Novel structural materials with multi-scale fibre components (NoMa)

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NoMa consortium

**Budget of project ~1.3 M€**
**Duration 01.6.2015 - 30.11.2017**
**Research partners: VTT and LAMK**
**Funding partners: TEKES, VTT, companies and LAMK**

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<th>SMALL ENTERPRISES</th>
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<tr>
<td>3D Formtech Oy</td>
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<td>3DTech Oy</td>
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<td>Ahosen Taimisto Oy</td>
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<td>Brainwood Oy</td>
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<td>Co. Panu Isokangas Oy</td>
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<td>Earthpac Oy</td>
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<td>Novarbo Oy</td>
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<td>Hikinoro Oy</td>
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<td>Swanheart Design Oy</td>
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<td>FL-Pipe Oy</td>
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<th>LARGE ENTERPRISES</th>
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<td>Metsä Board</td>
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<td>Metsä Fibre</td>
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28/06/2017
Novel fibre foams and biocomposites applications
Goal of the study

Multi-scale fibres (from centimeters to nanoscale, various aspect ratios) for stronger material structures

- Optimal combination of fines, long fibers, nanocelluloses, polymers and additives to obtain good adhesion in biocomposites and bonding in fibre foam structures

- Novel bio based products for SMEs through innovative raw material combinations (hemp fractions, hydrophobins, lignocellulosic fines, nanocelluloses, wood wool, side streams) and technologies combined with design approach
Fibre composites according to fibre content

- Increased fibre/cellulose content
  - Foam formed materials
  - Printing paper, Coated paper, Sized paper
  - Non-woven
  - Classic Wood Composites
  - All cellulose composites

- MFC, NFC, containing plastic films
- Injection moulded products with cellulosic fibres
- Extrusion moulded profiles with cellulosic fibres
- Materials for 3D-printing
- Thermosetting moulded fibre composites
Fiber foams

• Fiber suspension + air
  – Typical air content 40 - 70%
  – Foam stability can be controlled
  – Typical bubble diameter ~100 µm

• No fiber flocculation
  – Small bubbles fill the free space
Foam forming of low density structures

- Foaming of water-fiber-surfactant mixture to reach air content 50 - 60%
- Foam is poured into a foam forming mould, size 42 x 42 cm$^2$
- Drainage of liquid using gravity or low vacuum level, no wet pressing
- Drying in oven 60 - 70°C, ~24 h, drying time depends on pulp type
Application: Light weight inner packages

- Light and soft fibrous cushioning element that protects the product from impacts
- Product shape made in manufacturing phase
- Replacement of non-biodegradable EPS based inner packages
  (Europe: 1.6 million tons of EPS waste in 2010)

Foam formed inner package

Cellulose fibre material to replace plastic bubble wrap
Design: Kaisa Jäntti, LAMK
Materials and foam forming: VTT
Photos: Kaisa Jäntti, LAMK and Juha Hakulinen, VTT
Application: Designed decorative sound absorber panels

- Foam forming and design-driven aspect lead to designed porous structures with special 3D form and sound absorption property.
- Cellulose pulp used as raw material instead of highly processed and disposable materials.

Kaarna wall panels designed by Hannakaisa Pekkala LAMK
Exhibition of “Designed Cellulose For Future II” in May 2016, Helsinki
Multi-scale material experiments: Hemp, refined bark and wood wool fractions with cellulose pulp
Multi-scale material experiments:
Hemp fractions, fibres, bast and dust with polymers
3D printed biocomposite decorative hydrogels

Patent pending

Exhibition of "Designed Cellulose For Future II" in May 2016, Helsinki Aalto Arts

3D printed bio-based hydrogels for decorative applications
Design Susanna Kettunen LAMK
3D printing and material development: VTT
Photo: Juha Hakulinen VTT
Pure 100% cellulose pulp sheets moldable materials

Moldable pure cellulose pulp sheets
Design: Tomi Laukkanen LAMK
Materials: Metsä Group
Photos: Juha Hakulinen VTT
3D printed wood sawdust and biopolymer stimulus toys for production animals

Exhibition of "Designed Cellulose For Future II" in May 2016, Helsinki

3D printed toys for animals
Design: Kristoffer Heikkinen LAMK
3D printing: 3DTech
Commercial materials
Photos by Juha Hakulinen VTT