

Optimisation of the MBT Schwanebeck

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Optimierung des Betriebes der MBT Schwanebeck

Abstract

After the completion of the MBT Schwanebeck on 01/06/2005 its capacity was noticeably expanded. In the course of the expansion process and also during the operation time of two years by now numerous actions were implemented to increase the operating safety of the plant and to control the stability of treatment costs. This paper reports about the actions for optimisation and their impact on the energy demand.

Keywords

Mechanical biological waste treatment, municipal solid waste, optimisation, plant conception, energy demand, climate protection

1 Mechanical-biological waste treatment in Havelland

Already the mechanical-biological waste treatment plant which was put into operation in Schwanebeck in 1998 was supposed to ensure a landfill site space-saving disposal in the administrative district of Havelland and to minimize climate-relevant emissions. The permitted capacity of the plant was 29 000 t/a. After a mechanical pre-treatment rotting took place in static windrows based on the chimney ventilation method on a sealed asphalt surface. The stabilized waste, which was hence reduced in volume and mass, was then transported to the landfills of the administrative district. The erection and operation of this plant led to a number of valuable experiences which have proven themselves extremely useful in planning and operating the following plant on site.

The legal changes operative from 01/06/2005, which led to significantly higher demands in the field of emission protection, did not allow further operation of the plant in its form at that time. Therefore, the planning preliminary works for an expansion of the plant according to the changed demands were initiated in 2002. After planning, authorization procedure and Europe-wide tender, the measures for the construction of the new MBT Schwanebeck started in February 2004. Responsible for planning and construction supervision of the plant was a planning group under participation of the offices Horn & Müller, Berlin, Umtec, Bremen and IGW, Witzenhausen. The plant technology was realized by the company AMB.

This first stage of expansion could be operated at full load starting on 01/06/2005 with its planned capacity of 32 000 t/a, and since that time it makes an important contribution to disposal security in the administrative district of Havelland (KLEINKE, 2005).

In planning and realization, a goal-oriented and simple process control was thought to be especially important. Therefore, the fraction of high calorific value is separated by a simple sieve cut of > 80 mm after crushing of the waste in a crusher. Further processing up to a high-quality secondary fuel is not carried out on site because of the comparatively low throughput. A two-stage rotting process serves the biological treatment. The first, intensive stage takes place in rotting tunnels, the second stage on a roofed post rotting area. For the storage and the retrieval in the rotting tunnels, no automatic charging or discharging system is used, but solely the wheel loader. The air and process water conduction was designed in a way that a multiple use of these resources is realized. For exhaust air cleaning, an initially double-row RTO was used. Process water is used together with the leachate of the on-site landfill to moisten the waste in the intensive rotting tunnels. Waste water that has to be disposed of externally is not produced in normal operation.



Figure 1 Expanded MBT Schwanebeck, view on exhaust air cleaning facility

On the basis of a longer-term bond of an additional 40 000 t/a of mechanically pre-treated municipal solid wastes, the construction of the second stage of expansion was started in August 2005. The biological capacity of the plant was a little bit more than doubled for the exclusively biological treatment of these wastes. So, the number of in-

tensive rotting tunnels was increased from 20 to 40. The roofed post rotting area was enlarged from 5 000 to 11 000 m².

On June 1st 2006, the second stage of expansion was put at full load. This expansion offered the possibility not only to just double the systems of the air and water cycle, but to make them more efficient by a number of optimisations and therefore to make the process flow safer. Both parts of the plant are running since their start-up without serious disturbances which would have put the disposal of the arising waste flows into question. In the plant, the requirements of the "Ordinance on Environmentally Compatible Storage of Waste from Human Settlements and on Biological Waste-Treatment Facilities" ABFABLV were fulfilled continuously by complying with these required parameters.

2 Aim of an optimisation

Following the corner points of sustainability, in an overall view at this plant the economical and ecological as well as social aims of the optimisation are striking.

The first aim is to ensure a proper operation and, related to that, to comply reliably with the emission limits in both the exhaust air flow and by meeting the deposit criteria (ABFABLV, 2001). Related to that is the guarantee of the disposal of the wastes in Haveland and beyond. By economizing on resources, costs can be reduced, which contributes to the stability of fees in the region.

How can these superior aims be reached concretely by a plant optimisation? First of all, the increase of plant capacity can lead to a better exploitation of machines and personnel and thus helps to reduce the specific treatment costs. This fact, however, was the basic background for the decision to expand and therefore should not be centre of further examination.

However, the effectiveness of the use of the existent exhaust air was optimised, which led to smaller specific amounts of exhaust air to be cleaned and thus to an economization of energy resources in both the field of electric energy and the field of the auxiliary gas that has to be used in RTO. Because of the redundant design of parts of the plants in the process water system as well as in the exhaust air cleaning the operating safety can be increased notably. Downtimes are reduced and necessary service measures can be carried out more simply and without disturbing the overall process. Furthermore, this optimisation saves additional costs.

These measures were accompanied by a constant improvement of the rotting process by the operational staff. The experiences gained in the course of operation helped to

optimise the plant's aeration and watering regime more and more. It was also possible to respond increasingly quickly to disturbances of the plant operation.

3 Realization of the optimisation measures

3.1 Material flow

In the original planning for the treatment of the municipal solid wastes in the administrative district of Havelland a second sieving stage to separate wastes of high calorific value after intensive rotting was intended. A sieve cut of 40 mm was supposed to separate the wastes of high calorific value in the magnitude of 40 to 80 mm after the first processing of the organic components. In operating the plant it arose, however, that the proportion of high calorific value of this fraction was clearly below the expectations. On the other hand first analyses in the field of postmaturation led to the conclusion that the coarser structure of the rotting material causes a better aeration of the windrows and thus accelerates the reaction process. In the operation, the second sieving is now relinquished, external disposal costs are economized. A critical increase of the carbon content in the solid matter could not be noticed.

In the course of the plant expansion, the conduction of the already mechanically pre-treated material flow had to be redesigned. The already carried out, intensive processing of the material with a humidity of approximately 35 % leads to a good water-absorbing capacity of the waste. To create optimal conditions for the aerobic degradation, the waste has to be watered before the charging into the rotting tunnel. For this – adapted to the material properties – the simple solution of a spraying strip was installed for watering. By spraying 7 to 10 m³/a of water into the falling waste flow, the humidity can be increased by up to 10 %. Compared to a potential method variant with a homogenization drum, which by the way stands in good stead in the treatment of waste in the first stage of expansion, investment costs and operating costs were saved thanks to the present system.

3.2 Exhaust air flow

The exhaust air system of the MBT Schwanebeck is designed to allow for the exhaust air of the plant to be subject to a multiple use before it is finally cleaned in the RTO-facility according to the requirements of the 30th "Ordinance on the Implementation of the Federal Immission Control Act" BImSchV (30. BImSchV, 2001). The air exhausted diffusely in the acceptance hall and locally extracted in the processing part of the plant is precleaned by means of a dust filter and served in the first stage of expansion in combination with the air exhausted from the replenishment aisle of the intensive rotting completely for the aeration of the 20 rotting tunnels. In the rotting tunnels the air con-

duction is designed in that way that one part of the air necessary for the aeration of the tunnels is run within the cycle and only the amount of fresh air which is necessary for the aerobic rotting is supplied. The installed ventilation technology supplied the rotting tunnels reliably with oxygen and was able to ensure the necessary heat dissipation. Also, a continuous extraction of the acceptance/processing hall was ensured. It proved disadvantageous that the maintained exhaust air flow from the acceptance/processing, the variable demand of the rotting tunnels and the regulated pressure increase before the RTO influenced each other in their regulatory mechanism and that it therefore came to a step-up of the exhaust air, which resulted in a high energy demand especially for cleaning the exhaust air. Following the construction of the second stage of expansion, this system was simplified and the number of control variables was minimized. By integrating 10 more tunnels into the utilization regime of the extracted air, the air demand is so high that it was possible to design the extraction in a demand-actuated way. The remaining 10 tunnels of the second expansion are supplied directly with fresh air according to their requirements. The underpressure that has to be produced by the compressors situated before the RTO was adjusted. By doing so, not all systems were able to be decoupled, but a variable battling of single compressors against each other was eliminated. The mean specific exhaust air flow was reduced significantly. A saving of energy is the consequence.

3.3 Water cycle

The process waters occurring within the intensive rotting process show a considerable degree of pollution. This makes high demands on the technology to be installed, but also leads to substantial expenses in the area of service and maintenance. It is to be emphasized, however, that an outage of this system, which is susceptible to disturbances, and the therewith associated deficiencies in watering the rots leads to severe consequences in the process of waste stabilization and that this results in substantial expenses in remoistening. If need be then an extension of the treatment process is required to reach the given deposition parameters. An additional demand for treatment capacities, energy and personnel is the consequence. In the course of the expansion of the plant it became possible to design the systems of the process water cycle in a redundant way. The plant now has two process water-tanks including the necessary pumps and control units. The installation of these tanks has been carried out by means of an additional fitting shaft in that way that all systems can substitute one another and a transfer of the waste water from one tank into the other is also possible (Fig. 2). Additional feeding points into the system were created so that also in case of total failure of both process water pumps or of the control units a manual watering of the intensive rots is possible. By doing so, the operating safety of the plant was significantly improved.



Figure 2 An additional fitting shaft ensures the redundancy of the plant components for watering

4 Results of the optimisation

With the start-up of the second stage of expansion, the plant's throughput has increased significantly according to plan. Accordingly, the energy demand of the MBT temporarily jumped up from June 2006 on. After realizing the optimisation of the aeration system and the related economy of compressor work it was possible to reduce the electricity demand again (Fig. 3).

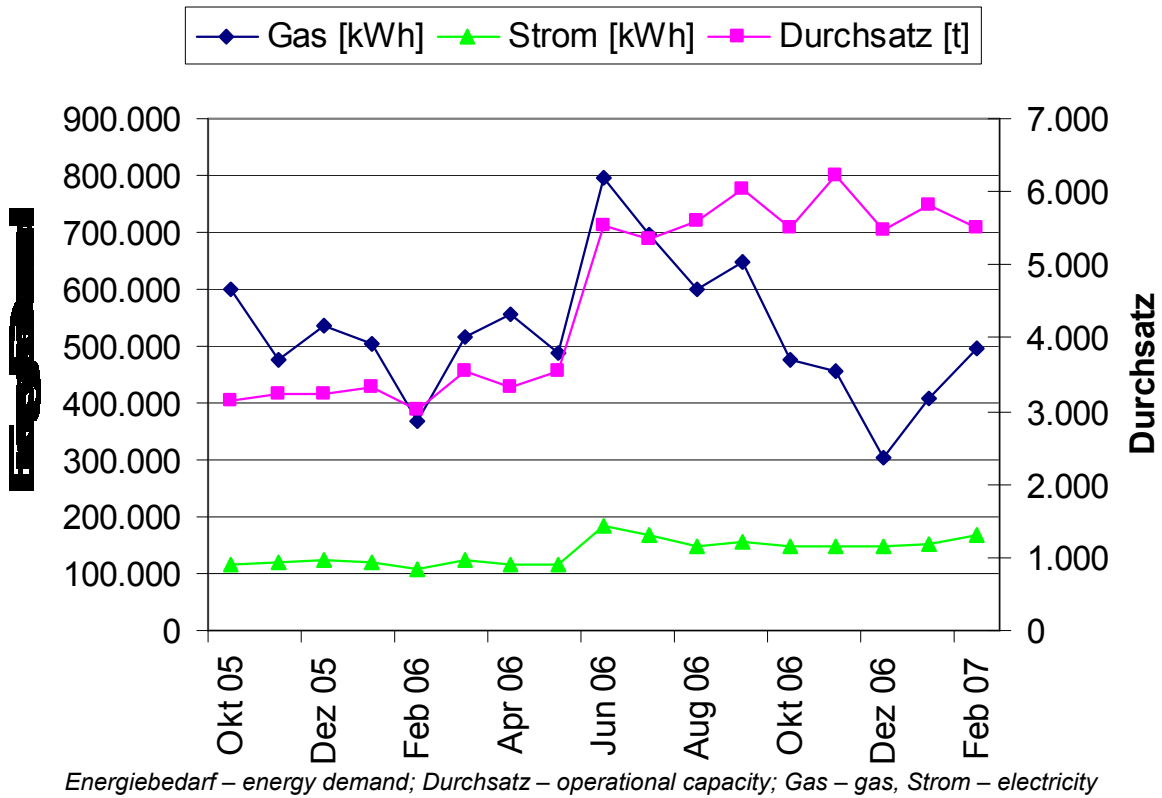


Figure 3 Energy demand and throughput of the plant

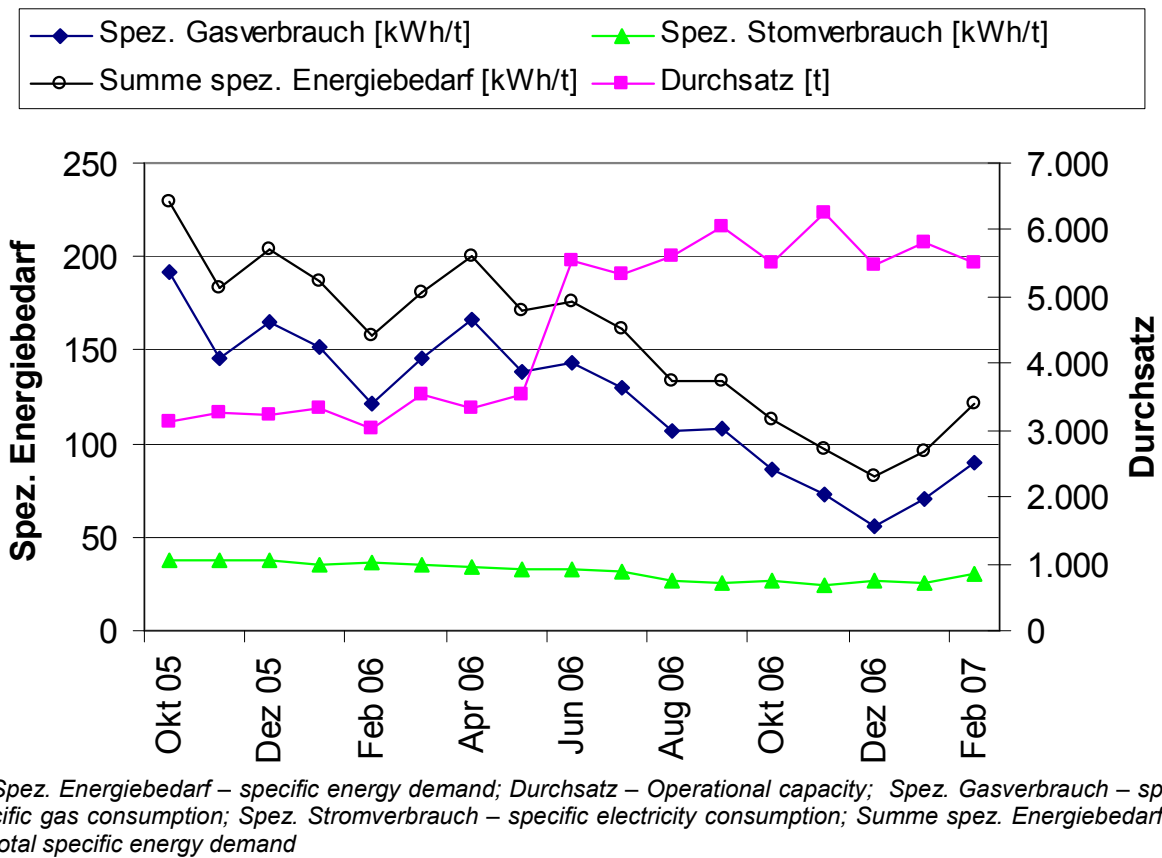
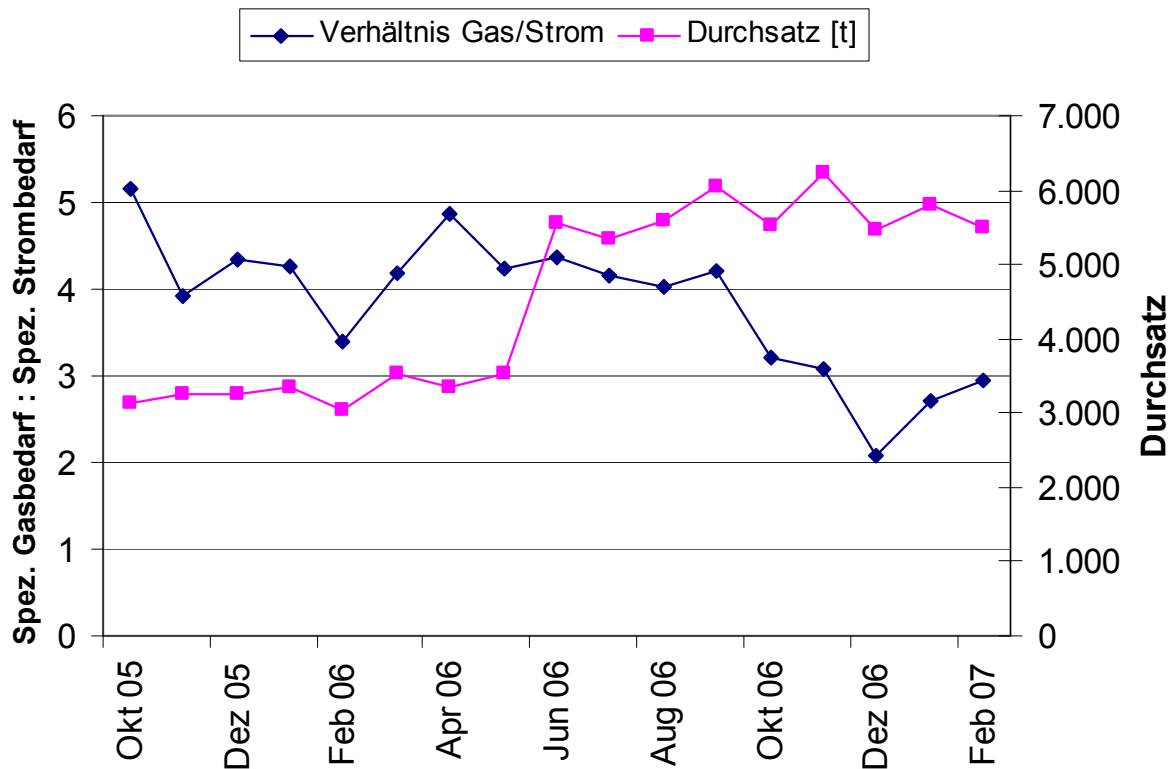


Figure 4 Specific energy demand and throughput of the plant

Even more clearly the economy potential of the optimisation is reflected in gas consumption of the exhaust air cleaning. Here a level was reached which despite the significantly increased throughput even lies below the gas consumption of the time before the expansion. Only the demand for gas and electric energy is incorporated into the following considerations.

As these considerations do not claim to be a complete energetic process evaluation it was possible to ignore the diesel demand in this case. The air demand and thus also the energy needed for the exhaust air conduction and cleaning is, however, influenced by a number of additional factors, for example the outdoor temperature or the composition of the waste. The efficiency of the RTO and thus the gas consumption are strongly dependant on the blocking of the ceramic bodies serving for the heat exchange with siloxanes. Occurring fluctuations in demand could be explained by that.

The specific consumption of electricity and gas per mass unit show this tendency even more clearly (Fig. 4). After the changes in the exhaust air system realized in summer 2006, it was possible to reduce the specific energy demand significantly once again.



Spez. Gasbedarf: Spez. Strombedarf – specific gas demand : specific electricity demand; Durchsatz – operational capacity; Verhältnis Gas/Strom – ratio gas/electricity

Figure 5 Ratio of gas and electricity demand and throughput of the plant

One look at the ratio of the supplied energy in the form of gas, which in the MBT Schwanebeck is at least partly of fossil origin, and the electric energy necessary for the operation of the whole plant makes clear how immensely high the energy demand of the

exhaust air cleaning system RTO is (Fig. 5). The question to what extent this energy-consuming cleaning process makes sense from the perspective of emission control and climate protection cannot be answered at this point, but is to be put into question urgently. If further balances lead to thorough doubts in the evaluation, the regulations documented in ordinances have to be questioned and, if needs be, modified. In the course of the optimisation of the MBT Schwanebeck it was fortunately possible to shift the ratio of gas consumption and electricity consumption from approximately 5:1 to approximately 3:1.

5 Summary

The expansion of the MBT Schwanebeck provided a good opportunity for the optimisation and adaptation of the plant technology. The alterations in the conduction of the exhaust air flow led to a prevention of the hitherto existing substantial fluctuations of the exhaust air flow. The redundancy of the process water system prevents the total failure of the watering of the intensive rotting tunnels and thus helps to prevent subsequent problems.

The improvements conducted in the course of the expansion and operation increased significantly the operating safety of the MBT. The legal requirements on the landfill fraction are continuously complied with. The reduction of the high energy demand helps at this point to save costs and thus to compensate deficits in other areas in which the real costs exceed the planned expenses significantly – like for example in the field of service and maintenance.

6 Literature

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