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Unleashing the power in waste

Comparison of Greenhouse gas and other Performance Indicators for Waste-to-Energy concepts and Landfilling

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Abstract

A CO_2-evaluation is made for landfill and Waste-to-Energy (WtE) concepts.
Different concepts are identified and compared for their performance on energy and materials recovery. ***Performance indicators for WtE*** *are compared; like energy efficiency, EXergy efficiency, the R1-D10 formula from the EU Waste Framework directive, and CO_2-emission and avoidance.*

It is shown that, due to the biomass content and the avoidance effect due to the recovery of energy and materials, conventional WtE has a near zero CO_2-emission per ton of waste. Optimised WtE can have a significant ***negative overall emission*** *of 200-300 $kgCO_2$/ton of waste. This means an absolute net avoidance of CO_2 by WtE. The reduction relative to land filling is as much as 500-1200 $kgCO_2$/ton of waste. The potential for optimisation of the energy recovery as well as the material recovery of the WtE infrastructure is demonstrated.*

If WtE is evaluated as a power plant, an optimised plant can have an emission of only 0,336 $kgCO_2$/kWh, lower than a gas fired electrical power plant, and this absolute figure does not include the avoided landfill emissions. With CHP this can be reduced even further.

The actual potential of electricity production from WtE for the EU-15 is calculated to be over 7,5% of total electricity production. Additionally heat and the metal recoveries could be doubled.

1 Introduction

Waste is mainly dealt with as a problem of hygiene and other health related risks. The potential of waste as a resource is seldom taken as the starting point for waste management regulations. Until recently WtE was principally designed around the paradigm *"design to be clean"*, designed to minimize the quantity and the (negative) effect of its emissions. There is however a new and strong tendency to develop a new generation of WtE that are *"designed for output"*, maximising the recovery of energy and materials. This requires new evaluations of the effects of the outputs of WtE.

In this study the calculations for the Green House Gas (GHG) evaluation are) compared with some other performance indicators. Eight cases are defined and evaluated with all performance indicators.

The study is focussing on the residual Municipal Solid Waste (MSW) and similar commercial waste, difficult streams that remain after all other possibilities of the waste hierarchy are exhausted. For this waste, the normal choices are landfilling or combustion (incineration) in Waste-to-Energy (WtE) plants. Of course incineration should only be considered as the alternative for landfilling. Only an effective outlet for the difficult material will allow breaking the impossible competition of Reuse, Recovery and Recycling (RRR) with low landfilling prices. This is so, because of the relative high price, WtE is never a competitor to RRR. But by avoiding the cheap outlet to landfilling it is an effective stimulus for RRR. This is also shown by the data of countries in EU where a high RRR is corresponds perfectly with the installed waste-to-energy capacities [1] [2].

The many variations in mechanical sorting of residual MSW are not dealt with in this note. They can be considered as combinations of partial landfilling, partial WtE (e.g. in the form of RDF), and some other processes like biological drying, composting or digestion (biological materials) and reuse of specific fractions (e.g. iron, aluminium, plastics). Their