Mechanical Biological Treatment (MBT)
- Processes and Products -

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Background

- **Waste management in Germany in the 70s**:
  - several thousands of insecure dumps, only few environmentally compatible safe landfills
  - comparably few incineration plants, with low emission standards (dust, dioxin, heavy metals)
- **Political actions**:
  - 1972: Federal Waste Law
  - 1974: Federal Immission Protection Law
  - 1974: Technical Guideline for Clean Air (TA Luft), regulating under others incineration plants
- **New focus on environmental problems in the early 80s**:
  - growing waste amounts, only few material recovery systems
  - emission problems of dumps (odor, leachate, disposal gas, uncontrolled fires)
  - MSWI: high emissions of dioxins and other hazardous substances, low energy recovery rates
- **Political actions** (*at the end of a very long process*):
  - 1990: Ordinance on incineration plants for wastes and similar combustible materials
  - 1993: Technical Guideline for municipal solid waste (TA Siedlungsabfall), with limiting the content of organic compounds in waste going to landfill, which could only be reached by incineration
- **Public discussion asked for alternatives to conventional MSWI**, resulting in
  - new thermal treatment concepts like pyrolysis, Thermoselect, Siemens Schwelbrennverfahren
  - **mechanical biological treatment before disposal**.
- **Political actions**:
  - 1995 to 1999: financing of a great research programme on MBT (about 7 million €)
  - **2001**: Ordinance on Environmentally Compatible Storage of Waste from Human Settlements, in force since march 1st, 2001, **permitting disposal of MBT-output** under certain conditions.

MBT Processes

MBT plants differ in

- **Type of waste input**
  - only domestic waste,
  - all residual wastes,
  - with/without sewage sludge.
- **Facility characteristics**
  - capacity
  - location (landfill, ...)
  - legal status (old/new plant)
  - technical standard, e.g. waste gas treatment.
- **Process steps**
  - mechanical treatment
  - biological treatment
  - physical treatment
  - integrated thermal treatment/energy recovery.
- **Output fractions**
  - ferrous metals scrap
  - non-ferrous metals scrap
  - combustible fraction(s)
  - rot fraction/fermentation residue
  - inert fraction.
- **Object of the output fractions**
  - energy recovery (cement kiln, power plants)
  - thermal treatment in a MSWI,
  - mechanical recycling
  - feedstock recycling
  - disposal on a landfill.

MBT Processes

MAIN CONCEPTS:

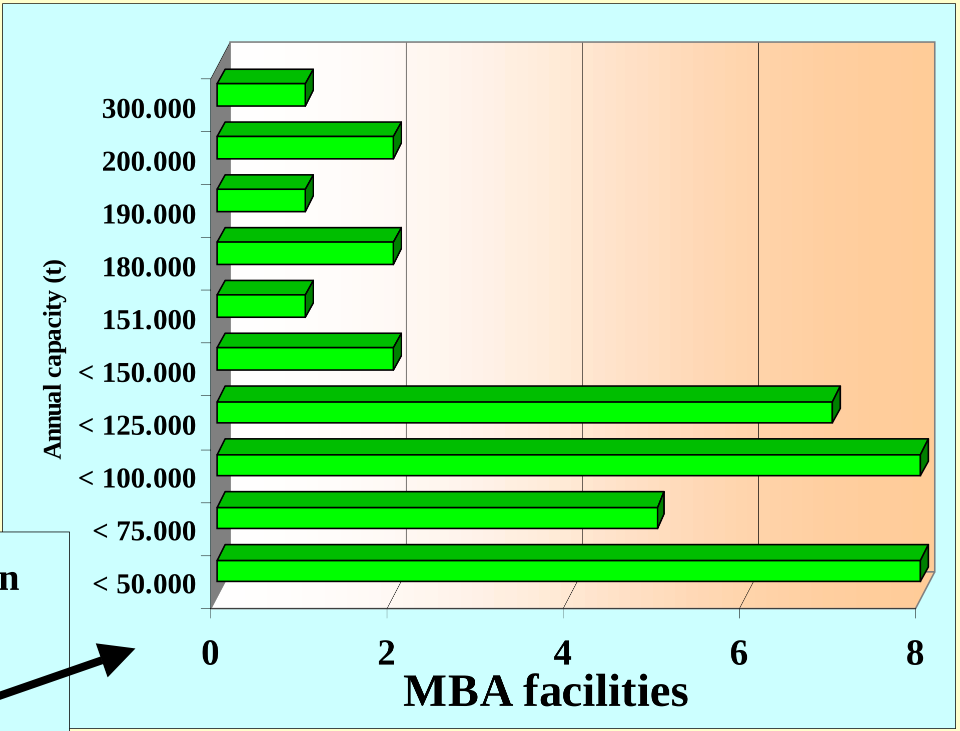
- **MA: Mechanical treatment like shredding, sieving, classification, ferrous and in many cases non ferrous-separation**
- **MBA: Mechanical treatment as in MA, biological treatment of the metal-freed fraction before or after separation of the high calorific fraction in a one or two stage composting or fermentation system. The rot fraction or the fermentation residue is going to landfill.**
- **MBS: Mechanical treatment like shredding, dry stabilization (below 15 % water) by short composting for improving the subsequent mechanical treatment. Only inert material goes to landfill or can be reused.**
- **MPS: Mechanical treatment like shredding, dry stabilization by thermal drying for improving the subsequent mechanical treatment. Only inert material goes to landfill or can be reused.**

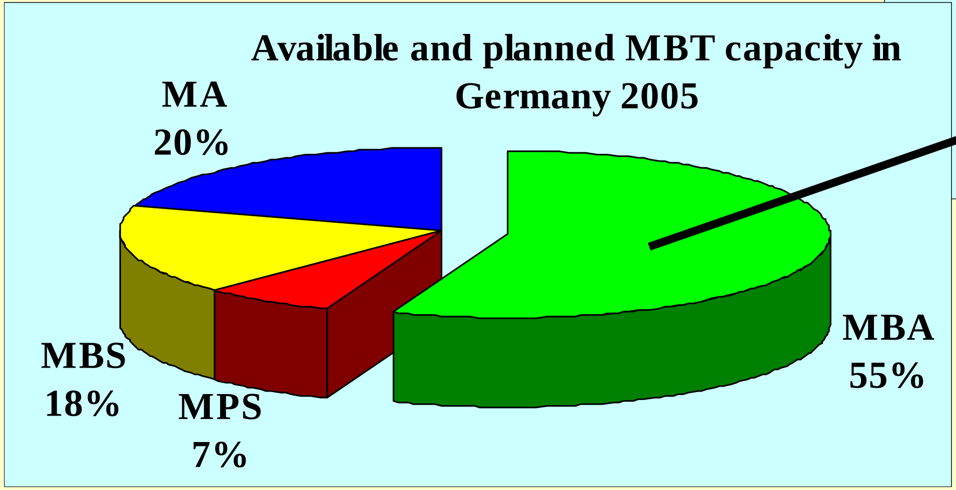
Though **MA** and **MPS** do not include a biological treatment step, they are summarized here under MBT processes. They are regulated by TA Luft No. 5.4.8.11.1.

MBT Processes

Status in Germany 2005:

- Available MBT capacity: 6,12 million t
- Available & planned MBT capacity: 7 million t (64 facilities).





Source: Federal Environment Ministry: **Waste from Human Settlements - Change in German legislation starting.** (1.2.2005) http://www.bmu.de/files/pdfs/allgemein/application/pdf/wastestorage_report.pdf *and* http://www.bmu.de/files/pdfs/allgemein/application/pdf/wastestorage_report_annex.pdf

MBT Products

MAIN PRODUCTS OF MBT PLANTS

Main output streams	MA	MBA	MBS	MPS
Ferrous metal scrap	+	+	+	+
Nonferrous metal scrap	+/-	+/-	+	+
High calorific fraction	+	+	+	+
Inert material	+	included ⇩	+	+
Rot fraction / fermentation residue	-	+	-	-
Biogas (after anaerobic treatment)	-	+/-	-	-

Further separation steps can lead to additional output streams:

- **separation of high calorific fraction in further fractions for different recipients, a fraction with very high calorific value for e.g. cement kilns or power plants and a fraction with a lower calorific value for MSWI; realized e.g. at GAVI VAM/Wijster (NL), MBA Vagron (NL),**
- **glass separation for glass recycling, realized at MBS Aßlar (D)**
- **separation of selected plastic types by near infrared (NIR) detection for mechanical recycling; test runs in some german MBS, planned for some MBS/MPS.**

Objects of the output fractions

MAIN OBJECTS OF MBT PRODUCTS

Main output streams	Process	Main object
Ferrous metal scrap	Mechanical recycling	Steel industry
Nonferrous metal scrap	Mechanical recycling	Aluminium industry
Inert material	Disposal	Landfill
	Mechanical recycling	Road construction, additive in cement kilns
High calorific fraction	Energy recovery	Cement kiln, power plants
	Feedstock recycling*	Steel industry (substitution of heavy fuel oil**) Gasification plant (SVZ***)
	Thermal treatment	MSWI
Lower calorific fraction	Thermal treatment	MSWI
Rot fraction / fermentation residue	Disposal	Landfill
Biogas	Energy recovery	Gas motors, combined heat and power plant
Glass	Mechanical recycling	Glass industry
Plastics (PE, PP, PUR ...)	Mechanical recycling	Plastic industry
	Feedstock recycling*	Gasification plant (SVZ***)
	Energy recovery	Cement kiln, power plants
PVC	Mechanical recycling	Production facilities of window profiles, tubes
	Feedstock recycling*	Gasification***, Pyrolysis
	Thermal treatment	MSWI

* Defined as a change in the chemical structure of the material, where the resulting chemicals are used for another purpose than producing the original material.

** Synthetic gas from e.g. plastic wastes catches the oxygen of the iron core and reduces the iron salts to pig-iron.

*** SVZ accepts all types of plastic wastes (mono and mixed); actually there is no other gasification plant for plastics in operation in Germany.

Transformation of high calorific fraction to solid recovered fuel

Increasing demands on SRF

HIGH CALORIFIC FRACTION - PROCESSING TO SOLID RECOVERED FUEL (SRF)					
Quality	1*	2	3	4	5
Demands	1.) Net calorifc value > 11.000 MJ/Mg 2.) Corn size, if necessary, e.g. < 300 mm	a) No heavy materials (inerts) b) Ferrous metal free c) Non-ferrous metal free d) Maximum corn size 20 to 50 mm	Defined, small corn size (e.g. < 20 mm) for improving the transportation behaviour (free flowing, fluffy)	Defined (high) net calorific value	Compressed fuel with defined characteristics
Treatment steps	1.) Elimination of unsuitable input materials, if necessary 2.) Additional shredding, sieving	a) Classification (e.g. air separater, pneumatic tables etc.) b) Magnetic separators c) Eddy current separators** d) Fine grinding (cutting mill, granulator)	Pellet compactor for light pelleting	Drying: drum dryer, conveyer dryer; biological drying, in necessary	Pelleting, if necessary briquets
Recovery plants	MSWI, pyrolysis facilities	Fluidized bed plants (incinerators, cement kiln Rüdersdorf), blast furnace	Cement kilns, lignite power plants	Cement kilns	SVZ Schwarze Pumpe
* Fraction gained by sieving of household or commercial wastes (High calorific fraction of an MBT plant) ** Wirbelstromabscheider					

Source: Müller W., Wallmann R., Hake J., Turk T.: Stand der Technik und Entwicklungspotenziale der mechanisch-biologischen Restabfallbehandlung. In: Wiemer K., Kern M. (Hrsg.): Bio- und Restabfallbehandlung V, 542 – 558, 2001

Potential users: Power plants

- ☑ There is a high calculatory potential of using solid recovered fuels (SRF, also named RDF, refuse derived fuel) in power plants, but other wastes like sewage sludge and carcass meal offer higher revenues and smaller technical problems.
- ☑ Therefore, actually only few power plants use high calorifc fraction from municipal solid waste. One reason is that most power plants need special application forms: e.g. pyrolysis drums (Hamm (ConTherm), Bremen (THERKO)), satellite grate (Saarland) or have to be rebuilt (Bremen/BWK).
- ☑ At present only few power plants perform test runs with SRF from municipal solid waste (e.g. Jänschwalde, Weisweiler).
- ☑ Few projects plan specialized energy recovery plants solely for high calorifc fraction (e.g. Neumünster) or solid recovered fuels (e.g. for steam for paper industry, SCA/Witzenhausen), but this demands a high investment.
- ☑ Chlorine in SRF has a considerable potential of corrosion (alkalichloride) especially of the heat exchangers and has therefore to be limited in SRF. Some, like the Austrian power plant St. Andrä, demand a maximum of 0,15-0,2 weight-% Cl (waterfree) in SRF, which is hardly to keep by BMT, but requires advanced treatment steps (removal of PVC).

Potential users: Cement kilns

- ☑ There is a high calculatory potential of using solid recovered fuels, but other wastes like hazardous and commercial wastes offer higher revenues.
- ☑ The high calorific fraction from municipal solid waste has NCV between 11.000 and 14.000 MJ/t. Primary furnaces need material with a higher NCV (above 18.000 to above 20.000 MJ/t), otherwise there is no energy equivalency, and the need for regular fuels increases. This requires further treatment steps and a solution for the separated lower calorific fraction (e.g. MSWI).
- ☑ The transfer factor of mercury to clean gas ranges from 30 to 40 % (!), therefore strong limitations of the input are needed.
- ☑ Chlorine/chloride leads to performance problems in the kiln and limitation for chlorine content in cement, therefore content ins SRF has to be limitited to below 1 % Cl in fuel.
- ☑ Cement kilns will in the future probably be the main consumer of SRF.

Potential users: Iron and steel industry/SVZ

Iron- and steel industry:

- ☑ There is a high calculatory potential of using solid recovered fuels, but other wastes like shredder ligth fraction from car recycling offer higher revenues.
- ☑ Several demands like limited content of ashes, copper and mercury in the SRF complicate the use in blast furnaces.
- ☑ The interest of steel industry in SRF is actually small. The use of high calorific mixed plastic waste (from DSD, not from MBT) will in future only take place in one blast furnace (Eko-Stahl). Steelworks Bremen has announced to stop this kind of recycling in autumn 2005.

Other industrial plants: SVZ

- ☑ Perspectives actually uncertain because of insolvency.

Status quo in Germany (summer 2005)

- The offerings of high calorific fraction or solid recovered fuels from municipal solid waste on the market exceed thermal treatment or energy recovery capacities by far.
- High calorific fractions or SRF from MBT facilities have no positive market value. They are not sold, in contrast, the owner has to pay for thermal treatment or energy recovery of his product. Contracts before disposal was banned lay in the range up to 35 € /t. Spot market prices can range much higher.
- Now the market is narrowed by some million tons of commercial waste, that had been dumped hitherto on cheap landfills. Prices for delivery of commercial waste to thermal treatment plants have nearly triplicated, since the ban on disposal came into force on june 1st, 2005. Actually 190 € /t is reached (bvse). In the long run, 120 to 150 € /t are regarded as realistic (BDE). These wastes and SRF produced of them compete with SRF from MBT plants.
- This is a problem especially for municipalities which have installed MBT facilities without long running contracts with one or more consumers.
- Interim storage will not solve the problem. The run on consumers - and not on providers - of SRF from municipal solid waste may hold on for several years.

Perspectives

SRF and renewable energies:

- In many countries energy produced from biomass is remunerated with regard to the RES-E-directive. SRF contains partly of biomass, so this can lead to lowering the negative market value of SRF.
  - In Germany coincineration and MSWI plants are exempted from remuneration due to the RES-E directive resp. German EEG.

SRF and emission trading:

- Biomass containing SRF can reduce the emission of fossil CO_2.
- This is of interest for power plants, cement kilns and other industrial plants obliged to take part in emission trading.
- Per ton of SRF replacing e.g. lignite the savings can reach 1,4 t CO_2 (depending on the NCV), resulting in a corresponding increase in tradeable certificates.
- In Germany the price for CO_2-emission certificate has actually increased from initially 10 to about 21 € /t.
- This saving does at present not compensate the negative market value of SRF, but reduces it.

Conclusions

- ☞ **It's vital for the concept of MBT to solve the problem of treatment or recovery of the separated high calorific fraction.**

- ☞ **At the moment there is no perspective that SRF from MBT of municipal solid waste will gain a positive market value, - that means, the consumer will pay for it in the future.**

- ☞ **In the long run, emission trading conditions - *annual reduction of certificates* - can lead to a further increase in certificate prices and therefore reduce the negative market value of SRF. But if - and when - the break-even point can be reached, is not predictable.**