Experiences with the Operation of the Nehlsen-Drying-MBT-Plant Stralsund

Wolfram Breuer

Nehlsen Contracting GmbH & Co. KG, Bremen

Betriebserfahrungen mit der Nehlsen-MBS-Anlage Stralsund

Abstract

Mechanical Biological Treatment (MBT) is an indispensable component for waste treatment in order to meet the specific requirements of the respective waste producers. The flexibility of the plants layout and the equipment assembly are essential, to adapt to the changing requirements of the MBT outputs users. Even for renowned suppliers of system components this specific case of operation is frequently new. For this reason, the complexity of the requirements for waste treatment plants is sometimes not evaluated adequately. Only the close collaboration between plant operators, planners and suppliers will solve the resulting technical difficulties. Nehlsen is running, planning and supplying MBT-plants. The experiences from all tree areas are being combined and used for future projects.

Keywords

Shredding, flexibility of the plants layout; energy demand

1 MBT as a component for ensuring a reliable waste disposal

When it comes to the disposal of wastes, it is essential to offer to the waste producer environmentally sound disposal solutions which meet both legal requirements and the waste producer's specific requirements in a cost-effective way. Nehlsen, as a service provider for cities, municipalities, business and industry, has translated this idea into its NEHLSEN 3-Säulen-Plus-Konzept® (NEHLSEN 3 Pillar Plus Concept) (Figure 1).

The first pillar symbolizes the MBT-process including the use of the refuse-derived fuel CALOBREN® for energy recovery. The second pillar represents waste incineration and thermal recycling and the third pillar corresponds to the landfill. PLUS stands for the materials recycling of glass, paper and lightweight packaging as a basis for a material flow and utilisation management.

The treatment of residual waste in cities, municipalities and districts requires solutions which take the conditions of the local waste industry (existing landfills and plants, settlement structure, direct labour organization etc.) into consideration by keeping costs as low as possible. Nehlsen's 3-Säulen-Plus-Konzept (3 Pillar Plus Concept) flexibly adapts to different client situations. There certainly is one kind of treatment which is predominant but just like communicating pipes, one treatment is connected with other procedures and can only durably exist because of this connection.

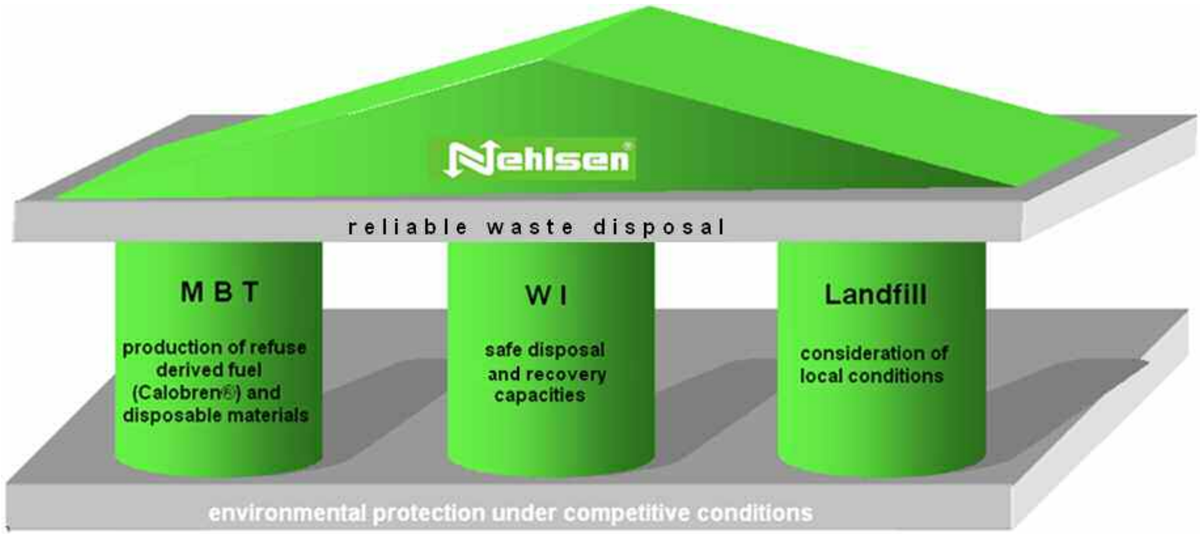

Figure 1 3 Pillar Plus Concept (NEHLSEN 3-Säulen-Plus-Konzept®)

The MBP/RDF-plant Stralsund consistently translates this strategy. As an MBT-plant, it is designed for the production of high-grade refuse-derived fuel, but at the same time, it also falls back on WI and landfill capacities.

2 Nehlsen-MBT-plant Stralsund

2.1 Project overview

In the Nehlsen-MBT-plant Stralsund, the waste produced by the cities Stralsund and Greifswald as well as by the district Rügen is mechanically-biologically treated since 1 June 2005. The plant has an approved capacity of 70,000 Mg/a which is processed into a high calorific fuel fraction and a low calorific landfill fraction. The focus is set on the treatment of domestic waste, bulky waste and commercial waste similar to domestic refuse as well as on the production of refuse-derived fuel (RDF).

The plant is situated at the boundary of Stralsund's urban area, on the premises of the Stralsunder Entsorgungs GmbH. The closest residential buildings are only some hundred meters away and, to the east, several allotment gardens border on the premises. The 3,600 m²-sized halls, a vehicle scale, the staff rooms and the vehicle trackways which already existed on the 30,000 m²-sized premises have been integrated into the plant and are still in use.

2.2 Procedure

2.2.1 Division of the plant into operational units

The plant was divided into five operational units (OU):

- OU 1 Waste reception and processing (mechanical pre-treatment)
- OU 2 Intensive composting / stabilisation (biological treatment)
- OU 3 Processing and shipment of the refuse-derived fuels
- OU 4 Closed biological post processing
- OU 5 Exhaust gas collection and cleaning

The basic flow diagram of the MBT-plant Stralsund including a mass balance is shown in Figure 2.

2.2.2 Operational unit 1: waste reception and processing

In OU 1, the waste is delivered separated, shredded, sieved and loaded into mobile stabilisation and transport containers. Separated contraries and recyclable materials such as scrap metal are passed on to recovery or disposal. Biologically treatable waste components are separated, loaded into closed composting containers and transported to operational unit 2. Fuel components and high calorific waste components are passed on via conveyor belts to operational unit 3 where fuel processing takes place.

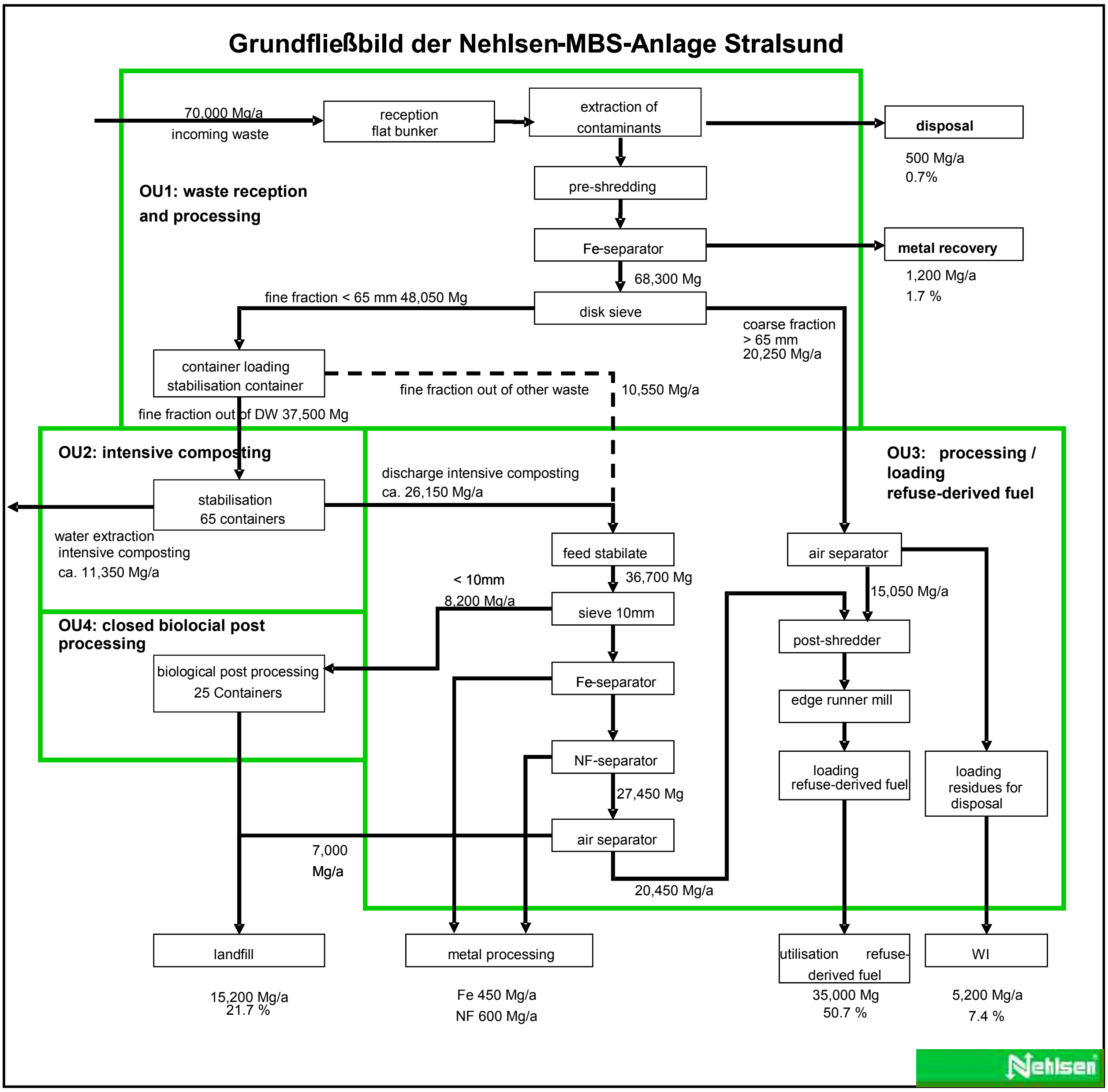

Figure 2 Basic flow diagram and mass balance of the Nehlsen-MBT-plant Stralsund

2.2.3 Operational unit 2: intensive composting / stabilisation

The composting containers coming from operational unit 1 are aerated with exhaust gas from the halls. The containers are gas- and watertight to avoid emissions during composting (Figure 3).

Readily biodegradable waste components are largely decomposed within a week at temperatures of about 70°C. At the same time, the waste is to a great extent dehumidified by the exhaust gas, which facilitates further treatment and raises the calorific value of the waste.

Figure 3 Stabilisation in composting containers, thermal exhaust gas cleaning and biofilter

2.2.4 Operational unit 3: RDF-processing

The “stabilised“ waste is transported in composting containers to operational unit 3 and unloaded in an encapsulated hall. The waste is further treated together with the high calorific waste coming from operational unit 1. During this process, low calorific material for biological post processing, high calorific material for energy recovery as well as ferrous and non-ferrous metals are separated by sieving, screening, post-shredding and metal separation.

The low calorific fraction is again loaded into composting containers and transported to operational unit 4. All remaining fractions are transported off-site for external processing.

2.2.5 Operational unit 4: closed biological post processing

The low calorific fraction which was separated during RDF-processing undergoes a further container composting of ten days to even further reduce the remaining biodegradable components.

The closed biological post processing containers are aerated with exhaust gas from the composting containers of operational unit 2. Afterwards, the exhaust gas from the exhaust gas cleaning is passed on to operational unit 5.

2.2.6 Operational unit 5: Exhaust gas cleaning

All air flows which have been collected in operational units 1 to 4 are cleaned in operational unit 5.

The high contaminated air flows, especially those used multiply, which were first abstracted from the halls and then used in intensive composting, are now passed on to a thermal exhaust gas cleaning, in which all organic exhaust gas components are completely destroyed. The energy demand for the thermal exhaust gas cleaning (regenerative thermal oxidation, RTO) is considerably reduced by the recovery of heat from the exhaust gas. The low contaminated air flows are passed on to a biofilter where they are cleaned in an energy-saving way.

The total amount of the exhaust gas coming from the RTO and the biofilter is emitted into the environment via a common stack. This central point of emission is situated in the western part of the site so that a maximum distance to the residential area and the allotment gardens is kept.

3 Optimization of the treatment steps

3.1 Adaption of pre- and post-shredding

Due to the amended legal framework valid since 1 June 2005, the composition of the waste delivered to the plant Stralsund changed within a very short period of time. The amount of commercial waste increased and the amount of plastic film heavily grew whereas the amount of wood in the incoming waste sank. The pre-shredder originally used in Stralsund worked according to a break-rip shredding system. The altered waste composition reduced the throughput and the shredding quality of the processed material. This resulted in a degradation of the separation efficiency of the subsequent units. Furthermore, the shredder unit was sometimes clogged. The increased amount of plastic film and the sinking amount of wood in the waste flow as well as the higher lumpiness of the pre-shredder output had a negative effect on the performance of the hammer mill used for post-shredding that even before had not been optimal. In spite of the manufacturer extensively trying to improve the shredder function, the necessary throughputs and availability for operation could not be achieved. As also further problems arose, such as vibrations, clogging and safety-related difficulties which the manufacturer was not able to eliminate, the pre- and post-shredders were replaced. For both, pre- and post-shredding, devices working with a cutting shredding system were used, to cope with the increased amount of plastic film (Figure 4). Both devices are electrically operated single-shaft shredders in which the material is cut between rotor and stationary knife (Figure 5). A repressing device ensures that the material is safely drawn in. The adjustment of the rotation speed to different load rates and output requirements is realized by way of a frequency converter. The shredding quality is regulated with sieves of corresponding perforation.

Figure 4 New pre-shredder in Stralsund

Figure 5 Cutting process rotor knife in stationary knife

3.2 Extraction of contraries

Due to the cutting shredding system, the new post-shredder (Figure 6) demands a lower amount of contraries in the input. Materials such as metal parts, especially iron parts, stones etc. which would easily be crushed by a hammer mill, must be eliminated before entering a cutting device. Within the pulverizing chamber of a cutting mill such materials lead to a wear and tear that is way above average and may cause the knifes to break or even more serious damage. For this reason, the plant has been equipped with an additional Fe-separator within the input streams of the post-shredder (Figure 6).

In the existing air separators, a supplementary separation stage was added in form of a film-post-separation. This allowed to ensure a considerably lower amount of contraries in the post-shredder input, i.e. the separation of stones, glass and heavy non-magnetic metal parts was improved. The newly configured extraction of contraries has been so effective that in the course of the operation of the new post-shredder in Stralsund only one case of damage because of contraries occurred in the previous year causing a 2 hour breakdown of the plant operation.

Figure 6 New post-shredder with additional magnetic separator in Stralsund

3.3 Pelletization

In the Stralsund-plant, the final conditioning and the compaction of the RDF is realized with the help of two pelletizing presses with a flat matrix (Figure 7). The material feed and the dosing to the presses was realized by the supplier with spiral conveyors. The conveyors were undersized for the dosing and transportation of the material. They threw over causing a partial material compaction and a discontinuous input flow of material into the pelletizing presses. Even though the presses are equipped with an automatic load regulation, they were unable to cope with the sudden input load drifts so that the presses were clogged. Although the conveyors underwent several technical changes, the problem could not be solve.

To improve the conveyor system, the supplier installed rotary valves above the conveyors to ensure correct dosing. Furthermore, the automatic load regulation of the presses was disabled and instead they were driven with a fixed admission pressure and a constant spacing between the circulation rollers and the matrix. Since these changes were made, the presses have been able to process the necessary quantities of material without affecting the plant operation.

Figure 7 Pelletizing presses with spiral and dosing conveyor

3.4 Additional conveyors for the production of varying fuel qualities

In its original configuration, the plant Stralsund produced pelletized refuse-derived fuel with densities of between 0.25 and 0.35 Mg/m³ and a grain-size of < 25 mm. In the course of 2005/2006, fuel users increasingly demanded less processed fuels of a bigger grain-size. In 2007, Nehlsen wants to put into service a utilisation plant in Stavenhagen which will as well need more coarse-grained secondary fuels as input. By installing various conveyor routes, it is now possible to bypass the highly abrasive and labour-intensive steps of post-shredding and/or pelletization. This allows to produce fuels in three different qualities and the plant is now able to react more flexibly to changes on the fuel market and changed requirements of the individual fuel users. Furthermore, it is able to work with a wider range of waste. Because of the different treatment options, the expenses of wear and tear and of maintenance can moreover be reduced. The changed conveyor routes are shown in the basic flow diagram of OU 3 in figure 2

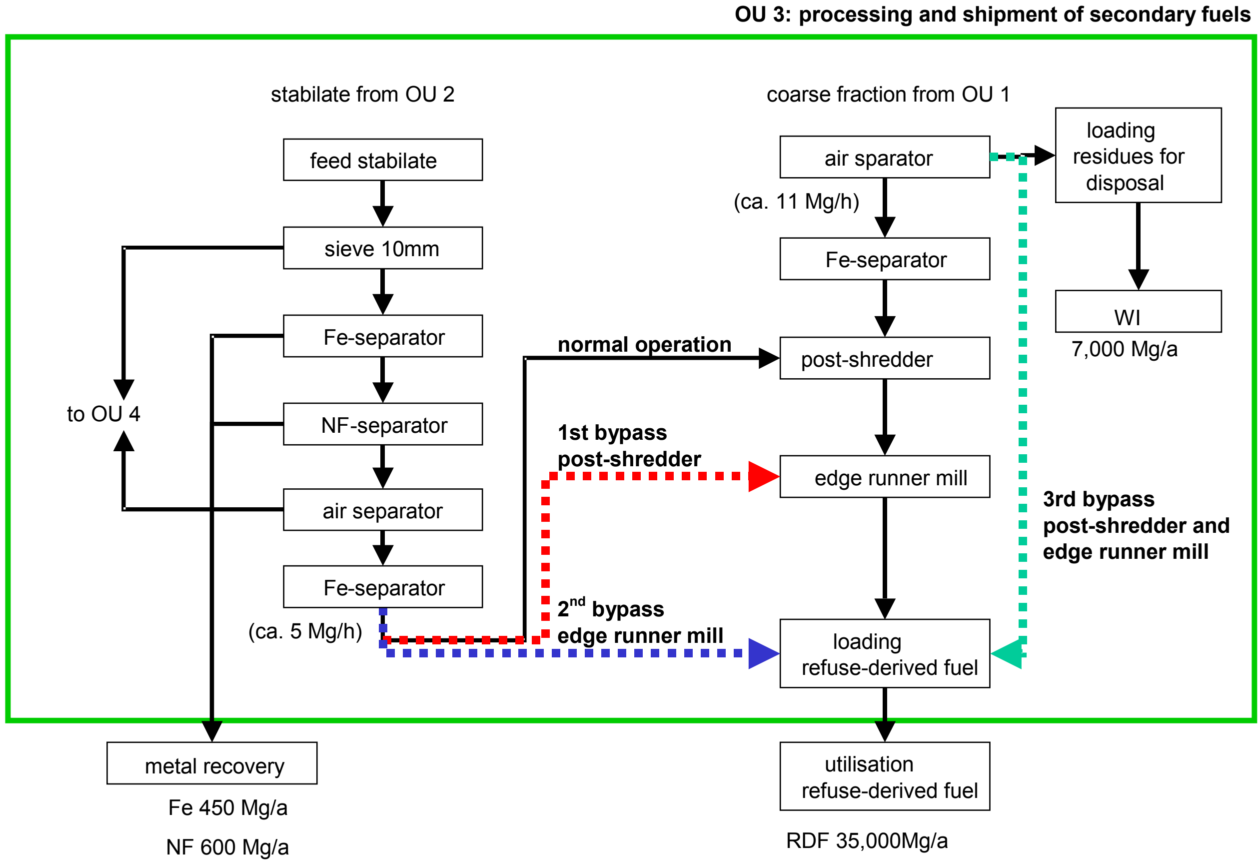

Figure 8 Basic flow diagram OU 3 after rearrangement of the conveyor routes

The following products can be produced:

- Pelletized refuse-derived fuel

  To produce pelletized refuse-derived fuel, the refuse-derived fuel is post-shredded and pelletized. The result is a fuel with densities of between 0.25 and 0.35 Mg/m³ and a grain-size of < 25 mm. The raw refuse-derived fuel is processed through the post-shredder and the lightweight fraction out of stabilate together with the output of the post-shredder is passed on to the edge runner mill. The quality of this RDF corresponds to the output that was formerly produced in the plant Stralsund and is suitable for incineration in power stations or cement factories.

- Post-shredded refuse-derived fuel

  To produce post-shredded refuse-derived fuel, the raw RDF is processed through the post-shredder. The lightweight fraction out of stabilate is loaded together with the post-shredded material. The calorific value and the chemical composition of the RDF remain unchanged. Its density is reduced to 0.15 – 0.25 Mg/m³. Depending on the user's requirements, the grain-size can be varied by changing the sieve perforation in the post-shredder, e.g. from 50 to 80 mm feed size. This material can be used in industrial firing plants.

- Raw RDF

  After separation of the fraction < 65 mm, the contrary-free lightweight fraction is loaded into the existing loading facilities together with the lightweight fraction out of stabilate. The density of the material is also about 0.15 – 0.25 Mg/m³. The calorific value and the chemical composition of the RDF remain unchanged. 95 % of the material have a screen underflow of < 200 mm. It is especially suitable for use in refuse-derived fuel heating plants such as the heat and power station in Stavenhagen.

3.5 Exhaust gas cleaning

3.5.1 Situation and problems of the exhaust gas cleaning system

In Stralsund, the exhaust gas cleaning, in compliance with the 30th BImSchV, is accomplished by using a combination of a biofilter and a regenerative thermal oxidizer system (RTO). Low contaminated air flows are cleaned by the biofilter and through adsorption and microbial degradation and high contaminated air flows by the RTO through afterburning at 850°C. In this respect, the supplier of the air conduction and exhaust gas cleaning system provides a control system to regulate the emission values, the energy consumption and the efficiency of the exhaust gas cleaning system.

During normal operation, the air conduction and exhaust gas cleaning system was unreliable and broke down several times so that the necessary availability for operation could not be achieved. In certain operation modes, the system would convey air against shut valves and cause damage. During the frost period, the plant was not always operable because of freezing. The RTO systems often broke down and the cleaning performance of the biofilter was not satisfactory. Furthermore, the guaranteed energy consumption and efficiency could not be reached and it was not always possible to adhere to the emission values in compliance with the 30th BImSchV with the combination of the biofilter and the RTO.

After multiple attempts of the supplier had failed to improve the performance of the air conduction and exhaust gas cleaning system, Nehlsen analysed the defects, worked out possible solutions and was then able to eliminate the defects in the framework of an execution by substitution.

3.5.2 Operational reliability

To ensure the necessary availability of the plant, the complete system control of the RTO and of the air conduction system were replaced and parts of the EICA installations such as the flow control, the orifice flowmeter, the pressure sensor and the temperature sensor were replaced or complemented with corresponding devices. Furthermore, the installation of heat tracing on all relevant measuring and control points and on the condensate discharges was able to ensure the frost resistance of the whole plant. The measuring point displays, the reasonableness check and warning signs, which are necessary for fault detection and are to be provided by the supplier, were implemented and visualized for the operational staff. Since these reconstruction measures have been taken, the plant works with the necessary availability for operation. In case of problems, the plant goes on standby according to a prearranged pattern. It is easier to identify and eliminate malfunctions. Violations of limit values can now be avoided

3.5.3 Energy consumption

Concerning energy consumption, the plant missed the guaranteed values by up to 65 % depending on the load. The heat loss which determines the efficiency of the plant was even exceeded by up to 90 %. After an analysis of the RTO to find possibilities for reducing the energy consumption, the following steps have been taken:

- Improvement of the biofilter

  As the irrigation unit of the biofilter did not work properly and the preceding scrubber did not work because of malfunctions of its control system, the filter material of the biofilter dried out almost completely and the cleaning performance was correspondingly poor. After the connection of the irrigation unit to a controllable water supply and after the scrubber control system was repaired, the cleaning performance has steadily improved and has now reached a level which can be expected of such a plant.

- Introduction of a pollutant-dependent air volume control prior to the RTO

  The concentration of pollutants in the plant's exhaust gas differs depending on the operating status. By introducing a graduated pollutant-dependent air volume control, a greater air volume can be passed on to the biofilter when the load status is low without exceeding the limit values specified in the 30th BImschV. This way, the energy consumption can be reduced because less air has to be heated up in the RTO.

- Augmentation of the heat exchanger mass

  The RTO was equipped with additional heat exchanger mass (Figure 9), which also helped reducing energy consumption.

Figure 9 RTO in Stralsund and additional layer of honeycombs

- Direct gas injection

  By installing a direct natural gas injection, it was possible to save combustion air of the gas burner. The saved air volume does not need to be heated up and contributes to a reduction of energy consumption.

As the air volume passed on to the RTO and the specific energy consumption in the RTO was reduced depending on the load status, the measures taken led to a reduction of fuel consumption of about 30 %. To achieve the energy consumption guaranteed by the supplier further process-related optimizations are at the moment implemented on the RTO.

4 Conclusions

Due to changed waste composition and insufficient dimensioning of single parts of the plant, the MBT-plant Stralsund had to cope with various problems concerning pre-shredding of wastes, post-shredding and pelletization of refuse-derived fuel. Furthermore, the availability of the exhaust gas conduction and cleaning system was not sufficient, a high frost resistance was not guaranteed and energy consumption was too high.

Thanks to a close cooperation of the plant operators and planners, it was possible to eliminate these problems partly by replacement and to render the plant more flexible by installing additional conveyor routes. The throughput of the plant was raised so that more waste than originally planned can now be processed. The energy consumption of the exhaust gas cleaning system was considerably reduced.

The experiences made in improving the plant have been integrated into the planning of new Nehlsen-MBT-plants (e.g. MBT-plant Ölsnitz).

Author's address

Wolfram Breuer
Nehlsen Contracting GmbH & Co. KG
Bereich Engineering
Kap-Horn-Str. 3
28237 Bremen
Phone: +49 4 21 898 21-153
Email: wolfram.breuer@nehlsen.com
Website: www.nehlsen.com