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SIGNIFICANCE OF BIOLOGICAL TREATMENT IN MUNICIPAL SOLID WASTE MANAGEMENT

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Municipal solid waste (MSW) contains a certain share of biodegradable compounds. In industrialised countries this share in average is approx. 25-30 % WM. In low income countries and those with increasing economy the average share is 50 % up to 80 % in some regions. By the anaerobic conditions in landfills these biodegradable compounds decompose into landfill gas and leachate. Approx. 90 % of the degradable carbon compounds are transferred into landfill gas, which is a mixture of mainly methane (CH_4, approx. 60 Vol.%) and carbon dioxide (CO_2, approx. 40 Vol.%). 10 % of the degradable carbon compounds get dissolved and leave the landfill by the leachate (together with many organic and inorganic pollutants).

The impact of CH_4 to greenhouse-effect is 27 times stronger than the effect of CO_2 (IPCC, 2013). Since landfills are the 3rd largest source of anthropogenic methane emissions (after rice production and cattle) the EU in 1999 started to reduce biogenous wastes from landfills. In the landfill directive (CD, 1999) a graduated scheme for reduction of biogenous wastes was set into effect. A 25 % reduction of landfilled biogenous wastes (compared to the amount in 1995) was target for 2006, 50 % for 2009 and 65 % for 2016. These targets were defined by the European Council - the way how to meet them, is to be chosen by the member states. Possible ways are avoidance, composting or digestion, biological pre-treatment and incineration.

Mechanical biological treatment of MSW. Austria already 1996 decided to ban landfilling untreated wastes (BGBl. Nr. 164/96). Again it was a graduated scheme – since 2004 it is forbidden to landfill waste with a content of total organic carbon (TOC) higher than 5 % DM. For MSW this limit can be met only by incineration. But there is an exception for mechanically biologically treated (MBT) wastes which have to be characterised by their reactivity. Limited parameters for MBT-wastes are Respiration Activity (RA_4 < 7 mg O_2/g DM) and Gas Generation (GS_{21} < 20 Nl/kg DM).

MBT combines mechanical and biological treatment steps. During mechanical treatment of MSW a thermal valuable fraction (sometimes also recyclables) is separated by screening, magnetic separation, air separation, ballistic separation etc.. For biological treatment aerobic or a combination of anaerobic/aerobic technique is used. Anaerobic processing always needs a following aerobic process. Otherwise the limits for reactivity parameters cannot be met. In Austria the first step of aerobic treatment (intensive phase) is to be done in enclosed systems in order to catch and treat emissions. After 4 weeks of intensive phase, or until a RA_4 < 20 mg O2/g DM is archived, further stabilisation takes place in open windrow systems. After 10 to 16 weeks of rotting the limit values for AT_4 and GS_{21} will be reached.

Currently (2015) in Austria 14 MBT-plants are in operation (BAWP. 2017). Approx. 440,000 t of MSW were transformed into 340,000 t of thermal fraction, 7,000 t recyclables and 91,000 t of landfill fraction (the difference is loss of degradation and water).

Composting of source separately collected bio-wastes. Composting is a well approved technology. Already in the 70ies of the last century in Austria composting plants for

mixed MSW were installed. Compost quality aspects (MSW is highly polluted by organic and inorganic pollutants like e.g. heavy metals) necessitated a source separate collection of biogenous waste fractions (the use of mixed waste compost in agriculture is not allowed in Austria any longer). Thus in Austria in 1995 the Bio-Waste Ordinance was set into effect (BGBl. Nr. 456/1994). Since 1995 Austrian households are forced to separate biogenous wastes. These biogenous wastes are collected separately and transported to composting or digestion plants. Thus these biogenous wastes never will end up in a landfill. Furthermore high quality fertiliser/soil-improver is produced which helps to close the nutrient cycle. Additional stable organic matter is added to the soil because during aerobic treatment humic compounds are synthesised. Enhancing the organic matter of soils is another very important topic for Europe. Approx. 45 % of European soils (in southern countries it up to 75 %) are poor in organic matter (TOC < 2 % DM); there is already the riskr of desertification.

In composting plants mechanical treatment is necessary to establish optimised conditions for microbial degradation. Yard wastes are shredded and mixed carefully with bio-wastes from households. Mixing the different types of biogenous wastes – if necessary also water is added - is essential for supply with nutrient (C/N-ratio) and oxygen (structure stability and pores to allow convective air-flow). During intensive degradation heat is produced by the microbes (temperature increases to 60 – 70 °C) which allows proper sanitisation. Minimum in weekly intervals the rotting material is turned (loosened and homogenised, if necessary also water is added) by special turning machines. During maturation (after approx. 6-8 weeks) turning frequency is reduced. After humification process is finished, the material is sieved through 8-20 mm mesh. The fines are used as compost, the coarse fraction may be used as structure material for the next batch or is disposed of.

Composting in Austria is managed decentralised. Most plants are operated by farmers, who compost their agricultural wastes (e.g. manure) together with biogenous wastes from settlements nearby. The produced compost mainly is applied at the own fields. Most of these very small plants use open windrow technique. Commercial plants working on larger scale, also prefer open windrow technique (the City of Vienna processes approx. 140,000 t of biowaste per year). Only few of them use enclosed, forced aerated composting systems. Related to compost quality, both systems – when run in a proper way – lead to similar results.

In 2015 approx. 1.14 Mio. t of source separately collected biogenous wastes (household, gardens, parks), in 400 composting plants were transformed into 340,000 t of high quality compost. Approximately 150,000 t of residues (mainly residues from sieving process) were treated. The difference (more than 50 % relating to Input) is loss of degradation and water (BAWP, 2017).

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