Energy efficiency in mechanical biological treatment plants

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Since June 1st 2005, in accordance with the German landfill ordinance ("DepV"), mixed municipal solid waste (MMSW: municipal solid waste without separate collected waste) has to undergo thermal or mechanical biological treatment before qualifying for final disposal on landfills.

In Germany, currently 46 mechanical biological treatment (MBT) plants with a total capacity of about 7.5 million Mg/a are in operation. Nearly 35 % of the MMSW is treated in such plants (ASA, 2015). The construction of the MBT plants was significantly affected by the 30th Ordinance of the Federal Emission control ("30. BImSchV"). Due to the ordinance the exhaust air of MBT plants has to be collected and treated. This ordinance includes amongst others limit values for dust, carbon and nitrous oxide emissions from MBT plants. Especially the limit value for carbon freight, which is limited by 55 $g/Mg_{InputMBT}$, forces MBT operators to use exhaust air treatment units with a high energy consumption. To comply with the limit values set out by the ordinance the exhaust air is treated mainly by a combination of biofilter and regenerative thermal oxidation units (RTO).

RTO units are not designated for the exhaust air treatment of MBT plants, which exhibits very low levels of organic contaminants hampering the autothermal catalytic oxidation. Additional exothermic energy is needed resulting in an increased natural gas consumption. The application of RTO units leads to the unsatisfying situation, that nearly 65 % of the total energy consumption of the process is sourced from natural gas for exhaust air treatment (Figure 1).

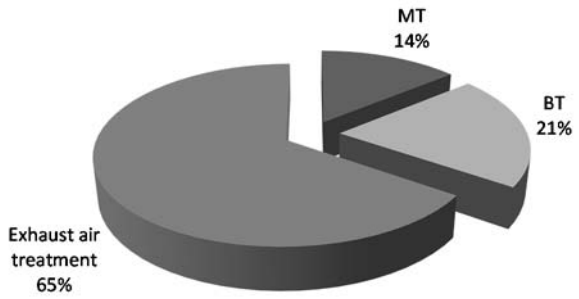

Figure 1: Distribution of specific energy consumption of MBT Großefehn in 2012

This has motivated the German Federal Ministry of Economics and Energy (BMWi) to fund the national 3-year collaborative research project "Energieeffiziente Abluftbehandlung - EnAB" (Energy-efficient Exhaust Air Treatment). EnAB started in August 2012 and finished in July 2015. The research took place in an operating MBT plant in northern Germany with an annual capacity of approximately 60,000 Mg. The input of the plant mainly consists of domestic waste. The MBT Großefehn is a classical aerobic MBT plant, which has a mechanical (MT) and a biological (BT) treatment part.

EnAB aimed at increasing the energy efficiency in exhaust air treatment by using an alternative exhaust treatment unit in a real-scale application. The modifications of operational settings in the mechanical as well as biological part have been studied in the project. Early-stage results indicate optimization potential of energy needed in BT for ventilation of rotting boxes by changing bulk parameters (modifications in MT and BT). The Influence of changed bulk parameters on energy consumption was also evaluated in a real-scale application. Partly modifications in the MT, BT and in the exhaust air treatment led to an approximately 13 % lower energy consumption.

Based on the results of EnAB the BMWi decided to fund the follow-up project "EnAB 2", which started in November 2015. EnAB 2 also aims at increasing the energy efficiency in MBT plants. In EnAB 2 additionally the impacts of a continuous feeding on the energy efficiency will be studied. Furthermore in EnAB 2 the chosen alternative exhaust air treatment unit in EnAB will be applied and evaluated in the whole MBT plant.

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