Wood-based Fibres for Fashion

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World fibre production

Shen et al., 2012
Lenzing Viscose/Modal and Tencel

**Viscose process**

- **Pulp**
  - Alkalisiation
  - Preageing
  - Xanthogen.
  - Dissolving
  - Ageing
  - Viscose
  - Spinning
  - Desulf. Bleaching Finishing Drying
  - Waste water

**Lyocell process**

- **Pulp**
  - Dissolving
  - Make up: NMMO
  - Spinning
  - Washing
  - Finishing Drying
  - Fibre

- NMMO/water
- Spin bath
- Water

Shen et al., 2012a & b (Lenzinger Berichte); Shen et al., 2012 c (RCR)
What is Life Cycle Assessment? (LCA)
Net Greenhouse Gas Emissions (t CO₂ eq./t fibre)

Cradle-to-factory gate plus post-consumer waste incineration with energy recovery

GHG emissions from waste incineration (energy recovery rate: 60%)
Cradle-to-factory gate GWP (including carbon sequestration)

Cotton: 3.1

Shen et al., 2012a & b (Lenzinger Berichte); Shen et al., 2012 c (RCR)
Single-score result (I)
Equally weighted, Cotton =100
1 tonne fibre, cradle-to-factory gate

- Global warming
- Abiotic depletion
- Ozone layer depletion
- Human toxicity
- Fresh water ecotoxicity
- Terrestrial ecotoxicity
- Photochemical oxidation
- Acidification
- Eutrophication
- Land use
- Water use

Shen et al., 2012a & b (Lenzinger Berichte); Shen et al., 2012 c (RCR)
Single-score result (II)
Equally weighted, normalised to World 1995
1 tonne fibre, from cradle to factory gate, cotton =100

CML Normalisation factors (global impact per year) World, 1995

- Global warming (kg CO₂ eq.) 4.1 x 10^{13}
- Abiotic depletion (kg Sb eq.) 1.6 x 10^{11}
- Human toxicity (kg 1,4 DB eq.) 5.7 x 10^{13}
- Fresh water ecotoxicity (kg 1,4DB eq.) 2.0 x 10^{12}
- Terrestrial ecotoxicity (kg 1,4 DB eq.) 2.6 x 10^{11}
- Photochemical oxidation (kg C₆H₆ eq.) 9.6 x 10^{10}
- Acidification (kg SO₂ eq.) 3.2 x 10^{11}
- Eutrophication (kg PO₄³⁻ eq.) 1.3 x 10^{11}

Shen et al., 2012a & b (Lenzinger Berichte); Shen et al., 2012 c (RCR)
Single-score result (III)
NOGEPA weighting factors (normalised to world)
1 tonne fibre, cradle-to-factory gate, cotton =100

Shen et al., 2012a & b (Lenzinger Berichte); Shen et al., 2012 c (RCR)

Cotton (US&CN)
Lenzing Viscose Asia
PET fibre (W.EU)
PP fibre (W.EU)
Tencel, Austria
Lenzing Modal
Lenzing Viscose Austria
Tencel, Austria 2012

Weighting factors (NOGEPA)

- Climate Change: 32
- Abiotic depletion*: 8
- Ozone layer depletion: 5
- Human toxicity: 16
- Fresh water ecotoxicity: 6
- Terrestrial ecotoxicity: 5
- Photochemical oxidation: 8
- Acidification: 6
- Eutrophication: 13
- Total: 99

(First normalised to World 1995)