Construction and Start-Up of the MBT Kahlenberg Results of an Attendant Research Project Promoted by the EU

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Bau und Inbetriebnahme der MBA Kahlenberg – Ergebnisse eines durch die EU geförderten begleitenden Forschungsvorhaben

Abstract

The MBT Kahlenberg, put into operation in May 2006, eliminates hazardous and foreign material extremely effectively, and thereafter shreds the waste selectively and homogenizes it in a percolator by circulation and irrigation in a way that optimum characteristics for the subsequent biological drying process and material separation are obtained. Within this process, effluent water accumulates which is rich in organic substances, and which is used for the generation of biogas. Due to the homogeneous drying level, dry matter is generated that can be transformed into above average high-quality fuel which can be stored almost without time-restriction. Because of the abundance of innovations, the low emissions and the high fuel qualities gained, the construction of the MBT Kahlenberg was supported financially by the EU.

Keywords

MBT, percolation, biogas, biological drying, fuels, emissions of greenhouse gases, LIFE, above-average proportion of utilization.

1 Introduction

Between October 2004 (laying of the foundation stone) and March 2006 (start of the cold start-up), the Zweckverband Abfallbehandlung Kahlenberg (ZAK, Special Purpose Association for Waste Treatment Kahlenberg) constructed an MBT plant for a throughput of 100,000 Mg/a according to ZAK technology, developed by the ZAK. The warm start-up of the MBT took place from May 2006 onwards. The MBT Kahlenberg is located in south-west Germany, close to Freiburg.

Because of the innovative technology, which to date is yet to be implemented on a large scale at any other location, the construction of especially innovative components of the MBT Kahlenberg was promoted financially by the financing instrument of the European Union, LIFE-Environment. To this end, between December 2003 and November 2006, a project attending to the planning, construction and start-up of the MBT Kahlenberg was conducted. The project is presented.

2 Description of the ZAK Technology and the MBT Kahlenberg

2.1 Development Objectives

The four-stage ZAK technology has been developed over a time span of about 10 years, and has been designed as an economic form of technology for the generation of high-quality refuse derived fuels with a simultaneous generation of sufficient energy for the own use, as well as of heat for an existing district heating grid. The technology has been implemented at the MBT Kahlenberg for the first time.

2.2 Process of the Technology

The ZAK technology applied at the MBT Kahlenberg consists of the stages shown in figure 1.

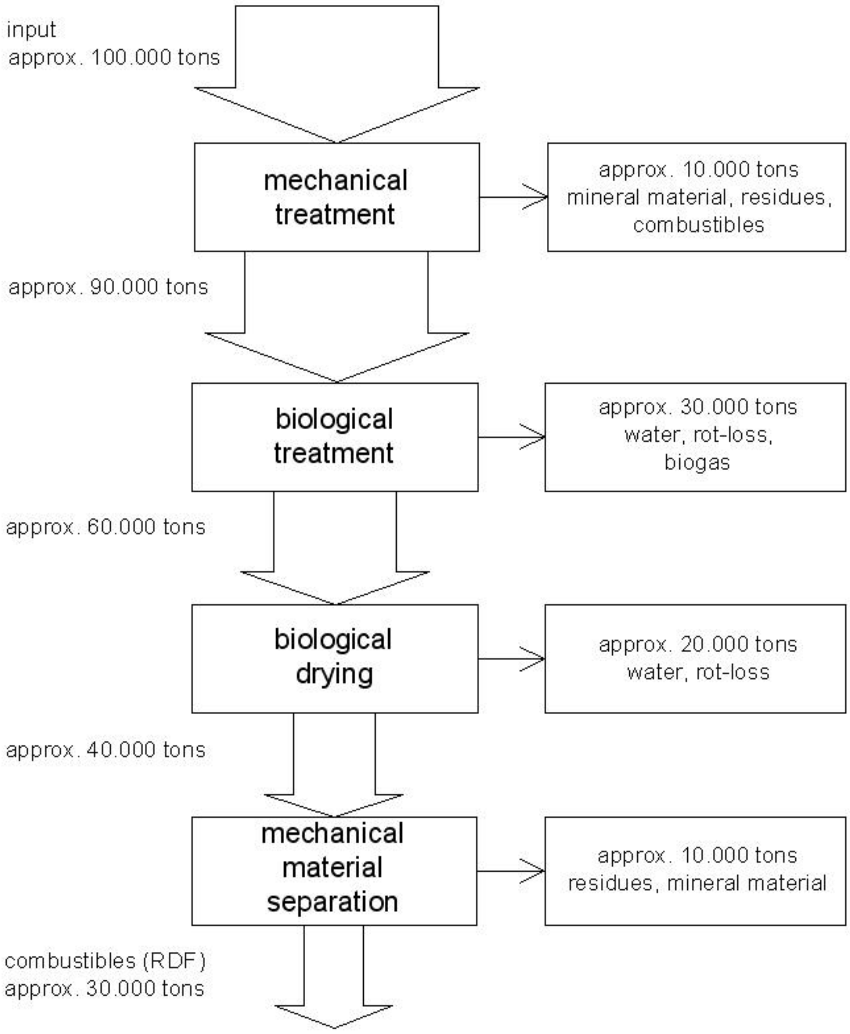

Figure 1 Material Flows at the MBT Kahlenberg

2.2.1 Mechanical Treatment

After the waste supply, (ref. figures 2 and 3) a first fuel fraction, as well as all foreign and hazardous materials are separated effectively in the mechanical treatment stage. The effective removal of the foreign and hazardous material at the end of the ZAK technology generates very high quality fuels.

Figure 2 Supply Area

Figure 3 Waste Input in the Supply Area

In the mechanical treatment stage, a multifunctional sieving drum is used, which has been developed by the ZAK. By using this drum the shredding is no longer necessary, and thus a more effective separation of the undamaged foreign and hazardous material is possible. In the multifunctional sieving drum, waste bags and similar bundles are opened by different tools, and the waste is divided into three fractions. The fine and the middle fraction are individually separated from the foreign and hazardous material and fed into the percolator. The coarse fraction is removed.

For the separation of the hazardous material, amongst others, high-performance neodymium magnets are used for the removal of weakly magnetic components such as, for example, electronic waste, spray cans or batteries.

Because of the use of the multifunctional sieving drum, the fuels obtained as coarse fraction in the mechanical treatment stage are of highest quality. Since the qualities of the fuels generated at the end of the ZAK process are even better, the amount of the separated coarse fraction is maintained as low as possible – in contrast to most conventional technologies – which increases quality further.

2.2.2 Biological Treatment

In the biological treatment, the mixture from fine and middle fraction remaining after the removal of the hazardous material, is fed into six percolators (ref. figure 4) and circulated continually under the addition of water. The percolator is a concrete half-shell, about 25 m long and 4.5 m wide, with horizontal mixing gear and sieve area.

Figure 4 Inside View of a Percolator

At the end of the percolator the solid material is drained (ref. figure 5). The water is collected, and fed via specially adapted conveyor systems into the newly developed treatment stage for mechanical water treatment and subsequently fed into several anaerobic reactors (ref. figure 6). The organic components of the water are fermented into biogas in the anaerobic reactors. The generated biogas is used for energy and heat generation in gas motors. The energy supply from biogas is higher than the needs of the MBT. A part flow of the run-off water from the anaerobic reactors is further cleaned and largely re-used for the irrigation in the percolator.

Figure 5 Draining Press

By circulation, using the mixer and irrigation, the waste is homogenized and shredded selectively in such a way that optimum characteristics for the subsequent processing stages are generated.

By fermenting the organic-rich water, the disadvantages known from fermentation plants for solid material are avoided (especially the complex operation with relatively low availability, and an odour intensive, and difficultly drained fermentation remnant).

Figure 6 Anaerobic Reactors

2.2.3 Biological Drying

In the biological drying stage, quick and very homogeneous drying of the material is possible because of the pre-treatment in the percolator. This is supported by a single transfer of the material to be dried (ref. figure 7).

Due to the homogeneous drying level, dry matter is generated, which can be transformed into a fuel which can be stored almost without time-restriction.

Figure 7 Conveyor System on the Roof of the Tunnel

2.2.4 Mechanical Material Separation

The mechanical material separation facilitates an extraordinarily strong separation of the material flows. Fuels of different qualities can be generated by subsequent mixing. Thus, the adaptation to the requirements of the customer of the fuels is possible at all times.

In the mechanical material separation (ref. figure 8), the dried waste is separated according to its size and weight, in order to remove stones, sand, ceramics, and glass, as well as components with an exceeding pollutant level, or a too low caloric value, and thus obtain a high-quality fuel. To this end, the dried waste is sieved. All components with a size superior to about 2.5 cm are separated as residual material which has to be incinerated in an incineration plant, since further treatment due to the very low proportion would be too costly.

Figure 8 Mechanical Material Separation

The main part of the dried waste is smaller than 2.5 cm, and is separated into several fractions of different sizes by further sievings. Each of these fractions is subsequently divided according to its size, and the separated light components are removed as fuels. The heavy components (mainly mineral material, sand, and stones: ref. figure 9) have a low polluting level, and can be deposited, or used in road constructions.

Figure 9 Mechanical Material Separation

The generated fuels (ref. figure 10) have very good storage-characteristics, and can be used diversely in industry as an alternative to fossil fuels.

Figure 10 One of the Fuel Fractions

The mechanical material separation has been conceived in such a flexible manner that a quick response is always possible to changed requirements on the fuel market through corresponding quality adaptations, by regulating the material flow within the mechanical separation. Thus, the economic sale of the generated fuels is guaranteed at all times.

3 LIFE-Project

3.1 Description

Because of the abundance of innovations, the process-related low emissions, and the high quality achieved for the fuels, and because of the significant reduction of greenhouse gas emissions overall, the construction of the MBT Kahlenberg was supported financially by the EU through the financing instrument LIFE-Environment. In order to guarantee the implementation of the advantages of the ZAK technology on the MBT Kahlenberg, a research project for the attendance of the planning, construction, start-up and trial operation has been conducted.

Title: ZAK Technology for the Economical Generation of High-Value and Quality-Optimised Refuse Derived Fuels from Municipal Waste with the Minimisation of Residuals and Greenhouse Gas Emissions.

Duration: December 2003 until November 2006

Funding recipient: Zweckverband Abfallbehandlung Kahlenberg, Ringsheim (Special Purpose Association for Waste Treatment Kahlenberg)

Partner of the funding recipient within the LIFE-project: Ingenieurgruppe RUK (Engineering Group RUK), Stuttgart

Funding institution: European Commission DG Environment D.1, Brussels

Funding instrument: LIFE - The Financial Instrument for the Environment

3.2 Essential Results Determined

3.2.1 Technological

Large-scale construction (ref. figure 11) and operation (ref. figure 12, the fluctuations occur due to fluctuating supply amounts, the plant is run with a bunker which is empty at the end of each working day) of a plant according to ZAK technology are documented. Within this, the functionality of the interplay of the individual processing stages in large-scale implementation is demonstrated and the economic and ecologic advantages that can be obtained have been proved.

Figure 11 Construction of the Percolators (left) and Land Scaping, February 2005

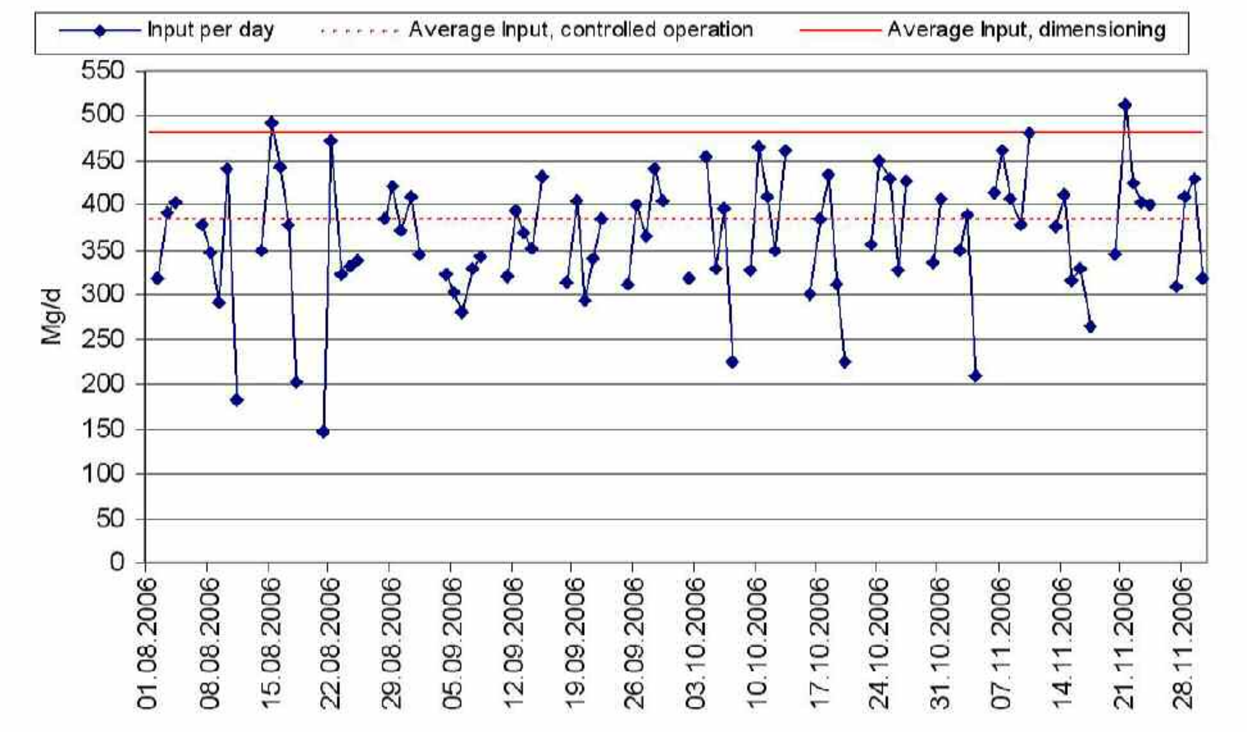

Figure 12 Daily Input Amounts from August until November 2006

3.2.2 Ecological

On the MBT Kahlenberg, a largely material flow specific re-use of the municipal waste has been achieved, and thus, together with process-related low emissions, a clear reduction of greenhouse gas emissions in comparison to today’s standard has been obtained (ref. figure 13 and table 1).

Out of 100,000 Mg of supplied domestic residual waste, after the treatment, only 6,000 Mg of no longer usable waste for incineration in a waste-fuelled power station remain in the case of the MBT Kahlenberg. This recycling rate is achieved by the linking of the four processing stages, and is to-date not equalled by any other procedure.

Table 1 Comparison of the Results from the Analysis of the Inert Material with the Limit Values of the Annex 2 of the AbfAblV (German Waste Storage Ordinance)

Parameter	**Unit**	**Inert Material MBT Kahlenberg 0-25 mm**	**Limit Values According to Annex 2 of the AbfAblV**	**Take-Up Rate**
Solid Material Parameter				
TOCSolid Material	Mass %	2.22	18	12.3%
Eluate Criteria				
Conductivity	µS/cm	602	50,000	1.2%
TOCEluate	mg/l	62.2	300	20.7%
Nickel	mg/l	0.026	1	2.6%
Zinc	mg/l	0.106	5	2.1%
Fluoride	mg/l	0.14	25	0.6%
Ammonium-nitrogen	mg/l	10.4	200	5.2%
AOX	mg/l	0.038	1.5	2.5%

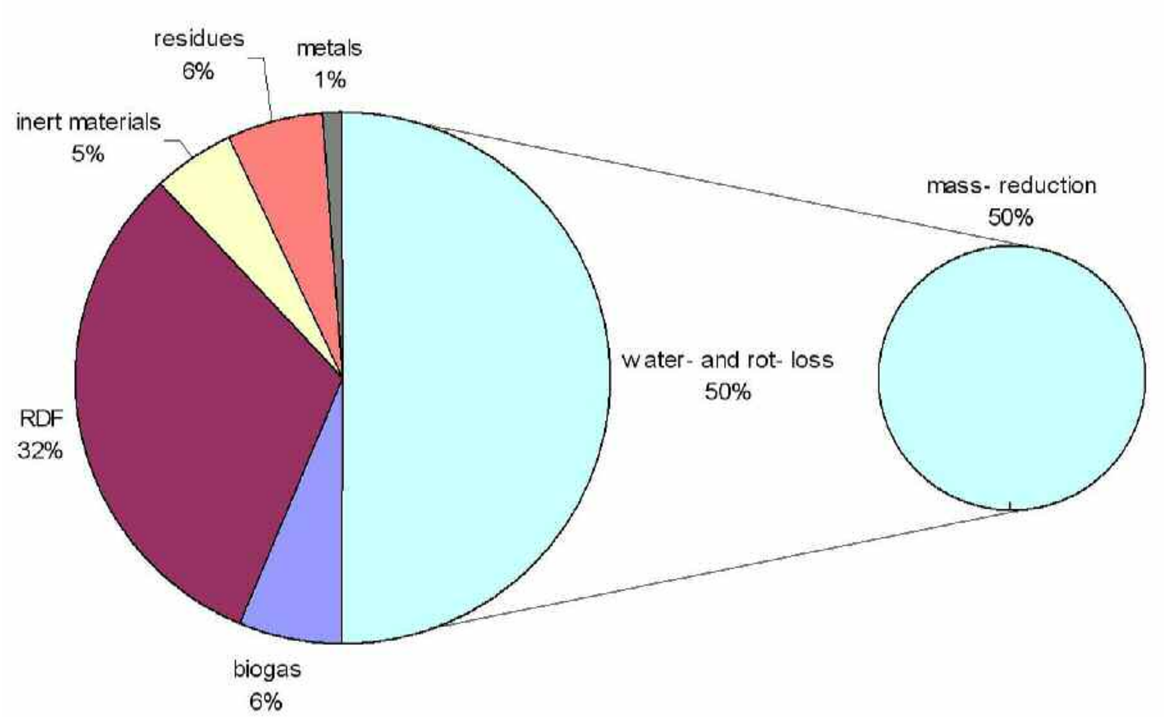

Figure 13 Material Flows during Normal Operation at the MBT Kahlenberg

3.2.3 Economical

The jobs which would have been lost due to the prohibition of the disposal of non-treated waste on the landfill existing on the site were saved by the construction of the MBT, and additionally, new jobs were created.

By the MBT Kahlenberg, seen from an overall perspective, the disposal can be guaranteed at lower specific costs (€ per ton waste) than with incineration of the waste in a waste-fuelled power station.

In the planning, construction and the start-up of the MBT Kahlenberg, comprehensive experience could be gained, which facilitate a shortening of the planning, construction and start-up, and thus result in cost savings on the following ZAK technology plants.

4 Summary and Outlook

In contrast to conventional MBT technologies, the ZAK technology has the following ecological advantages:

- high yield of refuse derived fuels.
- low amount of waste for disposal.
- high marketability of the generated refuse derived fuels.
- low emission potential of greenhouse gases.

In particular, due to the above average savings on primary fuels, the contribution of the ZAK technology to the greenhouse effect is lower than using conventional technologies. The reduction in greenhouse gas emissions by significantly lowering diffuse emissions from the MBT in contrast to conventional MBT technologies adds to this.

On the MBT Kahlenberg, the objectives of the ZAK technology were already achieved after a relatively short operation period, when the operation was still characterised by changes, repairs and adaptations. Under stable operation conditions with only little intervention in the industrial process, more clearly achieved objectives of the ZAK technology are to be expected.

The quality of the inert material, generated on the MBT Kahlenberg in the mechanical material separation, facilitates disposal or high-value re-use, whilst the refuse derived fuels are used as alternative for fossil fuels in a paper factory.

The MBT Kahlenberg sets itself very clearly and positively apart from the conventional MBT technologies by its very high technological standard and a virtually dirt-free operation outside the encapsulated aggregates, without higher specific costs, and is thus entirely appropriate as a reference plant.

In the planning, construction and start-up of the MBT Kahlenberg, numerous cost saving possibilities were determined which could not be implemented anymore on the MBT Kahlenberg. Additionally, on the MBT Kahlenberg, a more costly examination of all possible alternatives (variant testing) has already been conducted extensively, and subsequently the building owner of the MBT Kahlenberg and the funding recipient of the

LIFE project (ZAK) have the plans for optimum plant technology at their disposal. All this will clearly lead to more favourable specific costs for all possible follow-up plants (and of course also in the future, i.e. after the termination of the corresponding depreciation periods, including on the MBT Kahlenberg itself) than on the MBT Kahlenberg in the present form. The specific costs will be significantly lower than the specific costs for the operation of current conventional MBT technologies.

5 Literature

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