PROCESSING & SORTING OF WASTE GLASS

APPLICATION OBJECTIVE
- Preparation of (separately) collected container glass for use as raw material in production, especially in the glass industry

OUTLINE ON APPLICATION FRAMEWORK

PARTICULARLY APPLICABLE FOR WASTE TYPES

<table>
<thead>
<tr>
<th>Glass</th>
<th>Light-weight packaging</th>
<th>Biowaste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper / paperboard</td>
<td>Mixed household waste</td>
<td>Bulky waste</td>
</tr>
<tr>
<td>Lamps</td>
<td>Textiles</td>
<td>Electrical and electronic waste</td>
</tr>
<tr>
<td>Scrap metal</td>
<td>Waste wood</td>
<td>C&amp;D waste</td>
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<tr>
<td>Waste oil</td>
<td>Old paint &amp; lacquer</td>
<td>Waste tyres</td>
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<tr>
<td>Hazardous waste</td>
<td></td>
<td></td>
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<tr>
<td>Branch specific waste</td>
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<td></td>
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<tr>
<td>Other waste material</td>
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</tbody>
</table>

SPECIAL CHARACTERISTICS AND REQUIREMENTS OF THE APPLICATION

Pre-treatment of the input material:
The collection of waste glass shall be done separately from other waste materials (selective collection). Also a commingled collection of container glass with other glassware such as float glass, speciality glass or glass tableware must be avoided due to the different material compositions and the negative influence this has on the production process and quality of the recycling products. Where the collection is not separate from other materials, a segregation of the glass fraction must be performed first.

To increase efficiency, possibilities and quality of recycling it is also very useful to collect waste glass already separated by colour. The collection of waste glass by colour in Germany results in glass fractions separated at source in the proportion of 50% transparent / 40% green / 10% brown.

Options for the utilisation of the generated output:
The glass fractions obtained in the sorting can be introduced directly in the production of new glassware or used for other applications, such as insulating products (glass wool, foam glass products). Metals sorted out from the collected glass can be directly recycled as well.

Options for the disposal of process output and/or residues:
Other residues from sorting such as inert non-glass materials to the most part can be landfilled without further treatment.

Protective needs:
Measures for protecting the staff and surroundings against noise shall be implemented during sorting operations.

RESTRICTIONS OR INFLUENCE OF EXTERNALITIES ON THE APPLICATION

Infrastructural conditions:
Installations must be well accessible and possess of good connections to main transport lines resp. routes.

Others:
Larger supply areas will be needed for economically viable operations

TECHNICAL DETAILS

GENERAL OVERVIEW

ABSTRACT
The process of preparing the collected container glass for recycling generally comprises a mechanical processing with varying arrangements for pre-sorting of the glass, the removal of disturbing matter and separation of other materials (e.g. metal parts) and a subsequent automated sorting with the aim to obtain glass of a certain purity by colour.
**BASIC REQUIREMENTS**
- The input material must be glass selectively collected from other commercial and mixed household waste and preferably separated by colour. Main portion should be made up from container glass, in any case should be avoided a mix of different glass types (container/floater/shatterproof/heat-resistant glass) and the presence of ceramic components.
- For efficient sorting and to feed the melting furnace, maximum particle size should be approx. 20 mm (crushing might hence be necessary), high material purity must be ensured in addition.

**EXPECTED RESULTS**
- Glass cullet of defined quality conforming to industrial specifications.
- Sorted material usually is expected to have the following maximum content of impurities:
  - Ceramics, stones, other inert non-glass components ≤20 g/Mg (10 g/Mg is in discussion).
  - Non-ferrous metals ≤3 g/Mg.
  - Glass ceramics ≤5 g/Mg (for particles above 10mm), ≤10 g/Mg (for particles smaller than 10 mm).
  - Loose organic substances <300 g/Mg.
  - Mistakes in colour after sorting not exceeding prescribed limits.

Table 1: Maximum of acceptable mistakes in colour after sorting

<table>
<thead>
<tr>
<th>Glass Fraction</th>
<th>Acceptable mistakes</th>
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</thead>
<tbody>
<tr>
<td>Transparent</td>
<td>particles of brown glass: ≤ 0.3%</td>
</tr>
<tr>
<td></td>
<td>particles of green glass: ≤ 0.2%</td>
</tr>
<tr>
<td></td>
<td>particles of other colour: ≤ 0.2%</td>
</tr>
<tr>
<td>Green</td>
<td>brown particles max. 10%, minimum share of 75% green cullet</td>
</tr>
<tr>
<td>Brown</td>
<td>green particles max. 10% minimum share of 80% brown cullet</td>
</tr>
</tbody>
</table>

**SPECIFIC ADVANTAGES**
- Large automated process.
- High throughput.
- Output of stable quality.

**SPECIFIC DISADVANTAGES**
- Rather expensive.
- Large supply area is needed.

**APPLICATION DETAILS**

**TECHNICAL SCHEME**
For the processing and sorting of waste glass a set of standard techniques is adopted and more or less sophisticated combinations and cycles of repeated applications of these techniques are used. Manual separation has almost no role in processes of industrial scale.

Glass delivered to these kind plants is kept under a sheltered area separate by colours (if so collected at source). From here it goes into a feed bunker after which a coarse screening and manually performed pre-sorting for the removal of disturbing materials from the glass follow. Further undertaken are the elimination of light materials such as paper and plastics, a magnetic separation of ferrous components and additional steps of screening with different mesh size (e.g. 15 mm, 30 mm, 60 mm). Additional steps comprise:
- Improvement of material purity in the screen fractions 5–15 mm, 15–30 mm and 30–60 mm, for example by way of optical sorting devices,
- A comminution of the material,
- Repeated separation and discharge of non-glass particles and non-ferrous metal,
- Colour sorting with optical techniques such as near infrared technology.

The following two process schemes are common:

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1 BV Glas, BDE, bVse: Guideline „Quality requirements on glass cullet for use in the container glass production“ (in original “Leitlinie „Qualitätsanforderungen an Glasscherben zum Einsatz in der Behälterindustrie“) Standardblatt T 120, 14. August 2014
Waste treatment and material processing

Sorting of waste glass

Figure 1: State-of-the-art technical arrangements for sorting of waste glass

### QUANTITY ASPECTS

The throughput in a single line arrangement is about 20 Mg/h, in a multi-line arrangement a throughput of 50 Mg/h is possible.

### INTEROPERABILITY

The process can be combined with the actual recycling operations in the glass factory and integrated there as a preceding step based on additional installations; external facilities are not necessarily required. Glass sorting can also be integrated to the processing and sorting of dry packaging waste, although this does not normally happen then to the same extent and intensity like in the specialized facilities.

### OPERATIONAL BENCHMARKS: RESOURCE CONSUMPTION

#### ENERGY BALANCE

- The annual energy demand for plants using technical arrangements as outlined above may reach 10,000 MW.
- Generally associated with the use of 10% glass cullet from waste glass in glass production is the saving of 3% of energy input for the melting process.

#### CO₂-BALANCE

- Glass recycling reduces the need to use primary material for glass production and results in an overall lower consumption of energy for this process. In average an equivalent of 500 kg CO₂ is saved when one ton of waste glass is recycled and used to substitute primary raw materials in glass production².

#### AIDS/ADDITIVES NEEDED

- none

#### HUMAN RESOURCES

- About 11 persons per shift in a multi-line arrangement, most personnel is needed for pre-sorting and control operations

#### SPATIAL NEEDS

- Surface area in the range of 5,000 up to 8,000 m² including storage space

#### AFTERCARE DEMANDS

The residues from sorting normally require disposal at landfills (see the fact sheets on "Landfills for non-hazardous waste" and "Landfill for inert waste"), as far as the inert material is concerned a use for construction purposes at these landfills can be possible.

### OPERATIONAL BENCHMARKS: COST DIMENSIONS

#### INVESTMENT COSTS

Up to approx. EUR 12 million in total capital expenses for an average sized plant using technical arrangements as outlined above.

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² German Environment Agency: Umweltbundesamt Texte 46/2015: The Climate Change Mitigation Potential of the Waste Sector
### OPERATING COSTS

Incur mainly for:
- Personnel and energy needed
- Repair and maintenance: about 5% of initial investment p.a.

### POSSIBLE PROCEEDS

- The obtainable price for sorted glass on central European markets according to Eurostat has been in the range of 45–54 EUR/Mg during the first half of the year 2015

### MASS SPECIFIC OVERALL COSTS

- N.A.

### MISCELLANEOUS

#### MARKET INFORMATION

- **REFERENCE FACILITIES**
  
  Larger size sorting installations using technical arrangements as outlined above can be found in large number across Europe and in many developed countries elsewhere around the globe. In Germany such exists for example with the facilities of:
  - Glasrecycling Nord GmbH & Co. KG, Wahlstedt  
    [www.karl-meyer.de](http://www.karl-meyer.de)
  - Reiling Glas Recycling GmbH & Co. KG, Mariental  
    [www.reiling.de](http://www.reiling.de)
  
  Further locations of glass sorting plants are shown in a list of [Aktionsforum Glasverpackung](http://www.glasaktuell.de).

- **RECOGNIZED PRODUCER AND PROVIDER FIRMS**
  
  Many of the large and medium waste management providers undertake the processing of the collected waste glass in the described manner, e.g.
  - Alba-Gruppe  
    [www.alba.info](http://www.alba.info)
  - SUEZ Deutschland  
    [www.suez-deutschland.de](http://www.suez-deutschland.de)
  - Remondis  
    [www.remondis.de](http://www.remondis.de)
  
  The aggregates and equipment used for the process belong to the pool of technical equipment which is generally available and in use for mechanical operations in the waste management sector. In particular these are:

  - **Conveyor:**
    - Rudnick + Enners Maschinen- u. Anlagenbau GmbH, Alpenrod  
      [www.rudnick-enners.de](http://www.rudnick-enners.de)
    - Ludden & Mennekes, Meppen  
      [www.ludden.de](http://www.ludden.de)
    - Spezialmaschinen & Recylingtechnik, Chemnitz  
      [www.sr-recyclingtechnik.com](http://www.sr-recyclingtechnik.com)

  - **Screens:**
    - Mogensen GmbH & Co. KG, Wedel  
      [www.mogensen.de](http://www.mogensen.de)
    - EuRec Technology GmbH, Merkers  
      [www.eurec-technology.com](http://www.eurec-technology.com)
    - Spaleck – Förder- und Separiertechnik  
      [www.spaleck.de](http://www.spaleck.de)

  - **Baler/Comminutor/Shredder:**
    - HSM GmbH + Co. KG, Salem  
      [www.hsm.eu](http://www.hsm.eu)
    - Bomatic – Umwelt- und Verfahrenstechnik GmbH, Hamburg  
      [www.bomatic.de](http://www.bomatic.de)
    - Erdwich Zerkleinerungs-Systeme GmbH, Kaufering  
      [www.erdwich.de](http://www.erdwich.de)
    - ANDRITZ MeWa Gechingen:  
      [www.andritz.com/index/locations](http://www.andritz.com/index/locations)

  - **Metal separators (Fe, Non-Fe):**
    - Steinert Elektromagnetbau GmbH, Köln  
      [www.steinfertglobal.com](http://www.steinfertglobal.com)
    - IMRO Maschinenbau GmbH, Uffenheim  
      [www.imro-maschinenbau.de](http://www.imro-maschinenbau.de)
    - Wagner Magnete GmbH & Co. KG, Heimertingen  
      [www.wagner-magnete.de](http://www.wagner-magnete.de)

  - **Sensor supported sorting (e.g. NIR devices):**
    - Tomra Systems GmbH  
      [www.tomra.de](http://www.tomra.de)
    - Sesotec GmbH  
      [www.sesotec.com](http://www.sesotec.com)

### ADDITIONAL REMARKS AND REFERENCE DOCUMENTS

Further detailed information on the processing of waste glass, sector information and contact lists to relevant firms can be obtained from:

- Bundesverband Sekundärrohstoffe und Entsorgung:  
  [www.bvse.de](http://www.bvse.de)
- Federal Association of the German Glass Industry (Bundesverband Glasindustrie e.V.):  
  [www.byglas.de](http://www.byglas.de)
- Aktionsforum Glasverpackungen:  
  [www.glasaktuell.de](http://www.glasaktuell.de)
- European Container Glass Federation (FEVE):  
  [www.feve.org](http://www.feve.org)
- glasstec – International Trade Fair for Glass Production:  
  [www.glasstec.de](http://www.glasstec.de)