Waste to energy in Hungary: new trends in the North-Balaton Regional Waste Management System of Hungary

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Abstract

Minimizing the landfill load has become a must for EU member states. The mechanical and biological treatment of household wastes is one of the key methods for reaching this goal. The object of mechanical handling is to separate the recyclable fraction and transform the non-recyclable part into Refuse Derived Fuel (RDF) for energetic use and to produce organic fraction for biological treatment. The most appropriate method for mechanical treatment depends on different variables. Weather, climate, consumption patterns, education and many other factors influence the design of the optimal technology. Other inputs arrive from the end-users of the product according to their special needs. This paper presents our new complex technology for RDF production of the North-Balaton Regional Municipal Solid Waste Management System. This responds to the regional needs concerning quantity and quality of the local Municipal Solid Waste and it is flexible for future needs in accordance with Duna-Drava Cement plant as the present key customer of the product.
Keywords: anaerobic digestion, bio-waste, biogas, RDF, waste to energy.

1 Introduction

Taking care of the environment needs global thinking and local action. Waste is one of the most important issues for the modern society. It is connected to all industrial activity and consumption behaviour of people. The vast quantity of solid and liquid waste has become one of the most hazardous impacts for all elements of nature, including the soil, air, water and all life forms. The effects can already be seen on a large scale. To turn this general process backwards, international

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action should be taken and forced regarding waste management. New rules, acts, and directives need to come into force with financial support and strict penalties [1].

To enforce the priorities of the "waste pyramid" all level of that should be focused on. The less favoured landfill technologies should be seen as a possibility for the future needs. The municipal solid waste (MSW) has economic value. It contains fractions for recycling and also for incineration purposes. The appropriate selection of those fractions is a prestigious challenge for waste management systems which can be achieved by modern Mechanical and Biological Treatment technologies. This technologies should be continuously developed according the latest experiences and future needs.

2 Waste technologies in Europe and Hungary

All technologies are developed according to needs and priorities. Even if the landfill and thermal use of waste is not the most favoured technology compared to the zero waste emission, reuse and recycling, the research and development is very important as of the present quantity of disposal.

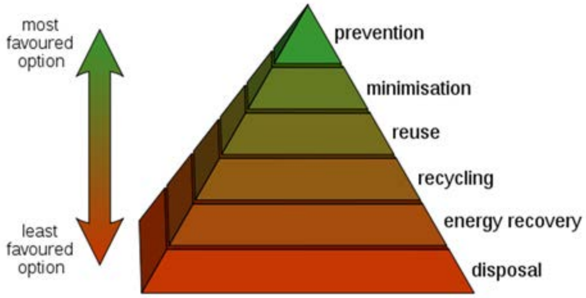

Figure 1: Waste management hierarchy.

The European practice regarding the MSW handling are mainly Mechanical, Biological Treatment (MBT) and waste incineration. MBT-s are more common in for example Germany, Austria; whilst incineration is a general procedure in e.g. Switzerland. MBT is focusing on the pre-selection of waste and try to minimise the biodegradable parts of the residues at the end of the process rather than to handle (incinerate) the total amount waste in one step.

The Hungarian Act, (2012), Act CLXXXV of 2012 on Waste Management set up the main priorities. Hungary support the realisation of regional waste management systems. These preferred systems are similarly to Austrian systems focusing on Mechanical and Biological Treatment. EU funds become available to plan and realise MBT plants for this areas. The financial support was arriving from ISPA (Instrument for Structural Policies for Pre-Accession) and Cohesion Funds [2]. The new systems allow Hungary to increase the handled waste from 250,000 ton to 1,900,000 ton [3].

3 North-Balaton Regional Waste Management System

Even the system was to be launched in 2011 – and still has not been – the original planning started more than 10 years ago. Different priorities were followed-up by the project during its lifetime. The changing legal and economic surrounding altered the project and the technology. One of the main challenge for environmental investment is the location that needs to be approved by the local habitants and this was the main reason of such delay in the realisation.

According to the above the first layout of the technology has not been changed for 10 years. The realised technology is the following (The input is app. 120,000 ton/year – 158 municipalities, 300,000 inhabitants).

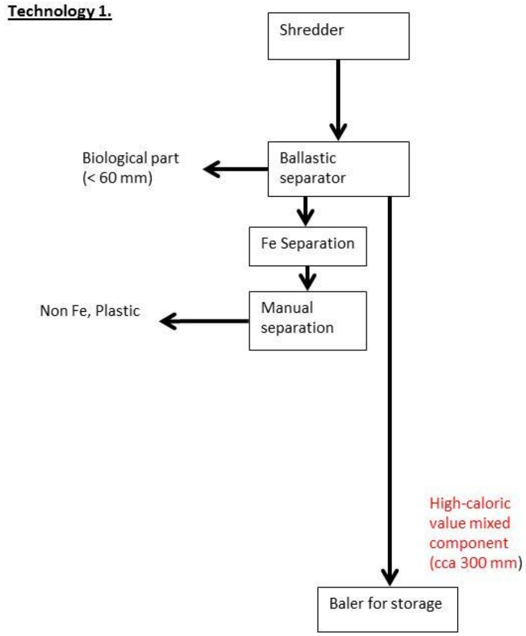

Figure 2: North-Balaton MBT layout.

The MSW at first step is shredded to app. 300 mm fraction. This fraction is separated by ballistic separator into three fraction. The ballistic separator contains a sieve with 80 mm holes, which is moving on an elliptic course. As of the degree of the sieve light fraction is moving upwards (angle is adjustable), mid (or rolling) fraction is moving downwards on the sieve. Fractions:

- *Bio-fraction* – 85% of the biological active parts is contained by the particles under 80 mm. Bio-fraction is treated in the aerobe bio stabilization chambers. Loss in weight occurs due to the processes where CO_2 and water is exhausted to the air through filters, while organic content of the fraction is reduced under the limit for landfill set by the legislations.

- *Light-fraction* – contains the highest calorific value parts. Particle size over 80 mm at North-Balaton technology. Light fraction is baled for incineration (for waste incinerator plans). Caloric value vs. particle size is shown in Table 1 [4].

Table 1: Particle size vs. calorific value.

<table>
<tr><th rowspan="2">Particle size</th><th rowspan="2">Mass %</th><th colspan="2">Mass rate</th><th rowspan="2">Caloric value (MJ/kg)</th></tr>
<tr><th>Plastic + textile + paper</th><th>Stone + other</th></tr>
<tr><td>> 200</td><td rowspan="4">50–60</td><td>81.17</td><td>7.22</td><td rowspan="2">21.22</td></tr>
<tr><td>150–200</td><td>77.59</td><td>12.87</td></tr>
<tr><td>100–150</td><td>79.1</td><td>9.86</td><td rowspan="2">13.95</td></tr>
<tr><td>50–100</td><td>61.2</td><td>23.71</td></tr>
<tr><td>20–50</td><td rowspan="4">40–50</td><td>41.44</td><td>42.3</td><td rowspan="4">7.37</td></tr>
<tr><td>12–20</td><td>19.13</td><td>66.29</td></tr>
<tr><td>8–12</td><td>12.12</td><td>80.6</td></tr>
<tr><td>< 8</td><td>0-10</td><td>90-100</td></tr>
<tr><td>Sum</td><td>100</td><td>53.41</td><td>33.88</td><td></td></tr>
</table>

- *Mid-fraction* – contains usually recyclable waste (e.g. PET, metal, HDPE, etc.). For Fe parts Mid-fraction is pre-sorted by an FE separator, than separated manually for materials that is appropriate for recycling technologies.

4 Experience, fire accident – issues or possibilities?

BAT (Best Available Technology) criteria were met by the layout however the system was realised about a decade later. By 2011 it became evident the original technology does not meet the new requirements and the improvement of the MBT is indispensable. The main reasons are:

- None of the planned waste incinerator plants were realized.
- New legislation goals emerged (new Waste Management Act [5]):
    - Landfill tax is to be introduced to divert waste from the landfill
    - Organic proportion limit of the waste is set for disposing waste
    - Possibly the heat value of the waste should not exceed 6,000 MJ/kg (Austria is already using this criteria) [6].

Run-up phase of the technology were conducted form February 2011 to June 2011 3 months data were present when an industrial fire accident occurred and destroyed the mechanical line. This contributed to a real must rather than a need for the new technology. Other factors for consideration:

- Experiences of pilot production.
- Reconstruction need in accordance with the new legal requirements.
- New technologies and machines had been developed.
- Rising subsidiaries for recyclable materials.

For economic reasons, even before the damage of the mechanical line occurred, need were investigated and auxiliary technology were plant by EU funds. With the fire new situation become a possibility to redesign the whole technology to meet the new industrial and environmental requirements.

5 New goals: new technology – refuse derived fuel

According the Figure 3, MSW can be an energy source. The major competitive technologies for classic waste incineration are the Co-combustion and pyrolysis. All these methods require different pre-treatments of the MSW.

Input material:
The RDF, similarly to Specified Recovered Fuel (SRF), is a high caloric value fraction of MSW produced by methods such as sorting, drying and shredding. The homogenised fraction is suitable for numerous technology as a direct energy input for energetic use. The main components of the RDF are biodegradable waste fractions (e.g. wood, textile) and plastics. RDF is considered as a good quality fuel with a caloric value of 12–24 MJ/kg.

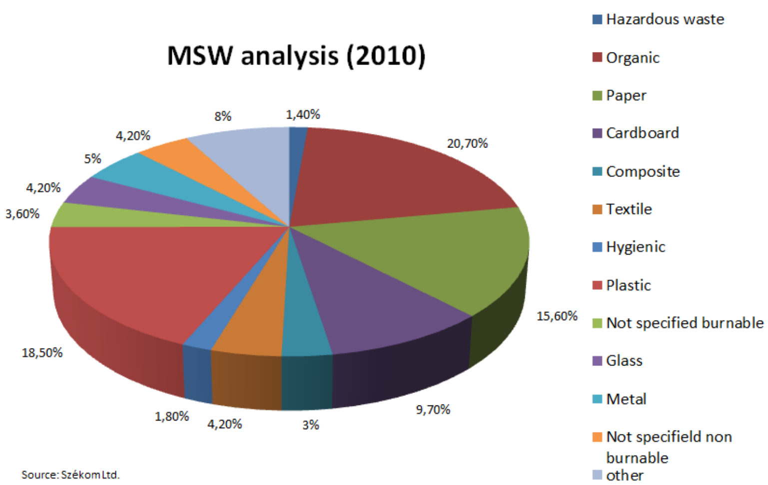

Figure 3: MSW analysis.

In case of the cement industry RDF is not only used for energy purposes but for the product as well as main fraction is integrated by the incineration process into the cement forming zero-emission technology [7].

For the new mechanical processes for the MSW the first objective to identify the needs. To meet the requirements a flexible mechanical technology should be developed. It is also necessary to take into consideration the characteristics of the local MSW and the budget size for the reinstallation.

Possible users:

- Energy industry.
- Cement industry.
- Fuel and gas producers.

Important parameters by the users:

- Particle size.
- Humidity range.
- Halogen content range.
- Calorific value range.

6 Technology for flexible RDF production

According to the needs we set up, new technology was outlined by us, that meets the flexible requirements, by different possibilities of set up and control. Also storage and various method of transportation were taken into consideration.

The MSW at first step is shredded to app. 300 mm fraction. Fe parts are taken out to protect the machinery of the line. The material is than separated by rotating sieve by 60 mm holes this parts is to be treated in the aerobe bio stabilization chambers.

The fraction bigger than 60 mm is introduced to air separator. The heavy parts (inert fraction containing manly inorganic compounds e.g. stones, bricks, etc.) fall out first, than mid and light fraction is divided into two stream. The non Fe and Fe content is separated by eddy current separator, so recyclable metals can be collected from MSW. Near Infra-Red separators are used to pick out the chosen materials (different types of plastic according to need – very important to reduce halogen content for cement industry) by pressurized air. RDF must be introduced to the technology (especially for incineration) with a specific particle size so last process is a fine-shredder where maximum particle size could be set.

The technology is planned to be built by December. 2012 and measurements are scheduled to optimise the system. For the planning of this line we had several technical meetings with the representatives of cement industries and other companies. We have also visited different plants and machine manufacturers. The investigation and planning took 6 months as the strict deadlines of the EU funds did not allow us more time and larger costs. The designed system is limited by the time of realisation and budget, but tries to be the most suitable for the Region.

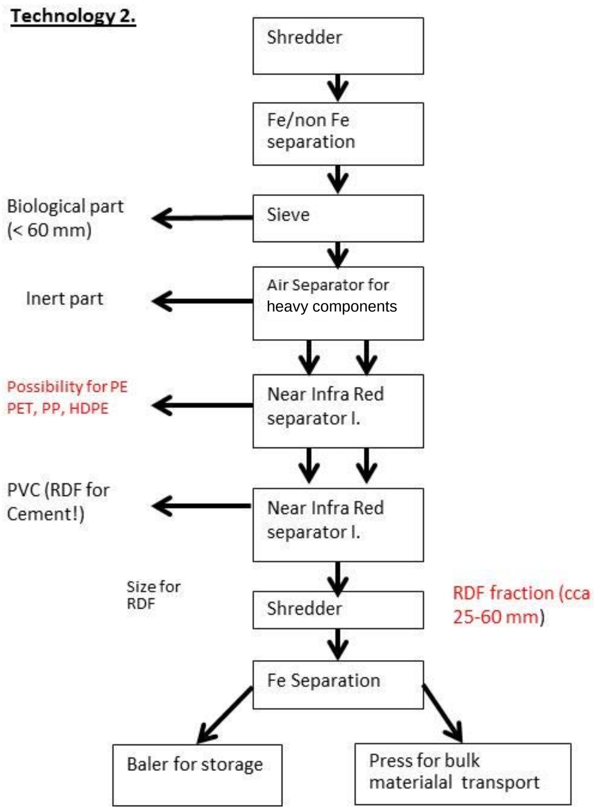

Figure 4: North-Balaton MBT new layout.

7 Conclusion

Protecting the environment is more and more difficult by the growth of the economy and production. All goods become waste by time. Waste management faces a great challenge to reduce, reuse and recycle the waste in its original format or as an energy source rather than depose it in a landfill. MSW generated by 300,000 people in the North-Balaton Region can be an appropriate source to produce RDF fraction that is suitable for multiple use. The shattered technology planned 10 years ago could not meet the new requirements so auxiliary investment become necessary. Investigating the legal, economic and technological changes new objectives were set for mechanical treatment. The new mechanical treatment technology proposed is to be realised by the end of 2012. The launch of the new system and the optimization of parameters should result RDF fraction that can become a "product" again for the economy.

Acknowledgements

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