Textile Industry Effluents Treatments and Waste management
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13th meeting PP Water and Industry and 1st Joint meeting Textile ETP + WssTP
Water Reclamration in Textile Industry

A significant reduction of effective rainfall is observed in EU countries were Textile Industry is located.

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**Textile Industry Effluents Treatments and Waste management**

**Water Reclamation in Textile Industry**

The availability of fresh water is reducing all over Europe.

WEI $> 20\%$: water resource is under stress

WEI $> 40\%$: severe water stress and unsustainable use of the water resource

Eurostat 2006
Water Reclamation in Textile Industry

In average in the EU water consumption is around 32% of water abstraction, since most of abstracted water is not consumed but returned to the water cycle and made available to further uses, after proper treatment or natural purification.

Excluding cooling water, the main industrial water users are the chemical industry, the steel and metallurgy industries, the pulp and paper industry and textile industry. Industrial use of water accounts for about 32% of total water abstractions in the EU.
Water Reclamation in Textile Industry

<table>
<thead>
<tr>
<th>Fabric type</th>
<th>Water use L/kg production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>Wool</td>
<td>111.0</td>
</tr>
<tr>
<td>Woven</td>
<td>5.0</td>
</tr>
<tr>
<td>Knit</td>
<td>20.0</td>
</tr>
<tr>
<td>Carpet</td>
<td>8.3</td>
</tr>
<tr>
<td>Stock/Yarn</td>
<td>3.3</td>
</tr>
<tr>
<td>Nonwoven</td>
<td>2.5</td>
</tr>
<tr>
<td>Felted fabric</td>
<td>33.0</td>
</tr>
</tbody>
</table>

The textile industry is energy-, water-, and chemical-intensive. Within the industry, the majority of energy, water, and chemicals consumed is for wet processing. At least 40 litres of water are required to produce 1 Kilogram of textile, on the average.
Water conservation strategy in Textile Industry

Water conservation is the hydrological answer to the problem and certainly water reuse is an important component of water conservation strategies.

1. Recycled Water is an alternative water resource

2. The reduction of environmental impacts by reducing or eliminating wastewater disposal, which results in the preservation of water quality downstream

3. Implementation of dry processes in the textile finishing
Wastewater Reuse – An Important Target for Textile Industry

Requirement of the treatment process depend on the final industrial reuse application

In textile industry high quality water is required and its reuse is not promoted.
Wastewater Reuse – An Important Target for Textile Industry

European Legislation forces the Industries to adopt strategies for wastewater management
The major water quality issues for textile production are to ensure that the dyes react properly and that discoloration or staining does not occur. Turbidity, colour, iron and manganese have the potential to cause staining of fabric during production. Hardness adversely affect soaps used in various cleaning processes and can cause durd-like deposits on the textile. Usually soaps are not deposited evenly with hard water, resulting in dyeing irregularities. Hardness may cause precipitation of some dyes and increase in the breakage of silk during reeling and throwing operation (Treweek, 1982).
Wastewater Reuse – Textile target

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Textile Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica (SiO₂)</td>
<td>mg/L</td>
<td>≤ 25</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>mg/L</td>
<td>600 - 1000</td>
</tr>
<tr>
<td>Dissolved solids (conductivity)</td>
<td>μS/cm</td>
<td>2000 - 7000</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>mg/L</td>
<td>15 - 8000</td>
</tr>
<tr>
<td>Hardness</td>
<td>mg/L (CaCO₃)</td>
<td>50 - 2000</td>
</tr>
<tr>
<td>pH</td>
<td>-</td>
<td>6 - 8</td>
</tr>
<tr>
<td>Colour</td>
<td>A/nm</td>
<td>20 - 2500</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>150 - 12000</td>
</tr>
<tr>
<td>BOD₅</td>
<td>mg/L</td>
<td>20 - 600</td>
</tr>
<tr>
<td>Total Surfactants</td>
<td>mg/L</td>
<td>0.1 - 5.0</td>
</tr>
</tbody>
</table>

Textile wastewater is very heterogeneous and there are huge variations according to the different finishing processes applied onto the textiles. Chemicals are the main responsible for the pollution loads.
**Textile Industry Effluents Treatments and Waste management**

**Wastewater Reuse – Textile target**

A combination of Primary sedimentation; Secondary treatments (CAS and Clariflocculation) and Tertiary treatment (Filtration and Oxidation via Advanced Oxidation Processes) have been and could be efficiently applied for wastewater purification at Industry or MWWTP.

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## Textile Industry Effluents Treatments and Waste management

### Wastewater Reuse – Textile target

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Outlet MWWTP</th>
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</thead>
<tbody>
<tr>
<td>Silica (SiO₂)</td>
<td>mg/L</td>
<td>≤ 25</td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>mg/L</td>
<td>403</td>
</tr>
<tr>
<td>Dissolved solids (conductivity)</td>
<td>μS/cm</td>
<td>1940</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>mg/L</td>
<td>1.0</td>
</tr>
<tr>
<td>Hardness</td>
<td>mg/L</td>
<td>≤ 50</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>7.6</td>
</tr>
<tr>
<td>Colour</td>
<td>A/nm</td>
<td>2-4</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>30</td>
</tr>
<tr>
<td>BOD₅</td>
<td>mg/L</td>
<td>≤ 5</td>
</tr>
<tr>
<td>Total Surfactants</td>
<td>mg/L</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Production costs (personnel excluded) €/m³ 0.154 - 0.175
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Wastewater Reuse – Costs

€ 0.70 – 2.40

€/m³ 0.120 - 0.130
Freshwater costs

€/m³ 0.260
Overall production costs

€/m³ 0.142
Selling costs (reduced price by tax concession)

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Within BISCOL project (ECO/09/256112) some finishing processes (antifelting and dyeing processes) have been analysed by a LCA approach.

Reducing wet-treatments – Required for the Environment
Wastewater Treatments – Required for the Environment

The investigated processes have an high environmental impact related with the usage of chemicals (i.e. antifelting agents and dyestuffs, surfactants, etc.).
Effect on the replacement of wet-processes and usage of safer chemicals

Basolan process has been replaced with Plasma and safer auxiliaries used

**Textile Industry Effluents Treatments and Waste management**

**Human Toxicity (kg DB eq/kg pollen fabric) = 0.0035**
- Dyeing: 94%
- Washing: 5%
- Drying: 1%
- Other: 0%

**Carbon footprint (kg CO₂ eq/kg pollen fabric) = 4.7 10⁻⁴**
- Dyeing: 94%
- Washing: 3%
- Drying: 3%
- Other: 0%

**Food Depletion (kg oil eq/kg pollen fabric) = 0.457**
- 75.00%
- 5.24%
- 7.28%
- 4.95%
- 2.29%
- -68%

**Water Depletion (m³/kg pollen fabric) = 0.0454**
- 47.00%
- 25.80%
- 1.40%
- -42%

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Conclusion

Water reuse is a fundamental target for European Textile Industry.

Technologies are available for the purification of the effluents even if the costs are often higher than Fresh water.

Innovation in the production chain could promote the reduction of water depletion and in the textile pollution.