Pohlsche Heide (AML) MBT Plant

Terms of use/Disclaimer

This case-study contains information obtained directly from companies that could not be verified. The reporting of commercial products, their sources or their use in connection with the material reported herein is not to be construed as actual or implied endorsement of technology or services. All images are reproduced with the permission of the site/company. The information in this report is supplied in good faith and the University of Glamorgan makes no representation as to its accuracy or content. University of Glamorgan is not liable, so far as law permits, for any expenses or losses including any special, incidental, consequential or similar damage or loss which directly or indirectly arise as a result of using the report or the information available on it.

Case studies were produced following site visits undertaken during 2005 and 2006 and information is therefore relevant for operating conditions at the time of visit only. Some plants now operate under different conditions to those specified within the case studies.

Part funded by

CASE STUDY – CENTALLY SEGREGATED BIOWASTES

Pohlsche Heide (AML) MBT Plant

INTRODUCTION

The Pohlsche Heide MBT plant and wastes treatment centre is located at a landfill site between the towns of Hille and Minden, on the northern boundary of the Minden-Lübbecke district. The Pohlsche Heide Waste Disposal Centre is owned by AML (Abfallentsorgungsbetrieb des Kreises Minden-Lübbecke) which is the council-owned waste treatment company for the Minden-Lübbecke region. The site is operated by GVOA mbH & Co. KG, which is also primarily owned by Minden Lübbecke Council and employs 60 people. The mechanical separation equipment and the tunnel-composting facility was provided by Horstmann, the anaerobic digester by OWS Dranco Ltd, and the gas cleaning equipment by HAASE. The facility is located next to a landfill site, with a recycling facility, windrow composting plant and a wastewater treatment plant on the same site. Prior to the construction of the MBT plant the residual municipal waste from the region was landfilled without treatment. The MBT plant accepts 40,000 tpa of residual MSW from 320,000 inhabitants in the Minden-Lübbecke region. It also accepts around 40,000 tpa of commercial wastes, around 12,500 tpa of sewage sludge from the water treatment works on-site, and around 7,500 tpa of other sludges. Therefore in total the plant accepts 100,000 tpa of wastes.

In August 1999 detailed plans for the project were submitted to the local authority in Detmold. The MBT plant was approved for construction in May 2002. Construction began in September 2002, and the plant was brought into trial operation in January 2005. The MBT plant has been in continuous operation, treating the designed waste capacity since June 2005. An aerial photograph of the site is shown in Figure 1. Figure 2 shows the plant from the entrance. More information on the plant is available on the Pohlsche Heide website (www.pohlsche-heide.de). Unfortunately most of this information is in German. Some financial figures about gate fees are available. The site also contains a webcam of the MBT plant, which is updated hourly.

Figure 1 Aerial photograph of MBT plant (Pohlsche-Heide website, accessed November 2005)

The top building contains the wastes reception area (left), the mechanical separation stages (middle) and the biogas engines (right, beside digester). The smaller green building towards the bottom of the photograph is the composting hall. The wastewater treatment plant, which was part of the existing landfill site can be seen in the bottom left.

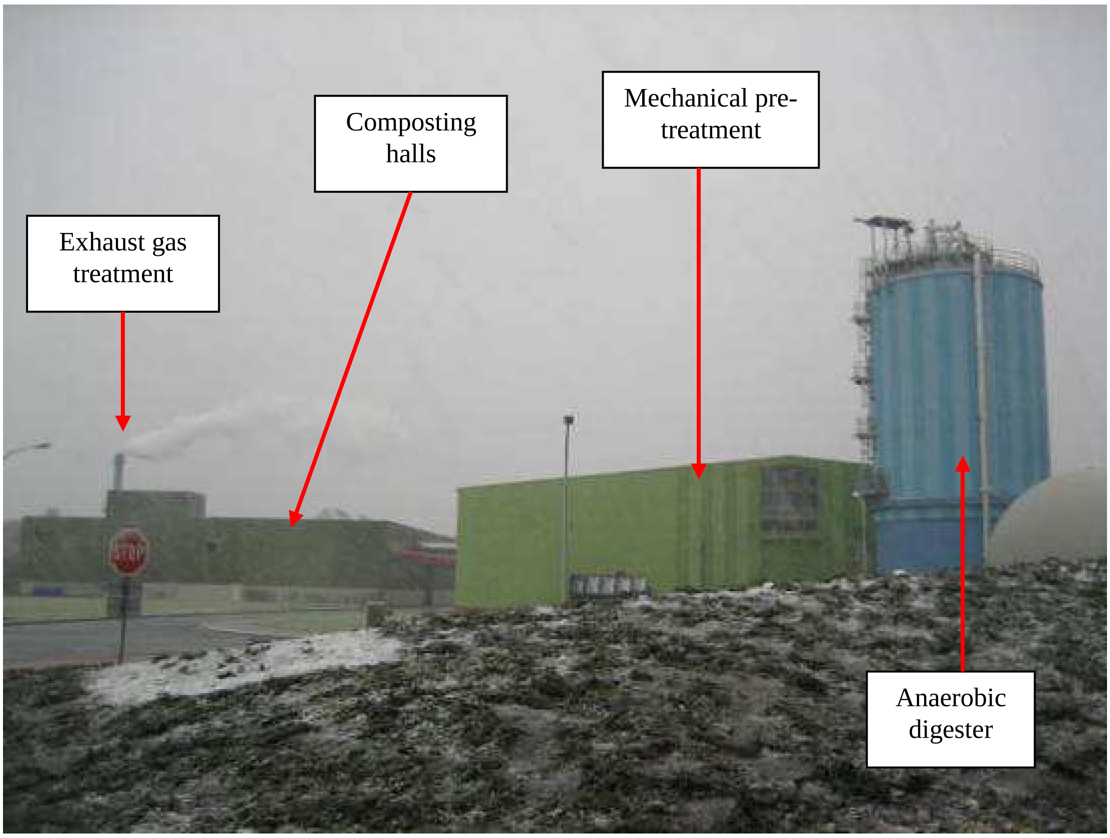

Figure 2 MBT Plant at Pohlsche-Heide

The gas storage bell and anaerobic digester can be observed on the right of Figure 2. The green building to the left contains the unloading bay (at the far end), and the mechanical separation stages. The building on the left (connected to the other building by overhead conveyors) is the composting hall. The composting hall building also contains the exhaust gas treatment facilities (see chimney). A diagram of the process concept can be observed in Figure 3, and a process flow diagram can be observed in Figure 4. Both Figure 3 and Figure 4 are sourced from the IBA website (accessed July 2006).

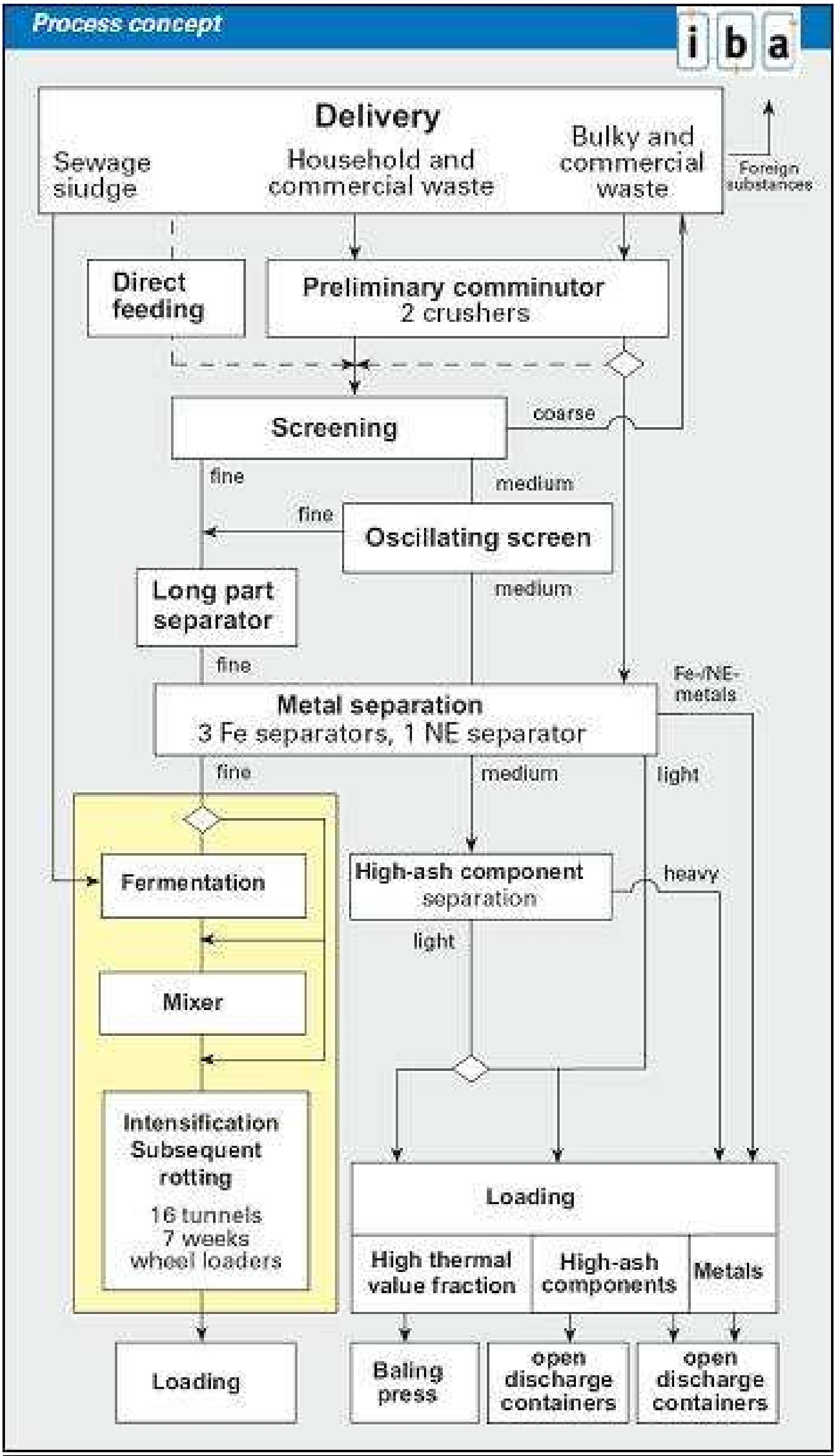

Figure 3 Process concept (IBA website, accessed July 2006)

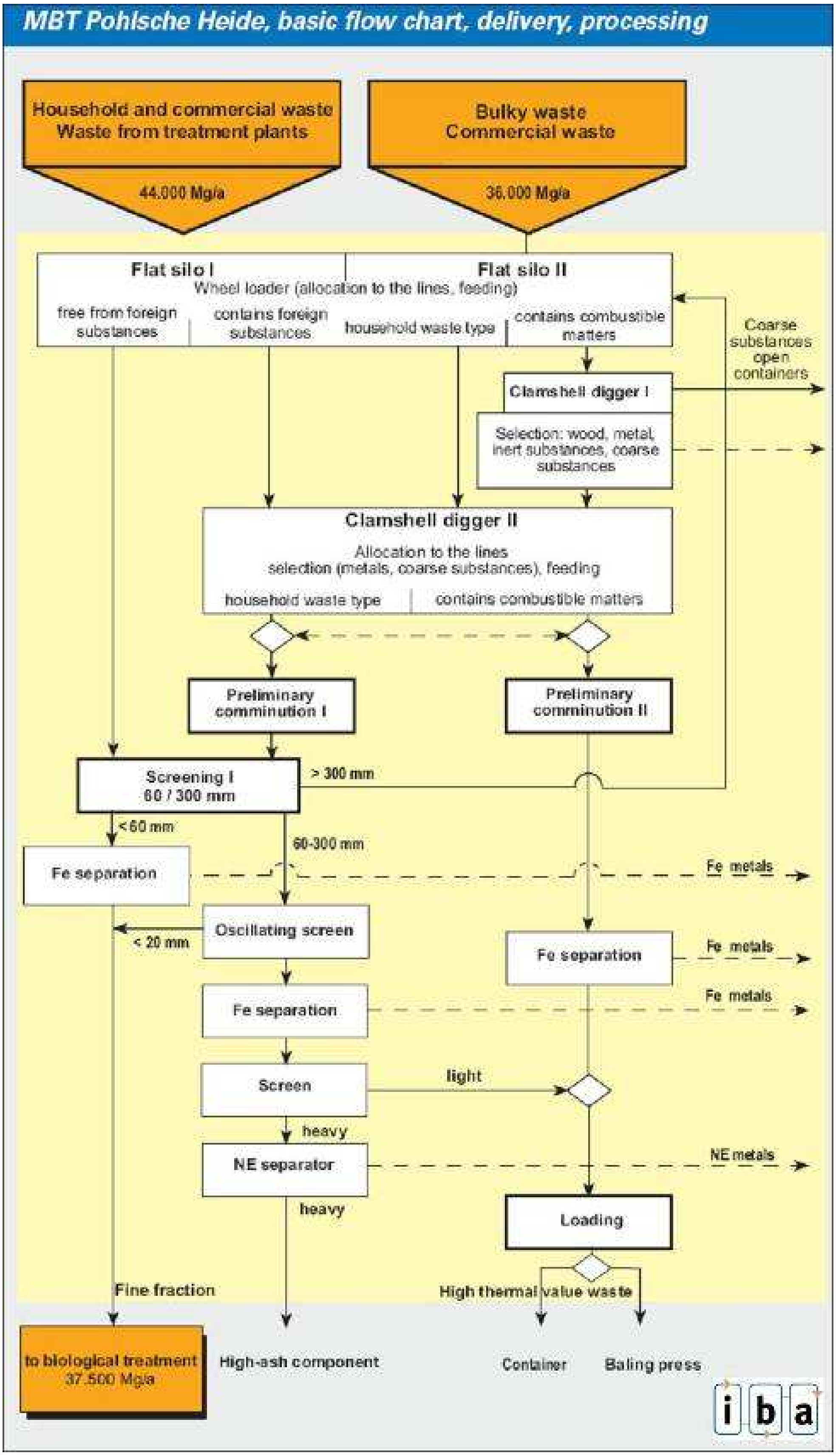

Figure 4 Process flow diagram (IBA website, accessed July 2006)

WASTES RECEPTION AND PRE-TREATMENT

The reception area is in the form of a standard covered warehouse (Figure 5) with fresh air re-circulation to minimise dust and bio-aerosols. Lorries drive in, unload their residual municipal waste (or commercial waste) directly to the floor (Figure 5) and drive out. Doors are kept closed when not in use, although during the day deliveries are fairly constant.

Figure 5 Wastes reception area

The waste is manoeuvred around the reception are floor by JCB diggers, and lifted into a shredder by picking-cranes (Figure 5). All the incoming waste is shredded, and passed on to a conveyor belt. All recyclable materials such as wood, metals and plastics are separated from the waste stream and sent for recycling. Of the remaining waste stream particles <100 mm are sent for biological treatment, while particles >100 mm are sent for energy recovery by thermal treatment. Separation techniques used include air classification (to separate heavy wastes from RDF), magnetic separation techniques (to remove recyclable ferrous metals) and vibrating trommel sieves to separate the waste stream by particle size. As with every MSW stream, problems were caused by long slivers of plastic (*e.g.* the inside of video tapes, strips from fertiliser sacks *etc.*) that wound around moving parts and needed to be periodically removed. Figure 6 shows some of the conveyors between different stages of the mechanical separation. Figure 7 shows the 'light fraction' being wind separated from the heavier wastes. This 'light fraction' will go to be baled as RDF and sent off-site for energy recovery.

Figure 6 Conveyors between mechanical separation stages

Figure 7 'Light fraction' separation by wind sifting

Organic materials (along with small impurities that have passed through the mechanical separation stages) are then sent for biological treatment.

ANAEROBIC DIGESTION

The biological treatment is carried out in two stages. The first stage is anaerobic digestion in a Dranco reactor (Figure 8), and the second is tunnel composting (Horstmann GmbH) to achieve complete biostabilisation. The anaerobic digester was supplied by OWS Dranco Ltd. The Dranco process consists of a dry thermophilic, one-phase anaerobic digester. Annual throughput is around 48,000 tpa and digester volume is 2,500 m^3.

Figure 8 Dranco digester at Pohlsche-Heide

The green building on the left contains the gas engines and the mechanical treatment stages. The gas storage bell can be seen on the right. After the mechanical separation stages the waste stream has a maximum particle size of 60 mm. It contains mainly organics but also a significant amount of shredded card and plastic. Before its introduction to the reactor, steam is injected into the waste stream. This steam is renewably produced on-site as a by-product from the production of electricity from the biogas. It is estimated that approximately 3 or 4% of the total biogas produced is used to make this steam. Steam injection ensures the correct moisture content (45% TS in the input in this case), and raises the temperature of the reactor influent prior to its introduction into the reactor. The Dranco process operates between 55 and 59^{o}C. This particular digester is operated at as close to 55^{o}C as possible. This steam-injection to the inflowing waste stream is sufficient to maintain the reactor within the desired temperature range without further heating. The waste is mixed with a recycled portion of the reactor contents (removed at the bottom of the reactor) at a ratio of 1/3 fresh feed to 2/3 recyclate, and pumped back to the top of the reactor for re-introduction. In newly built Dranco reactors such as this one the inflow piping to the top of the reactor is inside the reactor vessel, rather than outside as in the Salzburg plant. This reduces heat loss, but could cause extra problems in the case of pipe corrosion/blockage etc. Similar to all other Dranco processes, a Putzmeister pump (Putzmeister, Germany) is used. These pumps, designed for heavy duty use in the cement industry, are used to pump feed to the top of the reactor, where it is introduced. Once pumped in to the top of the reactor, there is no internal mixing apart from the downward flow of the waste due to gravity. There is no internal or external heating, with the thermophilic operating temperature being solely controlled by steam addition to the influent stream. An advantage of this mixing system is that there are no moving parts inside the reactor, so no danger of blockage or malfunction leading to downtime. With more internal flow-pattern data it could possibly be argued that better waste/biomass contact could be achieved with more mixing, provided by an additional mixing system. An advantage of this heating system is that the steam from the production of electricity is re-used. The organic loading rate is in the range of 5 – 8 kgVS/m^3 reactor/day. The waste entering the reactor has an average total solids content of 45%. A C:N ratio was not given. Retention time is 21 days. For more information on the Dranco process see the OWS Dranco website (www.ows.be/dranco.htm).

The anaerobic digester does not receive all of the organic waste stream, only around 70 - 80% of the OFMSW. This set-up forfeits the biogas available in the other 20 - 30% of the waste stream, but means that de-watering of the digestate is not required. Wastewater treatment costs and the costs associated with connecting the site to the grid to export the renewable electricity are also saved, as the site uses all of the energy it produces, and does not produce any wastewater.

POST AD TREATMENT

The second biological treatment stage is the tunnel composting stage, provided by Horstmann. The tunnel composting stage contains 39 tunnels, each measuring 26 m *x* 6 m *x* 5.3 m. In the first few weeks an intensive de-gassing of the material takes place. In this stage anaerobic conditions are replaced with aerobic conditions over a period of a few weeks. Including the AD digestate, 65% of the residual waste is treated in the tunnel composting stage. In a mixing and homogenization vessel, the digestate is mixed with the other 20% of the organic waste stream, sent directly for aerobic decomposition from the mechanical treatment and moistened (with water recovered from another part of the process) if necessary. These composting tunnels are managed with an automatic entry system and a manually operated wheeled loader as discharge equipment. Composting occurs 'in-vessel' in a concrete tunnel system with automatic control of aeration, temperature and moisture content. The composting takes place computer-aided and personnel-free. It was not possible to see these tunnels, but the waste entering the tunnel-composting system is shown in Figure 9.

Figure 9 Waste entering tunnel composting system

The material remains in the composting tunnels for about 7 weeks. Usual retention time in Horstmann tunnels is around 10 weeks, but this organic waste has already been anaerobically digested, which minimises the organic decomposition required. During this period waste is moved from one tunnel to another other several times. This aerates the waste. The biostabilised output conforms to the standard values of German law, and can be landfilled. Horstmann claim the tunnel composting process raises the temperature to 70 °C in the tunnels, resulting in the hygienisation of the material. The Horstmann tunnel composting system, as with other tunnel composting systems, is modular, and can therefore be easily scaled as desired.

DIGESTATE

After tunnel composting the material is fully biostabilised. Therefore it can no longer release any contaminants after it is landfilled. As a consequence the aftercare of the landfill is significantly lowered. The waste landfilled after recyclables recovery and biological treatment represents around 1/3 of the combined input to the plant. Therefore, even after source separation of recyclables and kitchen waste in the home, around 2/3 of the residual waste can be successfully diverted from landfill using this MBT system. The biostabilised output is stored on separate part of the Pohlsche Heide landfill site. This ensures that the storage properties of the decomposed output can be monitored. It is deposited highly compacted to minimize space requirements and the build-up of leachate.

BIOGAS UTILISATION AND ENERGY PRODUCTION

Around 115 – 120 m^3 of biogas are produced per tonne of waste treated in the Dranco digester. This biogas is estimated to be 50 – 60% methane. The total annual throughput of the Dranco reactor is 48,000 tpa. This equates to 57.5 – 72 m^3 of methane per tonne of residual waste entering the MBT plant. Assuming a conversion efficiency of 30% for electricity and 55% for heat, this methane could produce 8287 – 10,376 MWh/a of electricity and 15,192 – 19,023 MWh/a of renewable heat.

Biogas is stored in a 600 m^3 steel bell (Figure 8). Around 3 – 4% of the biogas produced is used to produce steam for the heating of the influent of the Dranco reactor. The rest is sent to the existing CHP unit on the landfill site (200 – 300 m away) for conversion to electricity and heat. The electricity and heat produced are used to supply all on-site requirements. The biogas produced in the AD stage covers the energy requirements of the plant, both in terms of electricity and heat. The presence of the anaerobic reactor as well as the composting tunnels leads to reduced emissions compared to a single-stage aerobic method without anaerobic digestion. The tunnel composting process is a net energy user. Each composting tunnel has a ventilation unit with approximately 45 kWh installed capacity. These units are used 24 hours a day, but not always at full capacity.

EXHAUST GAS TREATMENT

The Pohlsche Heide MBT plant was conceived as an in-vessel plant. Polluted exhaust-air flows (building air-conditioning, wastes reception area air, composting area exhaust-air) is intercepted and fed to a multi-stage exhaust-air scrubber consisting of a cooler, a washer, a humidifier, a closed biofilter and an exhaust gas chimney fitted with emission monitoring sensors. The exhaust air treatment system was supplied by HAASE. An overview of the exhaust air treatment system can be observed in Figure 10.

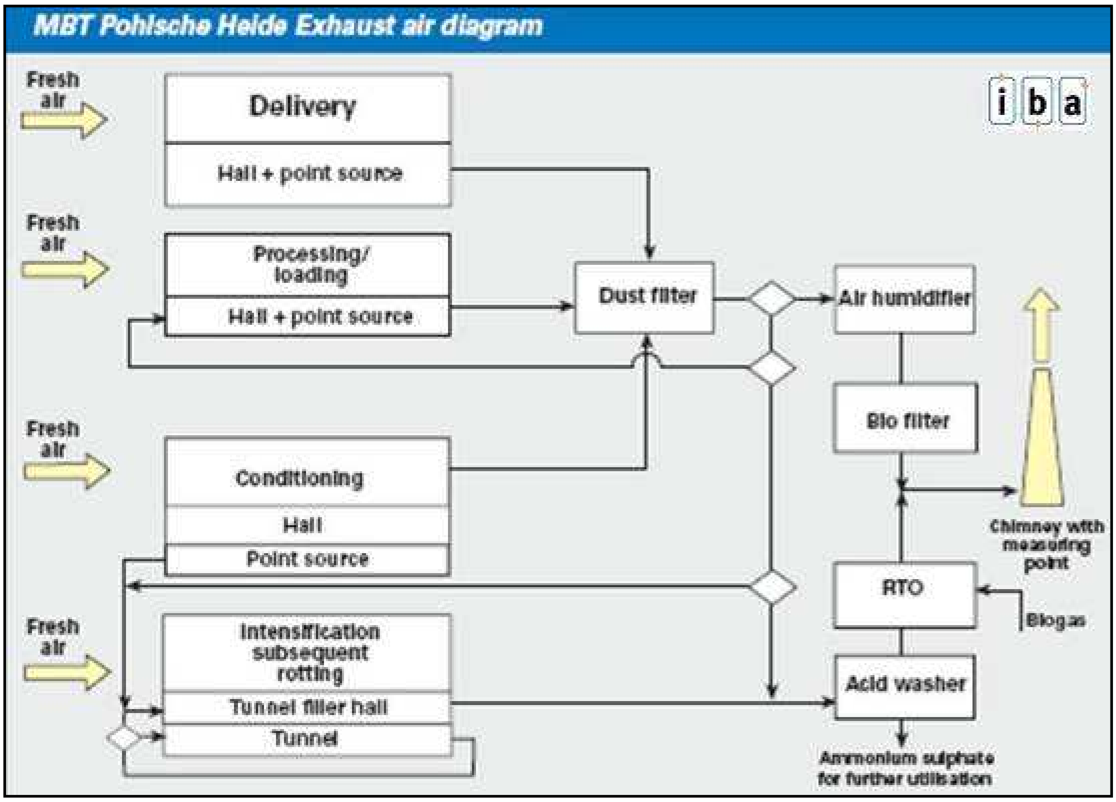

Figure 10 Exhaust gas treatment system overview (IBA website, accessed July 2006)

This system ensures that the requirements of TA-Luft (the German regulations covering air cleanliness) are reliably maintained. Exhaust air from the first few weeks of the tunnel composting process, which can smell particularly bad, is cleaned using regenerative thermal oxidation (RTO) before being added to the rest of the exhaust gas stream for treatment. This RTO involves the exhaust gas being passed through ceramic material heated to 1,100°C. The composting systems had a strong odour, despite being in-vessel, but this is normal and the odour at this site was perhaps less offensive than on other composting sites visited.

Figure 11 Exhaust gas treatment

Noise and odour emissions from the MBT plant lie well below the statutory limits.

WATER AND WATEWATER TREATMENT

The MBT plant only generates a small amount of residual wastewater because the concept provides for using any wastewater in the process itself. The water used in the biological process evaporates and is dissipated with the exhaust-air. Water evaporated from the tunnel composting stages is recovered, and converted to steam, which is used to pre-heat and add moisture to the inflow of the Dranco system. The digestate from the Dranco system is produced in exactly the right quantity that when mixed with the residual OFMSW stream that was not digested, contains a water content perfect for tunnel composting. It was estimated by a Horstmann representative on site (Dippert, Personal Communication, 2005) that only around 6,000 tpa of water is needed by the MBT process. This corresponds to 0.06 m^3/tonne of incoming wastes. This is a low water requirement, although as well as residual MSW the plant accepts sewage sludge (12,500 tpa), commercial wastes (40,000 tpa) and other sludges 7,500 tpa). These other waste streams may contain a high water content. Very little wastewater is produced (exact volume and content was not disclosed) and therefore very little wastewater treatment is required. Wastewater produced is treated in the wastewater treatment plant that already existed on-site to treat landfill leachate (Figure 12 and Figure 11).

Figure 12 Wastewater treatment plant

VISUAL AND LOCAL IMPACT

The plant was built on the site of an existing landfill site, and is completely surrounded on all sides by woodland (Figure 11). As the plant was surrounded on all four sides by forestry trees, with the access road passing through the forest the site was not visible until you were inside. The total surface area of the Pohlsche-Heide Waste Disposal Centre is 270,000 m^2 including the landfill and wastewater treatment plants. The area of the MBT plant was quoted as 30,000 m^2 (IBA website, accessed July 2006). The highest points on site are the anaerobic digester and the gas exhaust chimney, at approximately 30 m (Figure 2). The plant was landscaped well, and was invisible from public roads.

COSTS AND ECONOMICS

The MBT plant cost a total of €26 million. It was estimated by a Dranco representative on-site (Six, Personal Communication, 2005) that the Dranco reactor and the biogas cleaning and utilisation equipment cost approximately €6.4 million of this. Operational costs (excluding RDF disposal) were stated as €60 per tonne, with the gate fee received being €125 - 145 per tonne. The low water usage and wastewater treatment requirement contributes to keeping the operational cost down. As the plant covers the vast majority of its energy requirements, energy costs will be low, although as no energy is exported, there is no income for this.

MASS BALANCE

The flow of materials entering the plant can be observed in Table 1, and the materials leaving the plant can be observed in Table 2.

Table 1 Wastes treated at Pohlsche Heide MBT Plant

Input Waste	Amount (tpa)
Municipal residual waste	40,000
Commercial waste	40,000
Sewage sludge	12,500
Other sludges	7,500
Total	**100,000**

Table 2 Approximate mass balance of the output

Output	Amount (tpa)
Recovered metals	2500
Biostabilised output	33,500
RDF	32,500
Digestion losses	6,700
Composting losses	16,500
Miscellaneous	8,300
Total	**100,000**

CHALLENGES AND DISCUSSION

This system is newly commissioned and has operated continuously without interruption since June 2005. The percentage of the residual waste diverted from landfill is 66.5%. Without the exact details of what the 40,000 tpa of commercial wastes were, it is difficult to speculate on the efficiency of the process in this context. All of the waste landfilled is fully biostabilised. From a water use point of view, the plant is efficient, and the concept is very strong. Energetically, the plant does not compare so well, as other MBT plants treating residual wastes export significant amount of the renewable energy they produce. The system is designed to minimise water addition and wastewater treatment, and for these reasons not all of the organic waste is digested in the Dranco reactor. Therefore from an energy production point of view the plant does not produce as much biogas as it would if it were to digest the whole organic waste stream anaerobically. In this case the savings made on de-watering, wastewater treatment and electricity grid connection must have outweighed the potential income from electricity if the whole organic waste stream had been digested. From this point of view this concept is different from any others reviewed in this report.

REFERENCES

Pohlsche-Heide website, (www.pohlsche-heide.de), accessed December 2006.

IBA website, (www.iba-hannover.de/referenzprojekte/MBT_PohlscheHeide_en.pdf#search=%22iba%20pohlsche%22), accessed September 2006. Contact details; iba@iba-hannover.de.

OWS Dranco, (www.ows.be), accessed July 2006.

Dippert T. (Engineer, Horstmann GmbH). Personal Communication, 2005.

Six W. (Marketing Manager, OWS Dranco), Personal Communication, 2005.