Development of Textile recycling chain in Finland
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Development of Textile recycling chain in Finland – insights of TELAKETJU project

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Finland now and in future

Reference: Environment Intitute of Finland, Texjäte project
Re-producing old cotton clothing into new material has been very challenging, because the worn-out fibers are too short to be spun into new thread. New cotton also needs to be added to each batch, making 100% post-consumer-waste textiles an impossible dream.
Cellulose Carbamate technology in EU Trash to Cash

- EU funded project Trash to Cash aims to utilise the zero-value waste textiles and fibres with design-driven technologies to create high quality products.
- Coordinator of the project is SP Technical Research Institute of Sweden

VTT’s efforts include:
- chemical pretreatment of cotton and CO/PES waste materials to remove impurities and to decrease DP (cellulose)
- carbamation of the pretreated materials
- dissolution of CCA and preparation of regenerated fibres
- dissolution of carbamated CO/PES blends and separation of the PES fraction for purification, characterisation and reuse
The collecting, sorting, and recycle chain for Textiles
YM project
1.2.2017 - 31.12.2018
Main coordinator LSJH
Total budget 205 000 €
and other investors
Consists of three experiments

TEKES project
1.4.2017 - 30.9.2018
Main coordinator VTT
Companies’ own projects
Public part
Total budget 2,3M €
Consists of six work packets

Additionally, includes companies and organisations participating with work, networks, material use and communication. Also international cooperation.
Kuva Inka Mäkiö, Poistotekstitiliiketjun roolikartta ja johdonmukainen viestintä

- TEXTILE FOR REUSE
- REUSE AS A NEW MATERIAL
- MECHANICAL RECYCLE
- CHEMICAL RECYCLE
- CONVERTING
- NEW PRODUCT
- NEW MATERIAL
- ENERGY REUSE
Recovered Textile Waste 100%

Re-Wear 60%
- well preserved 10%
- moderate wearability 50%

Re-Use/ Re-Cycle 40%
- wipers 15%
- fibre-pulling 14%
- other recycling & re-use 8%
- waste 3%

Sales in over 90 countries around the globe

For utilization in the industry

Incineration

EUROPEAN MODEL
FINNISH MODEL

Common standards and quality tools

Local Products

HUB B

HUB A

HUB C

CHEMICAL RECYCLE

MACHANICAL RECYCLE

Added Value Export
A project for regional recycling experiments of municipal

**TELaketju**
A collection, sorting and utilisation network for end-of-life textile

**EXPERIMENT 1**
Creating a national end-of-life textile recycling network and supporting its function
Lounais-Saomen Jättehuuto Oy with TUAS, Finnish Environment Institute SYKE and Vaconia

**EXPERIMENT 2**
Regional textile sorting at the place of origin, textile reception and consumer communication
Lounais-Saomen Jättehuuto Oy with UFF, Ekopartnerit and TUAS

**EXPERIMENT 3**
Expertise for textile sorting - Textile sorter training *Telakoulu*
Pääkaupunkiseudun kerttyskeskus with Pirkkanmaan kerttys ja työtoiminta ry, Turun seudun TST ry, TUAS and Fida International

Advisory steering group with the Tekes project.
Executive board consisting of organisations and investors in the project

Other investors in the project:
Bioruukki Pilot Centre

Speed to scale-up of bio and circular economy innovations

- **BIOMASS**
- **WASTE**
- **SIDE STREAMS**

**BIORUUKKI**

**INNOVATIVE PROCESSES, VALUE ADDED PRODUCTS & SERVICES**

- **A new piloting ecosystem** for process industry scale-up and demonstrations.
- A former printing plant transformed to world scale R&D centre.
- 8000 m², room for several pilot units and laboratories.
- Located close to Otaniemi campus.

**THERMOCHEMICAL CONVERSION PLATFORM**
Started Q3/2015

**ENERGY STORAGE PLATFORM**
Starts 2016

**BIOMASS PROCESSING PLATFORM**
Starts 2017

**GREEN CHEMISTRY PLATFORM**
Starts at Bioruukki 2018

Pilot scale wet spinning machine will be transferred from Valkeakoski to Bioruukki during spring 2017. Capacity of the line is 60 kg fibres /day.
Our breakthrough technology benefits all major stakeholders in the fashion industry value chain.

Infinitely® fibers are manufactured of textile waste, recycled paper, or biomaterials like wood. Technology is patented, proven, and competitive.

Fast and low CAPEX market entry by licensing the technology to any pulp and fiber producers or machinery manufacturing companies.

Global market is >$6 billion with >CAGR 10%. Major brands like H&M, IKEA, Levi’s & Strauss Co have strong interest on our pilot.
Sustainable CCA technology

- VTT has developed technology for 20+ years
- Finland is the leading country globally on cellulose chemistry
- Largest scale pilot and very close to industrial process productivity
- Five major competitive edges:
  - *Up to 40% more economical*
  - *Sustainability (infinite loop, ecological chemistry, water utilization, etc.)*
  - *Fastest scale-up as can utilize simultaneously several raw materials*
  - *Minimized CAPEX as technology can be added to any existing pulp or viscose fiber plant*
  - *New business opportunities for the customers*
The technology enables manufacturing fiber equal to Viscose but without CS2

- Technical properties are equal to Viscose
- Touch and feel is more cottonish and colouring feature is better than Viscose has
- Applying for the new trade name to differentiate from Viscose as the process is different

<table>
<thead>
<tr>
<th>Property</th>
<th>1 Reference: Viscose values (market qty)</th>
<th>2 Infinitely fiber made of virgin dissolving pulp</th>
<th>3 Infinitely fiber made of recycled paper</th>
<th>4 Infinitely fiber made of textile waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>Dissolving pulp (wood)</td>
<td>Dissolving pulp (wood)</td>
<td>Recycled paper</td>
<td>Textile waste (cotton rich)</td>
</tr>
<tr>
<td>Fineness, dtex</td>
<td>1,7</td>
<td>2,0⁵</td>
<td>2,0⁵</td>
<td>2,0⁵</td>
</tr>
<tr>
<td>Tenacity (cond.), cN/tex (ASTM 1446D)</td>
<td>26</td>
<td>26</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Elongation (cond.), %</td>
<td>12-14</td>
<td>12</td>
<td>13</td>
<td>16</td>
</tr>
</tbody>
</table>

¹Tenacity is expressed in relative to the fineness (1 tex = 1 gram per 1000 metres). Figures for tenacity are based on both fiber fineness (tex) and cross-sectional area of the sample conditioned according to technical standard ASTM 1446D (65% relative humidity and temperature of 20°C).

²VTT machinery has only this fineness option as per today. According to needs the fineness can be adjusted between 1,3-2,6.
Foam-laid nonwovens from cellulosic fibres
Semi pilot scale - Hydroentanglement

- Brilliant formation in the case of long fibres, even though high forming consistency applied
- Mechanical bonding instead of chemical bonding → aspect for sustainability
- Widening of raw material combinations → process simplifying

Mechanical bonding of foam laid nonwovens (MECBO), VTT internal project, 2014
PAPTIC® IS A REVOLUTIONARY, ENVIRONMENTAL NEW MATERIAL REPLACING PAPER AND PLASTIC
Conclusions

Environmentally sustainable and safe recycled textile:

- Efficient production methods
  - Safe chemistry
  - Less losses
- High performance products
- Properties that can be adjusted
- Startups
  - Demonstration factories
  - Attracting international investments
- Novel businesses
  - Technology
  - Machinery
  - Applied materials
From R&D projects to pilots and startup

The Relooping Fashion Initiative

The Relooping Fashion Initiative received a Highly Commended status in the Awards Program's public sector category in The Circulars' 2016 Awards Ceremony held at the WEF Meeting in Davos on 19 January. The Circulars is the world's premier circular economy award programme, whose judging panel includes the circular economy pioneers such as Ellen MacArthur and William McDonough, as well as representatives from global business and university sector.
Thank you!

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