness of 14.1 μm and covering 76% of the surface. An analysis of the community composition by use of terminal restriction fragment length polymorphisms showed a correlation between the population profile and the age of the sample, separating the samples into young (1 to 94 days) and old (571 to 1,093 days) biofilms, whereas a limited spatial variation in the biofilm was observed. A more detailed analysis with cloning and sequencing of 16S rRNA fragments illustrated how a wide variety of cells recruited from the bulk water initially attached and resulted in a species richness comparable to that in the water phase. This step was followed by the growth of a bacterium which was related to Nitrospira, which constituted 78% of the community by day 256, and which resulted in a reduction in the overall richness. After 500 days, the biofilm entered a stable population state, which was characterized by a greater richness of bacteria, including Nitrospira, Planctomyces, Acidobacterium, and Pseudomonas. The combination of different techniques illustrated the successional formation of a biofilm during a 3-year period in this model drinking water distribution system.

Måling af indikatororganismer kan kontrollere drikkevandets kvalitet

Møling af indikatororganismer kan kontrollere drikkevandets kvalitet

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Urban Water Engineering
Contributors: Martiny, A., Jørgensen, T., Albrechtsen, H., Arvin, E., Molin, S.
Pages: 6899-6907
Publication date: 2003
Peer-reviewed: Yes
Mikrobielle drikkevandsforureninger i Danmark 1996-1999

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Andersen, U. T., Albrechtsen, H.
Pages: 24-31
Publication date: 2003
Peer-reviewed: Unknown

Mikrobielle forureninger - Vi ser kun toppen af isbjerget

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Department of Informatics and Mathematical Modeling
Contributors: Boe-Hansen, R., Albrechtsen, H., Arvin, E., Spliid, H.
Pages: 86-90
Publication date: 2003
Peer-reviewed: Unknown

Monitoring of biofilm formation and activity in drinking water distribution networks under oligotrophic conditions

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Department of Systems Biology
Contributors: Boe-Hansen, R., Martiny, A. C., Arvin, E., Albrechtsen, H.
Pages: 91-97
Publication date: 2003
Peer-reviewed: Yes
Pesticides in European groundwaters: Detailed study of representative aquifers and simulation of possible evolution scenarios (PEGASE)

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 248-263
Publication date: 2003

Host publication information
Title of host publication: The water cycle and soil-related aspects : EU Workshop: The functioning and management of the water-soil-system at river-basin scale: Diffuse pollution and point sources, Orléans, France, 26th-28th November 2003
Place of publication: Stuttgart
Publisher: UW Umwelwirtschaft GmbH
Source: orbit
Source-ID: 135728
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 2003 → Research

Polymerer kan få bakterier til at vokse i drikkevand

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H., Arvin, E., Jørgensen, C., Boe-Hansen, R.
Pages: 69-74
Publication date: 2003
Peer-reviewed: Unknown

Publication information
Journal: Ny Viden fra Miljøstyrelsen
Issue number: 1
Original language: Danish
Source: orbit
Source-ID: 43467
Research output: Contribution to journal – Journal article – Annual report year: 2003 → Communication

Rensning af grundvand med aktivt kul for BAM og atrazin

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Kagstrup, T., Christensen, T., Corfitzen, C. B., Albrechtsen, H., Arvin, E.
Publication date: 2003

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 859).
URLs:
Shifts in biodegradation kinetics of the herbicides MCPP and 2,4-D at low concentrations in aerobic aquifer materials

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Toräng, L., Nyholm, N., Albrechtsen, H.
Pages: 3095-3103
Publication date: 2003
Peer-reviewed: No

Publication information
Journal: Environmental Science and Technology
Volume: 37
ISSN (Print): 1382-3124
Original language: English
Source-ID: 43867

Sorption and degradation of the herbicide dichlobenil and its metabolite BAM in non-agricultural soils and aquifer sediments

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Larsen, F., Albrechtsen, H.
Pages: 33-33
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-ID: 135569

The groundwater geochemistry of waste disposal facilities

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Bjerg, P. L., Albrechtsen, H., Kjeldsen, P., Christensen, T. H., Cozzarelli, I.
Pages: 579-612
Publication date: 2003

Host publication information
Title of host publication: Treatise on geochemistry: Environmental geochemistry
Volume: 9
Place of publication: Amsterdam
Publisher: Elsevier
Editors: Holland, H., Turekian, K., Lollar, B.
Source-ID: 43366
Tolkning af mikrobiologiske resultater ved forureninger

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 355-357
Publication date: 2003
Peer-reviewed: Unknown

Publication information
Journal: DanskVand
Volume: 71
Issue number: 6
ISSN (Print): 1602-3609
Original language: English
Source: orbit
Source-ID: 43265
Research output: Contribution to journal › Journal article – Annual report year: 2003 › Communication

Undersøgelse for patogener i udvalgte vandværker

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Publication date: 2003

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 786).
URLs:
Source: orbit
Source-ID: 43262
Research output: Book/Report › Report – Annual report year: 2003 › Research

Vand og velfærd

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Fredericia, J., Gravesen, P., Albrechtsen, H., Rosbjerg, D., Jensen, K. H.
Pages: 7-11
Publication date: 2003
Peer-reviewed: Unknown

Publication information
Journal: Miljoforskning
Issue number: 54
Original language: Danish
Source: orbit
Source-ID: 43529
Research output: Contribution to journal › Journal article – Annual report year: 2003 › Communication

Afgivelse af organisk stof fra polymere materialer - mikrobiel vækst

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Corfitzen, C. B., Albrechtsen, H., Arvin, E., Jørgensen, C., Boe-Hansen, R.
Publication date: 2002
Are bioassays useful tools to assess redox processes and biodegradation?

When evaluating potentials for natural attenuation, assessment of ongoing redox processes are important. Terminal electron accepting processes (TEAPs) such as denitrification, Fe(III), Mn(IV), and sulphate reduction and methane production have been assessed by several approaches including redox sensitive hydrochemical or geochemical parameters, levels of hydrogen, and redox potential. However, all these approaches have to be evaluated against TEAP-bioassays as the most direct measure. We assessed successfully ongoing microbial-mediated redox processes by TEAP-bioassays in degradation studies of aromatic and chlorinated aliphatic compounds in landfill leachate plumes, and of pesticides in aquifers with various redox conditions.

Atrazine removal in Danish anaerobic aquifers

The pesticide atrazine (6-chloro-N-2-ethyl-N-4-isopropyl-1,3,5-triazine -2,4-diamine) was removed from the water phase in anaerobic laboratory batch incubations with sediment and groundwater from a number of Danish anaerobic aquifers, but not in incubations from aerobic aquifers. The removal process was abiotic since atrazine was also removed from microbially inhibited autoclaved and chloroform amended controls, although in controls amended with mercury, atrazine removal was slowed down. (ring-U-C-14)- atrazine amended samples showed no mineralization to (CO2)-C-14 or transformation to soluble degradation products, indicating that a slow sorption process was responsible for the atrazine removal. Approximately 20% of the applied C-14-atrazine was present in a non-extractable residual sediment bound fraction, indicating the slow sorption process to be in part irreversible. The irreversible sorption process may be important in terms of natural attenuation of atrazine in aquifers.
Biofilm formation in a hot water system

The biofilm formation rate was measured in situ in a hot water system in an apartment building by specially designed sampling equipment, and the net growth of the suspended bacteria was measured by incubation of water samples with the indigenous bacteria. The biofilm formation rate reached a higher level in the hot water distribution system (2.1 d⁻¹ to 2.3 d⁻¹) than in the hot water tank (1.4 d⁻¹ to 2.2 d⁻¹) indicating an important area for surface associated growth. The net growth rate of the suspended bacteria measured in hot water from the top, middle and bottom of the hot water tank, in the sludge, or in the water from the distribution system was negligible. This indicated that bacterial growth took place on the inner surfaces in the hot water system and biofilm formation and detachment of bacteria could account for most of the suspended bacteria actually measured in hot water. Therefore, attempts to reduce the number of bacteria in a hot water system have to include the distribution system as well as the hot water tank.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Bagh, L., Albrechtsen, H., Arvin, E., Ovesen, K.
Pages: 95-101
Publication date: 2002
Peer-reviewed: Yes

Publication information
Journal: Water Science and Technology
Volume: 46
Issue number: 9
Bulk water phase and biofilm growth in drinking water at low nutrient conditions

In this study, the bacterial growth dynamics of a drinking water distribution system at low nutrient conditions was studied in order to determine bacterial growth rates by a range of methods, and to compare growth rates in the bulk water phase and the biofilm. A model distribution system was used to quantify the effect of retention times at hydraulic conditions similar to those in drinking water distribution networks. Water and pipe wall samples were taken and examined during the experiment. The pipes had been exposed to drinking water at approximately 131°C, for at least 385 days to allow the formation of a mature quasi-stationary biofilm. At retention times of 12 h, total bacterial counts increased equivalent to a net bacterial growth rate of 0.048 day⁻¹. The bulk water phase bacteria exhibited a higher activity than the biofilm bacteria in terms of culturability, cell-specific ATP content, and cell-specific leucine incorporation rate. Bacteria in the bulk water phase incubated without the presence of biofilm exhibited a bacterial growth rate of 0.30 day⁻¹. The biofilm was radioactively labelled by the addition of 14C-benzoic acid. Subsequently, a biofilm detachment rate of 0.013 day⁻¹ was determined by measuring the release of 14C-labelled bacteria of the biofilm. For the quasi-stationary phase biofilm, the detachment rate was equivalent to the net growth rate. The growth rates determined in this study by different independent experimental approaches were comparable and within the range of values reported in the literature.

Degradation and sorption of the herbicides isoproturon, mecoprop and atrazine in samples from four European aquifers

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Clausen, L., Pedersen, P. G., Albrechtsen, H.
Publication date: 2002
Host publication information
Title of host publication: ISSM 2002 : International Symposium on Subsurface Microbiology, Copenhagen, Denmark, September 8-13, 2002. Abstract book
Place of publication: Copenhagen
Publisher: GEUS
Editors: Albrechtsen, H., Aamand, J.
Development of methodology for hazard identification of rainwater collected for reuse

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Publication date: 2002

Host publication information
Title of host publication: Global solutions for urban drainage : 9ICUD, Portland, Oregon, 8-13 September 2002
Volume: CD-ROM
Place of publication: Reston, VA
Publisher: American Society of Civil Engineers
Editors: Strecker, E. W., Huber, W. C.
Keywords: reuse, xenobiotic organic compounds, collected rainwater, hazard identification, heavy metals, problem identification, microorganisms

Development of preferential flow in bioclogging of porous media

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Engesgaard, P. K., Holm, J., Jensen, K. H., Henze, M., Albrechtsen, H.
Pages: 803-810
Publication date: 2002

Host publication information
Place of publication: Amsterdam, NL
Publisher: Elsevier
Editors: Hassanizadeh, S. M., Schotting, R. J., Gray, W. G., Pinder, G. F. (Developments in Water Science; No. 47).

Drikkevandet trues af mange stoffer

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Arvin, E., Albrechtsen, H.
Pages: 8-11
Publication date: 2002
Peer-reviewed: No

Publication information
Journal: Vækst
Volume: 123
Issue number: 1
Original language: Danish
Source: orbit
Source-ID: 43300
Dynamics of biofilm formation in a model drinking water distribution system
The dynamics of biofilm formation in non-chlorinated groundwater-based drinking water was studied in a model distribution system. The formation of biofilm was closely monitored for a period of 522 days by total bacterial counts (AODC), heterotrophic plate counts (R2A media), and ATP content determinations. The biofilm grew at a rate of 0.030±0.002 day−1 reaching quasi-stationary state at 2.6×106 cells/cm2 after approximately 200 days. The low substrate level in the bulk phase (AOC at approximately 6 g ac-C/l) most likely caused the relatively slow biofilm formation rate observed. During the maturation of the biofilm, the bacterial community changed properties in terms of cell-specific ATP content and culturability of the bacteria.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Boe-Hansen, R., Albrechtsen, H., Arvin, E., Jorgensen, C.
Pages: 399-406
Publication date: 2002
Peer-reviewed: Yes

Effect of exposure history on microbial herbicide degradation in an aerobic aquifer affected by a point source
The effects of in situ exposure to low concentrations (micrograms per liter) of herbicides on aerobic degradation of herbicides in aquifers were studied by laboratory batch experiments. Aquifer material and groundwater were collected from a point source with known exposure histories to the herbicides mecoprop (MCPP), dichlorprop, BAM, bentazone, isoproturon, and DNOC. Degradation of the phenoxy acids, mecoprop and dichlorprop, was observed in five of six sampling points from within the plume. Mecoprop was mineralized, and up to 70% was recovered as 14CO2. DNOC was degraded in only two of six sampling points from within the plume, and neither BAM, bentazone, nor isoproturon was degraded in any sampling point. A linear correlation (R2 g 0.83) between pre-exposure and amount of herbicide degraded within 50 days was observed for the phenoxy acids, mecoprop and dichlorprop. An improved model fit was obtained from using Monod degradation kinetics compared to zero- and first-order degradation kinetics. An exponential correlation (R2 g 0.85) was also found between numbers of specific phenoxy acid degrading bacteria and pre-exposure. Combination of these results strongly indicates that the low concentration exposure to phenoxy acids in the aquifer resulted in the presence of acclimated microbial communities, illustrated by the elevated numbers of specific degraders as well as the enhanced degradation capability. The findings support application of natural attenuation to remediate aerobic aquifers contaminated by phenoxy acids from point sources.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., de Lipthay, J., Albrechtsen, H., Aamand, J., Bjerg, P. L.
Pages: 2205-2212
Publication date: 2002
Peer-reviewed: Yes
Enhanced degradation of phenoxy acids and chlorophenols in aquifers

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Bjerg, P. L., Tuxen, N., Ask Reitzel, L., Albrechtsen, H.
Publication date: 2002
Peer-reviewed: No
Event: Poster session presented at 3rd International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, United States.
Source: orbit
Source-ID: 135596
Research output: Contribution to conference › Poster – Annual report year: 2002 › Research

Fjernelse af MTBE i danske vandværker

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Nielsen, L., Tully, A., Albrechtsen, H., Mosbæk, H., Arvin, E.
Publication date: 2002

Publication information
Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Arbejdsrapport fra Miljøstyrelsen; No. 17 - 2002).
URLs:
Source: orbit
Source-ID: 43813
Research output: Book/Report › Report – Annual report year: 2002 › Research

Hazard Identification of rainwater collected for non-potable reuse in households

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Pages: 53-62
Publication date: 2002

Host publication information
Volume: Vol. 2
Place of publication: Vitry sur Seine, France
Publisher: Centre d'Enseignement et de Recherche Eau Ville Environnement
Source: orbit
Source-ID: 135766
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2002 › Research

In situ examination of microbial populations in a model drinking water distribution system

A flow cell set-up was used as a model drinking water distribution system to analyze the in situ microbial population. Biofilm growth was followed by transmission light microscopy for 81 days and showed a biofilm consisting of microcolonies
separated by a monolayer of cells. Protozoans (ciliates and flagellates) were often seen attached to the microcolonies. The biofilm was hybridized with oligonucleotide probes specific for all bacteria and the α- and β-subclass of Proteobacteria and visualized with a scanning confocal laser microscope. Hybridization showed that the microcolonies primarily consisted of a mixed population of α- and β-Proteobacteria. 65 strains from the inlet water and 20 from the biofilm were isolated on R2A agar plates and sorted into groups with amplified rDNA restriction analysis. The 16S rDNA gene was sequenced for representatives of the abundant groups. A phylogenetic analysis revealed that the majority of the isolated strains from the bulk water and biofilm were affiliated to the family of Comamonadaceae in the β-lineage of Proteobacteria. The majority of the strains from the α-lineage were affiliated to the family of Sphingomonadaceae. We were unable to detect any strains from the Pseudomonas genus and found a low abundance of bacteria affiliated to the γ-subclass of Proteobacteria where Pseudomonas and E. coli are positioned. The analysis revealed a high bacterial diversity in the water phase as well as the biofilm, but no strains were found in both environments.

**General information**
Publication status: Published
Organisations: Department of Systems Biology, Department of Environmental Engineering, Exiqon A/S
Contributors: Martiny, A. C., Nielsen, A. T., Arvin, E., Molin, S., Albrechtsen, H.
Pages: 283-288
Publication date: 2002
Peer-reviewed: Yes

**Publication information**
Journal: Water Science and Technology: Water Supply
Volume: 2
Issue number: 3
ISSN (Print): 1606-9749
Ratings:
Scopus rating (2002): SJR 0.154 SNIP 0.257
Original language: English
Keywords: Sphingomonadaceae, Comamonadaceae, Phylogeny, Biofilm, FISH, Drinking water
Source: orbit
Source-ID: 43779
Research output: Contribution to journal › Journal article – Annual report year: 2002 › Research › peer-review
Microbiological investigations of rainwater and graywater collected for toilet flushing

Seven Danish rainwater systems were investigated with respect to the microbial water quality. The general microbiological quality (total numbers of bacteria (AODC)), and heterotrophic plate counts on R2A and Plate Count Agar in the toilets supplied with rainwater were approximately the same as in the reference toilets supplied with drinking water. However, in 12 of the 27 analysed samples one or more pathogens were observed (Aeromonas sp., Pseudomonas aeruginosa, Legionella non-pneumophila, Campylobacter jejuni, Mycobacterium avium, and Cryptosporidium sp.). These pathogens were not found in any of the reference toilets (32 toilets). This means that the use of rainwater introduced new, potentially pathogenic microorganisms into the households which would normally not occur in toilets supplied with water from waterworks. Furthermore, four graywater systems were investigated where water from the shower and hand wash basin was reused. The graywater systems gave more problems in terms of bad smell and substantially higher numbers of E. coli and Enterococcus in some toilet bowls supplied with graywater.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 311-316
Publication date: 2002
Peer-reviewed: Yes

Publication information
Journal: Water Science and Technology
Volume: 46
Issue number: 6-7
ISSN (Print): 0273-1223
Ratings:
Scopus rating (2002): SJR 0.903 SNIP 0.894
Web of Science (2002): Indexed yes
Original language: English
Keywords: Bacteria, hygienic, reuse, graywater, rainwater, microorganisms
Source: orbit
Source-ID: 43259
Research output: Contribution to journal › Journal article – Annual report year: 2002 › Research › peer-review

MTBE-fjernelse i et dansk vandværk

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Nielsen, L., Tully, A., Albrechtsen, H., Mosbæk, H., Arvin, E.
Pages: 105-111
Publication date: 2002

Host publication information
Title of host publication: Vandforsyningssteknik
Volume: 51
Place of publication: Århus
Publisher: Dansk Vand- og Spildevandsforening - DANVA
Source: orbit
Source-ID: 135787
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2002 › Research

MTBE kan fjernes ved simpel vandbehandling

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Nielsen, L., Tully, A., Albrechtsen, H., Mosbæk, H., Arvin, E.
Pages: 35-38
Natural attenuation of herbicides: Importance of growth-based degradation

A field injection experiment in a sandy, aerobic aquifer showed that two phenoxy acids MCPP (mecoprop) and dichlorprop were degraded within 1 in downgradient of the injection wells after an apparent lag period. The plume development and microbial measurements indicated that microbial growth governed degradation. The results were satisfactorily described by a newly developed three-dimensional reactive solute transport model including growth based degradation kinetics. The model was applied at a larger scale to simulate the effect of growth kinetics on a release of phenoxy acids. The results revealed an efficient removal of phenoxy acids close to the source. However, a significant mass escaped during the initial growth phase and the resulting plume was only slowly degraded as short exposure time and low concentrations limited the growth of specific degraders and thereby degradation. The observations may be important for application of natural attenuation as a remedy in field scale systems.
Redox states of anaerobic, sandy aquifers: A Mössbauer spectroscopy based classification

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Pedersen, P. G., Albrechtsen, H., Koch, C.
Publication date: 2002

Host publication information
Title of host publication: ISSM 2002: International Symposium on Subsurface Microbiology, Copenhagen, Denmark, September 8-13, 2002
Volume: Abstract book
Place of publication: Copenhagen
Publisher: GEUS
Editors: Albrechtsen, H., Aamand, J.

Shifts in biodegradation kinetics of pesticides at low concentrations

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Toräng, L., Albrechtsen, H., Nyholm, N.
Publication date: 2002

Host publication information
Title of host publication: ISSM 2002: International Symposium on Subsurface Microbiology, Copenhagen, Denmark, September 8-13, 2002
Volume: Abstract book
Place of publication: Copenhagen
Publisher: GEUS
Editors: Albrechtsen, H., Aamand, J.

Sorption og diffusion af glyphosat i morænele

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Mathiesen, L., Broholm, M. M., Albrechtsen, H.
Pages: 539-548
Publication date: 2002
Stimulering af pesticidnedbrydning i grundvandssement fra to punktkilder

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., Albrechtsen, H., Bjerg, P. L.
Pages: 47-53
Publication date: 2002

Substrate turnover at low carbon concentrations in a model drinking water distribution system

Water quality changes caused by microbial activity in the distribution network can cause serious problems. Reducing the amount of microbial available substrate may be an effective way to control bacterial aftergrowth. The purpose of the present study was to study the kinetics of substrate utilisation and bacterial growth at low nutrient conditions in a model distribution system. The model system consisted of two loops in series, where flow rate and retention time were controlled independently. Spiking the drinking water of the model system with two different environmentally realistic concentrations of carbon allowed for a close monitoring of the kinetics of substrate turnover (less than 10 μg C/L 14C-benzoic acid was added). The mineralisation of benzoic acid was rapid and could be modelled by a no-growth Monod expression using a maximum degradation rate of 0.59 μg C/L/h and a half-saturation constant of 2.6 μg C/L. Only 2–4% of the carbon being degraded was incorporated into the biofilm. The results from our study suggest that the cellspecific respiration of biofilm was much higher than for suspended bacteria, and that the growth rate of the bulk phase bacteria was approximately 10 times higher than the biofilm bacteria.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Boe-Hansen, R., Albrechtsen, H., Arvin, E., Jørgensen, C.
Pages: 89-96
Publication date: 2002
Peer-reviewed: Yes

Publication information
Journal: Water Science and Technology: Water Supply
Volume: 2
Issue number: 4
ISSN (Print): 1606-9749
Ratings:
Scopus rating (2002): SJR 0.154 SNIP 0.257
Original language: English
Keywords: biofilm, yield, turnover, bacterial growth, AOC, drinking water, substrate
Source: orbit
Source-ID: 43369
Research output: Contribution to journal › Journal article – Annual report year: 2002 › Research › peer-review

Udsivning fra utætte kloakker - betydningen for grundvandskvaliteten?

General information
Undersøgelse af bakterieantal og eftervækstpotentiale i vandværksvand

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Jørgensen, C., Albrechtsen, H., Arvin, E., Corfitzen, C. B.
Publication date: 2002

Place of publication: København
Publisher: Miljøstyrelsen
Original language: Danish
(Miljøprojekt; No. 719).

URLs:
Research output: Book/Report › Report – Annual report year: 2002 › Research

Undersøgelse af patogener i råvand og færdigbehandlet vandværksvand

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Pages: 149-163
Publication date: 2002

Host publication information
Title of host publication: Vandforsyningsteknik
Volume: 51
Place of publication: Århus
Publisher: Dansk Vand- og Spildevandsforening - DANVA
Source: orbit
Source-ID: 135742
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2002 › Research › peer-review

Application and Strategy for Identifying and Monitoring Bacterial Fouling

General information
Publication status: Published
Organisations: Department of Systems Biology, Department of Environmental Engineering
Contributors: Martiny, A. C., Albrechtsen, H., Arvin, E., Molin, S.
Pages: 354-364
Publication date: 2001

Host publication information
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 years, and the number of well-documented full scale leachate plumes is 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.
Degradation of herbicides in shallow Danish aquifers - an integrated laboratory and field study

Degradation of pesticides in aquifers has been evaluated based on a number of co-ordinated field and laboratory studies carried out in Danish aquifers. These studies included investigations of vertical and horizontal variability in degradation rates from the vadose zone to an aquifer, the effects of aerobic versus anaerobic conditions, and the importance of concentration on degradation kinetics for a selected range of herbicides. The studies were based on different experimental approaches ranging from simple batch experiments to column studies to field injection experiments and, where appropriate, results were compared. Some herbicides were degraded under aerobic conditions (some phenoxy acids, DNOC and glyphosate) and others under aerobic conditions (other phenoxy acids, DNOC; there was some indication of atrazine transformation). Certain pesticides were not degraded in any investigations (dichlobenil, the dichlobenil metabolite 2,6-dichlorobenzamide (BAM), bentazone, isoproturon, metanitron and metsulfuron-methyl). The spatial variability was substantial, since hardly any of the investigated pesticides were degraded in all comparable samples. This means that it is very difficult to claim that a given pesticide is readily degradable in aquifers. However, the experimental approaches used (with incubations lasting more than a year) may not be sensitive enough to verify the low degradation rates that may be significant as a result of the long retention time of groundwaters. (C) 2001 Society of Chemical Industry.
Effects of organic matter on clogging in sand columns

Factors affecting quantification of assimilable organic carbon (AOC) release from polymers in drinking water systems

Fate of pesticides in groundwater
Fate of the herbicides 2,4,5-T, atrazine, and DNOC in a shallow, anaerobic aquifer investigated by in situ passive diffusive emitters and laboratory batch experiments

The fate of the three herbicides 2,4,5-T (2,4,5-trichlorophenoxyacetic acid), atrazine (6-chloro-N-ethyl-N’-[1-methyl-ethyl]-1,3,5-triazine-2,4-diamine), and DNOC (4,6-dinitro-2-methylphenol) in an anaerobic sandy aquifer was investigated. In the field, each of the herbicides was released simultaneously with tritiated water (HTO) as tracer in the depth interval 3 to 4 rubs (meters below surface) by use of passive diffusive emitters. Atrazine and 2,4,5-T were persistent during the approximately 18 days residence time in the aquifer. In contrast, DNOC was rapidly removed from the water phase following first-order kinetics. The removal mechanism was likely an abiotic reduction. At day 25, the first-order rate constant was 1.47 d(-1), but it decreased with time and seemed to stabilize at 0.35 d(-1) after 150 to 200 days. In the laboratory, batch experiments were conducted with sediments from 3 to 4 rubs and from 8 to 9 rubs. In these incubations, formation of Fe2+ and depletion of sulfate showed iron and sulfate reduction in sediment from 3 to 3.5 rubs sediment. In sediment from 8 to 9 rubs, the dominant redox process was methane formation. In sediment from 3 to 3.5 rubs, only 27% to 52% of the 2,4,5-T remained after 196 days. 2,4,5-trichlorophenol was identified as the major metabolite. A lag period of at least 50 days was observed, and no degradation occurred in HgCl2 amended controls, verifying that the process was microbially mediated. In the other 2,4,5-T incubations and all the atrazine incubations, concentrations decreased linearly, but less than 25% was removed within 200 to 250 days. No degradation products could be detected, and slow sorption was the likely explanation. In all the laboratory incubations DNOC was degraded, following first-order kinetics, and when normalized to the sediment/water-ratio, the field and laboratory derived rate constants compared well. The DNOC degradation in the methanogenic incubations (8 to 9 rubs) was up to 50 times faster than in the sediments from 3 to 4 rubs, likely due to the low redox potential.

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Arildskov, N., Pedersen, P. G., Albrechtsen, H.
Pages: 819-830
Publication date: 2001
Peer-reviewed: Yes

Publication information
Journal: Ground Water
Volume: 39
Issue number: 6
ISSN (Print): 0017-467X
Ratings:
Scopus rating (2001): SJR 1.27 SNIP 1.115
Web of Science (2001): Indexed yes
Original language: English
DOI:
10.1111/j.1745-6584.2001.tb02470.x
Source: orbit
Source-ID: 43290
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Research › peer-review

Forurening af grundvandet med pesticider

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Tuxen, N., Albrechtsen, H., Bjerg, P. L.
Pages: 11-13
Publication date: 2001
Peer-reviewed: Unknown

Publication information
Journal: AVJ-info fra Amternes Videncenter for Jordforurening
Issue number: 10
Original language: Danish
Electronic versions:
MR2001-172.pdf
Source: orbit
Source-ID: 43994
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Communication
Microbial clogging in sand column experiments

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: 73-79
Publication date: 2001

Host publication information
Title of host publication: Artificial recharge of groundwater : EC project ENV4-CT95-0071. Final Report
Volume: Chapter 5.4
Place of publication: Luxembourg
Publisher: European Commission
Source: orbit
Source-ID: 43256

Pesticides in European groundwaters: Detailed study of representative aquifers and simulation of possible evolution scenarios (PEGASE)

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Pages: GRA3. 2773
Publication date: 2001
Peer-reviewed: No

Publication information
Journal: Geophysical Research Abstracts
Volume: 3
Issue number: 26th General Assembly
Original language: English
Source: orbit
Source-ID: 43803
Research output: Contribution to journal – Journal article – Annual report year: 2001 – Research

Plastmaterialer: Er plastmaterialer det fuldendte alternativ? Eller er der også her særlige forhold vi skal tage hensyn til?

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Publication date: 2001

Host publication information
Title of host publication: Metaller i drikkevand : Ny bekendtgørelse fra Miljøstyrelsen. Får vi for meget? Og hvordan undgår vi det? Danvak konference, Radisson SAS Scandinavia Hotel, København 1. oktober 2001
Source: orbit
Source-ID: 135803
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 2001 – Research

Removal of atrazine in Danish anaerobic groundwater

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Pedersen, P. G., Arildskov, N., Albrechtsen, H.
Number of pages: 117
Publication date: 2001
10 Nedbrydning i grundvandsmiljøer

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Bjerg, P. L.
Pages: 215-237
Publication date: 2000

Afrapportering af Det strategiske Miljøforskningsprogram SMP96 om 'Pesticider og grundvand'

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Number of pages: 210
Pages: 69-82
Publication date: 2000

Begrænsninger for nedbrydning af pesticider i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Department of Environmental Science and Engineering
Contributors: Aamand, J., Toräng, L., de Lipthay, J., Albrechtsen, H.
Pages: 21-24
Publication date: 2000
Peer-reviewed: No
Biodegradation kinetics at low concentrations (A)
Aerobic biodegradation of 2,4-dichlorophenoxyacetic acid (2,4-D) was studied in groundwater added sediment fines. At concentrations at or below 1 µg/L of 2,4-D degradation kinetic was of true first order without significant growth of specific degraders and with half-life for mineralization in the order of 200 days. Higher concentrations of 2,4-D resulted in a grossly overestimate of the actual degradation rate for concentrations characteristic for Danish found in groundwater.

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.
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.

General information
Publication status: E-pub ahead of print
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.
Number of pages: 1,494
Pages: 181-188
Publication date: 2000

Host publication information
Title of host publication: Contaminated Soil 2000 : Proceedings of the 7th International FZK/TNO Conference on Contaminated Soil
Place of publication: London
Publisher: Thomas Telford
ISBN (Print): 0727729543
Keywords: groundwater, redox, bioasays, hydrogen, plume, site investigation, contaminated sites
Source: orbit
Source-ID: 318603
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2000
Research

Continuous exposure of pesticides in an aquifer changes microbial biomass, diversity and degradation potential
We studied in situ effects of pesticide exposure on microbial degradation potential and community structure of aquifer sediments. Sediment samples pre-exposed to pesticides were significantly different to non-exposed control samples. Pre-exposed sediment showed an increased degradation potential towards phenoxyalcanoic acid herbicides as well as impact on microbial diversity was observed. Furthermore, bacterial biomass was changed, e.g. increased numbers of phenoxyalcanoic acid degraders in pesticide exposed sediment.

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Geological Survey of Denmark and Greenland
Contributors: de Lipthay, J. R., Johnsen, K., Aamand, J., Tuxen, N., Albrechtsen, H., Bjerg, P. L.
Pages: 157-158
Publication date: 2000

Host publication information
Title of host publication: Groundwater 2000 : Proceedings of the International Conference on Groundwater Research
Place of publication: Rotterdam, Netherlands
Publisher: CRC Press/Balkema
ISBN (Print): 90-5809-133-3
Keywords: biodegradation, aquifer, bacterial biomass, pesticides, bacterial diversity, adaptation
Source: orbit
Source-ID: 318375
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 2000
Research

Degradation of herbicides under different redox conditions in eight Danish aquifers
The degradation potential of the herbicides 2,4-D, 2,4,5-T, atrazine, dichlobenil, DNOC, bentazone, DCP (dichlorprop), IPU (isoproturon), MCPA and MCPP (mecoprop) and the degradation product from dichlobenil 2,6-dichlorobenzamide (BAM) were investigated in laboratory incubations with sediment and groundwater from eight Danish anaerobic and aerobic aquifers.

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Pedersen, P. G., Mosbæk, H., Albrechtsen, H.
Development of a model distribution system for studies of changes in water quality and microbial activity in drinking water distribution systems

Fate of Eleven Pesticides: Degradability and Sorption in Eight Danish Aerobic and Anaerobic Aquifers

Fate of seven pesticides in an aerobic aquifer studied in column experiments

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Pedersen, P. G., Mosbæk, H., Albrechtsen, H.
Publication date: 2000
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
ISSN (Print): 1382-3124
Ratings:
Web of Science (2000): Indexed yes
Original language: English
Source: orbit
Source-ID: 318576
Research output: Contribution to journal › Journal article – Annual report year: 2000 › Research › peer-review

The fate of selected pesticides (bentazone, isoproturon, DNOC, MCPP, dichlorprop and 2,4-D) and a metabolite (2,6-dichlorobenzamide (BAM)) was investigated under aerobic conditions in column experiments using aquifer material and low concentrations of pesticides (approximately 25 lg/l). A solute transport model accounting for kinetic sorption and degradation was used to estimate sorption and degradation parameters. Isoproturon and DNOC were significantly retarded by sorption, whereas the retardation of the phenoxy acids (MCPP, 2,4-D and dichlorprop), BAM and bentazone was very low. After lag periods of 16±33 days for the phenoxy acids and 80 days for DNOC, these pesticides were degraded quickly with 0.-order rate constants of 1.3±2.6 lg/l/day. None of the most probable degradation products were detected. © 2000 Elsevier Science Ltd. All rights reserved.
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 41
Issue number: 9
ISSN (Print): 0045-6535
Ratings:
Scopus rating (2000): SJR 0.88 SNIP 0.876
Web of Science (2000): Indexed yes
Original language: English
Keywords: Aquifer, Aerobic degradation, Pesticides, Kinetic sorption, Herbicides, Column, Modelling
DOI:
10.1016/S0045-6535(99)00533-0
Source: orbit
Source-ID: 176359
Research output: Contribution to journal › Journal article – Annual report year: 2000 › Research › peer-review

Fjernelse af atrazin i anaerobt grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Pedersen, P. G., Mosbæk, H., Albrechtsen, H.
Pages: 425-433
Publication date: 2000

Host publication information
Title of host publication: Proceedings of ATV Møde : Vintermøde om grundvandsforurening
Source: orbit
Source-ID: 317818
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2000 › Research

Microbiological characteristics of groundwater and degradation of pesticides

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Pedersen, P. G., Broholm, M. M., Rügge, K., Bjerg, P. L.
Publication date: 2000
Peer-reviewed: No
Source: orbit
Source-ID: 318565
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2000 › Research

Mikrobiel adaptation til nedbrydning af pesticidet MCPP i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Geological Survey of Denmark and Greenland
Contributors: Tuxen, N., Albrechtsen, H., Bjerg, P. L., de Lipthay, J. R., Johnsen, K., Aamand, J.
Pages: 415-423
Publication date: 2000

Host publication information
Title of host publication: Proceedings of ATV Møde : Vintermøde om grundvandsforurening
Source: orbit
Source-ID: 317816
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 2000 › Research
Natural Attenuation of Herbicides from a Simulated Point Source Contamination (Vejen, Denmark)
The migration and degradation of herbicides was studied in a continuous field injection experiment in an aerobic aquifer. The sorption of MCPP and dichlorprop was insignificant. Rapid degradation after a lag phase was observed. Enhanced degradation of MCPP and dichlorprop was observed in laboratory experiments with pre-exposed aquifer materials from the field site.

Natural attenuation of pesticides in an aerobic aquifer (Vejen, Denmark)

Natural nedbrydning som afværgesteknologi til pesticidpunktkilder?
Nødbydning af glyphosat i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Albrechtsen, H., Fest, B., Bjerg, P. L.
Pages: 16-17
Publication date: 2000
Peer-reviewed: No

Nødbydning af pesticider i grundvandsmagasiner

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H., Aamand, J., Larsen, L., Pedersen, P. G., Bjerg, P. L., Rügge, K., Broholm, M.
Pages: 25-28
Publication date: 2000
Peer-reviewed: No

Pesticiders skæbne i grundvandsmagasiner - et delprogram under SMP 96

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Pages: 4-5
Publication date: 2000
Peer-reviewed: No
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.

Collected rainfall as a water source in Danish households - what is the potential and what are the costs?
The water resource, energy and economy aspects of rainwater collection are assessed to evaluate rainfall collection as an alternative option for sustainable water supply. A maximum of 229 million m$^3$/year of rainwater can be collected from Danish roofs, provided that all possible surfaces are used and all rain falling on the surfaces is collected. This is equivalent to 24% of the total present production of drinking water, which is mainly based on groundwater. From household roofs...
64.5 million m\(^3\)/year can be collected if used for toilet flushing and washing of clothes. This is 68% of the actual demand for toilet flushing and washing of clothes in households and 22% of the total water consumption in households, but only 7% of the total present drinking water production in Denmark. From the society point of view there is neither an environmental nor an economic reason to systematically promote rainfall collection on a larger scale in Denmark. Thus it is important to see rainfall collection in a local context, and in each case to evaluate whether there are cheaper alternative water sources or options for minimising the water consumption. (C) 1999 IAWQ Published by Elsevier Science Ltd. All rights reserved.
Degradation of glyphosate in aquifers. Abstracts

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Bjerg, P., Kreilgaard, L., Carlsson, C., Bengtsson, G.
Publication date: 1999

Host publication information
Title of host publication: Degradation of glyphosate in aquifers. Abstracts
Place of publication: Lawrence, Kansas
Publisher: University of Kansas
Source: orbit
Source-ID: 172990
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999

Degradation of herbicides under different redox conditions in eight Danish groundwater aquifers. Abstract

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Pedersen, P., Albrechtsen, H., Mosbæk, H.
Publication date: 1999

Host publication information
Title of host publication: Degradation of herbicides under different redox conditions in eight Danish groundwater aquifers.
Abstract
Place of publication: Lawrence, Kansas
Publisher: University of Kansas
Source: orbit
Source-ID: 173001
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999

Degradation of seven pesticides in an aerobic aquifer: Batch experiments. Abstract

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Rügge, K., Schouw, N., Christiansen, T., Albrechtsen, H.
Publication date: 1999

Host publication information
Title of host publication: Degradation of seven pesticides in an aerobic aquifer: Batch experiments. Abstract
Place of publication: Lawrence, Kansas
Publisher: University of Kansas
Source: orbit
Source-ID: 173003
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999

Development of equipment for in situ studies of biofilm in hot water systems
New equipment was developed for in situ studies of biofilms in hot water tanks and hot water pipes under normal operation and pressure. Sampling ports were installed in the wall of a hot water tank and through these operating shafts were inserted with a test plug in the end. The surface of the test plugs was made of the same material as used in the hot water system and the test plugs were flush with the inner surface of the tank. When the operating shaft was removed from the tank, biofilm could be collected. In the distribution system, biofilm samples were collected from test plugs inserted in sampling ports in a by-pass. Heterotrophic plate counts (HPC) revealed $10^{4}$-$10^{6}$ CFU cm$^{-2}$ on the test plugs in the hot water system after an exposure period of 7 d. The number of bacteria was not influenced by the location of the plug within each cluster of plugs in the distribution system, or at different horizontal levels in the hot water tank after an exposure period of 7 d.
General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Christiansen, T., Schouw, N., Rügge, K.
Publication date: 1999

Host publication information
Title of host publication: Ecophysiological parameters of importance for microbial degradation of MCPP in an aerobic aquifer. Abstracts
Place of publication: Vail, Colorado
Publisher: American Society for Microbiology
Source-ID: 172991
Research output: Chapter in Book/Report/Conference proceeding ⇒ Article in proceedings – Annual report year: 1999 ⇒ Research

Forbrugerinformationer - hvorfor og hvordan?

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Larsen, T., Raben, A., Arvin, E., Albrechtsen, H.
Pages: 110 - 111
Publication date: 1999
Peer-reviewed: No

Publication information
Journal: Vandteknik
Volume: 67
Original language: Danish
Source-ID: 172965
Research output: Contribution to journal ⇒ Journal article – Annual report year: 1999 ⇒ Research

Identifikation og måling af betydnende redoxprocesser

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Publication date: 1999

Host publication information
Title of host publication: Identifikation og måling af betydnende redoxprocesser
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source-ID: 172969
Research output: Chapter in Book/Report/Conference proceeding ⇒ Article in proceedings – Annual report year: 1999 ⇒ Research

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

General information
Publication status: 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
Nedbrydning af pesticider i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Tuxen, N., Tüchsen, P. L., Rügge, K., Albrechtsen, H., Bjerg, P. L.
Pages: 141-143
Publication date: 1999
Peer-reviewed: No

Publication information
Journal: Vand & Jord
Volume: 6
Issue number: 4
ISSN (Print): 0908-7761
Original language: Danish
Source: orbit
Source-ID: 172967
Research output: Contribution to journal > Journal article – Annual report year: 1999 > Research

Prøvetagningssonde til vandværksfiltre

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Johansen, G., Rasmussen, T., Arvin, E., Albrechtsen, H.
Pages: 190 - 194
Publication date: 1999
Peer-reviewed: No

Publication information
Journal: Vandteknik
Volume: 67
Original language: Danish
Source: orbit
Source-ID: 172964
Research output: Contribution to journal > Journal article – Annual report year: 1999 > Research

Sorption af pesticider i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Tüchsen, P., Tuxen, N., Rügge, K., Albrechtsen, H., Bjerg, P. L.
Pages: 63 - 67
Publication date: 1999
Peer-reviewed: No

Publication information
Journal: Vand & Jord
Volume: 6
Issue number: 2
ISSN (Print): 0908-7761
Original language: Danish
Source: orbit
Source-ID: 172968
Research output: Contribution to journal > Journal article – Annual report year: 1999 > Research
Spatial variability of redox processes, microbial activity and degradation of herbicides in eight shallow Danish aquifers. Abstracts

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Pedersen, P., Albrechtsen, H., Mosbæk, H.
Number of pages: 26
Publication date: 1999

Host publication information
Title of host publication: Spatial variability of redox processes, microbial activity and degradation of herbicides in eight shallow Danish aquifers. Abstracts
Place of publication: Vail, Colorado
Publisher: American Society for Microbiology
Source: orbit
Source-ID: 173002
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999 › Research

Status for kvalitetskontrol i et par veirrenommerede vandforsyninger

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Larsen, T., Raben, A., Arvin, E., Albrechtsen, H.
Pages: 94 - 97
Publication date: 1999
Peer-reviewed: No

Publication information
Journal: Vandteknik
Volume: 67
Original language: Danish
Source: orbit
Source-ID: 172966
Research output: Contribution to journal › Journal article – Annual report year: 1999 › Research

Transport og omsætning af pesticider i grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Number of pages: 56
Publication date: 1999

Host publication information
Title of host publication: Transport og omsætning af pesticider i grundvand
Place of publication: Roskilde
Publisher: Danmarks Miljøundersøgelser
Source: orbit
Source-ID: 172970
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1999 › Research

 Mikrobiologisk vandkvalitet i varmtvandsinstallationer

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Bagh, L. K., Arvin, E., Albrechtsen, H.
Activated carbon filtration of water: Lecture note for 63233 Water Supply

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Arvin, E., Albrechtsen, H., Boe-Hansen, R.
Number of pages: 16
Publication date: 1998

Aerob nedbrydning af pesticider i sælxfforsøg med grundvandsmateriale

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Tuchsen, P. L., Tuxen, N., Rügge, K., Albrechtsen, H., Bjerg, P. L.
Pages: 57-66
Publication date: 1998

Aktiv kulfiltrering, teknik

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Arvin, E., Albrechtsen, H., Boe-Hansen, R.
Pages: 181-193
Publication date: 1998
Anaerobic microbial redox processes in a landfill leachate contaminated aquifer (Grindsted, Denmark)

General information
Publication status: 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
Original language: English
Source: orbit
Source-ID: 171469
Research output: Contribution to journal › Journal article – Annual report year: 1998 › Research › peer-review

Boligernes vandforbrug: Mikrobiologisk undersøgelser af regn og gråvandsanlæg

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Publication date: 1998

Publication information
Place of publication: Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: Danish
Source: orbit
Source-ID: 173017
Research output: Book/Report › Report – Annual report year: 1998 › Research › peer-review

Boligernes vandforbrug. Den udnyttelige regnvandsressource

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Henze, M., Mikkelsen, P. S., Adeler, O. F.
Number of pages: 98
Publication date: 1998

Publication information
Publisher: Miljøstyrelsen
Original language: Danish
Source: orbit
Source-ID: 171571
Research output: Book/Report › Report – Annual report year: 1998 › Research › peer-review

Degradability of chlorinated aliphatic compounds in methanogenic leachates sampled at eight landfills

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kromann, A., Ludvigsen, L., Albrechtsen, H., Christensen, T. H.
Pages: 54 - 62
Publication date: 1998
Peer-reviewed: Yes
Effects of biomass growth on the hydraulic properties of groundwater aquifers

General information
Publication status: Published
Organisations: Department of Hydrodynamics and Water Resources, Department of Environmental Science and Engineering
Contributors: Holm, J., Engesgaard, P. K., Høgh Jensen, K., Henze, M., Albrechtsen, H.
PUBLICATION DATE: 1998

Host publication information
Title of host publication: Part II: Hydrology, Oceans & Atmosphere, Supplement II to Volume 16
Publisher: European Geophysical Society
Source-ID: 170790

H2 Concentrations in a Landfill Leachate Plume (Grindsted, Denmark): In Situ Energetics of Terminal Electron Acceptor Processes

General information
Publication status: 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
Original language: English
Source-ID: 170771

Kontrollerende faktorer for aerob pesticidnedbrydning i grundvandsmagasiner

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. G., Schouw, N. L., Albrechtsen, H., Rügge, K.
Pages: 47-56
Publication date: 1998

Host publication information
Title of host publication: Pesticider i grundvand og drikkevand, ATV-komiteen vedrørende Grundvandsforurening, Hotel Marselis, 28. oktober
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source-ID: 171518
Microbial growth and clogging in sand column experiments simulating artificial recharge of groundwater

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Boe-Hansen, R., Henze, M., Mikkelsen, P. S.
Publication date: 1998

Host publication information
Place of publication: Rotterdam
Publisher: CRC Press/Balkema
ISBN (Print): 90-5809-017-5
Source: orbit

National Report Denmark

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Arvin, E., Albrechtsen, H., Bagh, L.
Pages: 105
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Water Supply
Volume: 16
Original language: English
Source: orbit

Naturlig nedbrydning af miljøfremmede stoffer i jord og grundvand. Litteraturstudium af 1.-ordens nedbrydningshastigheder af miljøfremmede stoffer for hvilke der er fastsatt et kvalitetskriterium i jord eller grundvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Kjærgaard, M., Ringsted, J., Albrechtsen, H., Bjerg, P.
Publication date: 1998

Publication information
Original language: Danish
Source: orbit

Regenwassernutzung für Wasserversorgung einzelner Haushalte? - Beispiel Dänemark

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Mikkelsen, P. S., Albrechtsen, H., Henze, M., Adeler, O. F.
Pages: 726-732
Publication date: 1998
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.
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.
Effects of biomass growth on the hydrodynamic properties of groundwater aquifers

General Information
Publication status: Published
Organisations: Department of Hydrodynamics and Water Resources, Department of Environmental Science and Engineering
Contributors: Holm, J., Engesgaard, P. K., Høgh Jensen, K., Henze, M., Albrechtsen, H.
Publication date: 1997

Host Publication Information
Title of host publication: EOS, vol. 78, no. 46
Source: orbit
Source-ID: 171923
Research output: Chapter in Book/Report/Conference proceeding – Annual report year: 1997 – Research

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

General Information
Publication status: 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
Original language: English
Source: orbit
Source-ID: 169643

Groundwater and drinking water. Research and development

General Information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Arvin, E., Albrechtsen, H.
Pages: 318 - 322
Publication date: 1997
Peer-reviewed: No

Publication Information
Journal: Water Supply
Volume: 65
Issue number: 6
Original language: English
Source: orbit
Source-ID: 169704
Research output: Contribution to journal – Journal article – Annual report year: 1997 – Research
Importance of sediment fines in laboratory studies on the degradation of organic chemicals in aquifers

General information
Publication status: 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
Original language: English
Source: orbit
Source-ID: 169637
Research output: Contribution to journal › Journal article – Annual report year: 1997 › Research › peer-review

Kan den sundhedsmæssige effekt af vandbesparelser måles

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Publication date: 1997

Host publication information
Title of host publication: Kan den sundhedsmæssige effekt af vandbesparelser måles
Place of publication: Copenhagen
Publisher: Miljøkontrollen et al.,
Source: orbit
Source-ID: 169717
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1997 › Research

Microbial processes in a leachate contaminated aquifer

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Ludvigsen, L., Albrechtsen, H., Bjerg, P. L., Christensen, T. H.
Publication date: 1997

Host publication information
Title of host publication: Proceedings of The Sixth International Landfill Symposium
Place of publication: Cagliari, Italy
Publisher: CISA, Environmental Sanitary Engineering Centre
Source: orbit
Source-ID: 169696
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1997 › Research › peer-review

Natural biological attenuation: integrative transition zones. Chapter 20

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

Host publication information
Pesticidforskningen under Det strategiske Miljøforskningsprogram

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Publication date: 1997

Host publication information
Title of host publication: Pesticidforskningen under Det strategiske Miljøforskningsprogram
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 169718
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1997 – Research

Rensning af drikkevand uundgåeligt

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Arvin, E.
Pages: 4 - 5
Publication date: 1997
Peer-reviewed: No

Publication information
Journal: Teknologidebat
Issue number: 6
Original language: Danish
Source: orbit
Source-ID: 169702
Research output: Contribution to journal – Journal article – Annual report year: 1997 – Research

Vandbehandling - og vandforsyning. Foredrag. Refereret

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H.
Publication date: 1997

Host publication information
Title of host publication: Vandbehandling - og vandforsyning. Foredrag. Refereret
Place of publication: Lyngby
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 169719
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1997 – Research

Biodegradation and bioremediation

General information
Biofilmdannelse i vandforsyningen

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Number of pages: 2
Publication date: 1996
Peer-reviewed: No
Event: Paper presented at IDA - miljømøde om biofilmproblemer i tekniske systemer, Denmark.

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

General information
Publication status: 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: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1996 › Research

Degradation of organic chemicals in landfills and their attenuation zones

General information
Publication status: 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: Contribution to conference › Paper – Annual report year: 1996 › Research


General information
Publication status: 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.
Pesticider og grundvand

Significance of biomass support particles in laboratory studies on microbial degradation of organic chemicals in aquifers

Bakteriologisk vækst i varmtvandsbeholdere
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.

In Situ and Laboratory Studies on the Fate of Specific Organic Compounds in an Anaerobic 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\textsuperscript{3−}-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\textsuperscript{3−}, 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
Publication status: 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

Publication information
Journal: Journal of Contaminant Hydrology
Volume: 20
ISSN (Print): 0169-7722
Original language: English
Source: orbit
Source-ID: 317686
Research output: Contribution to journal › Journal article – Annual report year: 1995 › Research › peer-review

Laboratory Evaluation of Biomass Support Particles for Microbial Degradation of Organic Chemicals in Water Treatment

General information
Publication status: 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.
Research output: Contribution to conference › Poster – Annual report year: 1995 › Research › peer-review

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 microbially 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(II) is not available for reduction.

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Heron, G., Christensen, T. H.
Pages: 233-248
Microbial Fe(III) Reduction - A Process Resulting in Transport of Iron in Aquifers

General information
Publication status: 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: orbit
Source-ID: 318934
Research output: Chapter in Book/Report/Conference proceeding – Conference abstract in proceedings – Annual report year: 1995 › Research › peer-review

Mikrobielle reoxprocesser

General information
Publication status: Published
Organisations: Department of Environmental Engineering
Contributors: Albrechtsen, H.
Number of pages: 10
Publication date: 1995
Peer-reviewed: No
Research output: Contribution to conference – Paper – Annual report year: 1995 › Research

Attenuation of Landfill Leachate Pollutants in Aquifers

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering
Contributors: Christensen, T. H., Kjeldsen, P., Albrechtsen, H., Heron, G., Nielsen, P. H., Bjerg, P. L., Holm, P. E.
Pages: 119-202
Publication date: 1994
Peer-reviewed: Yes

Publication information
Journal: Critical Reviews in Environmental Science & Technology
Volume: 24
Issue number: 2
ISSN (Print): 1064-3389
Original language: English
Source: orbit
Source-ID: 317448
Research output: Contribution to journal – Journal article – Annual report year: 1994 › Research › peer-review
Bacterial Degradation Under Iron-Reducing Conditions

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering
Contributors: Albrechtsen, H.
Number of pages: 496
Pages: 418-423
Publication date: 1994

**Host publication information**
Title of host publication: Hydrocarbon Bioremediation
Place of publication: USA
Publisher: Lewis Publishers
Editors: Institute, B. M., Hinchee, R. E., Alleman, B. C., Hoeppel, R. E., Miller, R. N.
ISBN (Print): 0873719840
Source: orbit
Source-ID: 317442
Research output: Chapter in Book/Report/Conference proceeding ➔ Book chapter – Annual report year: 1994 ➔ Research ➔ peer-review

Bakteriereduktion i rensningsanlæg

**General information**
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Technical University of Denmark
Contributors: Andersen, P., Pedersen, S., Henze, M., Albrechtsen, H.
Pages: 20-23
Publication date: 1994
Peer-reviewed: Yes

**Publication information**
Journal: Vand & Jord
Volume: 1
Issue number: 1
ISSN (Print): 0908-7761
Original language: Danish
Source: orbit
Source-ID: 317631
Research output: Contribution to journal ➔ Journal article – Annual report year: 1994 ➔ Research ➔ peer-review

Bakteriologisk vækst i varmtvandsbeholdere

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Science and Engineering, Danish Building Research Institute
Contributors: Bagh, L., Albrechtsen, H., Arvin, E.
Pages: 79-89
Publication date: 1994

**Host publication information**
Title of host publication: ATV Møde : Tema-Møde om Vandforsyningsteknik
Place of publication: Danmark
Publisher: Akademiet for de Tekniske Videnskaber, ATV
Source: orbit
Source-ID: 317159
Research output: Chapter in Book/Report/Conference proceeding ➔ Article in proceedings – Annual report year: 1994 ➔ Research ➔ peer-review

Distribution of Bacteria, Estimated by Viable Count Method, and Heterotrophic Activity in Different Size Fractions of Aquifer Sediment
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.

Groundwater microbiology and geochemistry
Landfill Leachate-Polluted Groundwater Evaluated as Substrate for Microbial Degradation Under Different Redox Conditions

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering, Residual Resource Engineering
Contributors: Albrechtsen, H., Lyngkilde, J., Grøn, C., Christensen, T. H.
Number of pages: 512
Pages: 371-378
Publication date: 1994

Host publication information
Title of host publication: Applied Biotechnology for Site Remediation
Place of publication: USA
Publisher: Lewis Publishers
ISBN (Print): 0-87371-982-4
Source: orbit
Source-ID: 317435


General information
Publication status: 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

Nedbrydning og sorption i kaalkaflejring

General information
Publication status: 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
Original language: Danish
Source: orbit
Source-ID: 317002
Relationships Between Aquifer Properties and Microbial Populations in the Borden Aquifer

Microbial numbers and activity were determined for 9 sediment cores 1.5 m in length collected from a shallow sandy aquifer at Canadian Forces Base, Borden, Ontario. Cores were extracted from a pristine Zone 0.5-1.0 m below the water table (1.5-3.0 m below the ground surface). Viable cell counts, electron transport system (ETS) activity, dissolved oxygen (DO), dissolved organic carbon (DOC), weight fraction of organic carbon (FOC), and hydraulic conductivity (K) were determined for contiguous samples of aquifer material removed at 10.0-cm intervals from the 9 cores. Viable cell counts (0-10-4 cfu/g aquifer material) and ETS activity, measured as the amount of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyltetrazolium chloride formazan (INT-for) produced (0-70 μg/g INT-for), were found to be greatest in the upper region of the aquifer (1.55-2.15 m below ground surface). Microbial occurrence and activities were found to be predominantly correlated with depth and dissolved oxygen. Evaluation of these results revealed an oxygen threshold level, occurring at approximately 3.0 mg/L, below which bacterial populations isolated in this study were less able to proliferate. Further evaluation of the microbiological and geologic data collected in this study suggests that, in conjunction with low dissolved oxygen, the naturally occurring carbon may be unsuitable to support large numbers of microorganisms. Similarly, an increase in the production of INT-for when aquifer material was amended with nitrogen suggests that the low microbial numbers and activity obtained in this study may be the result of nitrogen-limited conditions in this aquifer.

Vejen Landfill Site: In Situ Injection Studies in the Leachate Plume

Attenuation of Organic Leachate Pollutants in Groundwater
**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: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 1993
Research: peer-review

**Attenuation of Organic Pollutants in Redox Zones of Landfill Leachate Plumes**

General information
Publication status: 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: Chapter in Book/Report/Conference proceeding – Book chapter – Annual report year: 1993
Research: peer-review

**Bakterielt vækspotentiale i et varmtvandssystem**

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Urban Water Engineering, Department of Environmental Engineering
Contributors: Bagh, L. K., Albrechtsen, H., Arvin, E.
Pages: 528-534
Publication date: 1993
Peer-reviewed: Yes

**Publication information**
Journal: Vandteknik
Volume: 10
ISSN (Print): 0106-3677
Original language: Danish
Source: orbit
Source-ID: 315779
Research output: Contribution to journal – Journal article – Annual report year: 1993
Research: peer-review

**Grundvandets selvrensningsevne ved forurening fra lossepladser**

General information
Publication status: 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**
Microbial Activity and Degradation Processes in a Landfill Leachate Polluted Aquifer

**General information**
Publication status: 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: Chapter in Book/Report/Conference proceeding → Conference abstract in proceedings – Annual report year: 1993 → Research → peer-review

Substratwert von durch deponiesickerwasser verunreinigtem grundwasser für den mikrobiellen abbau unter verschiedenen redoxbedingungen

**General information**
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental 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: Chapter in Book/Report/Conference proceeding → Book chapter – Annual report year: 1993 → Research

The Degradation of Chlorinated Aliphatic Compounds in a Sanitary Landfill

**General information**
Publication status: 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: orbit
Source-ID: 314620
Research output: Chapter in Book/Report/Conference proceeding → Article in proceedings – Annual report year: 1993 → Research → peer-review
Verringerung von organischen schadstoffen in redoxzonen von deponiensickerwasserfahnen

General information
Publication status: 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
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: 314027

Bakterieantal i varmt brugsvand

General information
Publication status: Published
Organisations: Department of Environmental Science and Engineering, Urban Water Engineering, Department of Environmental Engineering
Contributors: Bagh, L. K., Albrechtsen, H., Arvin, E.
Pages: 84-87
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Vand og Miljø
Volume: 3
Original language: Danish
Source: orbit
Source-ID: 313097

Biodegradability of Dissolved Organic Carbon In Groundwater From An Unconfined Aquifer

General information
Publication status: Published
Organisations: Risø National Laboratory for Sustainable Energy, Urban Water Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering, Water Quality Institute, Denmark, Science Park Aarhus
Contributors: Grøn, C., Tørsløv, J., Albrechtsen, H., Jensen, H. M.
Pages: 241-251
Publication date: 1992
Peer-reviewed: Yes

Publication information
Journal: Science of the Total Environment
Volume: 117/118
ISSN (Print): 0048-9697
Original language: English
Source: orbit
Source-ID: 313141
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.
Microbial biomass and activity in subsurface sediments from Vejen, Denmark

Subsurface sediment samples were collected from 4 to 31 m below landsurface in glacio-fluvial sediments from the Quaternary period. The samples were described in terms of pH, electrical conductivity, chloride concentration, organic matter content, and grain size distribution. Viable counts of bacteria varied from 0.5 to 1,203 x 10^3 colony forming units/g (gdw); total numbers of bacteria acidine orange direct counts (AODC) varied from 1.7 to 147 x 10^7 cells/gdw; growth rates (incorporation of [3H]-thymidine) varied from 1.4 to 60.7 x 10^4 cells/(gdw · day); and rate constants for mineralization of 14C-labelled compounds varied from 0.2 to 2.3 x 10^-3 ml/(dpm · day) for acetate, and from 0 to 2.0 x 10^-3 ml/(dpm · day) for phenol. Sediment texture influenced the total number of bacteria and potential for mineralization; with increasing content of clay and silt and decreasing content of sand, AODC increased and the mineralization rate declined. Intrinsic permeability calculated from grain size correlated positively with mineralization rate for acetate. Statistical correlation analysis showed high correlations between some of the abiotic parameters, but it was not possible to point out a single abiotic parameter that could explain the variation of size and activity of the microbial population. The microbial data obtained in these geologically young sediments were compared to literature data from older sediments, and this comparison showed that age and type of geological formation might be important for the size and activity of the microbial populations.

Microbial Iron Reduction In a Landfill Leachate Polluted Aquifer

General information
Publication status: Published
Organisations: Urban Water Engineering, Department of Environmental Engineering, Department of Environmental Science and Engineering
Contributors: Albrechtsen, H., Lyngkilde, J.
Number of pages: 97
Pages: C1-6-4
Publication date: 1992

Host publication information
Title of host publication: Proceedings of Sixth International Symposium on Microbial Ecology (ISME-6)
Place of publication: Barcelona
Source: orbit
Source-ID: 313309
Research output: Chapter in Book/Report/Conference proceeding › Conference abstract in proceedings – Annual report year: 1992 › Research › peer-review

Grundvandzonens mikrobiologi: Undersøgelser ved Vejen losseplads
The use of ecocores to evaluate biodegradation in marine sediments
A laboratory sediment microcosm called the ecocore is described. It has been used to test the biodegradability of substances which predominantly enter the sediment. A new method for introducing hydrophobic test substances such as hydrocarbons to the test system is also described. In a series of tests using 14C-labelled hydrocarbons, it has been demonstrated that evolved and trapped 14C0₂ in all probability reflects the rates of mineralization of the test substance. The fate of the substances within the test system has been described and the total recovery exceeds 80%. The system shows good biological stability in longterm experiments.
Drinking water quality - effects of organic micropollutants  
Thomsen, A. H., PhD Student, Department of Environmental Engineering  
Albrechtsen, H., Main Supervisor  
01/05/2019 → 30/04/2022  
Project: PhD

Optimal and holistic implementation of central drinking water softening  
Tang, C., PhD Student, Department of Environmental Engineering  
Albrechtsen, H., Main Supervisor  
Rygaard, M., Supervisor  
Wormslev, E. C., Supervisor  
Samfinansierede - Virksomhed  
01/12/2016 → 29/04/2020  
Award relations: Optimal and holistic implementation of central drinking water softening  
Project: PhD

Pesticiders nedbrydning i umættet zone og i grundvandszonen  
Janniche, G. S., PhD Student, Department of Environmental Engineering  
Albrechtsen, H., Main Supervisor  
Bjerg, P. L., Examiner  
Eisner, M., Examiner  
Aamand, J., Examiner  
DTU, Samfinansiering  
01/01/2005 → 26/05/2010  
Award relations: Pesticiders nedbrydning i umættet zone og i grundvandszonen  
Project: PhD

ATP-målinger til monitering af mikrobiel drikkevandskvalitet  
Vang, Ó. K., PhD Student, Department of Environmental Engineering  
Albrechtsen, H., Main Supervisor  
Smith, C., Supervisor  
Lützhøft, H. H., Examiner  
Boe-Hansen, R., Examiner  
Hammes, F., Examiner  
DTU, Samfinansiering  
01/06/2008 → 27/11/2013  
Award relations: ATP-målinger til monitering af mikrobiel drikkevandskvalitet  
Project: PhD

Eftervækstpotentiale for polymere materialer i drikkevand  
Corfitzen, C. B., PhD Student, Department of Environmental Engineering  
Albrechtsen, H., Main Supervisor  
Arvin, E., Supervisor  
Schmidt, J. E., Examiner  
Miettinen, I. T., Examiner  
Roslev, P., Examiner  
Eksternt EU-finansieret  
01/11/2001 → 01/11/2004  
Award relations: Eftervækstpotentiale for polymere materialer i drikkevand  
Project: PhD

Afværgeteknologier for grundvand forurenet med pesticider fra punktkilder  
Tuxen, N., PhD Student, Department of Environmental Engineering  
Bjerg, P. L., Main Supervisor  
Albrechtsen, H., Supervisor  
Arvin, E., Examiner  
Helweg, A., Examiner  
Schirmer, M., Examiner  
DTU-lønnet stipendie  
01/02/1999 → 02/10/2002  
Award relations: Afværgeteknologier for grundvand forurenet med pesticider fra punktkilder  
Project: PhD
Proceskinetik og mekanismer for bionedbrydning af kemikalier i naturlige systemer ved miljørølevante koncentrationer
Toräng, L., PhD Student, Department of Environmental Engineering
Nyholm, N., Main Supervisor
Albrechtsen, H., Supervisor
Bjerg, P. L., Examiner
Boethling, R., Examiner
Madsen, T. O., Examiner
DTU-lønnet stipendie
01/09/1998 → 26/03/2004
Award relations: Proceskinetik og mekanismer for bionedbrydning af kemikalier i naturlige systemer ved miljørølevante koncentrationer
Project: PhD

Mikrobiel vækst i drikkevandsdistributionssystemer
Boe-Hansen, R., PhD Student, Department of Environmental Engineering
Arvin, E., Main Supervisor
Albrechtsen, H., Supervisor
Hentze, M., Examiner
Block, J., Examiner
Grüttner, H., Examiner
Jørgensen, C., Supervisor
Erhvervsforskerordningen
01/10/1997 → 02/11/2001
Award relations: Mikrobiel vækst i drikkevandsdistributionssystemer
Project: PhD

Microbial community evolution models for describing the degradation of chlorinated solvents
Murray, A. M., PhD Student, Department of Environmental Engineering
Broholm, M. M., Main Supervisor
Broholm, M. M., Supervisor, Department of Environmental Engineering
Rolle, M., Supervisor
Holliger, C., Supervisor
Albrechtsen, H., Examiner
Nijenhuis, I., Examiner
Jakobsen, R., Examiner
Technical University of Denmark
01/09/2015 → 20/04/2019
Award relations: Microbial community evolution models for describing the degradation of chlorinated solvents
Project: PhD

Swimming pool disinfection by-products
Cheema, W. A., PhD Student, Department of Environmental Engineering
Andersen, H. R., Main Supervisor
Kaarsholm, K. M. S., Supervisor
Albrechtsen, H., Examiner
Chowdhury, S., Examiner
Uhl, W., Examiner
Privatist
15/10/2014 → 30/08/2017
Award relations: Swimming pool disinfection by-products
Project: PhD

Chemical disinfection of combined sewer overflow (CSO) water
Chhetri, R. K., PhD Student, Department of Environmental Engineering
Andersen, H. R., Main Supervisor
Albrechtsen, H., Supervisor
Mikkelsen, P. S., Examiner
Stasinakis, A., Examiner
Dalsgaard, A., Examiner
Technical University of Denmark
01/10/2014 → 20/12/2017
Award relations: Chemical disinfection of combined sewer overflow (CSO) water
Project: PhD

Biofilm architecture vs composition attenuates pathogen invasion
Kinnunen, M., PhD Student, Department of Environmental Engineering
Smets, B. F., Main Supervisor
Albrechtsen, H., Supervisor
Dechesne, A., Supervisor
Trapp, S., Examiner
Burmølle, M., Examiner
Curtis, T. P., Examiner
Marie Curie (EU-stipendium)
01/06/2014 → 05/12/2017
Award relations: Biofilm architecture vs composition attenuates pathogen invasion
Project: PhD

Effect of niche dimensionality on nitrifier community diversity
Diwan, V., PhD Student, Department of Environmental Engineering
Dechesne, A., Main Supervisor
Albrechtsen, H., Supervisor
Smets, B. F., Supervisor
Fotidis, I., Examiner
Nicolaisen, M. H., Examiner
Paul, C., Examiner
15/01/2014 → 14/01/2017
Project: PhD

Vandkvalitet i varmtvandsinstallationer
Bagh, L. K., PhD Student, Department of Environmental Engineering
Arvin, E., Main Supervisor
Albrechtsen, H., Supervisor
Struwe, S., Examiner
Forskerakademiets Samfinansier
01/03/1993 → 06/01/1998
Award relations: Vandkvalitet i varmtvandsinstallationer
Project: PhD

Redox Processes at the Seawater/Freshwater Interface in an Anaerobic Aquifer
Iversen, V. M. N., PhD Student, Department of Environmental Engineering
Jakobsen, R., Main Supervisor
Albrechtsen, H., Examiner
Thamdrup, B., Examiner
Van Capellen, P., Examiner
Blandet Finansiering - SU
01/04/1998 → 15/10/2003
Award relations: Redox Processes at the Seawater/Freshwater Interface in an Anaerobic Aquifer
Project: PhD

The Microbial Gene Pool and Gene Transfer in Agricultural Soils: Effects on Pesticide Biodegradation
Musovic, S., PhD Student, Department of Environmental Engineering
Smets, B. F., Main Supervisor
Albrechtsen, H., Examiner
Simonet, P., Examiner
Smalla, K., Examiner
Sørensen, J., Supervisor
Offentlig finansiering
01/01/2007 → 21/04/2010
Award relations: The Microbial Gene Pool and Gene Transfer in Agricultural Soils: Effects on Pesticide Biodegradation
Project: PhD
Afgivelse af organiske stoffer fra drikkevandsledninger af plast
Denberg, M., PhD Student
Arvin, E., Main Supervisor
Hassager, O., Supervisor
Mosbæk, H., Supervisor
Albrechtsen, H., Examiner
Flemming, H., Examiner
Karlisson, S., Examiner
Forskningsrådsfinansiering
01/04/2005 → 11/02/2009
Award relations: Afgivelse af organiske stoffer fra drikkevandsledninger af plast
Project: PhD

Development of an immunological biochip assay for the analysis of pesticides in groundwater and water supply systems
Belleville, E., PhD Student, Department of Micro- and Nanotechnology
Christensen, C. B. V., Main Supervisor
Petersen, J. W., Supervisor
Telleman, P., Supervisor
Albrechtsen, H., Examiner
Joos, T. O., Examiner
Koch, C., Examiner
Forskningsrådsfinansiering
01/03/2000 → 19/09/2003
Award relations: Development of an immunological biochip assay for the analysis of pesticides in groundwater and water supply systems
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
Centerfinansieret
01/10/1993 → 21/10/1997
Award relations: Mikrobiel aktivitet i lossepladsforurenet grundvand.
Project: PhD

Optimization of Filters for Water Treatment by Development of new Diagnostic Tools
Lopato, L. R., PhD Student, Department of Environmental Engineering
Arvin, E., Main Supervisor
Binning, P. J., Supervisor
Albrechtsen, H., Examiner
Gimbel, R., Examiner
Grützmacher, G., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/11/2007 → 24/08/2011
Award relations: Optimization of Filters for Water Treatment by Development of new Diagnostic Tools
Project: PhD

The Connection between Residence Time and Water Quality in Water Distribution Networks - Effects of Small animals
Christensen, S. C. B., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Arvin, E., Supervisor
Experimental and numerical investigations of changes in flow and solute transport processes in porous media affected by bioclogging
Seifert, D., PhD Student
Jakobsen, R., Main Supervisor
Engesgaard, P. K., Supervisor
Albrechtsen, H., Examiner
Brun, A., Examiner
Valocchi, A. J., Examiner
DTU-lønnet stipendie
01/09/2000 → 12/07/2005
Award relations: Experimental and numerical investigations of changes in flow and solute transport processes in porous media affected by bioclogging
Project: PhD

Livscyklus- og risikoanalyse af alternative teknologier og ressourcer til drikkevandsforsyningen
Godskesen, B., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Hauschild, M. Z., Supervisor
Rygaard, M., Supervisor
Zambrano, K. C., Supervisor
Astrup, T., Examiner
Lindgaard-Jørgensen, P., Examiner
Lundie, S., Examiner
ErhvervsPhD-ordningen VTU
01/05/2009 → 06/02/2013
Award relations: Livscyklus- og risikoanalyse af alternative teknologier og ressourcer til drikkevandsforsyningen
Project: PhD

Resistance to gene flow in soil microbial communities
Klümper, U., PhD Student, Department of Environmental Engineering
Smets, B. F., Main Supervisor
Dechesne, A., Supervisor
Albrechtsen, H., Examiner
Rensing, C., Examiner
Graham, D. W., Examiner
Technical University of Denmark
15/12/2011 → 02/09/2015
Award relations: Resistance to gene flow in soil microbial communities
Project: PhD

Mikrobiel nedbrydning efter dampoprensning af forventet jord og grundvand
Friis, A. K., PhD Student, Department of Environmental Engineering
Bjerg, P. L., Main Supervisor
Albrechtsen, H., Supervisor
Udell, K. S., Supervisor
Christensen, T. H., Examiner
Suhr Jacobsen, C., Examiner
Major, D. W., Examiner
DTU-lønnet stipendie
01/02/2003 → 31/03/2006
Award relations: Mikrobiel nedbrydning efter dampoprensning af forventet jord og grundvand
Project: PhD
Detection and Quantification of Subsurface Pesticide Degrading Microbial Populations
Lindberg, I. E., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Schmidt, J. E., Supervisor
Bjerg, P. L., Examiner
Martin-Laurent, F., Examiner
Nybroe, O., Examiner
DTU-lønnet stipendie
01/02/2003 → 16/04/2007
Award relations: Detection and Quantification of Subsurface Pesticide Degrading Microbial Populations
Project: PhD

Characterization of a Drinking Water Biofilm
Martiny, A. C., PhD Student, Department of Systems Biology
Molin, S., Main Supervisor
Albrechtsen, H., Supervisor
Arvin, E., Supervisor
Westermann, P., Examiner
Halkjaer Nielsen, P., Examiner
Wuertz, S., Examiner
DTU-lønnet stipendie
01/02/2000 → 19/09/2003
Award relations: Characterization of a Drinking Water Biofilm
Project: PhD

Occurrence and degradation of contaminants at the groundwater surface water interface
Brauns, B., PhD Student, Department of Environmental Engineering
Bjerg, P. L., Main Supervisor
Jakobsen, R., Supervisor
Song, X., Supervisor
Albrechtsen, H., Examiner
Holm, P. E., Examiner
Liu, S., Examiner
Technical University of Denmark
15/12/2011 → 29/02/2016
Award relations: Occurrence and degradation of contaminants at the groundwater surface water interface
Project: PhD

Attenuation of landfill leachate pollutants at a groundwater - surface water interface
Milosevic, N., PhD Student, Department of Environmental Engineering
Bjerg, P. L., Main Supervisor
Albrechtsen, H., Supervisor
Kjeldsen, P., Examiner
Rivett, M. O., Examiner
Tuxen, N., Examiner
Marie Curie (EU-stipendium)
01/04/2009 → 22/08/2012
Award relations: Attenuation of landfill leachate pollutants at a groundwater - surface water interface
Project: PhD

Enhanced degradation of pesticides in transition zones around water abstraction fields
Levi, S., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Bjerg, P. L., Supervisor
Dechesne, A., Examiner
Springael, D., Examiner
Aamand, J., Examiner
Marie Curie (EU-stipendium)
15/08/2009 → 30/09/2013
Award relations: Enhanced degradation of pesticides in transition zones around water abstraction fields
Project: PhD
Unravelling the microbiological limitations for degradation of low pesticide concentrations in aquifers

Gozdereliler, E., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Jakobsen, R., Examiner
Springael, D., Examiner
Aamand, J., Supervisor
Ansat eksternt
01/05/2009 → 30/09/2012
Award relations: Unravelling the microbiological limitations for degradation of low pesticide concentrations in aquifers
Project: PhD

The role of spatial heterogeneity as a limiting factor for pesticide biodegradation in contaminated aquifers

Pazarbasi, M. B., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Aamand, J., Supervisor
Dechesne, A., Examiner
Martin-Laurent, F., Examiner
Aamand, J., Supervisor
Nybroe, O., Examiner
Ansat eksternt
01/05/2009 → 27/03/2013
Award relations: The role of spatial heterogeneity as a limiting factor for pesticide biodegradation in contaminated aquifers
Project: PhD

Controlling factors for nitrification in biological rapid sand filters for drinking water treatment

Wagner, F. B., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Boe-Hansen, R., Supervisor
Jensen, M. M., Examiner
Roslev, P., Examiner
van der Wielen, P. W. J. J., Examiner
Samfinansieret - Andet
15/11/2013 → 25/10/2017
Award relations: Controlling factors for nitrification in biological rapid sand filters for drinking water treatment
Project: PhD

Microbiological risk assessment of urban water. Development of methods for detection and analysis of pathogens with Legionella as model organism

Krejgaard, L. H., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Krogfelt, K. A., Supervisor
Uldum, S., Supervisor
Arvin, E., Examiner
Ricci, M. L., Examiner
Roslev, P., Examiner
1/3 DTU-stip, 2/3 FUR/andet
15/04/2008 → 21/09/2011
Award relations: Microbiological risk assessment of urban water. Development of methods for detection and analysis of pathogens with Legionella as model organism
Project: PhD

Development of modelling tools to assess design and performance of bioremediation of chlorinated ethenes in low permeable geologic media

Chambon, J. C. C., PhD Student, Department of Environmental Engineering
Binning, P. J., Main Supervisor
Bjerg, P. L., Supervisor
Albrechtsen, H., Examiner
Barry, D. A., Examiner
Molson, J. W., Examiner
DTU-lønnet stipendie
01/07/2008 → 22/08/2012
Award relations: Development of modelling tools to assess design and performance of bioremediation of chlorinated ethenes in low permeable geologic media
Project: PhD

Microbial degradation of pesticides in rapid sandfilters in water supply - Process understanding
Hedegaard, M. J., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Boe-Hansen, R., Supervisor
Bjerg, P. L., Examiner
Nybroe, O., Examiner
Bjoorn, N., Examiner
Technical University of Denmark
01/05/2013 → 21/03/2018
Award relations: Microbial degradation of pesticides in rapid sandfilters in water supply - Process understanding
Project: PhD

Strategies for chemical healthy public swimming pools
Kaarsholm, K. M. S., PhD Student, Department of Environmental Engineering
Andersen, H. R., Main Supervisor
Albrechtsen, H., Supervisor
Møsbæk, H., Supervisor
Lützhøft, H. H., Examiner
Grønborg, O., Examiner
Technical University of Denmark
01/01/2009 → 27/03/2013
Award relations: Strategies for chemical healthy public swimming pools
Project: PhD

Microbial Ecological Investigation of Rapid Sand Filtration
Gülay, A., PhD Student, Department of Environmental Engineering
Smets, B. F., Main Supervisor
Albrechtsen, H., Supervisor
Bælum, J., Examiner
Schramm, A., Examiner
Sloan, W. T., Examiner
Technical University of Denmark
01/01/2011 → 05/11/2014
Award relations: Microbial Ecological Investigation of Rapid Sand Filtration
Project: PhD

Model-based analysis and optimization of biological rapid sand filters at pilot and full scale
Lee, C. O., PhD Student, Department of Environmental Engineering
Binning, P. J., Main Supervisor
Albrechtsen, H., Supervisor
Boe-Hansen, R., Supervisor
Smets, B. F., Supervisor
Plósz, B. G., Examiner
Rietveld, L. C., Examiner
Roslev, P., Examiner
Technical University of Denmark
01/01/2011 → 05/11/2014
Award relations: Model-based analysis and optimization of biological rapid sand filters at pilot and full scale
Project: PhD

Nitrification in rapid sand filters-process understanding and removal of organic micropolutants
Tatari, K., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Nielsen, P. B., Supervisor
Smets, B. F., Supervisor
Andersen, H. R., Examiner
Pettersson, T., Examiner
Uhl, W., Examiner
Technical University of Denmark
01/09/2010 → 02/04/2014
Award relations: Nitrification in rapid sand filters-process understanding and removal of organic micropollutants
Project: PhD

Quantitative health and microbial risk assessment for public warning during flood
Andersen, S. T., PhD Student, Department of Environmental Engineering
Albrechtsen, H., Main Supervisor
Helwigh, O. M., Supervisor
Mikkelsen, P. S., Examiner
Djordjevic, S., Examiner
Ethelberg, S., Examiner
Technical University of Denmark
01/01/2010 → 01/04/2015
Award relations: Quantitative health and microbial risk assessment for public warning during flood
Project: PhD

Determining the impact of point sources of contamination on groundwater based drinking water resources
Malaguerra, F., PhD Student, Department of Environmental Engineering
Binning, P. J., Main Supervisor
Albrechtsen, H., Supervisor
Bauer-Gottwein, P., Examiner
Kjaer, J., Examiner
van Breukelen, B., Examiner
DTU, Samfinansiering
15/06/2008 → 21/09/2011
Award relations: Determining the impact of point sources of contamination on groundwater based drinking water resources
Project: PhD

Rensning af drikkevand
Christensen, S. C. B., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Andersen, H. R., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Refstrup, M., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering
15/09/2013 → 30/04/2014
Project: Research

Microbial water quality in clean water tanks following inspection and cleaning
Christensen, S. C. B., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering
01/03/2013 → 30/09/2013
Collaborators: VandCenter Syd A/S
Project: Research

Assessment of the drinking water quality sensor prototype "Zebra"
Christensen, S. C. B., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Vang, O. K., Project Participant
Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering
01/12/2013 → 31/07/2014
Collaborators: Grundfos DK AS
Project: Research

ATES: Ressourceeffektivisering af anlæg til opvarmning og/eller køling af bygninger mv. med brug af grundvand
Christensen, S. C. B., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Tønder, M. M., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering
01/06/2014 → 30/06/2015
Collaborators: Enopsol, Krüger Veolia Water Technologies
Project: Research
**Aquavalens: Aquavalens: Protecting the health of Europeans by improving methods for the detection of pathogens in drinking water and water used in food preparation**

New research approaches are needed to enable rapid determination of the pathogen load of European drinking water sources and supply systems used for food processing and preparation, human consumption and drinking. The new approaches should be based on molecular methods and complement the current time-consuming microbiological techniques, which are based on the cultivation of indicator bacteria. Highly standardised methods are essential, validated with certified molecular reference material. The approaches will need to address the issue of inhibition of molecular methods and assess the significance of any positive detection. The combination of molecular techniques with electronic sensors will also be investigated. The new techniques will result in detailed insight into the pathogen load, the hygienic quality and the specific microbial strains (viruses, bacteria, protozoa) responsible for outbreaks of waterborne infections. They will lead to better understanding of the sources, infectivity and virulence of these strains. The efficacy of the new techniques has to be demonstrated. **AQUAVALENS** is centred on the concept of developing suitable platforms that harness the advances in new molecular techniques to permit the routine detection of waterborne pathogens and improve the provision of hygienically safe water for drinking and food production that is appropriate for large and small systems throughout Europe. Whilst in recent years there has been considerable developments, especially in molecular technology, very few systems are available that meet the needs of water providers. Consequently, and unless it proves essential, rather than necessarily develop new technologies, the key focus will be to adopt and, where appropriate, adapt existing technologies to develop these detection systems.

Schultz, A. C., Project Manager, National Food Institute, Division of Food Microbiology
Bang-Berthelsen, I., Project Participant, National Food Institute, Division of Food Microbiology
Idrizi, R., Project Participant, National Food Institute, Division of Food Microbiology
Bang, D. D., Project Participant, National Food Institute, Division of Food Microbiology
Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering

01/03/2013 → 28/02/2017

**Collaborators:** Swedish University of Agricultural Sciences, University of Surrey, Vienna University of Technology, Public Health Wales National Health Service Trust, Moredun Research Institute, Helmholtz-Zentrum für Infektionsforschung, Heriot-Watt University, University of East Anglia, Medical University of Vienna, Universidade Rovira i Virgili, Technologiezentrum Wasser Karlsruhe (DVGW), University of Helsinki, University of Genoa, University of Belgrade, University of Iceland, National Food Agency, University of Barcelona, Instituto Superior Técnico

**Project:** Research

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**sundhedseffekter - caries: Redegørelse om sundhedseffekter af blødgøring spicialt med fokus på caries**

Delpædag og rammeafsat: Fremtidens vandhåndtering i storbyer.

En række studier har påvist væsentlige fordele ved at sænke hårdheden af drikkevand leveret til København og omegn. Fordele er også påvist i andre land omkring Danmark, hvor vandforsyningen er baseret på relativt hårdt vand. København Energi overvejer at indføre blødgøring af drikkevand. Et studie har vist en signifikant korrelation mellem flourid- og calciumkonzentrationerne i dansk drikkevand og forekomsten af caries (Bruvo et al. 2008). Ved blødgøring ændres calcium koncentrationen i drikkevandet og det er derfor nødvendigt at få afklaret hvilken betydning det forventes at have for sundhedstilstande hos forbrugerne. Dette projekt har som formål at:

- at redgøre for betydningen af Bruvo et al (2008) resultater i forhold til et konkret forslag om blødgøring i København, Herunder:
  - forklare enheden D;F-S og præsentere viden om DMF-S niveauer i landene omkring Danmark
  - diskutere betydningen af en ændring af DMF-S niveauet for den enkelte forbruger
  - diskutere spesifikt drikkevandets calciumindhold og eventuel kombinationseffekt af calcium og flourid i forhold til tandhygiejenen
  - indhente erfaringer og betragtninger om calciums rolle fra tandlæger og fra internationale erfaringer med ændring af drikkevandskvalitet
- redgøre kort for andre betydende sundhedsseffekter af blødgøring, herunder børneeksem og knogleskærd

Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering

Rygaard, M., Project Manager, Department of Environmental Engineering

Utendt: DKK0.00

15/10/2011 → 01/02/2012

**Award relations:** Redegørelse om sundhedseffekter af blødgøring spicialt med fokus på caries

**Project:** Research

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**terminologi: Vandkvalitet og terminologi for alternativ vandforsyning; Rammeafsat: Fremtidens vandhåndtering i storbyer**

Delpædag og rammeafsat: Fremtidens vandhåndtering i storbyer.

Dette projekt har følgende formål:

1) Etablering af ordborg/terminologi for elementerne i vandkresløbet.
2) Beskrivelse af kvalitetskrav og karakteristika for vandtyper til forskellig brug
3) Etablering af forslag til ramme for vandkvalitetskriterier, der åbn forelægges myndighederne.

Albrechtsen, H., Project Participant, Department of Environmental Engineering, Urban Water Engineering

Rygaard, M., Project Manager, Department of Environmental Engineering

Utendt: DKK0.00

01/10/2011 → 30/03/2012
**MoreDesiCSO: Forbedret Rensning Og Desinfektion af Overløbsvand (FRODO)**

De nye vandplaner vil medføre skærpede krav til mængde og kvalitet af overløbsvand, og behandlingsmetoderne skal forbedres. Behandling af overløbsvand er et økonomisk attraktivt alternativ til store forsinkelsesbassiner, f.eks. i tætbebyggede havnemiljøer. Der er i tidligere projekter undersøgt muligheder for at rense overløbsvand (LOTwater-projektet), men de undersøgte teknologier sikrer ikke overholdelse af mikrobiologiske krav til badevand. Projektet vil derfor fokusere på forskellige kombinationsmuligheder, der kan rense fordyndet råspildevand til en kvalitet, således at badevandskravene kan holdes. De mulige kombinationer der kan blive tale om er fældning, filtrering, UV-behandling, kemisk desinfektion.

I et innovationsprojekt under Vand i Byer vil DTU-miljø undersøge flere mulige kemikalier til desinfektion med hensyn til produktion, effektivitet og henfald. I dette projekt afprøves de mest velegnede kandidater i større skala dels i København (fx på anlægget på Scherfigsvej) og dels på en række andre overløb i andre forsyninger i Øresundsregionen. Effekten på badevandskvaliteten af de enkelte tiltag evalueres og kvantificeres gennem en modelanalyse for Københavns havn og/eller Øresundsregionen.

Endeligt vurderes løsningens samlede bæredygtighed mod hinanden.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering
Andersen, H. R., Project Manager, Department of Environmental Engineering

Ukendt: DKK0.00
30/01/2012 → 30/01/2014
**Award relations: Forbedret Rensning Og Desinfektion af Overløbsvand (FRODO)**
**Project: Research**

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**DesiCSO: Chemical options for desinfection of combined sewer overflows**

(Kemisk desinfektion af kloakoverløb)

Eriksson, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering
Andersen, H. R., Project Manager, Department of Environmental Engineering
Sharma, A. K., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Chhetri, R. K., Project Participant, Department of Environmental Engineering, Urban Water Engineering

Project ID: 30879
Ukendt: DKK0.00
01/07/2011 → 31/12/2012
**Award relations: Chemical options for desinfection of combined sewer overflows**
**Project: Research**

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**RiskStyr-VF: From surveillance to risk management – Risk management in the water supply**

The goal of the project is to develop and implement risk management as part of the climate change adaptation strategy in the water supply.

Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Ambjerg-Nielsen, K., Project Participant, Department of Environmental Engineering
Larsen, S. L., Project Participant, Department of Systems Biology, Department of Environmental Engineering, Urban Water Engineering
Rygaard, M., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Christensen, S. C. B., Project Participant, Department of Environmental Engineering, Urban Water Engineering

Project ID: 30850
Ukendt: DKK1,150,000.00
01/01/2011 → 31/12/2013
**Award relations: From surveillance to risk management – Risk management in the water supply**
**Project: Research**

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**FVS: Future water management in big cities**

Large cities (>200 000 inhabitants) are facing a range of challenges in managing the urban water cycle. Climate change, EU Water Framework Directive, over-exploited groundwater resources and pollution makes it increasingly difficult to manage the urban water infrastructure development. This collaboration is a framework for the development of tools and methods for enlightened decision making in urban water management.
REDD: Resins for disinfection of drinking water
SafeWater APS develops new surfaces for disinfection of drinking water. The project will develop protocols for test and documentation of effects of new surfaces at three levels. Test protocols will be used to investigate surfaces in the development process.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Rygaard, M., Project Participant, Department of Environmental Engineering
Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Project ID: 30811
01/01/2011 → 31/12/2015
Award relations: Future water management in big cities
Project: Research

1113: Innovation network for environmental Technology (Innovationsnetværk på miljøteknologi)
Innovationsnetværket for Miljøteknologi skal være det oplagte forum for netværkets medlemmer og cleantech-branchen, når den tager initiativ til at igangsætte teknologi- og udviklingsprojekter der kræver supplerende, tværgående kompetencer og nye samarbejdspartnere, uanset om medlemmernes forretningsområde og kernekompetencer primært er på luft-, vand-, jord- eller affaldsområdet.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Participant, Department of Environmental Engineering
Andersen, H. R., Project Manager, Department of Environmental Engineering
Arnbjerg-Nielsen, K., Project Participant, Department of Environmental Engineering
Project ID: 30856
01/07/2010 → 01/07/2014
Award relations: Innovation network for environmental Technology (Innovationsnetværk på miljøteknologi)
Project: Research

1073: Future climate change technologies
An assessment of emerging and future climate change technologies is needed that focus on national needs and possibilities for export of Danish technologies and services.

Eriksson, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Binning, P. J., Project Participant, Department of Environmental Engineering
Andersen, H. R., Project Participant, Department of Environmental Engineering
Rygaard, M., Project Participant, Department of Environmental Engineering
Arnbjerg-Nielsen, K., Project Manager, Department of Environmental Engineering
Sharma, A. K., Project Participant, Department of Environmental Engineering, Urban Water Engineering
Project ID: 30746
01/12/2009 → 01/07/2010
Award relations: Future climate change technologies
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 an 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 competences 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

01/10/2009 → 30/09/2013
Award relations: Sustainable Environmental Technology. Application for 5 fellowships
Project: Research

946: Flow cytometer and UV-laser for Confocal Laser Scanning Microscope
The Flow cytometer will increase our options in cell quantification and the UV-laser for the Confocal Laser Scanning Microscope will enhance our possibilities in terms of direct observations of methanogens and of using tags and labels excited by UV-light

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Jakobsen, R., Project Participant, Department of Environmental Engineering
Angelidaki, I., Project Participant, Department of Environmental Engineering
Smets, B. F., Project Manager, Department of Environmental Engineering
Dechesne, A., Project Participant, Department of Environmental Engineering

02/03/2009 → 31/12/2009
Award relations: Flow cytometer and UV-laser for Confocal Laser Scanning Microscope
Project: Research

DW BIOFILTERS: Sustainable drinking water treatment biological filters
The project will cover a range of compounds and biological filter activities, but regarding the bulk compounds emphasis will be on ammonium removal (nitrification) and iron/manganese removal. Regarding organic micropollutants the activities will focus on pesticides (MCPP, BAM and Isoproturon as model compounds) and pharmaceuticals (with synthetic estrogen 17α-ethinylestradiol (EE2) as model compound). See section 6 in Project description, App D.

Arvin, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Smets, B. F., Project Participant, Department of Environmental Engineering

Project ID: 30766
Ukendt: DKK9,524,000.00
01/01/2010 → 31/12/2013
Award relations: Sustainable drinking water treatment biological filters
Project: Research

Afsaltning-A5: Egen vandressource projekt 5: Helhedsorienteret analyse af vandforsyningssalternativer - afsaltning
Indsamling af erfaring vedrørende afsaltning i vandforsyning og etablering af vandforsyningsscenarier baseret på afsaltet havvand samt analyse af nødvendigt beslutningsgrundlag for indførelse af sådanne teknologier.

Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Binning, P. J., Project Participant, Department of Environmental Engineering
Rygaard, M., Project Participant, Department of Environmental Engineering

Project ID: 30670
Ukendt: DKK562,359.00
25/02/2009 → 31/08/2009
Award relations: Egen vandressource projekt 5: Helhedsorienteret analyse af vandforsyningssalternativer - afsaltning
Project: Research

UVOV: Investigation of the effect of UV treatment on the microbial quality in Odense Waters distribution system – Phase 2
The project will investigate the effect on the microbial drinking water quality of applying UV treatment with medium pressure lamps within the distribution system. A range of chemical and microbial water quality parameters will be analysed over a one year period and compared to base line levels measured over a 3-year period prior to the implementation.
OKDK: On-line continuous monitoring of drinking water quality
To increase the safety for good drinking water, quality parameters should be monitored with a higher frequency than today’s spot checks. This project will investigate the possibilities for online, continuous and real-time monitoring by:
• Investigating the suitability of different on-line sensors e.g. turbidity, conductivity, flow, pressure or temperature to ensure good drinking water quality based on long-term time series.
• Improving the interpretation of the signal from on-line sensors by identifying the source causing the signal.
• Comparing and evaluate sensors with the goal to select the best suited sensors.
• Investigating to what degree a signal represents a significant change in the drinking water quality by introduces changes to the system in connection with intensive measuring campaigns including a large range of parameters.
• Combining measuring campaigns with newly developed equipment for on-line ATP-measurement.

UV-Gentofte: UV treatments effect on aftergrowth potential
Litterature studie on UV treatments effect on aftergrowth potential in drinking water distribution system in relation to Gentofte water supply

Vandportal: National climate change adaptation webportal, input on Water
Levering af input til klimatilpasningsportalen om emnet Vand på vegne af Miljøministeriet, By- og Landskabsstyrelsen

MiReSoWa: Microbial Remediation of Contaminated Soil and Water Resources
This project aims at developing new biotechnologies for remediation of pesticide-polluted soil and water resources. Bioaugmentation technology is the introduction of specific degradative micro-organisms to treat contaminated soil or water. In this project, new bioaugmentation technologies will be developed taking advantage of novel strategies for isolation of specific microorganisms with specialized degradation capabilities. Until now, research on contaminant degradation has focused on the role of bacteria, but in this project the potential of fungi will also be studied to explore the possibility of using fungal-bacterial consortia for bioaugmentation. To prevent predation by protozoa and to secure optimal conditions for degradation, selected strains or consortia will be immobi-lized on specifically designed carriers. The developed bioaugmentation technologies will be evaluated at the field-scale 1) for remediation of pesticide-polluted soil to prevent leaching of the com-pounds to underlying aquifers, 2) for treatment of pesticide-polluted drinking water in sand filters at waterworks and 3) in reactive barriers protecting drinking water wells by degrading pesticides be-fore they enter the waterworks.
The project will bring together a consortium of national and foreign research institutions, waterworks, private companies
udvikle, definere og beskrive en prøvetagningsmetode, der er repræsentativ for et ugentligt gennemsnit af det vand, som prøvetagningsmetode. For at opnå dette, er formålet med dette projekt, at forurening af det vand, der er kvalitetskravet i Drikkevandsbekendtgørelsen angivet som en beregnet gennemsnitsværdi.

Drikkevandskvaliteten, der stilles til rådighed for forbrugerne, skal kunne måles ved forbrugers taphane. For uorganiske sporstoffer - metaller - er kvalitetskravet i Drikkevandsbekendtgørelsen angivet som en beregnet gennemsnitsværdi.

For at sikre en sikker og repræsentativ måling af de uorganiske sporstoffer – metaller – er der behov for en velbeskrevet prøvetagningsmetode. For at sikre, at prøvetagningsmetoden er i overensstemmelse med de metoder, der udvikles inden for EU (Drikkevandsdirektivet), er det vigtigt, at prøvetagningsmetoden er klar til at anvende i den internationale samarbejdssammenhæng.

Drikkevandspolitikken i EU og de nationale drikkevandsbeslutninger er i øjeblikket under forbedringsomgivelser. Dette projekt har som mål at bidrage til udviklingen af en præcist og effektiv prøvetagningsmetode, der kan tilpasses de forskellige omgivelser, hvor drikkevandet tages.

For at sikre en sikker og repræsentativ måling af de uorganiske sporstoffer – metaller – er kvalitetskravet i Drikkevandsbekendtgørelsen angivet som en beregnet gennemsnitsværdi.
- sikre, at metoden er så simpel, robust og økonomisk som muligt
- undersøge, i hvilket omfang det er muligt at opstille konverterings- eller omrengningsfaktorer til andre prøvetagningsprincipper (fx henstand) og godkendelsesprocedurer for fx metalafgivelse fra enkeltkomponenter
- validere metoden gennem målinger

Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30578
Ukendt: DKK542,000.00
01/11/2007 → 31/08/2008
Award relations: Sampling for drinking water quality in household installations (metals) - Method description (MeMet)
Project: Research

AVIVA: AVIVA - Avanceret Industriel Vandbehandling
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Andersen, H. R., Project Participant, Department of Environmental Engineering

Ukendt: DKK0.00
01/02/2008 → 01/02/2012
Award relations: AVIVA - Avanceret Industriel Vandbehandling
Project: Research

785: Coli Risk - MST
Risk Assessment of coliform bacteria in drinking water
Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30506
Ukendt: DKK299,984.00
14/12/2006 → 31/05/2007
Award relations: Coli Risk - MST
Project: Research

784: ATP On-line
Continued 'real time' measurement of ATP and physical parameters in drinking water
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30507
Ukendt: DKK114,800.00
21/12/2006 → 15/02/2007
Award relations: ATP On-line
Project: Research

780: Feasibility Study Agreement
Fortroligt
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30513
Ukendt: DKK285,820.00
18/12/2006 → 18/10/2007
Award relations: Feasibility Study Agreement
Project: Research
SWI: Storm- and Wastewater Informatics
The main purpose of wastewater systems is to protect the health of the population, protect the envi-ronment and to provide welfare for society. Around the world a very high number of large and age-ing wastewater systems can be found nowadays. Many of these systems are located in densely populated city areas, making it impossible or very expensive to carry out major re-design of the sys-tems. Today’s wastewater treatment plants apply real time optimisation of the plants, where as nearly all sewer systems are static, meaning that once the sewer pipes, pumps, basin and overflows have been put in the ground, no further/very little action is taken to optimise the performance of the sewer system in real time.

Wastewater systems stress the aquatic environment and may put the health and safety of people at risk, e.g. when a mixture of rainwater and sewage floods residential areas or is discharged through overflows to receiving waters. Further, the operation of the wastewater systems is under an increas-ing pressure due to: 1.) The EU Water Framework Directive 2.) Increased rainfall and runoff, e.g. due to climate changes 3.) Ageing sewer systems with increased infiltration, exfiltration, structural problems and health risks.

The present project addresses the problem of fragmented operation of the wastewater systems by closing the knowledge gaps within: process understanding; now- and forecasting of the current con-ditions in the wastewater system.

Output from the project will be components for a real-time decision support system following a drop of water from the sky to the recipient. The benefits of such a real-time system are numerous and include improved water quality and reduced health risk, reduced energy consumption and op-eration costs, reduced flooding, increased reliability, and reduced environmental stress.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Manager, Department of Environmental Engineering
Smets, B. F., Project Participant, Department of Environmental Engineering

Project ID: 30614
Ukendt: DKK7,465,457.00
01/01/2008 → 31/12/2012
Award relations: Storm- and Wastewater Informatics
Project: Research

763: Methods for determining degradation of low pesticide concentrations in Danish aquifer environments
I Danmark stammer ca. 98% af drikkevandet fra grundvand. Gennem de sidste 10 år er der fundet mange indvindingsboringer, hvor råvandet indeholder pesticider eller nedbrydningsprodukter og for ti-den indeholder over 25% af de danske drikkevandsboringer i større eller mindre grad forskellige pesti-cidrester. Forekomsten af pesticider og nedbrydningsprodukter har krævet lukning af mange indvin-dingsboringer pga. overskridelse af EU grænseværdien på 0,1 g/l for pesticider i drikkevand. Generelt findes pesticidresterne i meget lave koncentrationer, hvilket påvirker den naturlige nedbrydning af dis-se stoffer i negativ retning, og der er i dag en særdeles mangelfuld viden omkring nedbrydningsrater for lave koncentrationer af pesticider i grundvandsmagasiner. Bestemmelse af realistiske nedbrydningsra-ter er centralt i forhold til regulering, risikovurdering og modellering af pesticiders skæbne i de danske grundvandsmagasiner, fordi selv en meget lille nedbrydningsrate kan betyde, at pesticiderne omsættes før de når dybereiggende magasiner, hvorfra mange større vandværker i dag indvinder grundvand. In-gen standardiserede metoder til bestemmelse af nedbrydningsrater for lave koncentrationer af pesticider i grundvandsmagasiner er i dag tilgængelige. Nedbrydningsrater ekstrapoleres derfor ofte med data op-nået med urealistisk høje pesticidkoncentrationer i prøver udtaget fra overfladejord, hvor den biologi-ske omsætning er af en anden karakter end den, der finder sted i oligotrofe grundvandsmiljøer. I grund-vandsmagasinerne er styrende faktorer som f.eks. indhold af organis stof, temperatur og mikrobiel ak-tivitet meget lavere end i rodzonjord.

Dette projekt vil sammenligne metoder udviklet i forskellige forskningslaboratorier til bestemmelse af nedbrydningsrater for lave pesticidkonzentrationer under realistiske grundvandsforhold. Sammenlig-ningen af disse metoder har til formål at afklare, hvilke parametre der er centrale i forhold til eksperi-mental bestemmelse af sådanne nedbrydningsrater i grundvandsedimenter. Der vil dernæst blive gen-nemført en række undersøgelser af danske sedimenter i laboratoriet under realistiske forhold, hvor sedimenterne udtages fra repræsentative danske grundvandsmagasiner. Projektet vil ud fra laboratoriefer-segene udvikle et koncept for bestemmelse af nedbrydningsrater for realistiske pesticidkonzentrationer i dansk grundvand, hvor der undersøges en række forskellige pesticider og nedbrydningsprodukter med forskellige egenskaber. Projektet vil derfor medvirke til at afklare, hvor stor den fremtidige påvirkning af den danske drikkevandsforsyning er i de betydelige grundvandsmagasiner, hvorfra vandværkerne i dag indvinder grundvand.

Albrechtsen, H., Project Participant, Department of Environmental Engineering

Ukendt: DKK0.00
01/01/2008 → 30/11/2010
Award relations: Methods for determining degradation of low pesticide concentrations in Danish aquifer environments
Project: Research
SENSOWAQ: SENSOWAQ - Sensors for monitoring and control of water quality

Scientific summary:
The vision is to construct new sensors for on-line or close to on-line measurement. Sensors are devices that detect physical, chemical or biological stimuli and transform them into signals, which can be measured or recorded. Sensor technology may provide rapid responses in contrast to traditional monitoring methods with long incubations or complex extraction and concentration procedures. The technology opens for development of miniaturised devices for on-line measurement of organic- and inorganic pollutants and microorganisms in different water bodies including groundwater, drinking water and water in industry. Unfortunately, hardly any sensors are available for measuring such water quality parameters, and the scientific challenge for this project is to identify and develop detection principles to enable detection of the very low concentrations typical for these parameters, and to transfer these detection principles to sensor platforms. Sensors can be divided into physico-chemical- and biological sensors. Biological sensors integrate a biological recognition element and a transducer capable of detecting the biological reaction and converting it into a measurable signal. Sensors for the drinking water supply will be developed for detection of selected pesticides (dichlobenil, 2,6-dichlorobenzamide (BAM), triazine and phenoxyacid herbicides), metals (copper, arsenic), specific microorganisms (e.g. Bacteroides, Enterococci, Campylbacter, E. coli, Legionella, Cryptosporidium) and microorganisms in general (suspended organisms, biofilm and corrosive organisms).

The research will use and develop several detection principles: 1) immunological and aptamer technology, 2) bioluminescent/fluorescent whole cell technology, 3) DNA and RNA array technology, 4) enzyme technology, 5) ATP-detection by bioluminescence, 6) auto-fluorescent biomolecule detection, and 7) electrical resistance for corrosion measurement. Depending on the target molecules these techniques will be transferred to the appropriate sensor platforms including 1) optical fibres, 2) cantilevers, 3) automated sampling, filtering and analysis robots, and 4) DNA/RNA array-technologies.

The project is divided into two main working areas (WA) focusing on development of sensors for analysis of pesticides and metals (WA1) and microbial contamination, including biocorrosive processes (WA2).

Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30535
Ukendt: DKK2,927,639.00
01/01/2007 → 31/12/2011
Award relations: SENSOWAQ - Sensors for monitoring and control of water quality
Project: Research

GOODWATER: GOODWATER, Marie Curie ITN

Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30628
Ukendt: DKK5,350,000.00
01/09/2008 → 31/08/2012
Award relations: GOODWATER, Marie Curie ITN
Project: Research

356: SAFEWATER. Hazardous chemicals and micro-organisms in urban water management.

No funding!
Eilersen, A. M., Project Participant, Department of Environmental Engineering
Ledin, A., Project Manager, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Schmidt, J. E., Project Participant, Department of Environmental Engineering
Christensen, N., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering
Angelidaki, I., Project Participant, Department of Environmental Engineering

Ukendt: DKK0.00
01/01/2003 → 02/01/2003
Collaborators: WaterTech A/S
Award relations: SAFEWATER. Hazardous chemicals and micro-organisms in urban water management.
Project: Research

337: Development of remediation technologies for chlorinated solvents

Samarbejdsaf tale med Fyns Amt:
*Gennemføre studier af de grundlæggende geokemiske, mikrobiologiske og hydrogeologiske processer for forskellige
oprensningsteknikker for klorerede opløsningsmidler med det formål at kunne forbedre anvendelsen af teknikkerne ved praktiske oprensninger
*Udvikle, afprøve og dokumentere forskellige afværgeteknikkers anvendelse ved konkrete oprensninger
*Udvikle og anvende egnede test i felt og laboratorium
*Udvækslig af data mhp. nærmere studier foretaget af speciale- eller Ph.D.studerende
*Udveksle viden om processer og teknikker
*Publicering af artikler
*Muliggøre praktikordning for studerende fra M&R i Fyns Amt

Scheutz, C., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Manager, Department of Environmental Engineering

Henriksen, K. B., Project Participant, Department of Environmental Engineering
Hønning, J., Project Participant, Department of Environmental Engineering

Project ID: 30260
Ukendt: DKK105,000.00
05/12/2002 → 31/12/2006
Collaborators: Fyns Amt
Award relations: Development of remediation technologies for chlorinated solvents
Project: Research

330: Risikovurdering af protozoerne "Crystosporidium parvum og Giardia intestinalis" i vand
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Boe-Hansen, R., Project Participant, Department of Environmental Engineering
Andersen, U. T., Project Participant, Department of Environmental Engineering

Project ID: 30243
Ukendt: DKK900,000.00
01/08/2002 → 31/12/2002
Collaborators: Dansk Veterinær Consult, Smittskydsinstituttet, COWI AS, Technical University of Denmark
Award relations: Risikovurdering af protozoerne "Crystosporidium parvum og Giardia intestinalis" i vand
Project: Research

335: Nedbrydning af pesticider i grundvandsmagasiner og opskalering af nedbrydningsrater med fokus på *Processtudier af anaerob nedbrydning i grund-vandsmagasiner.

Forskningsprojektet herer under SMP96 og koordineres af Grundvandsgruppens styregruppe.

Albrechtsen, H., Project Manager, Department of Environmental Engineering

Clausen, L., Project Participant, Department of Environmental Engineering

Project ID: 30259
Ukendt: DKK1,275,000.00
01/01/2002 → 31/12/2004
Collaborators: Geological Survey of Denmark and Greenland
Award relations: Nedbrydning af pesticider i grundvandsmagasiner og opskalering af nedbrydningsrater med fokus på *Processtudier af anaerob nedbrydning i grund-vandsmagasiner.
Project: Research

303: Enhanced bioremediation of groundwater contaminants

The use of microbial degradation processes as a remedy is attractive because contaminants are degraded to carbon dioxide, water and salts. The research activities focuses on on enhancement of microbial degradation by addition of electron, donors, nutrient or microbes. The target compounds are chlorinated aliphatic compounds actual contaminated sites. The activities are carried out in collaboration with the county of Funen, Copenhagen County and consulting companys in Denmark and North America. The work is supported by County of Funen and the Danish EPA.

Scheutz, C., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Manager, Department of Environmental Engineering

Jakobsen, R., Project Participant, Department of Environmental Engineering
Henriksen, K. B., Project Participant, Department of Environmental Engineering
Ukendt: DKK0.00
01/01/2000 → 31/12/2006
Collaborators: NIRAS A/S, Hedeselskabet, COWI AS, Fyns Amt, GeoSyntec Consultants
Award relations: Enhanced bioremediation of groundwater contaminants
Project: Research

322: Øresund Summer University; udvikling af kurset/kurserne indenfor emnet "miljø".
Foreløbig tilkendegivelse af bevilling på 400.000 SEK til gennemførelse af Øresund Summer University 2002.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Project ID: 30237
Ukendt: DKK320,000.00
01/06/2002 → 01/09/2002
Award relations: Øresund Summer University; udvikling af kurset/kurserne indenfor emnet "miljø".
Project: Research

See also research project no 282.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Project ID: 30167
Ukendt: DKK65,000.00
01/05/2002 → 15/11/2002
Project: Research

256: Forsøg med kulfilterrensning af grundvand for pesticider
Formålet er at bestemme 3 kultypers kapacitet til at fjerne pesticiderne BAM og Atrazin fra tre forskellige danske grundvandstyper. Kapaciteten bestemmes ud fra gennembrudskurverne opnået med kolonnesbøger. Såfremt undersøgelsens resultater giver mulighed for det, skal de undersøgte kultypers egnethed til at fjerne andre pesticider vurderes.
Skov, B. H., Project Participant, Department of Environmental Engineering
Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Clausen, L., Project Participant, Department of Environmental Engineering
Kagstrup, T., Project Participant, Department of Environmental Engineering
Project ID: 30165
Ukendt: DKK900,000.00
01/01/2001 → 28/02/2002
Collaborators: Geological Survey of Denmark and Greenland, Krüger Veolia Water Technologies, Danish Technological Institute
Award relations: Forsøg med kulfilterrensning af grundvand for pesticider
Project: Research

PEGASE: PEGASE. Part of EU project EVK1-CT-1999-00028.
Contract and direct costs transferred from University of Copenhagen, Faculty of Science, Department of Geology.

Overført fra KU: 870.000 DKK 1/3-02
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Clausen, L., Project Participant, Department of Environmental Engineering
Jørgensen, P. R., Project Manager, Department of Environmental Engineering
Project ID: 30217
Ukendt: DKK1,526,500.00
01/06/2000 → 30/11/2003
Award relations: PEGASE. Part of EU project EVK1-CT-1999-00028.
Project: Research

PEGASE: PEGASE. Pesticides in European Groundwaters.
The project is a detailed study of representative Aquifers and simulation of possible evolution scenarios to be carried out in the framework of the specific research and technological development programme Eenergy Environment and Sustainable Development (EESD).
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Clausen, L., Project Participant, Department of Environmental Engineering
242: Udarbejdelse af måleprogram for komposteret fæces.
Måleprogrammet skal benytte til at vurdere reduktionen af smitstoffører i human afføring som har været behandlet enten centralt i efterkomposteringsbeholdere eller i forskellige kommercielt tilgængelige komposttoiletter.

Albrechtsen, H., Project Manager, Department of Environmental Engineering

229: Undersøgelse af udvalgte patogener, herunder campylobacter i udvalgte vandværker.
Projektet består i udarbejdelse af en rapport vedrørende undersøgelse af udvalgte patogener, herunder campylobacter i 11 udvalgte vandværker.

Rapporten skal indeholde følgende:
Beskrivelse af de vandværker, der indgår i undersøgelsen. Hertil udarbejdes i samarbejde med Miljøstyrelsen et spørgeskema til de vandværker, der indgår i undersøgelsen med henblik på at få kortlagt eventuelle forureningskilder (græssende dyr tæt ved indvindingsområdet, tilledning eller nedsvingning af spildevand, udsprædning af husdyrgødning etc), der f.eks. kan forurene drikkevandet med protozoer.
Beskrivelse af de undersøgte parametre og de anvendte analysemetoder på baggrund af input fra de udførende laboratorier og med bistand fra Miljøstyrelsen.
Sammenstilling/skrivning af resultaterne ved de foretagne undersøgelser.
Vurdering af de fundne resultater i samarbejde med Miljøstyrelsen.

Albrechtsen, H., Project Manager, Department of Environmental Engineering

IMMUNALYZE: Development of immunological assays for the analysis of pesticides and determination of their prevalence and fate in groundwater and water supply systems.

Immunological assays have turned out to be powerful means to detect pesticides and other environmental contaminants including some of their metabolites at the low concentrations (sub-ug/L) actually found in groundwater. A compound like BAM can be detected even at a concentration of 0.02 ug/L. The project aims at developing the methods in order to cover more pesticides, to improve sensitivity and specificity, and to immobilize the immunological agents on a microchip so that a whole spectrum of pesticides can be detected rapidly and cheaply. The specific role of E&R is to verify the applicability of the methods for groundwater analysis and analysis of water from water supply systems. Furthermore E&R will use the immunological assays during studies of biodegradation processes in groundwater, water treatment plants, ans water distribution systems.

Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering

97: Field investigations of transport and fate of pesticides in a sandy aquifer

The behaviour of selected pesticides will be studied in the field e.g. migration, sorption, and degradation. A continuous injection experiment will be conducted for ambient flow gradients in an aerobic sandy aquifer. Hydrological and
geochemical characteristics of the aquifer are already known. The microbiological and sorption characteristics of the aquifer will be characterized. Selected pesticides and conservative tracer will continuously be injected for a period of 0.5-1 year. Multilevel samplers installed downstream of the injection will be monitored frequently during a period of about two years. The experiment will be evaluated based on: (1) breakthrough curves at sampling points downstream of the injection and (2) reactive solute transport simulation of the pesticide plume using a model developed and evaluated in this project. From the breakthrough data, dilution, sorption, and degradation can be determined and field degradation rates calculated. The spatial distribution of the pesticide plume will be determined by synoptic sampling at all monitoring points (2-3 times). The field investigation will be planned in detail autumn 1997.

The project is made in collaboration with GEUS and Department of .... (ISVA), and is fundes by The Danish Environmental Research Programme. The project period is 1997-1999.

Foverskov, A., Project Participant, Department of Environmental Engineering
Skov, B. H., Project Participant, Department of Environmental Engineering
Mosbæk, H., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Sørensen, J. S., Project Participant, Department of Environmental Engineering
Rügge, K., Project Participant, Department of Environmental Engineering
Broholm, M. M., Project Participant, Department of Environmental Engineering
Tuxen, N., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Manager, Department of Environmental Engineering
Nilsson, T., Project Participant, Department of Environmental Engineering
01/01/1997 → 31/12/1999

Project: Research

129: Determination of microbial available growth in lab. investigations.
Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Ukendt: DKK749,080.00
01/10/1998 → 30/06/2001
Collaborators: VKI Water Quality Institute, Danske Elværkers Forening, Miljøstyrelsen, HOFOR A/S
Award relations: Determination of microbial available growth in lab. investigations.
Project: Research

94: Activated carbon filtration of water
Contamination of ground water reservoirs by organic chemical pollutants (solvents and pesticides) is becoming common in Denmark. As a consequence, many wells have been closed and the loss of water resources has been compensated by savings of water. However, this strategy may lead to a shortage of water, and therefore treatment of the water for the organic chemicals may be required in the future. The purpose of the project is to: 1) Determine the capacity of activated carbon to remove atrazine and other pesticides at realistic very low concentrations (0.01-1 ug/l) in groundwaters with different contents of natural organic matter (NOM), and 2) To develop the laboratory and modeling methodologies to predict actual full scale sorption capacities.
Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
01/01/1997 → 31/12/1999
Project: Research

87: Microbial growth in drinking water distribution systems
The project concerns changes in water quality due to microbial growth during the transport of drinking water from waterworks to the consumer.

The major part of the biomass in drinking water system is attached to the inner surfaces of the waterpipes as a ‘biofilm’. The project focuses on the factors controlling the growth of this biofilm, primarily the concentration of microbial available nutrients and the flow velocity in the pipes. The kinetics of the growth will be investigated, with respect to determining the effect of the hydraulic retention time in the water distribution system. These factors will be investigated in a constructed model pipe system.

The goal of the project is to provide an useful tool for assessing the microbial growth potential of various types of water in different drinking water distribution systems.
Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Engineering
Ukendt: DKK0.00
01/10/1997 → 14/06/2001
Artificial recharge of groundwater

Artificial recharge is a method to increase the capacity to extract groundwater by augmenting the natural infiltration of surface water and at the same time utilize the top soil as a reactor for treatment of surface water. Artificial recharge has a wide spectrum of research challenges that need to be addressed to fully benefit from the technique. In the near future IMT will focus on physical, chemical and biological processes occurring during biological clogging of sand filters and soils. Methods for characterization of the water input and the clogging materials (biomass) found in artificial recharge systems will be tested. Furthermore, laboratory column experiments will be conducted to measure the development of redox zones during progress of biological growth and clogging. The project is part of the European research project Artificial recharge of groundwater (1996-98) which is funded partly by the European Committee through the 4th framework programme Environment and Climate.

This project involves nine different European partners, including the Water Quality Institute (VKI), and includes six work packages, (1) clogging and heterogeneity, (2) organic compounds and biodegradation, (3) redox dynamics, (4) water-aquifer material interaction, (5) fate of pathogens and (6) integration of knowledge from all work packages.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Engelsen, P. C., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Manager, Department of Environmental Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Engineering

01/02/1996 → 31/01/1999

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 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.

Foverskov, A., Project Participant, Department of Environmental Engineering
Skov, B. H., Project Participant, Department of Environmental Engineering
Mosbæk, H., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Sørensen, J. S., Project Participant, Department of Environmental Engineering
Rügge, K., Project Participant, Department of Environmental Engineering
Refstrup, M., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering

01/08/1994 → 30/08/1997

Rain as a water resource in households.

The water resource, energy and economy aspects of rainwater collection are assessed to evaluate rainfall collection as an alternative option for sustainable water supply in Denmark. A maximum of 229 million m³/year of rainwater can be collected from Danish roofs, provided that all possible surfaces are used and all rain falling on the surfaces is collected. This is equivalent to 24% of the total present production of drinking water, which is mainly based on groundwater. From household roofs 64.5 million m³/year can be collected if used for toilet flushing and washing of clothes. This is 68% of the actual demand for toilet flushing and washing of clothes in households and 22% of the total water consumption in households, but only 7% of the total present drinking water production in Denmark. From the society point of view there is neither an environmental nor an economic reason to systematically promote rainfall collection.

Albrechtsen, H., Project Manager, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering

01/05/1996 → 31/12/1997

Transformation processes in water treatment plants

A wide range of biotic and abiotic transformation processes are going on in treatment plants for groundwater. It is of particular interest whether organic chemical pollutants in trace concentrations (ug/l) can be degraded. Experiments with
Aromatic hydrocarbons in a pilot water works have shown very high treatment efficiencies resulting in residual concentrations of benzene, toluene, and naphthalene below 1 microg/l. This has to be further verified in larger scale, and a possible negative effect of iron precipitation has to be investigated. Studies of MTBE degradation in a full-scale water works has been conducted. MTBE was degraded efficiently from 10-50 ug/L to a few ug/L. It is planned to include a broader range of organic contaminants in the studies, including chlorinated aliphatic hydrocarbons and pesticides.

Biological transformation of some of the "traditional" pollutants is still an interesting research topic (nitrification, iron and manganese removal, etc.), in particular interactions between the specific groups of organisms involved.

Modelling of the organic and inorganic substrate removal and the simultaneous microbial growth and precipitation reactions is also considered as important. The better understanding of the processes will improve the chances of success of the modelling.

Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Engineering
01/01/1996 → 30/11/2003
Project: Research

17: Substitution of drinking water by rainwater or gray water for flushing of toilets in house holdings
The reduction of the groundwater resources, and maybe also the increasing drinking water prizes, have increased the interest for collecting rainwater for use in toilet flushing or laundry.

However, there is little knowledge of the hygienic quality of the collected and stored rainwater and of the hygienic consequences of this use. Therefore several rainwater collection systems and gray water reuse systems for use in toilet flushing established in different parts of Denmark are investigated with respect to occurrence of a range of microorganisms: bacteria, fungi and protozoans.

Albrechtsen, H., Project Manager, Department of Environmental Engineering
01/05/1996 → 31/12/1998
Project: Research

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-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.

Skov, B. H., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Bjerg, P. L., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Ukendt: DKK0.00
01/09/1996 → 30/09/1997
Award relations: Monitoring and interpretation of H2 as a redox indicator in an anaerobic leachate plume
Project: Research

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 denitrifyers, 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.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Refstrup, M., Project Participant, Department of Environmental Engineering
Christensen, T. H., Project Manager, Department of Environmental Engineering
Ukendt: DKK0.00
01/01/1994 → 30/03/1997
Award relations: Microbial studies of an anaerobic leachate plume
Project: Research
3: Pesticide & Grundvand 2.3, Kinetics of pesticide degradation

Kinetic undersøgelser af pesticidnedbrydning i grundvand ved realistisk lave koncentrationer og med særlig vægt på undersøgelse af tærskelkoncentrationer og dess afhængighed af primære substrater. Endvidere undersøges adaptationsfænomener. De absolute rater sammenlignes med rateestimater opnået i andre delprojekter ved feltforsøg/modellering.

Albrechtsen, H., Project Participant, Department of Environmental Engineering
Nyholm, N., Project Manager, Department of Environmental Engineering
01/01/1997 → 31/12/1997

Project: Research


Tætbefolkede områders erfaringer med alternativ vandhåndtering og høj grad af selvforsyning.

Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30493
Ukendt: DKK0.00
07/09/2006 → 31/03/2007

Award relations: Egen vandressource projekt A3: International erfaringssamling.

Project: Research

Determination of microbial available organic growth in lab. investigations.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Arvin, E., Project Participant, Department of Environmental Science and Engineering
Jørgensen, C., Project Participant, Unknown
Beck, J., Project Participant, Unknown
Lind, S., Project Participant, Unknown
Forslund, J., Project Participant, Unknown
Bagge, L., Project Participant, Unknown

Ukendt: DKK749,080.00
01/10/1998 → 30/06/1999

Collaborators: Unknown

Award relations: Determination of microbial available organic growth in lab. investigations.

Project: Research

Microbial growth in drinking water distribution systems

The project concerns changes in water quality due to microbial growth during the transport of drinking water from waterworks to the consumer.

The major part of the biomass in drinking water system is attached to the inner surfaces of the waterpipes as a ‘biofilm’. The project focuses on the factors controlling the growth of this biofilm, primarily the concentration of microbial available nutrients and the flow velocity in the pipes. The kinetics of the growth will be investigated, with respect to determining the effect of the hydraulic retention time in the water distribution system. These factors will be investigated in a constructed model pipe system.

The goal of the project is to provide an useful tool for assessing the microbial growth potential of various types of water in different drinking water distribution systems.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Science and Engineering
Arvin, E., Project Participant, Department of Environmental Science and Engineering
Jensen, B. K., Project Participant, VKI Water Quality Institute
Jørgensen, C., Project Participant, VKI Water Quality Institute
Lind, S., Project Participant, HOFOR A/S

Ukendt: DKK597,000.00, Ukendt: DKK789,000.00
01/10/1997 → 31/12/2000

Collaborators: VKI Water Quality Institute, HOFOR A/S

Award relations: Microbial growth in drinking water distribution systems, Microbial growth in drinking water distribution systems

Project: Research

Field investigations of transport and fate of pesticides in a sandy aquifer

The behaviour of selected pesticides will be studied in the field e.g. migration, sorption, and degradation. A continuous injection experiment has been conducted for ambient flow gradients in an aerobic sandy aquifer. Hydrological and geochemical characteristics of the aquifer are already known. The microbiological and sorption characteristics of the aquifer will be characterized. Selected pesticides and conservative tracer will continuously be injected for a period of 0.5-1 year. Multilevel samplers installed downstream of the injection will be monitored frequently during a period of about two
years. The experiment will be evaluated based on: (1) breakthrough curves at sampling points downstream of the injection and (2) reactive solute transport simulation of the pesticide plume using a model developed and evaluated in this project. From the breakthrough data, dilution, sorption, and degradation can be determined and field degradation rates calculated. The spatial distribution of the pesticide plume will be determined by synoptic sampling at all monitoring points (2-3 times). The field investigation will be planned in detail autumn 1997.

The project is made in collaboration with GEUS and Department of Hydrodynamics and Water Resources (ISVA). The project is funded by The Danish Environmental Research Programme. The project period is 1997-1999.

Bjerg, P. L., Project Manager, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Rügge, K., Project Participant, Department of Environmental Science and Engineering
Mosbaek, H., Project Participant, Department of Environmental Science and Engineering
Foverskov, A., Project Participant, Department of Environmental Science and Engineering
Sørensen, J. S., Project Participant, Department of Environmental Science and Engineering
Skov, B. H., Project Participant, Department of Environmental Science and Engineering
Broholm, M. M., Project Participant, Department of Environmental Science and Engineering
Tuxen, N., Project Participant, Department of Environmental Science and Engineering
Nilsson, T., Project Participant, Department of Hydrodynamics and Water Resources
Engesgaard, P. K., Project Participant, Department of Hydrodynamics and Water Resources

Threshold concentrations for biodegradation of pesticides in groundwater
The project is a subproject of project no. 2.2 of the pesticide and groundwater strategic environmental research programme. Methods and theory are used as established in the above STVF funded project on general biodegradation kinetics, except that tests are being conducted at even lower concentrations (pg/L levels
Nyholm, N., Project Manager, Department of Environmental Science and Engineering
Toräng, L., Project Participant, Department of Environmental Science and Engineering
Qualmann, S. , Project Participant, Department of Environmental Science and Engineering
Justesen, K. B., Project Participant, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Aamand, J., Project Participant, Geological Survey of Denmark and Greenland

Samordnat miljøforskningsprogram för Öresunduniversitetet.
Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Woin, P., Project Participant, Unknown Organization
Person, U., Project Participant, Unknown Organization
Christoffersen, K., Project Participant, Unknown Organization
Skärzbäck, E., Project Participant, Unknown Organization

Anaerobic field injection experiment with organic chemicals in a leachate plume
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 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
Mosbaek, 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
Sørensen, J. S., Project Participant, Department of Environmental Science and Engineering
Refstrup, M., Project Participant, Department of Environmental Science and Engineering
Effects of redox conditions and geology on pesticide degradation
Degradation of pesticides in aquifers will be investigated by aseptically collecting sediment and water samples from various redox environments (e.g., aerobic, denitrifying, sulfate- and iron-reducing and methanogenetic). Samples will be obtained from different aquifers representing typical geological settings in Denmark. Sediment and groundwater amended with low concentrations of pesticides (typically below 10 mg/l) will be incubated in the laboratory at field redox conditions and temperatures. The removal of pesticides and the accumulation of metabolites in the sediment-groundwater will be analyzed using HPLC and GC-MS. Complete mineralization will be assessed by addition of 14C-labelled pesticides and measurement of 14CO2 evolution. The degradation observed will be compared to the biomass and activity of dominant bacterial groups (i.e., aerobic, denitrifying, Fe(III)/Mn(IV)-reducing, sulfate-reducing and methanogenic) as well as to geochemical conditions in the aquifer. Finally, the degradation of pesticides in the field will be investigated at selected sites using in situ microcosms.

These field investigations will facilitate the comparison and transfer of laboratory results to field conditions.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Mosbæk, H., Project Participant, Department of Environmental Science and Engineering
Restrup, M., Project Participant, Department of Environmental Science and Engineering
Pedersen, P. G., Project Participant, Department of Environmental Science and Engineering

01/06/2000 → 30/11/2003
Collaborators: Unknown Organization
Award relations: Effects of redox conditions and geology on pesticide degradation
Project: Research

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. 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
Restrup, M., Project Participant, Department of Environmental Science and Engineering
Hansen, K., Project Participant, Department of Environmental Science and Engineering
Ringelberg, D. B., Project Participant, Waterways Experimental Station, Vikcsburg (PLFA)
Holst, H., Project Participant
Ekelund, F., Project Participant, University of Copenhagen

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
Artificial recharge of groundwater

Artificial recharge is a method to increase the capacity to extract groundwater by augmenting the natural infiltration of surface water. At the same time the top soil is utilized as a reactor for treatment of surface water. A wide spectrum of research challenges need to be addressed to fully benefit from the technique. In the project IMT focuses on physical, chemical and biological processes occurring during clogging of laboratory columns simulating the sand bed of artificial recharge basins. Methods for characterization of the water input and the clogging materials (particles, algae and biomass) found in artificial recharge systems are tested. Furthermore, experiments are conducted to measure the development of redox zones during progress of biological growth and clogging. The project is part of the European research project Artificial recharge of groundwater (1996-98) which is funded partly by the European Committee through the 4th framework programme Environment and Climate. This project involves nine different European partners and includes six work packages, (1) clogging and heterogeneity, (2) organic compounds and biodegradation, (3) redox dynamics, (4) water-aquifer material interaction, (5) fate of pathogens and (6) integration of knowledge from all work packages

Mikkelsen, P. S., Project Manager, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Henze, M., Project Participant, Department of Environmental Science and Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Science and Engineering
Hansen, K., Project Participant, Department of Environmental Science and Engineering
Engelsen, P. C., Project Participant, Department of Environmental Science and Engineering
Jensen, B. K., Project Participant, Water Quality Institute, Denmark, Science Park Aarhus

Ukendt: DKK650,000.00
01/02/1996 → 31/01/1999
Collaborators: Water Quality Institute, Denmark, Science Park Aarhus
Award relations: Artificial recharge of groundwater
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-reduction 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

OIP!: Overlevelse afindikatorbakterier og patogener i ledningsnet

1. Formål
Der er en lang række forhold og observationer i vandforsyningerne af forekomst af indikatororganismer i ledningsnet, som ikke kan forklares med den nuværende viden.
For at kunne optimere valg af materialer til ledningsnet, sikre og forbedre vandets mikrobiologiske kvalitet i distributionssystemerne og optimere strategier til ledningsnetets vedligeholdelse og renovering vil der blive undersøgt:
• overlevelsen af indikatororganismer og udvalgte patogener (sygdomsfremkaldende mikroorganismer) i drikkevandsrør
• betydningen af materialevalg (stål, plast) for overlevelsen
• styrende faktorer for disse bakteriers overlevelse, først og fremmest samspillet med rørens biofilm i nye og brugte rør
• betydningen af arbejdsprocedurer ved udskiftning af rør i ledningsnet, fx sediment i bunden af ledningsnettet, indtrængen af boremudder eller jord

Det ansøgte projekt vil således under virkelighedsnære forhold give ny viden om forekomst af bakterier og overlevelsen af patogener i distrophonysemen, og om hvorledes materialevalg og renoveringer indvirker på denne overlevelse. Desuden forventes projektet at bidrage til at forbedre de hygieniske procedurer ved ledningsrenoveringer.
Albrechtsen, H., Project Manager, Department of Environmental Engineering Forskningsprojekter - Miljø- og Energiministeriet: DKK0.00
01/01/2007 → 28/02/2008
Award relations: Overlevelse afindikatorbakterier og patogener i ledningsnet
Project: Research
EMG: EMG. Inter-laboratory testing for Enhancement of Microbial Growth.
Inter-laboratory testing regarding the assessment of the microbial growth concerning construction products in contact with drinking water -
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Project ID: 30397
Ukendt: DKK185,850.00
01/04/2005 → 31/12/2005
Collaborators: DVGW - Technologiezentrum Wasser, KWR Water Cycle Research Institute, Thames Water Utilities Ltd, Centre de Recherche D'Expertise et de Contrôle des Eaux de Paris
Award relations: EMG. Inter-laboratory testing for Enhancement of Microbial Growth.
Project: Research

AOP-Desinfektion: Anvendeligheden af avancerede oxidationsprocesser til desinfektion af vand.
Formål med projektet er at udvikle et beslutningsstyrkende værktøj, til brug ved beslutningsprocesser omkring desinfektion af vand i private og offentlige virksomheder. Samtidig forventes projektet at kunne bidrage til en teknologiøverførsel inden for området.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Ledin, A., Project Participant, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
Eriksson, E., Project Participant, Department of Environmental Engineering, Environmental Chemistry
Project ID: 30373
Forskningsprojekter - Miljø- og Energiministeriet: DKK200,000.00
01/11/2004 → 21/12/2005
Collaborators: Ramboll Group AS
Award relations: Anvendeligheden af avancerede oxidationsprocesser til desinfektion af vand.
Project: Research

Projektets formål er at indsamle og systematisere viden om kortlægning af nuværende ressourcer og forbrug samt eksisterende renseteknologier inden for vand- og spildevand til brug i det videre projektforsøg, herunder identifikation af scenarier.
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Binning, P. J., Project Manager, Department of Environmental Engineering
Hauger, M. B., Project Participant, Department of Environmental Engineering
Project ID: 30381
Sam.arb.aftaler - Amter og kommuner: DKK445,500.00
01/12/2004 → 31/05/2005
Collaborators: Københavns Energi A/S
Award relations: Delprojekt A1. Overordnet kortlægning af nuværende ressourcer og forbrug, samt eksisterende renseteknologier indenfor vand- og spildevand.
Project: Research

Det specifikke formål for projektet er: At identificere, opstille og foretage en indledende vurdering af 8-10 scenarier, der hver især varetager den samlede håndtering af drikkevand, spildevand og sekundavand i København. Den grove vurdering af scenarierne vil være en screening for scenariernes potentiale som en realistisk løsning ud fra nogle få udvalgte kriterier.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Eilersen, A. M., Project Participant, Department of Environmental Engineering
Project ID: 30395
Sam.arb.aftaler - Amter og kommuner: DKK553,500.00
01/04/2005 → 31/03/2006
Collaborators: Københavns Energi A/S
Award relations: Delprojekt A2. Opstilling og analyse af scenarier for fremtidens håndtering af Københavns Energi’s vandressource.
Project: Research
531: Copenhagen's water resources and investigation of possible future water supplies
Formålet er både at analysere en række væsentlige vandressourceforhold samt at undse-ge/udvikle en række teknologier og redskaber til brug for KE's fremtidige evne til at levere vand i tilstrækkelige mængder og i den ønskede kvalitet.

Vigtige forudsætninger for de forhold der skal samarbejdes om er at:
•Udnyttelsen af ressourcen skal være bæredygtig
•Klimaefekter vil kun indgå såfremt de vurderes at have effekt indenfor de næste 10 år

Da arbejdet har langsigtet karakter baseres det ikke på at opfylde nuværende lovgivning eller vandkvalitetskriterier. Gennemførelse af en del af samarbejdets forslag eller anbefalinger vil derfor i nogen grad afhænge af den fremtidige udvikling indenfor miljøforvaltningen i Danmark.

Det er samarbejdets formål løbende at sikre at KE frem til 2010 har den til enhver tid fornøden viden til at kunne tage de rigtige beslutninger baseret på den bedst tilgængelige viden og den gennem projektet opbyggede erfaring.  
Binning, P. J., Project Manager, Department of Environmental Engineering
Henze, M., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Ledin, A., Project Participant, Department of Environmental Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
01/01/2005 → 01/01/2006
Collaborators: Københavns Energi A/S
Project: Research

440: Belysning af konsekvenser/sammenhænge ved indtagelse/kontakt med forurenet drikkevand af varierende mikrobiologisk kvalitet.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Engineering
Andersen, U. T., Project Participant, Department of Environmental Engineering
Engelsborg, C. C., Project Participant, Department of Environmental Engineering
Bagge, L., Project Participant, Miljøstyrelsen
Project ID: 30344
Forskningsprojekter - Miljø- og Energimisteriet: DKK333,014.00
15/07/2004 → 31/08/2006
Collaborators: Miljøstyrelsen
Award relations: Belysning af konsekvenser/sammenhænge ved indtagelse/kontakt med forurenet drikkevand af varierende mikrobiologisk kvalitet.
Project: Research

438: Materialer anvendt i boringer - betydning for vandkvaliteten. Første del: Mikrobiologisk vækst.
Formålet med projektet er at foretage en vurdering af materialer der anvendes til boringer og til boringsfiltre med henblik på at aføre, hvorvidt de befødtes/giver anledning til mikrobiologisk vækst. Om mikroorganismer faktisk kan vokse på disse materialer afprøves af M&R DTU.
Corfitzen, C. B., Project Participant, Dansk Toksikologi Center
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Wessels, S., Project Participant, Dansk Toksikologi Center
Project ID: 30341
Sam.arb.aftaler - Statslige danske: DKK150,000.00
01/06/2004 → 15/09/2004
Collaborators: Dansk Toksikologi Center
Award relations: Materialer anvendt i boringer - betydning for vandkvaliteten. Første del: Mikrobiologisk vækst.
Project: Research

414: Undersøgelse af BAMs skæbne i grundvand.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Clausen, L., Project Participant, Department of Environmental Engineering
Janniche, G. S., Project Participant, Department of Environmental Engineering
Nygaaard, B., Project Participant, Department of Environmental Engineering
Project ID: 30306
Forskningsprojekter - Miljø- og Energimisteriet: DKK725,000.00
01/12/2003 → 31/12/2004
Collaborators: Hedeselskabet, Ramboll Group AS
Award relations: Undersøgelse af BAMs skæbne i grundvand.
420: Effekt af UV-bestråling i ledningsnet.
Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Arvin, E., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Project ID: 30328
Sam.arb.aftaler - Amter og kommuner: DKK298,716.00
24/03/2004 → 31/12/2004
Collaborators: VandCenter Syd A/S
Award relations: Effekt af UV-bestråling i ledningsnet.
Project: Research

426: Langsomfiltres effekt på drikkevands biostabilitet
En opsamling af erfaringer og gennemgang af den åbne internationale litteratur omkring praktiske erfaringer i forbindelse med biostabilisering af drikkevand ved langsom sandfiltrering.
Albrechtsen, H., Project Manager, Department of Environmental Engineering
Bennedsen, L., Project Participant, Københavns Energi A/S
Project ID: 30339
Sam.arb.aftaler - Amter og kommuner: DKK83,000.00
01/05/2004 → 15/07/2004
Collaborators: Københavns Energi A/S
Award relations: Langsomfiltres effekt på drikkevands biostabilitet
Project: Research

424: Disinfection in swimming pools
There is increasing focus on the water quality in swimming pools because of biological and chemical health risks. At the same time, new types of swimming pools have developed, some with elevated temperatures (baby swimming) and some with more complicated hydraulics than traditional swimming pools (recreational water lands). There is a demand for reducing the concentration of chlorine and in particular harmful disinfection by-products and there is a demand for improved methods of water quality monitoring. The aim of this project is in the first place to summarize the state of the art and identify potential methods of improving the water quality, including monitoring of quality.
Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
01/04/2004 → 31/12/2005
Collaborators: Scan Research A/S, DHI Water - Environment - Health, Ejcan ApS, Danish Technological Institute
Project: Research

411: Removal of xenobiotic compounds in water works sand filters
Sand filters in conventional water works treating groundwater harbour an active and diverse flora of micro organisms that are able to remove a range of easily biodegradable organic compounds concomitantly with the removal of the usual compounds methane, hydrogen sulphide, ammonia, iron, and manganese. The purpose of this project is to study the capacity of filters to remove gasoline compounds, BTEX, pesticides, phenols, and other biodegradable xenobiotic compounds. The study is conducted with filters that contain quarts sand and Filtralite (expanded clay) as filter materials. It has been observed that the gasoline compounds can be biodegraded effectively in the filters even in the low microgram per litre concentration range. The presences of iron, even in concentrations of 3 mg/L, did not have a significant inhibitory effect on the removal of gasoline compounds.
Skov, B. H., Project Participant, Department of Environmental Engineering
Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Engineering
Wolter, U. A. F., Project Participant, Department of Environmental Engineering
Kagstrup, T., Project Participant, Department of Environmental Engineering
Project ID: 30304
Forskningsprojekter - Miljø- og Energimæsterskabet: DKK450,000.00
01/11/2003 → 31/12/2005
Award relations: Removal of xenobiotic compounds in water works sand filters
Project: Research

408: Projekt om vandforbrug og forbrugsvariationer.
Fastlæggelse af nye realistiske værdier for vandforbrug og forbrugsvariationer til brug for den fremtidige dimensionering af vandledninger ved både nyanlæg og renovering af ledningsnet.
I undersøgelsen indgår:

a. Husholdningsforbrug
b. Erhvervsforbrug, inkl. landbrug
c. Forbrug i institutioner m.v.

Albrechtsen, H., Project Manager, Department of Environmental Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Engineering

Project ID: 30301
Sam.arb.aftaler, Private danske - Andre virksomheder: DKK124,200.00
01/10/2003 → 31/12/2004
Collaborators: Dansk Vand- og Spildevandsforening
Award relations: Projekt om vandforbrug og forbrugsvariationer.
Project: Research

CPDW: CPDW. Development of harmonized tests to be used in european approval scheme concerning construction products in contact with drinking water.

5. Framework Programme (EESD)
Corfitzen, C. B., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30182
Forsk. EU - Rammeprogram: DKK835,000.00
01/03/2001 → 31/05/2003
Collaborators: KWR Water Cycle Research Institute, WRC, Thames Water Utilities Ltd, OFICT-CGT Equipement- Environnement, DVGW, Centre de Recherche D'Expertise et de Contrôle des Eaux de Paris
Award relations: CPDW. Development of harmonized tests to be used in european approval scheme concerning construction products in contact with drinking water.
Project: Research

377: Removal of the pesticides BAM and Atrazine from drinking water by activated carbon
The Danish drinking water resource is increasingly polluted by pesticides, especially BAM and atrazine. Activated carbon filtration is an obvious technology that is used worldwide, but primarily for treatment of surface water, whereas Danish drinking water supply is based on groundwater. The purpose of the project has therefore been to investigate the opportunities for using activated carbon (AC) filtration to remove the pesticides BAM (2,6-Dichlorobenzamide) and atrazine from Danish groundwater. The main objective of the study was to determine the AC capacity, which is an expression for the amount of pesticide which can be bound to a certain amount of AC and maintain the outlet concentration below a certain, given value. The AC capacity was investigated for three different types of activated carbon (Chemviron Filtrasorb F400, Norit ROW 0.8, and Lurgi, Hydraffin CC 8 x 30). Experimentally three different approaches were used: Column experiments at bench-scale (near-realistic scale (one meter scale)), small-scale column test (centimetre scale) and adsorption isotherm test (batch test with suspended AC). In general this project showed that AC adsorption is a suitable method for removal of BAM from groundwater. Furthermore, the capacities for BAM unexpectedly were in the same order of magnitude as capacities for atrazine. It was expected that the adsorption of BAM onto activated carbon would be considerably lower compared to that of atrazine, because of the more polar structure of BAM (hydrophobicity). The capacity for BAM and atrazine did not vary significantly with the different types of activated carbon or groundwater investigated in this study. Modelling of break-through curves with the program AQUASIM of tracer experiments carried out in the bench-scale columns and of pesticide adsorption in bench-scale columns and small-scale columns has shown a potential for model-based scaling. It is possible to model sorption of BAM in both bench-scale columns and small-scale columns with isotherm data for BAM (Kd=1.15 m3/g AC). By modelling of the tracer experiments from the bench-scale columns, it is possible to estimate mass transfer parameters necessary for modelling the breakthrough profiles of BAM.

Skov, B. H., Project Participant, Department of Environmental Engineering
Arvin, E., Project Manager, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Clausen, L., Project Participant, Department of Environmental Engineering
Kagstrup, T., Project Participant, Department of Environmental Engineering

01/01/2000 → 31/12/2005
Project: Research

AquaTerra: AquaTerra. Integrated modelling of the river-sediment-soil groundwater system; advanced tools for the management of catchment areas and river basins in the context of global change.
Albrechtsen, H., Project Manager
Bjerg, P. L., Project Participant
Lindberg, I. E., Project Participant
Nygaaard, B., Project Participant
Refrstrup, M., Project Participant

Project ID: 30340
Ukendt: DKK2,165,000.00
01/06/2004 → 31/05/2009
Collaborators: University of Neuchatel, Wageningen IMARES, Consejo Superior de Investigaciones Cientificas, Technical University of Denmark, Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, BRGM
Award relations: AquaTerra. Integrated modelling of the river-sediment-soil groundwater system; advanced tools for the management of catchment areas and river basins in the context of global change.
Project: Research

**Fyns Amt-Mechlorprop: Fjernelse af Mechlorprop i Kerteminde Vandværk**
Formål med denne undersøgelse er at undersøge, hvordan mechlorprop tilsyneladende kan forsvinde i vandbehandlingen på Kerteminde Vandforsyning, herunder hvilken betydning udskiftning af filtrene har.
Arvin, E., Project Manager, Department of Environmental Engineering
Ferguson, C. K. H., Project Participant, Department of Environmental Engineering
Albrechtsen, H., Project Participant, Department of Environmental Engineering
Project ID: 30453
Ukendt: DKK400,000.00
01/01/2006 → 01/10/2006
Award relations: Fjernelse af Mechlorprop i Kerteminde Vandværk
Project: Research

**BAKMAT: Innovationskonsortiet - Overvågning og begrænsning af mikrobiel vækst.**
Corfitzen, C. B., Project Participant
Arvin, E., Project Participant
Albrechtsen, H., Project Manager
Boe-Hansen, R., Project Participant
Project ID: 30329
Ukendt: DKK995,000.00
01/02/2004 → 30/06/2007
Collaborators: Aarhus University, Aarhus Kommunale Værker, Aalborg University, Technical University of Denmark, Danish Technological Institute
Award relations: Innovationskonsortiet - Overvågning og begrænsning af mikrobiel vækst.
Project: Research

**Removal of MTBE from drinking water in biological active sand filters.**
MTBE can be removed from contaminated water in water works by a range of treatment methods. Biological destruction of MTBE with MTBE as the primary substrate offers an attractive method of removing MTBE without the disadvantages, as known from several of the other MTBE-removing technologies. It is the purpose of the project to investigate the effect of operating conditions (filter velocities, backwashing, etc.) on the biological removal of MTBE in sand filters in conventional water works. A field study at Svendborg Water Works, Denmark, showed that MTBE could be removed from 10-65 ug/L to a few 5 ug/L.
Arvin, E., Project Manager
Albrechtsen, H., Project Participant
Project ID: 30248
Sam.arb.aftaler - Udenlandske offentlige og private: DKK760,800.00
01/10/2002 → 31/12/2005
Collaborators: Svendborg Water Supply, Technical University of Denmark
Award relations: Removal of MTBE from drinking water in biological active sand filters.
Project: Research

**CORONA: CORONA, Confidence in forecasting of natural attenuation as a risk-based groundwater remediation strategy.**
The overall goal of CORONA is to increase confidence in assessment and forecasting of natural attenuation (NA) of groundwater pollution. M&R DTU collaborates with several European partners (http://www.shef.ac.uk/corona/) and together we will carry out multi-disciplinary research on 6 varied field sites and in the laboratory and use numerical modeling. The activities done by M&R DTU are primarily connected to a field site where landfill leachate infiltrates to an underlying sandy aquifer. This creates a reduced plume, with manganese and nitrate reducing conditions close to the landfill. Different phenoxy acid herbicides are the main pollutants in the leachate. These compounds are recalcitrant in the anaerobic core of the plume, but the hypothesis is that a significant mass reduction (by microbial degradation) occurs at the fringe of the plume, where aerobic water from the surrounding aquifer mixes with the contaminated water. This hypothesis will be tested by field observations (mass fluxes through control planes as well as high resolution multi-level-samplers) and laboratory investigations (micro-scale variations in fringe sediment cores of phenoxy acid degradation potential, microbial numbers and redox chemistry). The experimental results will be incorporated in a reactive solute transport model for the site.
Bjerg, P. L., Project Manager
Tuxen, N., Project Participant
Underskudsgaranti til konferencen ISSM02.

Underskudsgaranti til konferencen "International Symposium on Subsurface Microbiology" (ISSM02), 8-13. September 2002 i Kopenhagen.

Formål med konferencen er at sætte focus på funktion, diversitet og mikrobiel økologi i undergrunden - både under naturlige og menneskeligt påvirkede forhold. Der forventes 225 deltagere.

Albrechtsen, H., Project Manager, Department of Environmental Engineering

Project ID: 30167
Forskningsrådene - STVF: DKK100,000.00
01/06/2002 → 01/09/2003
Collaborators: Geological Survey of Denmark and Greenland
Award relations: Underskudsgaranti til konferencen ISSM02.
Project: Research

347: Øresund Sommer University 2003.

Øresund Sommer University 2003.

Albrechtsen, H., Project Manager. Department of Environmental Engineering
Kusk, K. O., Project Participant. Department of Environmental Engineering

Project ID: 30282
Sam.arb.aftaler - Udenlandske offentlige og private: DKK20,000.00
02/04/2003 → 01/09/2003
Award relations: Øresund Sommer University 2003.
Project: Research

‘Undersøgelse af udvalgte patogener, herunder campylobacter i udvalgte vandværker.

Projektet består i udarbejdelse af en rapport vedrørende undersøgelse af udvalgte patogener, herunder campylobacter i 11 udvalgte vandværker.

Rapporten skal indeholde følgende:
Beskrivelse af de vandværker, der indgår i undersøgelsen. Hertil udarbejdes i samarbejde med Miljøstyrelsen et spørgeskema til de vandværker, der indgår i undersøgelsen med henblik på at få kortlagt eventuelle forureningskilder (græsset dyr tæt ved indvindingsområdet, tidledning eller nedsivning af spildevand, udspredning af husdyrgødning etc), der f.eks. kan forurene drikkevandet med protozoer.
Beskrivelse af de undersøgte parametre og de anvendte analysemetoder på baggrund af input fra de udførende laboratorier og med bistand fra Miljøstyrelsen.
Sammenstilling/skrivning af resultaterne ved de foretagne undersøgelser.
Vurdering af de fundne resultater i samarbejde med Miljøstyrelsen.
Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
15/04/2000 → 15/12/2000
Project: Research

PEGASE. Pesticides in European Groundwaters

The project is a detailed study of representative Aquifers and simulation of possible evolution scenarios to be carried out in the framework of the specific research and technological development programme Energy Environment and Sustainable development (EESD).

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
01/06/2000 → 30/11/2003
Project: Research

Udarbejdelse af måleprogram for komposteret fæces

Måleprogrammet skal benytte til at vurdere reduktionen af smitstoffer i human afferind som har været behandlet enten centralt i efterkomposteringsbeholdere eller i forskellige kommercielt tilgængelige komposttoaletter.
Development of Immunological assays for the analysis of pesticides.

Immunological assays have turned out to be powerful means to detect pesticides and other environmental contaminants including some of their metabolites at the low concentrations (sub-ug/L) actually found in groundwater. A compound like BAM can be detected even at a concentration of 0.02 ug/L. The project aims at developing the methods in order to cover more pesticides, to improve sensitivity and specificity, and to immobilize the immunological agents on a microchip so that a whole spectrum of pesticides can be detected rapidly and cheaply. The specific role of IMT is to verify the applicability of the methods for groundwater analysis and analysis of water from water supply systems. Furthermore IMT will use the immunological assays during studies of biodegradation processes in groundwater, water treatment plants, and water distribution systems.

Arvin, E., Project Manager, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Ukendt: DKK1,500,000.00
01/11/1999 → 01/11/2004
Award relations: Development of Immunological assays for the analysis of pesticides.
Project: Research

Migration of organic compounds from tubings applied in the water supply.

Arvin, E., Project Manager, Department of Environmental Science and Engineering
Mosbæk, H., Project Participant, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Nilsson, D. B., Project Participant, Department of Environmental Science and Engineering
01/01/1998 → 30/11/1998
Project: Research

Activated carbon filtration of water

Contamination of ground water reservoirs by organic chemical pollutants (solvents and pesticides) is becoming common in Denmark. As a consequence, many wells have been closed and the loss of water resources has been compensated by savings of water. However, this strategy may lead to a shortage of water, and therefore treatment of the water for the organic chemicals may be required in the future. The purpose of the project was to make a status of the use of activated carbon for water treatment, including the economic consequences.

Arvin, E., Project Manager, Department of Environmental Science and Engineering
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Boe-Hansen, R., Project Participant, Department of Environmental Science and Engineering
01/01/1997 → ...
Project: Research

Rain as a water resource in households

The water resource, energy and economy aspects of rainwater collection are assessed to evaluate rainfall collection as an alternative option for sustainable water supply in Denmark. A maximum of 229 million m3/year of rainwater can be collected from Danish roofs, provided that all possible surfaces are used and all rain falling on the surfaces is collected. This is equivalent to 24% of the total present production of drinking water, which is mainly based on groundwater. From household roofs 64.5 million m3/year can be collected if used for toilet flushing and washing of clothes. This is 68% of the actual demand for toilet flushing and washing of clothes in households and 22% of the total water consumption in households, but only 7% of the total present drinking water production in Denmark. From the society point of view there is neither an environmental nor an economic reason to systematically promote rainfall collection.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Adeler, O. F., Project Participant, Department of Environmental Science and Engineering
Henze, M., Project Participant, Department of Environmental Science and Engineering
Mikkelsen, P. S., Project Participant, Department of Environmental Science and Engineering
Ukendt: DKK200,000.00, Ukendt: DKK100,000.00
01/08/1997 → 31/12/1997
Award relations: Rain as a water resource in households, Rain as a water resource in households
Project: Research

Microbial growth in domestic hot water systems

In domestic hot water systems, surprisingly high numbers of bacteria are often observed, even higher numbers than acceptable in cold drinking water. Aesthetic problems such as bad smell or discolorization of the hot water and technical problems such as bacterial biofilms in the heat transfers preventing the heating of the water have been observed in hot water systems with high numbers of bacteria but also allergic reactions such as itching and blushing skin after contact with
the water has been suggested to be related to the high numbers of bacteria. A corporation project together with the Statens Byggeforskningsinstitut has been established, and in the project a hot water system in an apartment block is investigated in details. This includes the cold drinking water which is the source for hot water, the hot water tank and the distribution system. A sampling system have been developed to follow the microbial growth on the inner surface of the hot water tank and in the distribution system. This system is used for investigations of the distribution of the bacteria and the bacterial growth in the hot water system. Another purpose is to quantify the bacterial growth in relation to quality of the cold water and operation conditions of the system such as e.g. hydraulic retention time and electrolytical corrosion protection.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Arvin, E., Project Participant, Department of Environmental Science and Engineering
Bagh, L. K., Project Participant, Department of Environmental Science and Engineering

01/01/1996 → ...

Collaborators: Danish Building Research Institute
Award relations: Microbial growth in domestic hot water systems
Project: Research

**Determination of microbial available organic matter and microbial growth potentials in drinking water systems**

There is a risk of deterioration of the quality of the raw (ground) water used for drinking water due to exploitation of resources with elevated content of organic matter or even with micropollutants. If these aspects are combined with the risk of increased hydraulic retention time in the distribution system (e.g. due to water saving campaigns) and the use of new materials of polymers used for the pipes, this might result in after-growth i.e. increasing number of bacteria in the drinking water in the distribution system after the water treatment at the water works. To quantify the part of the organic carbon available for microbial growth a range of methods are being evaluated: the biological available organic carbon method (BDOC), based on the change in content of dissolved organic carbon (DOC) during a standardized incubation in presence of sand from a sandfilter in a water works; the assimilable organic carbon method (AOC) based of the growth of pure cultures; and the rotating disc method, quantifying the growth rate of the autochthonous bacteria as microcolonies on a rotating disk as a result of the content of organic carbon.

Later in the project the microbial growth in the water as well as in the biofilm on the inner side of the tubes will be related to the quantification of organic carbon available for microbial growth.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Arvin, E., Project Participant, Department of Environmental Science and Engineering
Hansen, K., Project Participant, Department of Environmental Science and Engineering

01/01/1996 → ...

Project: Research

**Substitution of drinking water by rainwater or gray water for flushing of toilets in house holdings**

The reduction of the groundwater resources, and maybe also the increasing drinking water prizes, have increased the interest for collecting rainwater for use in toilet flushing or laundry. However, there is little knowledge of the hygienic quality of the collected and stored rainwater and of the hygienic consequences of this use. Therefore several rainwater collection systems and gray water reuse systems for use in toilet flushing established in different parts of Denmark are investigated with respect to occurrence of a range of microorganisms: bacteria, fungi and protozoans.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering

Ukendt: DKK48,000.00, Ukendt: DKK0.00

01/01/1996 → 31/12/1998

Award relations: Substitution of drinking water by rainwater or gray water for flushing of toilets in house holdings
Project: Research

**Transformation processes in water treatment plants and water distribution systems**

A wide range of biotic and abiotic transformation processes are going on in treatment plants for groundwater and in the water distribution network. Recently it has become particulary interesting whether organic chemical pollutants in trace concentrations (ug/l) can be degraded. Preliminary experiments with aromatic hydrocarbons in a pilot water works, have shown that very high treatment efficiencies can be obtained resulting in residual concentrations of benzene, toluene, and naphthalene below 1 microg/l. This has to be further verified in larger scale, and a possible negative effect of iron precipitation has to be investigated. The transformation capacity of aromatics in the water distribution system is another interesting topic. It is planned to include a broader range of organic contaminants in the studies, including chlorinated aliphatic hydrocarbons and pesticides.

Biological transformation of some of the "traditional" pollutants is still an interesting research topic (nitrification, iron and manganese removal, etc.), in particular interactions between the specific groups of organisms involved.

Modelling of the organic and inorganic substrate removal and the simultaneous microbial growth and precipitation reactions is also considered as important. The better understanding of the process and the development of mathematical tools will improve the chances of success of the modelling.

Albrechtsen, H., Project Manager, Department of Environmental Science and Engineering
Arvin, E., Project Participant, Department of Environmental Science and Engineering
Influence of iron reducing processes for degradation of organic pollutants
Iron reducing processes (reduction of Fe(III) to Fe(II)) seem to be important for the turnover of bulk organic matter and organic compounds in landfill leachate contaminated aquifers, based on field observations. This project has been initiated to obtain a better understanding of the factors governing the microbial Fe(III)-reduction in aquifers and to isolate and to characterize a pure culture of Fe(III)-reducing bacteria for controlled experiments. The interaction between the Fe(III)-reducing bacteria and the environmental factors such as the concentration and type of Fe-oxides and carbon sources, including xenobiotics, is specifically in focus.

Albrechtsen, H., Project Manager, 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

Ukendt: DKK290,000.00

01/01/1996 → …

Award relations: Influence of iron reducing processes for degradation of organic pollutants
Project: Research

Effects of Biomass Growth on the Hydrodynamic Properties of Groundwater Aquifers
The aim of the project is to experimentally and numerically describe the influence of a growing biomass on the hydraulic properties of porous media.

Ph.D. study by Jesper Holm, ISVA. Funded by the Groundwater Research Centre, Technical University of Denmark
Engesgaard, P. K., Project Manager, Department of Hydrodynamics and Water Resources
Jensen, K. H., Project Participant, Department of Hydrodynamics and Water Resources
Holm, J., Project Participant, Department of Hydrodynamics and Water Resources
Albrechtsen, H., Project Participant, Department of Environmental Science and Engineering
Henze, M., Project Participant, Department of Environmental Science and Engineering

01/04/1995 → 15/08/1998

Project: Research

Activities:

DNA and RNA SIP reveal ammonium and nitrite oxidizers in groundwater fed biofilters
Period: 13 Nov 2017 → 15 Nov 2017
Arda Gülay (Speaker)
Barth F. Smets (Other)
Jane Fowler (Other)
Hans-Jørgen Albrechtsen (Other)
Karolina Tatari (Other)
Department of Environmental Engineering
Water Technologies
Degree of recognition: International

Related event
Nordic Environmental Nucleotide Network, NENUN 2017
13/11/2017 → 15/11/2017
Denmark
Activity: Talks and presentations › Conference presentations

DNA and RNA SIP reveal nitrifiers in groundwater fed biofilters
Period: 13 Nov 2017
Arda Gülay (Other)
Jane Fowler (Other)
Barth F. Smets (Other)
Hans-Jørgen Albrechtsen (Other)
Department of Environmental Engineering
Water Technologies

Description
Poster presentation
Degree of recognition: National

Related event

Danish Microbiological Society: DMS Congress 2017
13/11/2017 → 13/11/2017
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

DRIP Annual seminar 2017
Period: 28 Sep 2017 → 29 Sep 2017
Berit Godskesen (Guest lecturer)
Hans-Jørgen Albrechtsen (Guest lecturer)
Department of Environmental Engineering
Urban Water Systems

Description
Annual seminar in the DRIP project (Danish Partnership for Resource and Water efficient industrial food production)
Degree of recognition: National

Related organisation

DRIP Annual seminar 2017
Berit Godskesen (Guest lecturer), Hans-Jørgen Albrechtsen (Guest lecturer)
28 Sep 2017 → 29 Sep 2017
Activity: Talks and presentations › Conference presentations

Microbial processes in rapid sandfilters - removal of ammonium and organic micropollutants (pesticides)
Period: 8 Mar 2017
Hans-Jørgen Albrechtsen (Invited speaker)
Department of Environmental Engineering
Urban Water Systems
Degree of recognition: International

Related event

New Technologies and Innovative Solutions in the Danish Water Sector
07/03/2017 → 08/03/2017
Tallinn, Estonia
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Miljøteknisk Topmøde
Period: 2 Feb 2017
Hans-Jørgen Albrechtsen (Participant)
Department of Environmental Engineering

Description
Miljøteknisk Topmøde

Related event

Miljøteknisk Topmøde: Vintermøde (Branchezoreningen Dansk Miljøteknologi)
02/02/2017 → 02/02/2017
Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.
Miljøteknisk Topmøde
Period: 2 Feb 2017
Hans-Jørgen Albrechtsen (Participant)
Department of Environmental Engineering
Urban Water Systems

Description
Drikkevand - er den danske holdning til vandbehandling tidssvarende?

Related event
Miljøteknisk Topmøde: Vintermøde (Branchezoreningen Dansk Miljøteknologi)
02/02/2017 → 02/02/2017
Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

Danske Vandværker, Temalørdag, Hotel Falster, Nykøbing F
Period: 26 Nov 2016
Hans-Jørgen Albrechtsen (Participant)
Department of Environmental Engineering
Urban Water Systems

Related event
Danske Vandværker, Temalørdag, Hotel Falster, Nykøbing F
Nykøbing F, Denmark
Activity: Attending an event › Participating in or organising a conference

Danske Vandværker, Temalørdag, Roskilde
Period: 12 Nov 2016
Hans-Jørgen Albrechtsen (Invited speaker)
Department of Environmental Engineering
Urban Water Systems

Description
Fordele og ulemper ved forskellige blødgøringsteknologier på vandværket

Related event
Danske Vandværker, Temalørdag, Roskilde
Roskilde, Denmark
Activity: Talks and presentations › Guest lectures, external teaching and course activities at other universities

Environmental Protection and Urban Water Systems
Hans-Jørgen Albrechtsen (Invited speaker)
Department of Environmental Engineering
Urban Water Systems

Related event
Chinese Mayors Training Programme
31/10/2016 → 04/11/2016
Copenhagen, Denmark
DRIP Workshop
Hans-Jørgen Albrechtsen (Speaker)
Department of Environmental Engineering
Urban Water Systems

Description
Feasibility of Direct Potable Reuse in California

Related event

IWA World Water Congress & Exhibition
Hans-Jørgen Albrechtsen (Speaker)
Department of Environmental Engineering
Urban Water Systems

Description
Optimizing nitrification in biological rapid sand filters for drinking water production

Related event

IWA World Water Congress & Exhibition: Shaping Our Water Future
09/10/2016 → 14/10/2016
Brisbane, Australia
Activity: Talks and presentations › Conference presentations

Description
Towards the development of an automated ATP measuring platform to monitor microbial quality of drinking water

Related event

IWA World Water Congress & Exhibition: Shaping Our Water Future
09/10/2016 → 14/10/2016
Brisbane, Australia
Activity: Talks and presentations › Conference presentations

DWF Gå-hjem-møde: Aktuelle forsknings- og innovationsinitiativer og calls på vandområdet
Period: 10 Mar 2016
Hans-Jørgen Albrechtsen (Speaker)
Department of Environmental Engineering
Urban Water Systems

Description
Opening speaker and chairman

Related event

DWF Gå-hjem-møde: Aktuelle forsknings- og innovationsinitiativer og calls på vandområdet
10/03/2016 → 10/03/2016
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

Tilsætning af spormetaller stimulerer nitrifikation i sandfiltre
Period: 17 Nov 2015
Hans-Jørgen Albrechtsen (Keynote speaker)
Department of Environmental Engineering

Related event

Dansk Vand Konference 2015
17/11/2015 → 18/11/2015
Aarhus, Denmark
Activity: Talks and presentations › Conference presentations

Risikofaktorer i spildevand og sygdomsrisko ved oversvømmelser
Period: 5 Oct 2015
Hans-Jørgen Albrechtsen (Invited speaker)
Department of Environmental Engineering

Related event

sygdomsrisko ved oversvømmelser og skybrudssikring
05/10/2015 → 05/10/2015
København, Denmark
Activity: Talks and presentations › Conference presentations

Biological rapid sand filters - optimizing nitrification
Period: 30 Sep 2015
Hans-Jørgen Albrechtsen (Keynote speaker)
Department of Environmental Engineering
Urban Water Engineering

Related event

3rd NordicRAS Workshop on Recirculating Aquaculture Systems
30/09/2015 → 01/10/2015
Molde, Norway
Activity: Talks and presentations › Conference presentations

Dialogmøde om disruptive teknologiers indflydelse på infrastrukturen
Period: 23 Sep 2015
Hans-Jørgen Albrechtsen (Panel member)
Department of Environmental Engineering
Urban Water Engineering

Related event

ATV Dialogmøde om disruptive teknologiers indflydelse på infrastrukturen
Panel Debate: Sustainable Urban Transformation
Period: 11 Sep 2015
Hans-Jørgen Albrechtsen (Panel member)
Department of Environmental Engineering

Related event

Chinese Mayors Training Programme
07/09/2015 → 11/09/2015
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

Environmental Protection and Urban Water Systems
Period: 10 Sep 2015
Hans-Jørgen Albrechtsen (Invited speaker)
Department of Environmental Engineering

Related event

Chinese Mayors Training Programme
07/09/2015 → 11/09/2015
Copenhagen, Denmark
Activity: Talks and presentations › Conference presentations

150 year jubilee for Environmental Engineering at DTU
Period: 27 Aug 2015
Hans-Jørgen Albrechtsen (Chairman)
Department of Environmental Engineering

Description
Water in the City: Water Fit for Purpose: Seminar 7

Related event

150 year jubilee for Environmental Engineering at DTU
27/08/2015 → 27/08/2015
Kgs. Lyngby, Denmark
Activity: Attending an event › Participating in or organising workshops, courses, seminars etc.

What is the right water quality for the given purpose?
Period: 27 Aug 2015
Hans-Jørgen Albrechtsen (Keynote speaker)
Department of Environmental Engineering

Related event

150 year jubilee for Environmental Engineering at DTU
27/08/2015 → 27/08/2015
Kgs. Lyngby, Denmark
Activity: Talks and presentations › Conference presentations

IWA Specialized Conference: Biofilms in Drinking Water Systems: from Treatment to Tap
Period: 26 Aug 2015
Hans-Jørgen Albrechtsen (Organizer)
As moderator giving a summary of the discussion.

Related event

IWA Specialized Conference: Biofilms in Drinking Water Systems: from Treatment to Tap
23/08/2015 → 26/08/2015
Arosa, Switzerland
Activity: Attending an event › Participating in or organising a conference

IWA Specialized Conference: Biofilms in Drinking Water Systems: from Treatment to Tap
Period: 26 Aug 2015
Hans-Jørgen Albrechtsen (Chairman)
Department of Environmental Engineering

Description
Biological rapid sand filtration in drinking water treatment: Insights, controls, potentials, limitations: Roundtable Discussion

Related event

IWA Specialized Conference: Biofilms in Drinking Water Systems: from Treatment to Tap
23/08/2015 → 26/08/2015
Arosa, Switzerland
Activity: Attending an event › Participating in or organising a conference

Campylobacter - findes andre steder end i kyllinger. Urbant vand.
Period: 27 Apr 2015
Hans-Jørgen Albrechtsen (Invited speaker)
Department of Environmental Engineering

Related event

One Health Forum: Tværministerielt Forum
27/04/2015 → 27/04/2015
2860 Søborg, DTU FOOD, Denmark
Activity: Talks and presentations › Conference presentations

Press clippings:

Stort fokus på branchens vækstpotentiale ved VandTek
Hans-Jørgen Albrechtsen
10/10/2016
Department of Environmental Engineering, Urban Water Systems
Media contribution (1)

**Stort fokus på branchens vækstpotentiale ved VandTek**
10/10/2016
DanskVAND, Print
Hans-Jørgen Albrechtsen
Department of Environmental Engineering, Urban Water Systems
Press/Media: Press / Media

**Bacteria Monitoring in 3D**
Hans-Jørgen Albrechtsen
01/01/2016

**Description**
Article on new 3D monitor that DTU Environment (Hans-Jørgen Albrechtsen) is collaborating on with Grundfos and HOFOR A/S. Published in Water online August 10, 2016
Department of Environmental Engineering, Urban Water Systems

Media contribution (1)

**Bacteria Monitoring in 3D**
01/01/2016
Water Online, Web
Hans-Jørgen Albrechtsen
Department of Environmental Engineering, Urban Water Systems
Press/Media: Press / Media