Mechanical Processing of Post-Consumer Plastics for Feedstock Recycling

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### Current situation

**Polymer production and consumption of 2015:**

- 4–6% of the global petroleum production was processed into polymer products
- This amounts to 322 Mt of polymer products
- Europe* produced 58 Mt and consumed 49 Mt
  - Germany 12.0 Mt (Greece 0.8 Mio. t)

*Europe in [1] consists of the 28 EU member states, Switzerland und Norway

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<table>
<thead>
<tr>
<th>Polyolefine</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene (PE)</td>
<td>48.5%</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>6.9%</td>
</tr>
<tr>
<td>Polyvinylchloride (PVC)</td>
<td>19.9%</td>
</tr>
<tr>
<td>Polyurethane (PUR)</td>
<td>7.1%</td>
</tr>
<tr>
<td>Polyethylene terephthalate (PET)</td>
<td>7.5%</td>
</tr>
<tr>
<td>Polystyrene (PS)</td>
<td>10.1%</td>
</tr>
<tr>
<td>Others (ABS, PMMA, PTFE ...)</td>
<td></td>
</tr>
</tbody>
</table>

* Europe in [1] consists of the 28 EU member states, Switzerland und Norway
Current situation

EU-Proposal for 2025

Material Recycling [%]

Landfilling [%]

Energy Recovery [%]
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Feedstock

- Feedstock criteria:
  - Non-hazardous
  - PO-content of at least 20%
  - Mass flow of at least 20,000 t per year in Austria

- A PO-potential of up to 310,000 t per year was estimated

- Additionally about 2.2 Mt are estimated to be recoverable by landfill mining
Feedstock

Particle size distribution

PO-distribution

PO - Content [%]

Mass percent [%]

Passage [%]

Mesh size [mm]

> 12.5 mm

12.5/8.0 mm

8.0 / 6.3 mm

6.3 / 4.0 mm

4.0 / 2.0 mm

2.0 / 1.0 mm

< 1.0 mm

[2]
## Feedstock

<table>
<thead>
<tr>
<th>Waste fraction</th>
<th>$k_{80}$ [mm]</th>
<th>$\tilde{g}_{PO,A}$ [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.8</td>
<td>55.8</td>
</tr>
<tr>
<td>B</td>
<td>9.8</td>
<td>34.4</td>
</tr>
<tr>
<td>C</td>
<td>10.9</td>
<td>11.8</td>
</tr>
</tbody>
</table>

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Process

- Heavy fraction (HF)
- Light fraction (LF)
- Inter fraction (IF)
Process
Process

Counter-current operation:

○ Particles $\rho > \rho_{\text{Medium}}$  
  Medium  
  Feed  
  Float

○ Particles $\rho < \rho_{\text{Medium}}$  
  Air  
  Sink  
  Float fraction

In-current operation:

○ Particles $\rho > \rho_{\text{Medium}}$  
  Medium  
  Feed  
  Float

○ Particles $\rho < \rho_{\text{Medium}}$  
  Air  
  Sink  
  Sink fraction
Process
Process

![Diagram](image)
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## Products – MF and HF

<table>
<thead>
<tr>
<th>Waste fraction</th>
<th>Exceedance of pollutant limit according to AVV**</th>
<th>Energy recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF</td>
<td>-</td>
<td>FBI*</td>
</tr>
<tr>
<td>HF</td>
<td>-</td>
<td>FBI</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF</td>
<td>-</td>
<td>ICC</td>
</tr>
<tr>
<td>HF</td>
<td>-</td>
<td>ICC</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF</td>
<td>-</td>
<td>FBI</td>
</tr>
<tr>
<td>HF</td>
<td>-</td>
<td>ICC</td>
</tr>
</tbody>
</table>

** Fluidized bed incineration (FBI), Industrial co-combustion (ICC)  
** Austrian Incineration Act (Abfallverbrennungsverordnung)
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Conclusions

• The results show, that treating post-consumer plastic fractions by wet mechanical processing using a jig and multiple centrifugal force separators enable the separation of a highly pure PO-fraction.

• This light fraction has a PO-content of over 90% and is therefore suitable for feedstock recycling by thermochemical conversation.

• The processed middle and heavy fraction have the potential to be used for energy recovery.

• Therefore this process can be used as a bridge technology to make additional shares of post-consumer plastics, especially polyolefins, available for feedstock recycling and to be a first step towards the proposed EU’s goal of 55 % material plastic recycling by the year 2025.
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Thank you for your attention!
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