Composition of municipal solid waste in Denmark

In response to continuous pressure on resources, and the requirement for secure and sustainable consumption, public authorities are pushing the efficient use of resources. Among other initiatives, the prevention, reduction and recycling of solid waste have been promoted. In this context, reliable data for the material and resource content of waste flows are crucial to establishing baselines, setting targets and tracking progress on waste prevention, reduction and recycling goals. Waste data are also a critical basis for the planning, development and environmental assessment of technologies and waste management. These data are obtained through the characterisation of waste material. In the absence of standardised and commonly accepted waste sampling and sorting procedures, various approaches have been employed, albeit they limit both the comparability and the applicability of results. Thus, waste sampling and sorting procedures, as well as a consistent and transparent waste-naming system, have been developed.

Classical statistics are applied increasingly when analysing waste data, in order to draw conclusions that underpin the development of waste legislation and policy. The existing statistical techniques ignore the inherent properties of waste data, which are "closed data," because the percentage or the mass of individual fractions are positive and add up to a constant. This constant constraint affects statistical analysis seriously and results in erroneous interpretations. Therefore, compositional analysis techniques have been introduced to analyse waste data more appropriately.

Waste was sampled directly from source, in order to attribute the waste data accurately to the geographical areas and types of household generating the waste. Sampling and contamination errors were minimised by avoiding sieving and the mass reduction of waste before manual sorting. Consequently, the waste was collected without compacting. Additionally, the entire sample was manually sorted into 10-50 waste fractions organised according to a three-level approach. This detailed waste fractions list facilitated the comparison of waste data with various objectives.

Analysis revealed that Danish residual household waste constitutes mainly food waste (42 – 45% mass per wet basis). Misplaced recyclable materials in residual waste bins, such as paper, board, glass, metal and plastic, amounted to 20% (mass per wet basis) of residual household waste. Moreover, special waste, such as hazardous waste, batteries and WEEE, was also misplaced in residual household bins, accounting for 0.4-0.8% of the total. Although the proportion of misplaced special waste was relatively small, these material fractions can have dire impacts on the environment when they are not disposed of appropriately.

Statistical analysis indicated that separating food waste residue from packaging during waste sorting was unnecessary, because this separation did not significantly influence overall waste composition, the percentage of food waste or packaging waste fractions. Furthermore, the difference in waste composition between municipalities was not significant. These results suggest that waste composition data obtained from one municipality could be applied to other municipalities in the same area (provided that municipalities share the same source segregation scheme), although socio-economic aspects between municipalities were not analysed.

Food waste consists of avoidable and unavoidable food waste. Here, “avoidable” food waste is defined as food that could be eaten but instead was thrown away regardless of the reason, whereas “unavoidable” food waste is food that would not be edible under normal circumstances (e.g. bones, banana peel, etc.). Food waste was estimated at 183 kg per household per year (86 kg per person per year), of which 103 kg per household (48 kg per person) per year was avoidable food waste and 80 kg per household (38 kg per person) per year was unavoidable food waste. These food waste fractions occurred in most of Danish households, which suggests that initiatives to reduce avoidable food waste should be combined with policies that promote the efficient treatment of unavoidable food waste, to ensure plant nutrient and resource recovery.

The mass of avoidable food waste discarded per household increased in line with household size. However, there was no statistical evidence that a household containing one person throws away more avoidable food waste per person than households containing more than one person. This suggests that campaigns and initiatives targeting food waste reduction should particularly aim at households containing more than one person.

Additionally, the mass of avoidable and unavoidable food waste per household and per person discarded in Danish houses was significantly influenced neither by periodic variation nor by geographical variations.

Waste analysis from kitchens in office areas showed that food waste generation amounted to 23 kg per employee per year, of which 20 kg per employee was source-segregated. This suggests that only 11% of food waste was misplaced in residual waste, which itself amounted to 10 kg per employee per year and consisted of 29% paper, 23% plastic and 24% misplaced food waste. Thus, sorting efficiency was estimated at 89% of food waste, accompanied by extremely high purity (99%). These results indicate that the 60% recycling target formulated by the Danish Government for food waste generated by the service sector should be achievable.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Edjabou, M. E., Astrup, T. F., Scheutz, C.
Number of pages: 152
Publication date: 2016

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