Functional coatings from nanocellulose - fire protection and colour

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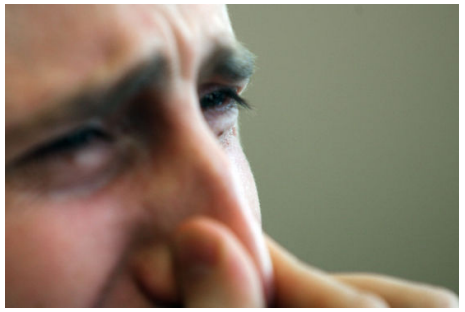
Main R & D and market drivers in paint and coatinfg industry

- Zero VOC paints for improved indoor quality
  - ➡ **Water-based coatings with high solids**
  - "In order to get to low and no VOC, producers had to make significant changes to raw materials in the paint,"
    VP David Green, ANGUS
- Sustainability
  - "Greener coatings", renewable raw materials, standards and regulations
  - "Major manufacturers are developing alternative recipes to address these standards and the desire for ever greener products,"
    VP Julie O. Vaughn, Emerald Performance Materials
- Functionality
  - Antimicrobial, scrub and stain resistant, insulating…
  - "This trend toward offering coatings that do more than beautify and protect is expected to continue into 2016 and beyond,"
    Sylvia Insogna, Dow Coating Materials



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Introduction to nanocellulose

Nano/Microfibrillated cellulose
(N/MFC)
Nanocrystalline cellulose (NCC)
Bacterial cellulose (BC)
High-Consistency enzymatic fibrillation (HefCel)*

Illustrations: Safa Hovinen, VTT (Cell wall structure, Fiber structure)
*FI126698 Process For Producing Fibrillated Material

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Production of high consistency CMF HefCel

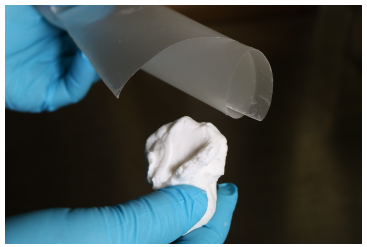
High consistency
20-40% dry matter content during treatment

Mechanical low energy agitation
Mixing of pulp together with enzyme in horizontal reactor, e.g. sigma mixer or kneader
High fibre-fibre friction in low water content
No need for abrasive, cutting or refining elements

Tailored cellulase enzymes
Small amount of side activities
Control of enzyme activities during processing

Simple up-scalable process
High yield of fibrillated cellulose together with valuable cello-oligosaccharides
Low energy consumption (SEC 0.6MWh/t)
Off-site production possible

STEP 01 — RAW MATERIAL
STEP 02 — SLUSHING
STEP 03 — MIXING
↑ ENZYMES
STEP 04 — INACTIVATION & WASHING
↓ FILTRATE INC. SUGARS
STEP 05 — DEWATERING
STEP 06 — FIBRILLATED MATERIAL



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Principles of dyed nanocellulose fibril as paint

Micro / nanofibrils

- Film forming ability
- Inherent binding ability to wood
- Binding of particles e.g **colour pigments** or **functional components**
- Rheology modifier
- Removable from surfaces

Paints and laquers

- Form smooth film
- Binding on various substrates
- Application using hand tools; brush, roller or spray

Novel nanocellulose technology (HefCel) adopted to produce material having 10% consistency, dyed and sprayed on wooden surfaces to provide

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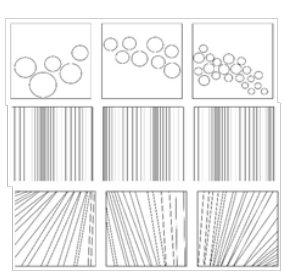
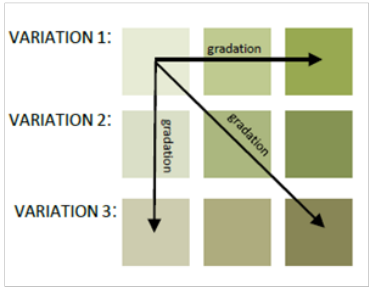
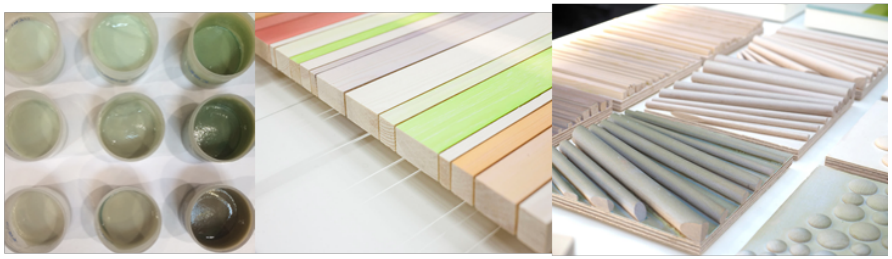
From technology to design

Wooden Reliefs







Design drawings: Heidi Turunen
Photos: Vesa Kunnari, Paula Berqvist, Eeva Suorlahti

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Fire retardancy

New functional properties using nanocellulose

Principle:

HefCel CMF mixed with inorganic nano scale pigment

HefCel acts as binder

Application using brush, roller or spray

No special equipment needed

Direct application to wood surface

No film forming stage needed

Fast layered structure formation and drying

No slow filtration based dewatering step needed

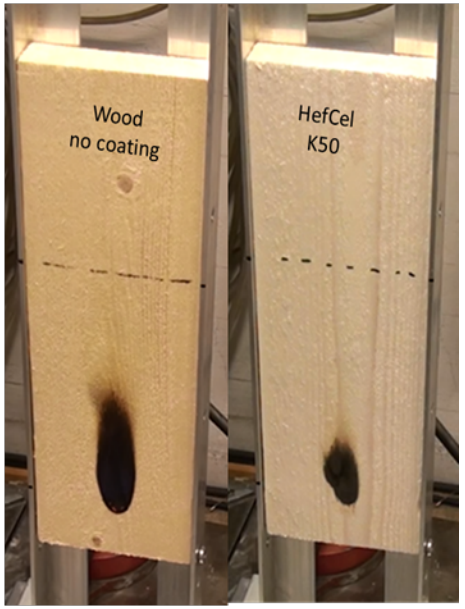
Drying using heat and air flow less than 60s for single layer

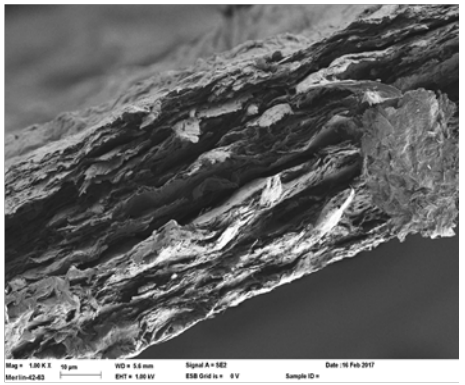
Multiple layers wet on dry

Depending on the amount of fire proofing needed

Environmentally safe & water vapour permeable

No additional chemicals present





Patent pending

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Dyed Cellulose Nanofibril Coating as Paint Conclusions

- Simple method to add visual effects on wooden surfaces with a colored, novel cellulose nanofibril type (HefCel) was demonstrated
- Nanofibrils were dyed using food dyes to produce visual effects
- Solids content was between 10…15% and drying time comparable with traditional water based paints
- Same application methods as for traditional paints may be applied
- Micro/nanofibril coating as paint provides a new eco-friendly option for interior decoration
- Functional properties of coating such as fire retardancy can be obtained by a simple biobased formulation including HefCel and pigment

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Thank You for your attention!