Textile waste management in Germany & developments in textile recycling technology

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### Main fields of excellence

<table>
<thead>
<tr>
<th>Web forming</th>
<th>- from fibres</th>
<th>- from films</th>
<th>- from filaments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web bonding</td>
<td>- mechanical</td>
<td>- chemical</td>
<td>- thermal</td>
</tr>
<tr>
<td>After-treatment</td>
<td>- thermofixing</td>
<td>- spunlacing</td>
<td>- laminating</td>
</tr>
<tr>
<td></td>
<td>- spraying</td>
<td>- calendering</td>
<td>- raising</td>
</tr>
<tr>
<td></td>
<td>- coating</td>
<td>- dyeing</td>
<td>- impregnating</td>
</tr>
</tbody>
</table>

Customer-oriented product development

Testing and Certification

<table>
<thead>
<tr>
<th>Recycling</th>
<th>- cutting</th>
<th>- agglomerating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- breaking</td>
<td>- re-granulating</td>
</tr>
</tbody>
</table>

### STFI - Nonwovens and Recycling

- Tearing machine
- Cutting mill
- Compacting plant for plastic waste material
Random web plant with an oven for thermo-fusion

- working width 1100 mm
- mass per unit area 300 – 4000 g/m²
- temperature max. 200 °C
- processing of man-made fibres, natural fibres and recycling fibres

Main fields of research:
- cutting and tearing of textile waste, also from special fibres, like glass, aramid
- material cycles and recycling friendly construction, e.g. for car interior equipment, upholstery or textile packages
- products made of reclaimed fibres
- cut-grinding and compacting
- use of processed waste material for filling in composite structures
- emissions of nonwovens
Textile waste – possible material cycles

Export
Production of Textiles

Import

Consumption of textiles
Clothing
Home textiles
Technical textiles
Non-textile applications

Production waste
Textile waste

Consumer waste

Disposal
Energetical exploitation
Textil-Recycling
Functional disposal

Secondary raw textile material

Collection of used clothes and ways of reuse

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount In kt</th>
<th>Secondary utilization (clothes)</th>
<th>Recycling</th>
<th>Cleaning rags</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>477</td>
<td>30</td>
<td>18</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>1990</td>
<td>520</td>
<td>45</td>
<td>19</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>1995</td>
<td>615</td>
<td>48</td>
<td>22</td>
<td>17.5</td>
<td>12.5</td>
</tr>
<tr>
<td>2000</td>
<td>620</td>
<td>50</td>
<td>21</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>2007</td>
<td>750</td>
<td>43</td>
<td><strong>21</strong></td>
<td><strong>10</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

**2007:**
1.126 kt total availability of used clothes in Germany

60% circulation ratio

750 kt collection and reuse

Source: bvse
Textile waste management in Germany

Textile waste material
Efficient systems for the collection, sorting and recycling of used textiles from households have been in existence in Germany’s medium-scale industry for a long time.

Processing
The traditional method is the use of the tearing process to obtain reclaimed fibres. Several companies are able to process used clothing into reclaimed fibres by an economical way.

Use of Reclaimed fibers
Almost exclusively in nonwoven products for insulation, upholstery and automotive textiles.
Tearing process – the principle

First step:
Cutting the waste material into pieces

- Cutting machine
- Guillotine-like principle
- Upper knife
- Compressing belt
- Outlet
- Fixed bottom knife
- Feeding belt

First step:
Cutting the waste material into pieces

- Guillotine-like principle

Second step:
Processing textile waste into fibres

- Feeding system
- Tearing cylinder
- Sieving drum
- Reclaimed fibres
- Waste material
- Non-textile parts, unopened pieces
- Dust, short fibres
- reclaimed fibres
Tearing process – the principle

Second step: Processing textile waste into fibres

Tearing process – the result

Reclaimed fibres as a blend of:

- Neps
- Fibre dust, short fibres
- Threads
- Unopened pieces
- Fibres with different length
**Use of reclaimed fibres in technical textiles**

<table>
<thead>
<tr>
<th>Use of reclaimed fibres in</th>
<th>Required fibre quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type of Polymer</td>
</tr>
<tr>
<td>Reinforcement (Plastic, Concrete)</td>
<td>X</td>
</tr>
<tr>
<td>Protection against Erosion</td>
<td>X</td>
</tr>
<tr>
<td>Geotextiles</td>
<td>X</td>
</tr>
<tr>
<td>Upholstery</td>
<td>X</td>
</tr>
<tr>
<td>Wipes</td>
<td>X</td>
</tr>
</tbody>
</table>

**Industrial sorting of used clothes**

**SOEX Textil-Sortierungsgesellschaft mbH**
Bitterfeld/Wolfen Germany

high standard sorting plant, sort out in 400 criteria
- Sighting of material input
- Presorting, type of cloth
- Sorting out in quality and material
- Capacity: 300 tons per day

**Flow of material:**
- 15 % tearing into reclaimed fibres
- 70 % secondary use (rags, clothes)
- 15 % refuse

www.soex.de
Industrial processing of used clothes

SOEX Textil-Recycling GmbH
Bitterfeld/Wolfen

High scale production of reclaimed fibres from used clothes

Tearing line 1.90 m working width, 7 cylinders, Automatically separation of non textile parts
Machine manufacturer: Dell’Orco & Villani/Italy
Throughput: 1500 bis 2000 kg/hour, 24 hours per day, 46 tons per day

Recycling of automotive textiles

Worldwide production of automotive textiles

<table>
<thead>
<tr>
<th>Production in 1,000 tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Fabrics, Knits</td>
</tr>
<tr>
<td>Nonwovens</td>
</tr>
<tr>
<td>Composites</td>
</tr>
<tr>
<td>Others</td>
</tr>
</tbody>
</table>

Source: Frost & Sullivan
Recycling of automotive textiles

Most of textiles used in cars cannot be economically recycled!

Textiles are combined with non-textile materials, e.g. parts of metal or plastic materials.

- Textiles are mixes of two to five different fibrous materials.
- Disassembling would be cost-intensive.
- There is no market for any recycled products from textiles used in cars.
- Textiles are not suitable to be recycled due to their age or to contamination.

But:
The recycling and reuse of production waste materials can contribute to improving sustainable developments!
Recycling of automotive textiles - problems

Emission minimisation – requirement for automotive uses

- Use of reclaimed fibres in nonwovens
- Limit values of emission in automotive industry

STFI-project:
Monitoring raw material use and manufacturing technology concerning source and intensity of harmful substances

Objective:
Technological recommendation to guarantee processability of reclaimed fibres in nonwovens for automotive uses
Machinery for recycling - State of the art

- modern technology/equipment for processing of nearly all kinds of textile waste
- quantity specialised or product specialised plant line concepts
- random web forming as cost-effective processing technology/concept
- machines manufactured in Europe for the world markets

Cutting of textile waste

Cutting line „ROBOT“
- up to 8000 kg/h
- cutting length 6 mm to 160 mm

PIERRET INDUSTRIES S.P.R.L., Corbion/Belgium
Tearing line - processing of production waste

**Tearing line „JUMBO + EXEL“**
- 2000 mm working width
- 1800 kg/h

LAROCHE S.A., Cours La Ville/France

Tearing line - processing of production waste

**Tearing line „MCM“**
- 2000 mm working width
- 2500 kg/h

MARGASA S.L., Cerdanyola del Vallés/Spain
Tearing line - processing of production waste

**Tearing line „DT“**
- 1400 mm working width
- 1400 kg/h

BALKAN textile and ginning machinery Ltd, Aydin/Turkey

Tearing line - processing of used clothes

**Tearing line „JUMBO“**
- 2000 mm working width
- 2500 kg/h

LAROCHE S.A., Cours La Ville/France
Tearing line - processing of used clothes

DELL’ORCO & VILLANI
DELL’ORCO & VILLANI, Capalle/Italy

Tearing line „MONDIAL“
- 1900 mm working width
- 2000 kg/h

Processing of reclaimed fibres

Random web plant „FELTECH“
Mass per unit area: 300 g/m² - 3000 g/m²
Working width: 3.2 m up to 2800 kg/h

MARGASA S.L., Cerdanyola del Vallès, Spain
Processing of reclaimed fibres

Random web plant „BEMAFORMER“
Mass per unit area: 300 g/m² - 4000 g/m²
Working width: 3.5 m
up to 3500 kg/h

BETTARINI & SERAFINI SRL - bematic, Prato/Italy

Random web plant „AIR LAY“
Mass per unit area: 300 g/m² - 4000 g/m²
Working width: 3.9 m
up to 3500 kg/h

LAROCHE S.A., Cours La Ville/France
Future efforts in application of recyclable materials

Needed:

- Solutions to design textiles which can be recycled, e.g.:
  - pure polymer structures of composite materials and textile composite materials
  - innovative principles of bonding and separating

- Development of textiles containing recycled materials

Wanted:

- New markets for products made from recycled textile materials

Thank you for your attention!

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