High Frequency Eddy Current Separator 4000 Rpm For Shredder Residue > 4mm - < 5/8”

Extra High Frequency Eddy Current Separator 6000 Rpm For Shredder Residue < 4mm

Extra Fines Metal Sensor Separator For Shredder Residue < 5/8”
1. Recyclables in MSW

Waste producers in households and urban commercial facilities are often using the same collection system offered by the municipalities. The users have a specific consumption of short life products like paper, glass, plastics and metals that can be called recyclables. Although separate collecting systems in particular for paper and glass are offered, the individual participation on these systems always is limited. There are wide spread reasons for this limitation like the knowledge of people or their motivation to support recycling, the result always is a limited efficiency of every kind of separate collection. Analyses of Municipal Solid Waste typically show that the non collected share is on a level that MSW can be called a source for recyclables. The following research results are focused on plastic products, what are mainly short life products like packages but also long life products from different utilizations. Figure 1 gives an impression of the main types of plastics in post consumer waste.

Figure 1: Plastic distribution in MSW

<table>
<thead>
<tr>
<th>Type</th>
<th>Mass Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELD</td>
<td>33.3%</td>
</tr>
<tr>
<td>PE HD</td>
<td>21.5%</td>
</tr>
<tr>
<td>PP</td>
<td>25.0%</td>
</tr>
<tr>
<td>PS and EPS</td>
<td>6.7%</td>
</tr>
<tr>
<td>PVC</td>
<td>5.2%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>8.3%</td>
</tr>
<tr>
<td>Packages</td>
<td>67.5%</td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>
The Miscellaneous fraction is coming from a wide mixture of former products utilized in households like kitchen aids, furniture and toys but also construction elements and also containing PET packages like bottles.

First step to determine the resource of plastics in MSW is analysing this very heterogeneous source. Several analyses are available but difficult for further interpretation. Three examples of MSW composition are given in figure 2, two rural regions with low specific waste amount and full service for separate collection of recyclables and one from an urban region in the Netherlands with lack of any additional collecting systems. Due to different analysing goals for the urban waste, data for biowaste, diapers, textiles and the fine fraction are missing and summarised in the Miscellaneous fraction.

Figure 2: MSW composition

A problem of waste management calculations is to determine the specific yearly amount of plastics that can be found in MSW. Calculations based on global data of percentage and total amount per year doesn’t fit to reality. Data like plastics content in a range between 4.6 % and 13.6 % aren’t comparable without considering the additional waste collecting systems and the level of specific waste production per capita and year.

The reason is the wide range of specific waste production per capita and year, that depends on the rural or urban structure, the more or less participation of commercial waste producers using the same garbage collecting system and the additional offered recycling options. Figure 3 compares the specific MSW production both in rural areas with a density of population < 250 capita/km² and urban structured areas with more than 2,000 capita/km² in North-Rhine Westphalia 2007.

The potential of recyclable plastics in MSW can be finally calculated from both the MSW and the recycling waste. Relating to the German Light Packaging Waste recycling system the separate collected plastic from Light Packaging Waste System (LPW) is on an average level of 9 kg/c•y as shown in figure 4. The total potential of plastics is resulting in a range between 17 kg/c•y in rural areas (MSW (8 kg/c•y) + LPW (9 kg/c•y)) and more than 46 kg/c•y in urban structures (MSW).
Figure 3: Specific waste production depending on density of population

Figure 4: Composition of Light Packaging Waste
Baseline for the calculation of separate collected plastics is the average result of yellow bin collection with 28 kg/c•y mass recovery of all separated fractions. For the additional collecting system the results are also varying but inversely to MSW. The higher the density of population the lower the recovery quantity is.

2. Plastic products in MSW

Plastic as well in separate collecting systems as in MSW is mainly origin from post consumer packages with a share of less than 8 % of non packages. Analyses on both waste types have pointed out the dominance of 2 dimensioned foils both from LDPE and PP and bags with a share of more than 40 %. The 3-dimensioned plastics and the bottles represent the second important group of products. The share of bottles in particular PET bottles however depends on the national regulations for bottle recycling e.g. deposit systems. Figure 5 pictures the plastic composition in the MSW from urban areas in the Netherland with bottle deposit system for bottles > 500 ml and a lack of additional recycling offers.

Due to different consumer behavior and national deposit regulations the composition in Germany is quite different with a significantly lower share of beverage cartons and PET bottles. From this follows a higher content of plastic foils in the mixture of plastic waste fractions.

The importance of thin plastic foils has to be considered in the discussion about the quality of recycled plastics, because except the plastic bags, foils are characterized by a bad relation between surface and weight. Due to the fact that impurities like humidity and organics are sticking on the surface, the foils are responsible for lower quality of recycled materials due to their high grade of contamination. The significance of products shape and weight for the purification of recycling products is arising from figure 6, where average compositions of PE films and PP rigid products sorted from mixed MSW (MMSW) are documented. Taking into account that a purification process is more challenging for light and thin foils than for 3-D plastics the high level recyclability at last will be different.
3. Plastic enrichment from MSW

Plastic recycling from MSW was first tested in the late 1970 at several plants in Europe. The results have been disappointing and hence plastic recycling was developed based on separate collected waste streams in particular from the commercial sector. A second try was started early in the 1990th based on pre selected post consumer waste from households. The economic need to increase efficiency led to automation in particular by developing sensor based sorting technologies with Near Infrared Detection systems.

Released by the European landfill directive a development of mechanical biological treatment of MSW has been established and this mechanical processing is now the base for new developments considering plastics recycling.

MBT technology is using a biochemical treatment and drying process to reduce the potential of biodegradable waste in MSW. Some of these systems are able to dry MSW from an average humidity of about 45% down to a level of about 10% – 15%. In 2009 a pilot plant was established at MBT Trier and over a year some 5,500 t of MSW were treated after the installed biochemical drying process. The results are promising and currently some Dutch MBT plants have started with similar operations with the intention of plastics enrichment from MSW.

Based on long experiences with sorting separate collected waste fractions and a remarkable development in sensor based sorting technology, technical separation without selection by users in advance now can be compared with the results from sorting pre-selected waste plastics.

The technical process is determined by a stepwise enrichment combined with purification processes. Figure 7 shows the quality of Trier waste after the biochemical drying process with a sortable plastics content of about 10%. 2-D an 3-D plastics are uniformly distributed in this mixture. The fine-fraction < 80 mm also contains plastics but due to their poor
quality and high graded contamination they arent available for recycling. First and main process step is always the size separation by sieving. The lower the humidity the higher the efficiency of this process will be. The plastic content of the sieve overflow is increased factor 3 according to figure 8.

![Figure 7: Trier MSW composition after biochemical drying](image)

The challenge for further mechanical sorting processes is obvious looking on the feedstock composition and the physical property of the main fractions. In order to get rid of impurities like textiles, papers, diapers, shoes and other residues. Due to similar behavior in the separation processes like wind sifters and ballistic separators the success is limited while plastic content is increased up to 60% (see figure 9). The quality now is close to the quality of separate collected packaging waste shown in figure 4.

![Figure 8: Composition of dry MSW > 80 mm](image)

Based on the pre-conditioning process and enrichment of plastics a positive separation with sensor based sorting systems can be added. According to quality requirements from plastic recyclers e.g. a mixed PE and PP product with limited content of LDPE can be produced just as well as other plastic qualities.
In Trier a PO = PE+PP product was enriched with impurities of < 4 %. Running this double staged sorting and purification process lossed results depending on the high quality requirements for the sorting product. While the main impurity is coming from the foils they have to be sorted out from the product stream for materials recycling. Figure 10 gives an impression of the quality of residues from the purification step where most of the impurities are plastics.

The testwork in Trier was successful in sorting Plastics from MSW although a significant share of the plastic potential had been pre-selected by the households and only the losses from this source separation had been available treating the MSW. A sufficient plastic quality only can be achieved by minimizing the share of foils in products for materials recycling. Summarizing the results from the Trier tests for sorting plastics from MSW the yield for PO plastics has been calculated (see figure 11).
As expected the losses are higher than the yield for materials recycling what is clear because of the high level quality demands from plastic recyclers. Following this requirements 28% of the PO stock could be sorted in a product suitable for the recycling market. Also a test run with some 60 t from this product was carried out with a well known plastic recycler and assed with reference to mass balance and quality. Taking into account the 65 % recovery rate in the last recycling step about 20 % of the PO stock had been transferred to a secondary raw material. The other 80 % contained in residues, fines and a medium calorific value fraction (MCF) are provided for energy recovery. Countries without any technical infrastructure for energy recovery will proceed these resource to landfills.

Considering the calculation of plastics potential in MSW about 13 kg/c•yr (0,28 • 0,138 • 337) can be separated from MSW as a feedstock for materials recycling facilities. In comparison with source separation systems and their limited efficiency due to the dependency on the peoples factor this result must be marked very good.
4. Conclusions

Municipal solid waste is a source for recyclables also in times of comprehensive source separation with separate collecting systems. Plastic is one example for the household sourced recyclables that can be recovered both from the selective collected and the mixed waste streams. The determination of the recyclable potentials always is difficult. A calculation based on specific waste production in kg/c·y is done to give a baseline for the assessment of results. Applying results from the Trier test run in 2009/2010 and some analysis from a current Dutch project comparing recovery options from source separation with technical sorting of MSW the process of MSW treatment has been described examplarily for materials recovery of plastics.

The challenging task of separating waste particles in order to produce a feedstock for the following materials recycling process is described taking into account both quality and quantity aspects of recycling. High quality of plastics products can only be achieved with low quantities of plastic films. A similar situation can be observed for other fractions from MSW, where specific quality conditions are always linked to more or less large quantities of a fraction.

The result of an ambitious mechanical treatment process with an output for materials recycling is evaluated examplarily for the plastics separation. It is better than well known source separation systems because of any limitations by the participation of waste producers. In particular EU countries with waste recycling infrastructure just in development an advanced MBT technology with additional tasks for separation of recyclables can be a suitable solution.

5. Literature


Recycling of Municipal and Industrial Waste

KAHL plants for the production of fluff and pellets as alternative fuels

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Die Deutsche Bibliothek – CIP-Einheitsaufnahme

WASTE MANAGEMENT, Volume 2
Waste Management, Recycling, Composting, Fermentation, Mechanical-Biological Treatment, Energy Recovery from Waste, Sewage Sludge Treatment
Karl J. Thomé-Kozmiensky, Luciano Pelloni.
– Neuruppin: TK Verlag Karl Thomé-Kozmiensky, 2011
ISBN 978-3-935317-69-6

ISBN 978-3-935317-69-6 TK Verlag Karl Thomé-Kozmiensky

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Verlag: TK Verlag Karl Thomé-Kozmiensky • Neuruppin 2011
Redaktion und Lektorat: Professor Dr.-Ing. habil. Dr. h. c. Karl J. Thomé-Kozmiensky, Dr.-Ing. Stephanie Thiel, M. Sc. Elisabeth Thomé-Kozmiensky, Janin Burbott
Erfassung und Layout: Janin Burbott, Petra Dittmann, Sandra Peters, Martina Ringgenberg, Ginette Teske
Druck: Mediengruppe Universal Grafische Betriebe München GmbH, München


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