Measurement of the Potential Heat and Ash Content of the Residue from Mechanical Biological Treatment in Thailand

○Satoru Ochiai¹, Tomonori Ishigaki¹, Komsilp Wangyao³, Masato Yamada¹)
1) National Institute for Environmental Studies,
2) King Mongkut’s University of Technology Thonburi

1. Introduction
Municipal solid waste (MSW) is being directly dumped on the open land without pretreatment and compaction in most of Asian regions. This activity could cause the pollution of aquatic environment and odor problem because of including the organic matters in the waste. Mechanical biological treatment (MBT) is known as one of the most attractive method of waste treatment, which is to reduce the waste volume and avoid the landfill. This treatment consists of the mechanical separation of resource and the biological degradation of organic matter. Refuse derived fuel (RDF) and recyclable materials can be collected by MBT process. Non-recyclable materials were generated as residue and landfilled. Additional separation of residue was proposed in this study in order to reduce the landfill waste and increase the high calorific materials as RDF production. The purpose of this study is to figure out the low heating value and ash content of the MBT residue. The effect of the additional separation against the MBT residue on the reduction of landfill waste was also discussed.

2. Materials and Methods
2.1 MBT operation and landfill
Figure 1 shows the operation and waste flow in Phitsanulok MBT facility in Thailand. The first MSW was carried into the biodrying process following the aggregation and homogenization. Processed waste was piled up at 2.5 m height and dried by the heat of sunlight and biological fermentation for nine months without the turning and forced aeration. The bio-dried-MSW waste was separated into high calorific materials and residue by screening and manual sorting. The faction over 40 mm was baled and utilized as fuels (RDF product) for cement industries. LHV of RDF was 18 MJ/kg. The fraction under 40mm was disposed to landfill in MBT facility.

2.2 Measurement of LHV and ash content
The residue sample was obtained from Phitsanulok MBT facility. The residue was separated by hand sieve at mesh size of 40mm, 20mm, 10mm, 5mm and 2mm. LHV and ash content of each fractions were measured as follows. Moisture content of fractions was measured by before and after drying for 3 hours at 105 °C. High heating value (HHV) of the dried fractions was determined by bomb calorimeter (CA-4AJ, SHIMADZU, Japan). LHV was calculated from HHV and moisture content. Ash content was determined a ratio of the remaining part after ignition (to keep in a muffle oven for 2 hours at 600 °C) to fractions sample.

2.3 Additional separation
Figure 2 shows the schema of the additional separation. Residue produced from MBT process was sieved again. The amount of sieved fractions were estimated from the ratio of oversize and undersize of sieve and total volume of the MBT residue (1.3\times 10^3 ton/year). It was assumed that all of oversize or undersize fractions of sieve was combined with total RDF (5.1 \times 10^3 ton/year) produced by MBT process. The fractions without mixing with RDF product were landfilled. LHV and ash content of each fractions were measured.
content are required to adapt the criteria for using the RDF in cement industries; LHV and ash content are higher than 17 MJ/kg and lower than 20 % (w/w), respectively.

3. Results and discussion

3.1 LHV and ash content of MBT residue

Figure 3 shows the LHV and ash content of each separated fractions. LHV was decreased in smaller fraction size. LHV of over 40 mm fraction was higher than 20 MJ/kg. Under 40 mm fractions were lower than 17 MJ/kg. Ash content of all fractions were higher than 20 %. These separated fractions could not be suitable for the RDF criteria for cement industries.

3.2 LHV and ash content of RDF mixture

Figure 4 shows the LHV and ash content of the mixture of RDF and fractions of MBT residue on the sieve. LHV of this mixture was also decreased in smaller mesh size. LHV of the mixture which fraction on the sieve of 40mm, 20mm, 10mm and 5mm mesh combined with RDF product were higher than 17 MJ/kg. Ash content of the mixture on the sieve was increased in smaller mesh size. Ash content of the mixture which fraction on the sieve of 40mm, 20mm and 10mm mesh combined with RDF product were lower than 20 %.

Figure 5 shows the LHV and ash content of the mixture of RDF and fractions under the sieve. LHV of the mixture under the sieve was increased in smaller mesh size. LHV of the mixture which fraction under the sieve of 2mm mesh combined with RDF product were higher than criterial LHV (17 MJ/kg). Ash content of the mixture under the sieve was decreased in smaller mesh size. Ash content of the mixture which fraction under the sieve of 2 mm mesh combined with RDF product were lower than 20 %.

3.3 Effect of the additional separation on reduction of landfill waste

It found that fractions of 10mm, 20mm and 40mm on the sieve and 2mm under the sieve mixed with RDF were adapted the criterial LHV (> 17 MJ/kg) and ash content (< 20 %) for RDF product. Table 1 shows result of the reduction of landfill waste and increase of RDF production by additional separation. It was estimated that additional separation using 10 mm sieve could contribute to reduction of landfill waste about 41 % and to increase of the RDF production about 10 % by combining the fraction on the sieve with RDF product. The effect of reduction of landfill was estimated 3 % based on the input MSW. It was suggested that the additional separation using 10 mm mesh was the most contribute to reduce the landfill waste and increase the RDF product in this study.

<table>
<thead>
<tr>
<th>Fraction size</th>
<th>Amount of reduction of landfill and increase of RDF production (ton/year)</th>
<th>Reduction of landfill ratio</th>
<th>Increase of RDF production ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi &gt; 40$ mm</td>
<td>$8.4 \times 10^2$</td>
<td>6.3%</td>
<td>1.7%</td>
</tr>
<tr>
<td>$\phi &gt; 20$ mm</td>
<td>$3.1 \times 10^2$</td>
<td>23%</td>
<td>6.1%</td>
</tr>
<tr>
<td>$\phi &gt; 10$ mm</td>
<td>$5.5 \times 10^2$</td>
<td>41%</td>
<td>11%</td>
</tr>
<tr>
<td>$\phi &lt; 2$ mm</td>
<td>$1.5 \times 10^2$</td>
<td>11%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

4. Conclusion

The potential heat as LHV and ash content of the residue from MBT facility were determined. LHV of all separated fraction were lower than the criteria (>17 MJ/kg) for RDF. Ash content of all separated fractions were higher than the criteria (< 20%) for RDF. The sieved fractions could not be used as RDF directly. Fractions of 40mm, 20mm, 10mm on the sieve and 2mm under the sieve could be used as fuel material by combining with RDF product. It was suggested that the additional separation against the MBT residue using 10mm mesh sieve was the most contribute to reduction of the landfill waste and increase of RDF production.