Low-Cost-Techniques of Intensive Biodegradation and Maturation

Runge, Karsten and Hölscher, Thomas

BACKHUS EcoEngineers, Edewecht, Germany

Low – Cost - Techniques for aerobic treatment

Abstract

Techniques for mechanical-biological treatment of solid fraction of household waste taking their seats in the waste management business of many countries. MBT facilities working as a complement or as a low cost option for incineration facilities. Further on there is still a large demand for many MBT facilities to improve the aerobic biological treatment process, to reduce operation costs and to increase reliability. With the help of some examples the possibilities to improve existing facilities will be shown and technical solutions for planning and construction of new facilities will be discussed.

Inhaltsangabe

Technologien zur mechanisch-biologischen Behandlung von festen Siedlungsabfällen haben ihren Platz in der Abfallwirtschaft vieler Länder gefunden. MBA-Anlagen fungieren als Ergänzungsbaustein oder kostengünstige Alternative zur Verbrennung. Im Bereich der aeroben biologischen Behandlung besteht weiterhin in vielen MBA-Anlagen Bedarf an einer Optimierung des Prozessablaufes, der Senkung der Betriebskosten und der Erhöhung der Betriebssicherheit. Anhand von Beispielen werden Möglichkeiten aufgezeigt, wie in bestehenden Anlagen Verbesserungen erreicht werden können und welche technischen Lösungen für Planung und Bau neuer Anlagen berücksichtigt werden sollten.

Keywords

MBA, aerobe Behandlung, Vorrotte, Nachrotte, Optimierung, Betriebskosten

MBT, aerobic treatment, composting, maturation, optimization, operating cost

1 Introduction

1.1 MBT – Current status and perspectives

Despite all difficulties techniques for mechanical-biological treatment of the solid fraction of household waste (MBT) took their seats in the European market. Exemplary for this development are the 48 plants operating in Germany which have a processing capacity of 6 million t/a and thus treat about 25% of Germany's solid fraction of household waste [1].

But the potential of MBT techniques is far from being fully exploited in Europe. While some countries like Denmark and Sweden focus on burning their household waste, there is still a great demand in France, Italy, Spain and Great Britain [2].

Even though MBT techniques in Europe still remain behind their possibilities and even though some MBT plants serve only for pre-treatment before final incineration, the MBT technique has still more advantages compared to direct dumping as it is done in many newly industrialising and developing countries. Due to the missing waste separation and since household waste normally has a high content of organic substances the mechanical-biological pre-treatment could save some valuable landfill capacities and the emission of landfill gases and leachates could be reduced by more than 90%. Simple MBT concepts are in demand [3].

1.2 Optimising potential

The start-up of new plants in 2005 and the subsequent operating experiences made the optimising potential of MBT plants subject to discussions and expert articles.

The main task of MBT plant operators during the aerobic treatment is to create ideal conditions for micro-organisms to maximise the degredation of organics. This is only possible if there is enough water and oxygen available and optimum temperatures are achieved. A continuous ideal three phase ratio (air – water – input material) is considered indispensable [4].

In practise modifications apply to intensive biodegradation and maturation in MBT plants to optimise the treatment progress and reach a higher operational safety and, above all, lower operational costs.

2 Optimising potential in aerobic treatment

2.1 The biodegradation process – Everything under control

The main goal of biological treatment is to reduce and stabilise the waste amounts to ensure a secured dumping on the landfill. The treatment is continued until reaching a set value. An optimised biodegradation process enables to reach this value as quickly as possible.

Usually, an aerobic biodegradation process is realised in two steps: an intensive biodegradation for the first two to three weeks followed by maturation for four to eight weeks.

Intensive biodegradation is marked by intensive aeration of the input material. Dynamic rotting systems (dynamic windrow, line) are completed by regular turning and irrigation

whereas a flexible adjustment of turning intervals is usually not possible in this system. Static rotting systems are not intended to be turned. Some plants, however, realise a one time turning with irrigation at a high expenditure (conveying technology, wheeled loader). If this cannot be done, the static rotting material is being irrigated constantly. The result of the technological requirements of the intensive biodegradation is an unsatisfactory rotting process due to poor rotting conditions. The problem is thus postponed to the maturation.

The maturation of most MBT plants is realised in material heaps that are processed by turning. Some plants optimise the maturing process with an underfloor aeration system. The desired degree of stabilisation of the material is obtained after a couple of weeks depending on treating intensity.

The rotting process can be optimised through intensive treatment of the material. Regular turning can notably reduce the maturation period. Systematic irrigation is essential as well since a great amount of humidity evaporates due to high temperatures inside the heaps. Special turning systems including a device for direct irrigation during the turning process will furnish special benefit. Thus, simultaneous turning and homogeneous irrigation can take place in one working step. The turning technology has to be powerful enough to enable the turning of all maturing heaps in one day if necessary.

2.2 The input material – flexibility counts

The organic content of the input material which goes through the biological process is decisive for the necessary duration of the process. It is determined mainly by the delivered household waste, but also by the quality of previous pretreatment through the mechanic separation.

When planning MBT plants the duration of the biological process is normally estimated according to empirical values of the past. The capacities and areas for intensive biodegradation and maturation are construed accordingly. A more or less continuous quality is assumed and, therefore, a relatively constant duration of process.

In practise this assumption was proven wrong. Plant operators report very unstable contents of organic substances in input material. Deviations of more than 200% from the average have been registered. The contents even vary within a couple of days. This requires flexibility concerning duration and intensity of the biological treatment.

Since intensive biodegradation often enables a batchwise treatment (composting tunnels or boxes), it is possible to treat single batches specifically at a time. The maturation in most plants does not enable such treatment because they are often treated in trapezoidal heaps where a separate storage and treatment of the charges is impossible. This requires optimisation.

Changing the maturation treatment from trapezoidal heaps to windrows allows the separate storage of single charges and to treat them individually by higher turning frequencies or better irrigation if necessary. The disadvantage of windrow composting concerning area utilisation is easily compensated through shorter maturation periods.

2.3 The financials – Efficient application of technology

A duly treatment of the input material through turning and irrigating causes expenses which are not to disregard when operating a plant. Therefore, the application of suitable turning technology should be thoroughly planned. Again, the change from trapezoidal heaps to windrow composting will provide financial benefits as the below exemplary calculation shall express:

Exemplary calculation operational costs MBT maturation:

Input in maturation:	40.000 t/a	
Specific weight:	0,55 t/m³	
Maturation period:	6 weeks	
material in maturation area:	approx. 8.400 m³ material/maturation period	
Tuning capacity:	1.000 m³/h with trapezoidal heap turner	
	2.000 m³/h with windrow turner	
Turning expenses:	100,- €/h with trapezoidal heap turner	
	85,- €/h with windrow turner	
Turning frequency:	2 times per week	
Machine hours:	875 h/a with trapezoidal heap turner	
	437 h/a with windrow turner	
Total costs:	trapezoidal heap:	87.500,- €/a
	windrow:	37.145,- €/a

2.4 Practical experience - Examples

2.4.1 MBT Cröbern

The MBT Cröbern south of Leipzig has licence for 300.000 t/a and is thus the biggest MBT in Germany. The biological treatment consists of a two stage process with an intensive aerobic biodegradation in static composting tunnels followed by a roofed maturation of several weeks.

The original design of the maturation was based on five composting areas with one trapezoidal heap each. Those should be turned one to two times per week. Due to op-

erational liability, two self-propelled trapezoidal heap turners were in plan for this. In the second half of 2005 there occurred more and more difficulties in maintaining the required stabilisation rates of the maturation output material. This was caused by some heap areas that had been either too wet or too dry or characterised by some other maturation processing due to their composition. When there was an unsatisfactory maturation processing in one part of the trapezoidal heap, consequently the whole trapezoidal heap had to be turned even if some areas would not have to be turned. This resulted in a great utilisation of the turning technology and thus to a lot of down time due to repair works.

Figure 1: Maturation MBT Cröbern after changing to windrows

To find a solution for this problem, the reorganisation of the maturation area into smaller heaps was discussed in order to treat the individual batches independently. The operating company *WEV* tested the possibility to optimise the stabilisation rates with a separate treatment of the single windrows instead of one heap. After a couple of months testing the maturation was reorganised into windrows.

2.4.2 MBT Rosenow

The MBT Rosenow is located in the North East of Germany. This plant approved for 125.000 t/a has also a two phase aerobic process. The intensive biodegradation lasts

two weeks in static tunnels with one time turning while unloading and re-loading the tunnels. The maturation takes place under roof.

From the beginning in 2005 until 2008 the maturation was carried out in six dynamic trapezoidal heaps which were turned two times per week with mobile technology and irrigated upon necessity.

At the beginning of 2008 the redesign towards windrows was started. Figure 2 shows the maturation area. The area of now seven windrows was originally used for two trapezoidal heaps.

Figure 2: Maturation MBT Rosenow after reorganisation towards windrows

According to the plant's operator *ABG* the new composting technique generates better results in the rotting process enabling the company to achieve the stipulated stabilisation level of the output material. Discrepancies to the ideal maturing process can be easily addressed with higher turning frequencies or adjusted irrigation. Because of replacing the turning technology the operational costs could be reduced significantly and operational liability increased at the same time.

2.4.3 MBT Schwanebeck

West of Berlin the MBT Schwanebeck is located. This plant was approved back in 1997 and after two extensions it has a total capacity of 88.500 t/a. The MBT processes not

only the organic fraction separated by its own mechanical preparation but also the organic fractions of other municipal waste treatment plants.

The biological treatment includes intensive biodegradation in composting tunnels followed by maturation in windrows on roofed ground. Initially planned as trapezoidal heap system the maturation was in the end changed to windrow composting turned by front loaders in 2006. To reduce the maturation time it was decided to purchase a special turning machine with corresponding irrigation unit in the middle of 2008.

Figure 3: Maturation MBT Schwanebeck, irrigation unit

The goal was to be able to treat the windrows more intensively and at the same time reduce the volume of the stored material to create better maturation conditions. After half a year of operation with the new system the facility owner *ABG* is very satisfied with the results and even records decreasing operational costs for the maturation scope of the plant.

2.4.4 Dynamic tunnel composting – a pilot scheme

In Great Britain the demand for MBT techniques is increasing, too. Due to legal instructions and increasing fees for waste dumping the reduction of such waste amounts is in everybody's interest. Cities and communities as well as private disposal companies are interested in the possibilities of MBT techniques. In the course of this cutting-edge approaches are being taken.

In the scope of a pilot scheme in the South East of Great Britain the combination of known technologies for agitated lane composting and contained static tunnel composting is being tested. The new process can be described as dynamic tunnel composting. The material in the contained aerated tunnel is being turned additionally to optimise the maturing process.

Figure 4: Dynamic Tunnel Composting – view of the pilot site

The compact design of the tunnel allows a great reduction of exhaust air meaning a significant decrease of operational costs. Emissions are limited to a definite contained space. The turning machine agitates from outside the aggressive environment. This prolongs the operational safety and the lifespan of the technology. Beneficial results of this pilot scheme are expected in July 2009.

3 Summary

There are possibilities for optimising the maturation of MBT material in many already existing plants. A successful way is to reorganise from trapezoidal heaps to windrow composting. The operational costs can be lowered and there are positive effects for the maturation process that should be taken into consideration when planning future treatment plants.

Combining proven turning technology with a new tunnel design improves the maturation process control of MBT material and cuts operational costs due to smaller emission amounts. Relocating the turning technology to the outside of the aggressive composting environment results in higher operational liability and longer equipment’s life.

Literature

Grundmann, Thomas	2007	Vorwort zu den MBA-Steckbriefen 2007/2008. Arbeitsgemeinschaft Stoffspezifische Abfallbehandlung (ASA) e.V.
Turk, Thomas; Müller, Wolfgang; Hake, Jürgen; Dorstewitz, Helge	2007	Deutsche MBA Technologie als Exportgut für Europa? Bio- und Sekundärrohstoffverwertung II. Witzenhausen Institut für Abfall, Umwelt und Energie GmbH, ISBN 3-928673-50-5
Bilitewski, Bernd; Wagner, Jörg	2007	Sind MBA-Anlagen zukunftsfähige Entsorgungsanlagen? Bio- und Sekundärrohstoffverwertung II. Witzenhausen Institut für Abfall, Umwelt und Energie GmbH, ISBN 3-928673-50-5
Rohring, Daniel	2008	Technisch-Wirtschaftliche Optimierungspotentiale der mechanisch-biologischen Abfallbehandlung in Deutschland. Bio- und Sekundärrohstoffverwertung III. Witzenhausen Institut für Abfall, Umwelt und Energie GmbH, ISBN 3-928673-52-1

Addresses of authors*:*

Karsten Runge
BACKHUS GmbH
Wischenstrasse 26
D-26188 Edewecht
Telefon +49 4486 92840
e-mail: karsten.runge@backhus.com
website: www.backhus.com

Thomas Hölscher
BACKHUS GmbH
Wischenstrasse 26
D-26188 Edewecht
Telefon +49 4486 92840
e-mail: thomas.hoelscher@backhus.com
website: www.backhus.com