Mechanical-biological Treatment of Waste in Austria: Current Developments

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Aktuelle Entwicklungen im Bereich der mechanisch-biologischen Abfallbehandlung (MBA) in Österreich

Abstract

The current development in the field of the mechanical-biological treatment of municipal and industrial wastes in Austria is a clear indication of the rising importance of this form of waste treatment. In the beginning of the year 2007, 17 mechanical-biological treatment plants were in operation with a treatment capacity of approximately 686,500 tons. Two more facilities were being planned. This means that Austria has made a successful step in the direction of decentralized facilities for the pre-treatment of waste before landfill as much before incineration. The mechanical-biological treatment of waste and of municipal waste in particular is now firmly established as an alternative and complementary method to thermal treatment.

The rapid developments in Austria require a higher level of standardization for the operation of mechanical-biological treatment plants than provided for in the Landfill Ordinance, in order to be able to cut emissions into environmental media or to control them. A first step in this direction was already made in Austria in 2002 when a guideline was issued on the mechanical-biological treatment of waste. This guideline specifies a standard state-of-the-art technology and is intended to provide orientation for all parties concerned (especially planners, plant applicants and authorities).

The documented results from investigations on 16 MBT plants in the year 2006 show that adaptation according to the state-of-the-art technology have been achieved only to a limited extent. Particularly need for action can be seen for the requirements concerning collection, reduction and cleaning of emissions into air. This is why a binding legal regulation (according to § 65 (1) of the Austrian Waste Management Law 2002 as amended) is recommended which would provide a suitable instrument in order to speed up the implementation of standard state-of-the-art technology as stipulated in the national guideline on the mechanical-biological treatment of waste.

Keywords

Mechanical waste treatment, biological waste treatment, mechanical-biological treatment, waste treatment in Austria, treatment of municipal waste, preparatory waste treatment.

1 Developments in Austria

The waste industry in Austria was decisively shaped in the last years by the guidelines of the landfill directive (BGBl. [Federal Law Gazette] No. 164/1996 version of BGBl. II No. 49/2004). In order to comply with the requirements of the landfill directive, most of the waste – particularly municipal wastes and similar commercial wastes (residual waste) – has to be treated thermally or mechanical-biologically before landfilling. Through this pre-treatment, the volume and gas-building potential of the waste disposed of is considerably reduced so that the landfill volume is cut down and the efforts for the follow-up treatment of the landfill body is reduced. The climate-relevant greenhouse gas methane (CH4) issueing from the landfill bodies is also being reduced considerably by the intensified treatment.

Wastes which were mechanical-biologically pre-treated may exceed the limiting value of five mass percent TOC, if the upper calorific value falls below the limiting value of 6,000 kJ/kg TS (in special cases 6,600 kJ/kg TS). Furthermore, mechanical-biologically pre-treated wastes before deposit must observe the limiting values of the stability parameters for proving the biological stabilisation and the emission standards for mass-waste landfills. These requirements ensure that only low reaction wastes are being deposited and that high calorific value fractions are being used for energy generation.

With the guideline for the mechanical-biological treatment of wastes (MBT Guideline), a unified state of the art in the form of requirements for an environmentally compatible operation of MBT plants was provided as early as 2002 by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.

In order to evaluta whether and to what extent the requirements of the MBT Guideline are already being taken into account in the operation of MBT plants, a census on the current status of MBT in Austria was taken in 2006 by the Federal Environmental Agency in cooperation with the Federal Ministry of Agriculture, Forestry, Environment and Water Management. Data concerning the amount of waste, plant operation and procedure and restrictions from notifications of permission were surveyed with as much detailing as possible and released in a publication of the Federal Environmental Agency with the title “Status quo of the mechanical-biological treatment of waste in Austria – Status report 2006” (download at: http://www.umweltbundesamt.at/mba).

2 Plant locations und capacities in Austria

Table 1 Capacities concerning the MBT of municipal and similar commercial wastes in the year 2007.

Location	Federal State	Treatment since	Input 2007[1]	capacity 2007[2] (t/a)
Aich-Assach	Steiermark	1977	RW, CW, SS, BW	15,250
Allerheiligen	Steiermark	1979	RW, SS, BW	17,100
Fischamend	Niederösterreich	1997	RW, CW, BW	27,000
Frohnleiten	Steiermark	2004	RW, SS	65,000
Frojach-Katsch	Steiermark	1981	RW, BW	4,000

Halbenrain	Steiermark	2004	RW, CW, SS, BW	70,000
Kufstein	Tirol	1995	RW, BW	9,500
Lavant	Ost-Tirol	2006	RW, CW, SS, BW	17,000
Liezen	Steiermark	2004	RW, CW, BW	25,000
Linz	Oberösterreich	2004	RW	65,000
Neunkirchen	Niederösterreich	1985	RW, CW, BW	28,500
Oberpullendorf	Burgenland	1978	RW, SS, BW	82,000
Ort im Innkreis	Oberösterreich	1976	RW, BW	15,000
Siggerwiesen	Salzburg	1978	RW, CW, BW	140,000
St. Pölten	Niederösterreich	2005	RW, CW, BW	42,000
Wiener Neustadt	Niederösterreich	2005	RW, BW	24,000
Zell am See	Salzburg	1978	RW, CW, SS, BW	40,000
Sum capacity				**max. 686,350**

[1] RW: residual waste (municipal and similar commercial wastes), CW: commercial wastes, SS: sewage sludges, BW: bulky waste; Apart from the input fractions mentioned, further biologically treatable wastes might be introduced to the mechanical-biological treatment according to the MBT-guideline.

[2] Capacities according to the respective operating method or stage of expansion; capacities for processing separately collected biogenous wastes which are processed in separate procedural processing lines in the plant (composting) are not contained in the mentioned capacities.

The new legal requirements with regard to an obligatory pre-treatment of municipal wastes and similar commercial wastes (residual waste) before deposit did not only lead to an adaptation of the old sites, but also to the building of new plants, however, all MBT plants are equipped with exclusively aerobic process technology. Table 1 shows the MBT plans operating at the beginning of the year 2007 with their capacities. Since apart from municipal and similar commercial wastes also other biologically treatable wastes are being introduced into an MBT plant, not the entire capacity of an MBT plant is available for the processing of municipal and similar commercial wastes.

With a total capacity of 686.350 tons, the aerobic mechanical-biological waste treatment, particularly that of municipal wastes, has been established as an alternative and accompanying pre-treatment procedure to the thermal treatment.

3 Appraisal of the status quo

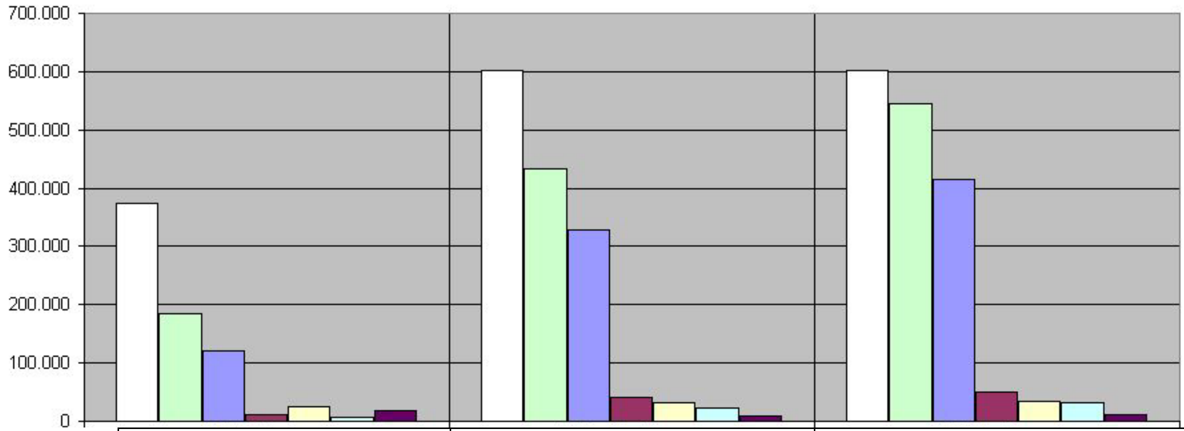
In order to evaluate if and to what extent the requirements of the MBT guideline are already being taken into account in the operation of MBT plants, a census was taken on the current status of MBT in Austria through inspections of plants and intensive contact with the plant operators. 16 MBT plants operating in the year 2006 were presented with as much detailing as possible. By means of the presentation of the status quo, the recent and still outstanding adaptations to the state of the art of the MBT guideline could be evaluated. The results were published in a status report concerning the MBT in Austria (http://www.umweltbundesamt.at/mba). Some of the most essential results from the report are being presented in the following.

3.1 Processed amounts of waste

Balancings of altogether 13 MBT plants could be issued, in which all essential in- and output waste amounts and in many cases also the amounts of exhaust air could be collected. In the year 2003, only eight plants, from the year 2004 all 13 MBT plants were operated. The utilisation of the 13 balanced MBT plants (i.e. the ratio between the total input to the capacity) was 91 % in the year 2005, whereas a further rising utilisation due to the growing full-load working of MBT plants that have only recently been put into operation can be anticipated.

As far as the total input is concerned, there was an increase of 184,543 tons in the year 2003 (eight balanced MBT plants) to 544,230 tons in the year 2005 (13 balanced MBT plants). The quantitative relation of the processed waste input fractions with regard to the total input changed particularly drastically from the year 2003 to the year 2004. The change from the year 2004 to the year 2005, however, was relatively small.

Figure 1 shows the waste fractions placed in the balanced MBT plants for processing in the years 2003, 2004 and 2005 compared to the capacity of the MBT plants.



	2003 (8 plants)	2004 (13 plants)	2005 (13 plants)
Capacity	372,850	600,850	600,850
Total	184,543	433,984	544,230
Residual waste	120,391	327,541	413,981
Comm. waste	11,760	41,216	50,808
Sewage sludge	26,064	33,035	34,085
Bulky waste	7,573	23,536	32,829
Misc. wastes	18,754	8,445	12,527

Figure 1 Processed waste amounts in the MBT plants 2003-2005 in tons.

Input of residual waste (municipal and similar commercial waste) as the quantitatively most relevant waste input fraction increased from approx. 65 % or 120,391 tons in the year 2003 (for eight balanced MBT plants) to approx. 76 % or 413,981 tons in the year 2005 (13 balanced MBT plants). The amount in the year 2005 equals roughly 68 % of the total capacity of 600,850 tons of the 13 balanced MBT plants.

As another quantitatively relevant waste fraction mixed commercial wastes from commercial and industrial companies were introduced in the MBT plants. The share of the total input in the period under review slightly increased from approx. 6 % or 11,760 tons in the year 2003 (for eight balanced MBT plants) to approx. 9 % or 50,808 tons in the year 2005 (for 13 balanced MBT plants).

The amount of sewage sludges, however, shows a downward trend. It decreased from approx. 14 % in the year 2003 (for eight balanced MBT plants) to approx. 6 % in the year 2005 (for 13 balanced MBT plants), the predominant share of the processed sewage sludge (over 90 %) having been stabilised by means of an according pre-treatment already before being placed in the MBT process. Reasons for the proportional decrease are on the one hand the alternative treatment methods for sewage sludge (drying and intensified thermal treatment) which gain momentum and on the other hand the negative consequences of the increased nitrogen input in the rotting process through the sewage sludge (odour problem and ammonia formation).

Due to the capacity increases in the last years, the processed sewage sludges have slightly increased in amount from 26,064 tons in the year 2003 (for eight balanced MBT plants) to 34,085 tons in the year 2005 (for 13 balanced MBT plants).

The share of bulky waste in the total input in the period under review slightly rose from approx. 4 % or 7,573 tons in the year 2003 (for eight balanced MBT plants) to approx. 6 % or 32,829 tons in the year 2005 (for 13 balanced MBT plants). The bulky waste delivered to the plant mostly passes a (pre-) sorting on the location of the plant before the MBT process, where large quantities of contaminants and reusable materials are being discharged.

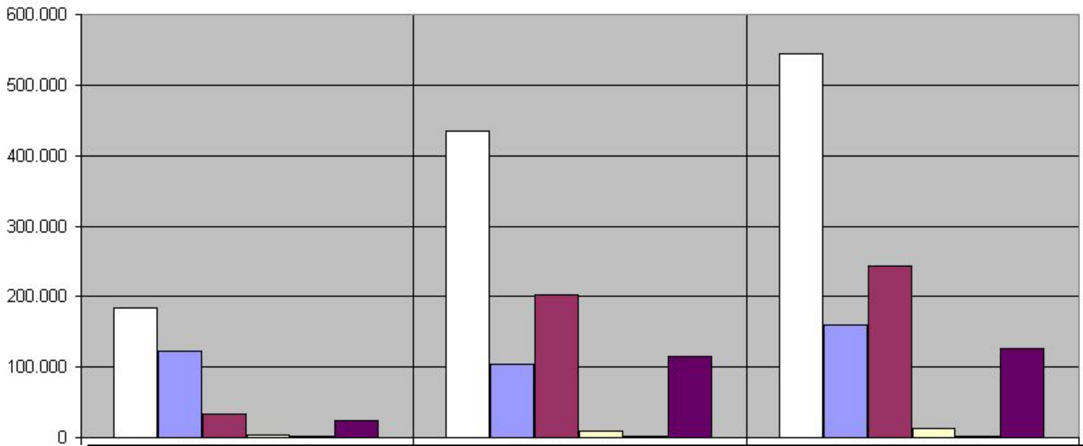
Apart from the quantitatively relevant input fractions, also plastics collected separately, which without exception pass a further sorting in the course of the mechanical processing, residues from the sewer and the waste water treatment, road sweepings, construction and demolition waste and food that has passed its shelf life are placed in the MBT plants. The share in the total input was at 2 % or 12,527 tons in the year 2005 for 13 balanced MBT plants and is thus considerably lower than the share of the year 2003 of appprox. 10 % or 18,754 tons (for eight balanced MBT plants).

3.2 Plant output for further processing

The plant output of an MBT plant depends mainly on the plant's objectives. Depending on the material properties, the output fractions of an MBT plant can be added to landfilling, a further thermal treatment or a material recycling. Figure 2 shows the output fractions and amounts of the years 2003, 2004 and 2005 for the balanced MBT plants, whereas a striking change of the mass relations also for the output fractions similarly to the waste input fractions from the year 2003 to the year 2004 is being discernible.

In the case of a complete balancing the input equals the output. As a difference between fixed in- and output results the rotting loss, which describes the weight reduction caused by biodegradation or by the drying. These mass differences summed up as rotting loss also contain separated contaminants and recyclable materials not considered in the further output of this data collecion.

In the year 2003 the share of the landfill fraction for eight balanced MBT plants was still at approx. 66 %, in the year 2005 only 29 % of the output (of 13 balanced plants) were introduced to landfilling. While in the year 2003 the total landfill fraction did not necessarily comply with the deposit criteria to the landfill directive (calorific value criterion and stability parameter) complementary since 2004, in the year 2005 only a very low percentage of approx. 4 % of the landfill fraction of all balanced MBT plants did not observe these criteria. A deposit of this fraction not observing the calorific value criterion and the stability parameters is only possible in federal states with corresponding derogation (possibility of a derogation for the prohibition of the deposit of certain unprocessed wastes by the issueing of a decree of the competent governor).



	2003 (8 plants)	2004 (13 plants)	2005 (13 plants)
Total in-/-output	184,543	433,984	544,230
landfilling	122,494	104,685	159,476
Thermal treatment	33,829	202,374	242,696
Material recycling	3,511	9,867	13,874
“waste compost” production	1,272	1,739	1,500
Rotting loss	23,436	115,320	126,684

Figure 2 Waste output of MBT plants 2003-2005 in tons

The amounts of the output fractions with high calorific value from the MBT process have considerably increased in the period under review from 2003 to 2005. High calorific fractions are being increasingly discharged throughout the MBT process basically through the deposit criteria (the calorific value criterion among others) and brought to a following thermal treatment.

The amounts for thermal treatment have increased from approx. 18 % or 33,629 tons in the year 2003 (for eight balanced MBT plants) to approx. 45 % or 242,696 tons in the year 2005 (for 13 balanceed MBT plants). This development is a result of the implementation of the landfill directive and clearly shows the increasing management of the residual waste flows (also after the corresponding pre-treatment) in the direction of thermal treatment. Depending on the quality or consistence of the separated fractions with high calorific value, the thermal treatment can take place by means of different firing technologies. Coarse fractions can only by incinerated in grate firing systems. Processed comminuted fractions with high calorific value are preferably being incinerated in fluidized bed combustors. Fractions with a high calorific value and low pollutant load can also be used for the production of refuse derived fuels which can also be incinerated in appropriate firing systems.

The quantitatively largest part of the separated fractions with high calorific value is being treated thermally in fluidized bed combustors, with a high increase of approx. 50 % or 16,852 tons in the year 2003 (of eight balanced MBT plants) to approx. 76 % or 184,995 tons a year in the year 2005 (of 13 balanced MBT plants). Grate firing units generally play a relatively minor role for the treatment of MBT output fractions.

From the year 2004 on, fractions with high calorific value from MBT plants have been used for the first time for the production of refuse derived fuels. The share for the year 2005 for 13 balanced MBT plants was at a low value of 4 % or 9,100 tons seen in relation to the total of the separated fractions with high calorific value.

As output for the material processing, the material flows of plastics, ferrous metals and non-ferrous metals were surveyed. Generally, the output fractions for the material processing make up with 2.5 % or 13,874 tons in the year 2005 (for 13 balanced MBT plants) a very small share as compared to the landfill fraction or fractions that are thermally treated.

It was not always quantifiable which material amounts were separated in the course of presorting or discharge of contaminants and recyclable materials before the introduction into the mechanical-biological treatment process in the plant. Partial amounts of plastics, ferrous metals and non-ferrous metals are thus to be found in the indications of quantity of rotting loss, which was calculated by means of the difference between in- and output. This is why the indications of quantity are always minimal amounts, which were mostly separated in the course of the mechanical processing.

With 0.3 % of all output flows in the year 2005 (of 13 balanced MBT plants), the quantities of produced “waste composts“ altogether play a rather minor role. Waste compost can only be used for the maintenance or production of a landfill restoration layer (except for excavation landfills) or for the building of biofilters, with particularly the labelling and declaration requirements of the Compost Ordinance (BGBl. [Federal Law Gazette] II No. 292/2001) to be observed.

The intensifying and adaptation of the rotting procedure to the state of the art led to an optimization of the aerobic degradation process, which becomes obvious from the increase of the rotting loss from approx. 13 % in the year 2003 (for eight balanced MBT plants) to approx. 23 % in the year 2005 (for 13 balanced plants) in relation to the total input amount. The rotting loss is a measure for the weight reduction in the course of the biological degradation processes.

3.3 Emission-related requirements

The exhaust air from certain processes (storage, mechanical processing and biological treatment among others) is, according to the MBT guideline, to be fed into waste gas cleaning or used as incoming air for the rotting process. In the 16 surveyed MBT plants, the exhaust air flows from three flat and two low bin areas, from four mechanical processing areas before the biological treatment and from two intensive / main decomposition processes with a treatment time of at least four weeks are being discharged into the open air without cleaning or use. Furthermore, exhaust air flows from a drying process, which serves as a pre-treatmnet before a further biological treatment, are being discharged into the open air without cleaning or use. The procedure with a discharge of the exhaust air flows into the open air without cleaning or use does not correspond to the state of the art of the MBT guideline.

As exhaust gas cleaning aggregates, mainly dust filters in the form of bag filters for the exhaust air flows from the mechanical processing are used; altogether seven MBT plants provide for a cleaning of these exhaust air flows with dust filters.

In the surveyed MBT plants different waste gas cleaning aggregates are used for the treatment of exhaust gases from the aerobic biological treatment procedures. Three of the 16 surveyed MBT plants do not clean the exhaust gases from the aerobic biological treatment. Four MBT plants use only a biofilter for exhaust gas cleaning. The method used most often for exhaust gas cleaning, a combination of a scrubber with a biofilter, is applied by seven MBT plants. In one MBT plant, the method of the regenerative thermal oxidation (RTO) in combination with a scrubber and a biofilter is being used. In another one of the 16 MBT plants, the exhaust gas from the aerobic biological treatment is being discharged into the environment over a rotting filter technique.

In the MBT guideline, the limiting values for exhaust gas emissions from the mechanic-biological waste treatment process are being defined. These are to serve the authorities among others as a basis for the approval procedure for MBT plants. Furthermore, the "Reference Document on Best Available Techniques for the Waste Treatments Industries" (European Commission 2005) defines the common emission values for air pollutants of selected parameters (VOC, dust, smell and NH_3) with application of the "best available technique (BAT)". Currently, the restrictions of exhaust gas emissions of the MBT guideline are only being considered to a limited extent in the notifications of permit, which is partly due to the fact that the permits for some MBT plants were issued before the publication of the MBT guideline.

In altogether eight MBT plants, the emissions of exhaust gases are being limited through air emission standards or load restrictions in the conditions of the respective notification of permit. The pollutant parameter "organic substances, stated as total carbon" is limited in six MBT plants, the parameter "nitrogen oxides, stated as nitrogen dioxide (NO_2)" in one (MBT plant with thermal exhaust air cleaning), the parameter "ammonia" in four and the parameters "total dust" and "odorous substances" are limited in eight MBT plants respectively. The limiting values specified by conditions are oriented mainly towards the limiting values of the MBT guideline with, however, occasional strong deviations.

The limiting value as a half-hourly average value for the parameter "organic substances, stated as total carbon" is not defined as strictly as suggested in the MBT guideline (40 mg/Nm^3) in four MBT plants. A limiting value of 150 mg/Nm^3 is stipulated as highest admissible concentration in one MBT plant. In another MBT plant, the limiting value is denoted in accordance with the notification as the parameter "organic substances, stated as total carbon (without methane)" (100 mg/Nm^3, without methane).

The limiting value for the parameter "odorous substances" is being defined more strictly than in the MBT guideline (500 OU/m^3) in three MBT plants, with 100 OU/m^3 being stipulated as the stictest condition in one MBT plant.

4 Summary and prospects

For IPPC treatment plants, an obligation to apply the "best available technique (BAT)" exists already for all new facilities, and from 31st October 2007 at the latest also for all existing facilities (cf. Article 78 § 5 AWG [Waste Management Act] 2002 as amended). It is from this point of time at the latest that an adaptation of IPPC treatment plants to the BAT must have taken place. Plant operators as well as permit authorities are obliged to observe the adaptation within the specified time, with the BAT Reference Document (BREF) "Waste Treatments Industries" (European Commission 2005) also defining the best available techniques (BAT) for the mechanical-biological waste treatment (point 5).

http://eippcb.jrc.es/pages/FActivities.htm.

An adaptation of existing MBT plants that are not obliged to the IPPC Directive to the state of the art and thus an operation of all MBT plants in Austria in accordance with the same conditions can in the authors' estimation only be secured through a binding legal regulation (e.g. with an ordinance). Particularly the restriction of the exhaust gas emissions is, according to the status survey, is still far from a standardization, so that the need for action can be derived with regard to a unified state of the art. With a transition period being taken into account, it should be prevented that MBT plants can be operated e.g with open main decomposition techniques without air suction and purification systems.

The adaptation to the state of the art took place only to a limited extent, as proven by the documented surveys. For this reason, a binding legal regulation (in accordance with article 65 § 1 AWG [Waste Management Act] 2002 as amended) as an appropriate tool is being recommended to accelerate the implementation of a unified state of the art according to the MBT guideline.

5 Literature

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