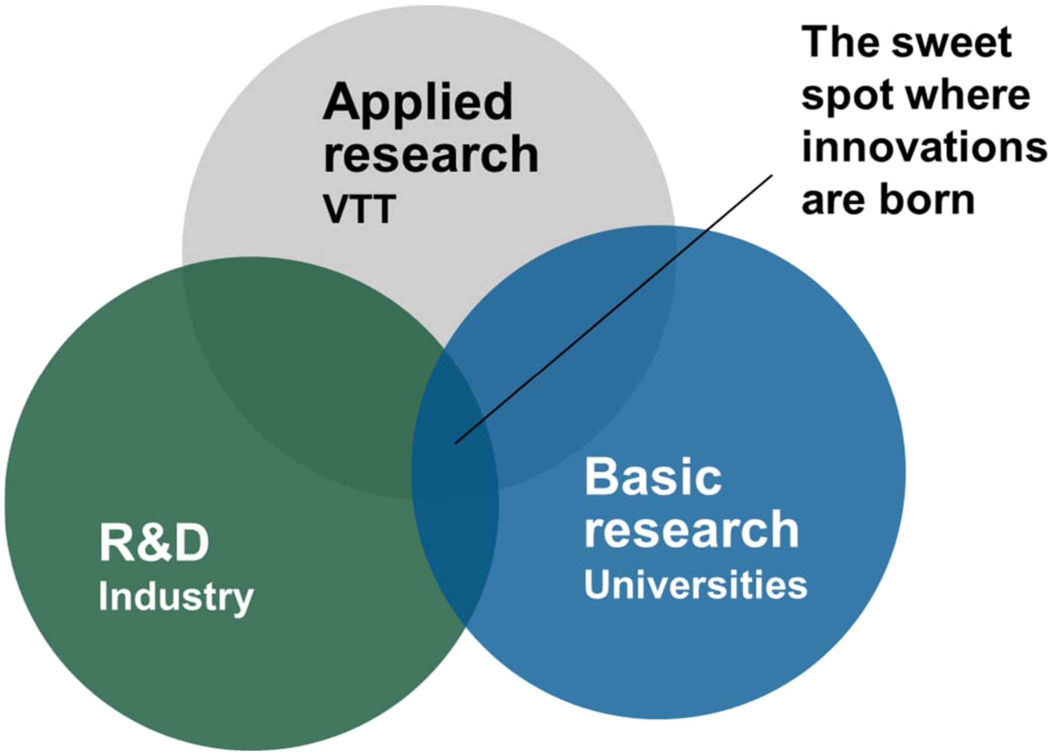
VTT uudistamassa Suomen rakennusklusteria,

XAMK 6.5.2026 klo 11:30-12:30

tutkimusprofessori Ali Harlin, VTT Biomaterials

VTT Technical Research Centre of Finland is one of the leading research organisations in Europe



284 M€
operating income

2,355
employees

45%
of the net turnover from abroad

1,135
customers

450
patent families

488
scientific articles

VTT pilot plants for bio and circular economy

1. JYVÄSKYLÄ
   Fibre based materials production
   Fluidised bed combustion
   Separation technology

2. TAMPERE
   Plastic materials processing

3. ESPOO/OTANIEMI
   Fermentation and bioprocessing
   Food and brewery

4. ESPOO/BIORUUKKI
   Gasification
   Pyrolysis
   Textile fibre spinning
   Biomass processing
   Hydrometallurgy
   Process chemistry
   R2R surface treatment
   Cellulose films

KEY FEATURES FOR VTT PILOTS

- Open access pilot facilities.
- Key role in derisking process technology scale-up at the early stage of crossing the “valley of death”.
- Main customers large companies and start-ups looking for new business opportunities.
- Cover the development chain from raw materials to end products.
- Two types of pilots: Process specific and multi-purpose.
- Customer projects ~ 40% of turnover.

- Annually ca. 150 customers
- 1/3 from outside Finland

VTT research and technology infrastructures support commercialization of new technologies

VTT Bioruukki
Pilot Centre

Biotechnology & food
research piloting

MIKES
Centre for Metrology
and Accreditation

Micronova
clean room

SMACC Machinery
and vehicle
research facilities

PrintoCent
Printed intelligence
research
environment

ROViR
Remote control and
virtual technology
centre

New
fibre products
piloting environment

Centre for
Nuclear Safety

Advanced Bio-based Materials

- Resource efficiency: Lower water use and energy demand compared with conventional wet forming.
- Design freedom: Enables multilayer, gradient, and highly porous structures in a single forming step.
- Industrial relevance: Pilot-scale validation reduces scale-up risk for insulation, packaging, nonwovens, and construction materials.
- Sustainability: Supports biobased, recyclable, and plastic-replacing material solutions aligned with EU circular economy objectives.

Advanced materials for low-carbon, healthy buildings

Construction materials

- Bio-based insulation panels
- Fire-safe, non-toxic building materials
- Lignin-based plasticizers and dispersants
- Breathable building envelopes
- Multifunctional materials enabling circularity

LigniOx: parempaa betonia liniinin avulla

-innovaatio tarjoaa biopohjaisen vaihtoehdon rakennuskemikaaleille

Mahdollisuus: Ligniini on selluntuotannon tärkein sivuvirta, jota voidaan käyttää uusiutuvana vaihtoehtona fossiilisille raaka-aineille.

Ratkaisu: Hapetetun ligniinin tuotantoon liittyvän VTT:n innovaation pohjalta ANDRITZ, Metsä Fibre ja Dow kehittivät yhteistyössä VTT:n kanssa LigniOx-teknologian kestävien **ligniinidispersanttien** valmistamiseksi.

Lopputulos: Metsä Group rakentaa Äänekosken biotuotetehtaan yhteyteen koelaitoksen ligniinin jalostusta varten.

Ekotehokkaat materiaalisovellukset huonekaluvalmistuksessa

Kuinka yhdistää taloudellisuus ja ekologisuus?

- Vähennä - Uusiokäytä - Kierrätä – Käytä pitkään
- Yhdistä käytettävyys ja toiminnallisuus ekologisuuteen
- Raaka-aine tehokkuus = valmistuksen talous paranee

Ekotehokkuus

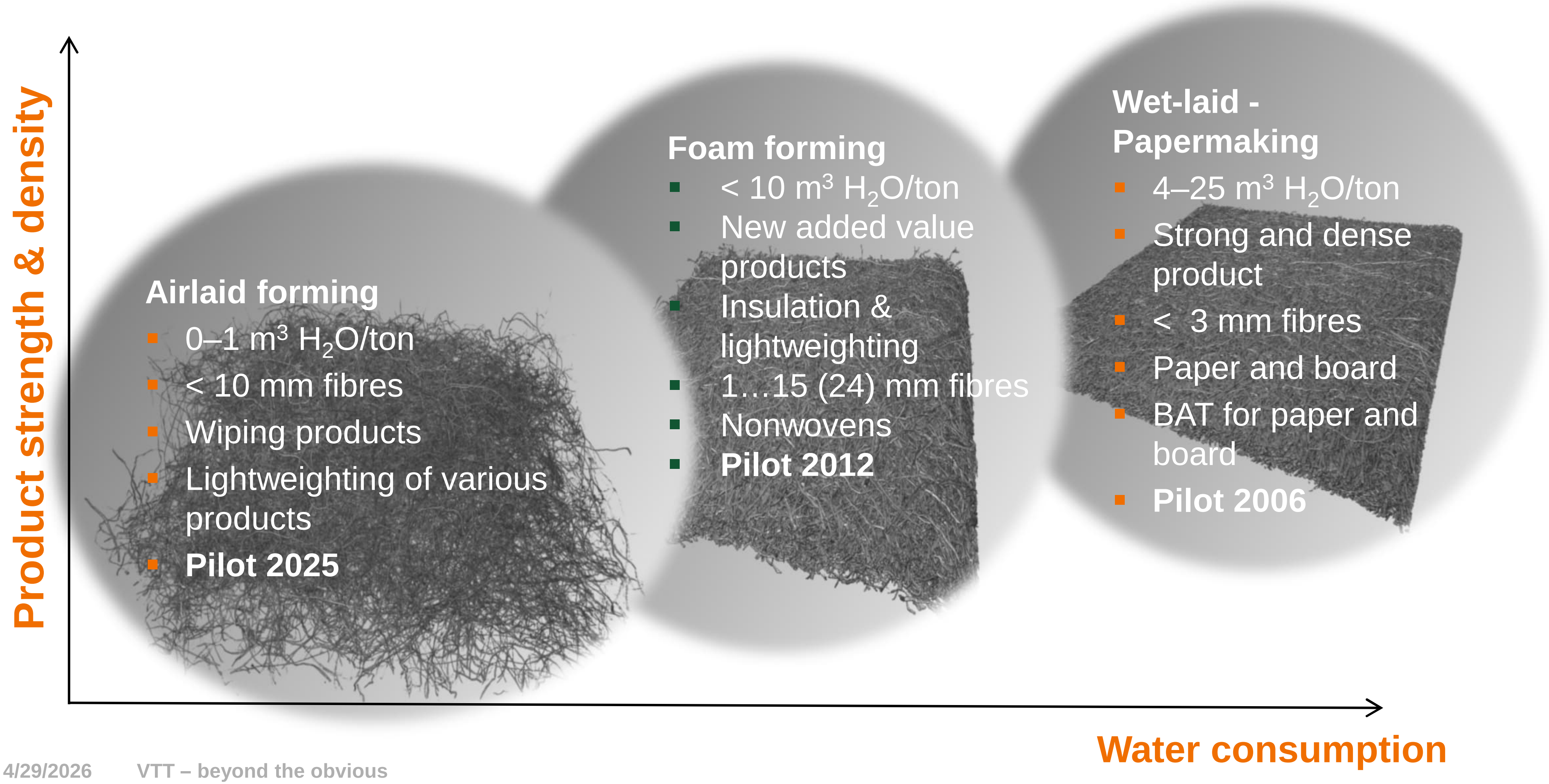
- Biomuovi ja luonnonkuitu komposiitit
- Sovelletaan muovintyöstön tekniikoita
- -35% painoa ja -45% CO_2

Helposti huollettavat ja kestävät pinnat

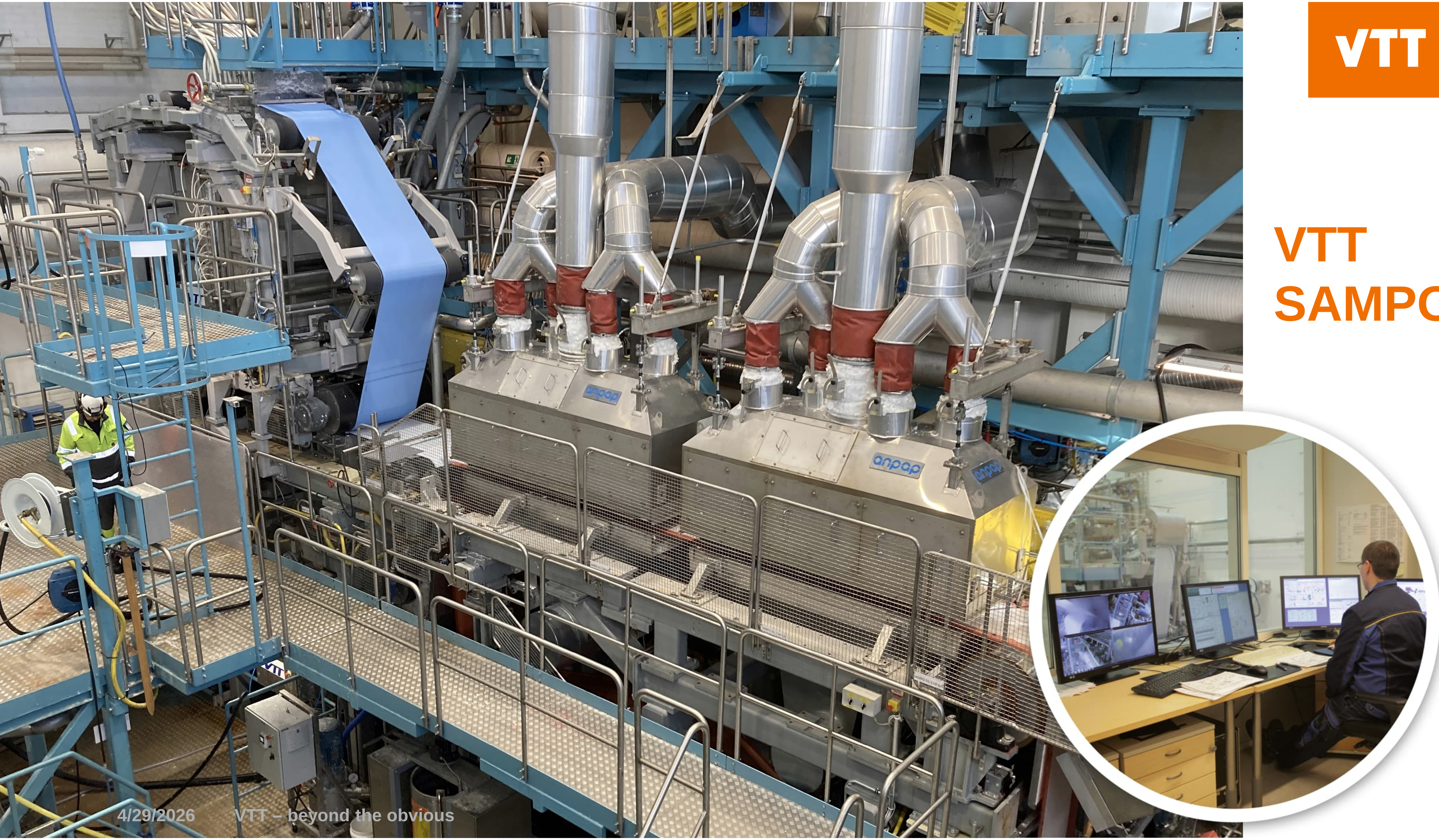
- Ohut ja käpinäkyvä AddSol® sooli-geeli pinnoite
- Likaa hylkivä ja helppo puhdistaa

CASE: Puustelli Ecokitchen 2012
Ethical and sustainabale production, fact based and sertified (ISO 14025) kitchen, which life-cycle impact is markedly lighter that typical today

Forming technologies for fibrous products



VTT SAMPO



VTT SAMPO

General

Parameter	Value
Design speed	1000 m/min
Operating speed	0,3 - 200 m/min
Web width	< 0,7 m
Basis weight	10 - 1000 g/m^2
Max consistency	LC pumps up to 6 % consistency
Product thickness	up to 50 mm
Drying input power (gas-fired)	460 kW

Forming

Parameter	Value
Fourdrinier headbox slice opening	from 5 mm to 20 mm (basically no limits)
Vertical former slice opening	from 3 mm to 15 mm
Suction width	0,7 m
Flat vacuum boxes	max -20 kPa
High vacuum box	max -70 kPa

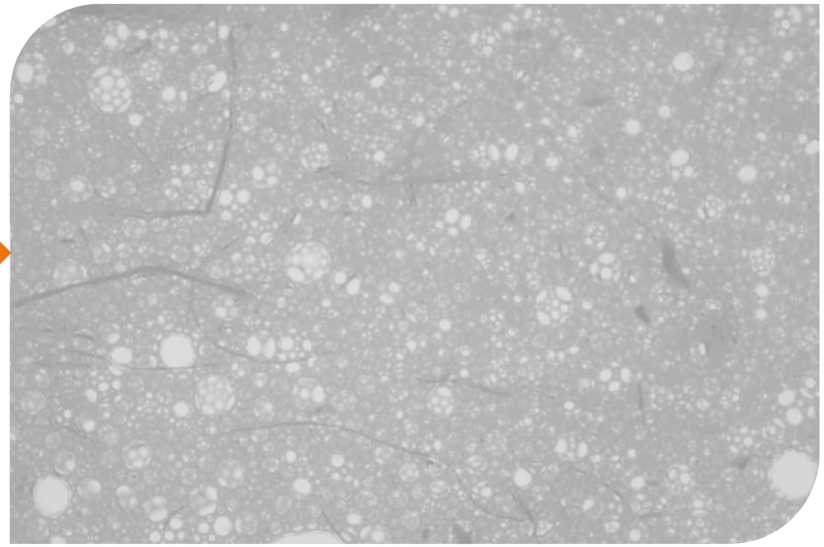
Drying

Parameter	Value
Drying technology	1. Hot air impingement / TAD (Dryer 1) 2. Hot air impingement /TAD (Dryer 2) 3. Infrared profiling
Input power (gas-fired)	2 * 230 kW
Temperature range	Max. 450 ˚C, typical operating temperature 200ºC

Radical innovation: Foam in forming

- Fibres and other furnish components are mixed with foam instead of water.
- Foam consists of water, foaming agent and air. Typical air content 30-70%.
- Air bubbles prevent flocculation of fibres in the headbox.
- Important to have a “right type of foam”.

Enables totally new composites



Examples of potential applications

Composites
- Pre-preg materials
- Fibre reinforcements

Automotive
- Interior textiles

Filtration
- Air filters

Personal Care and Hygiene
- Wipes
- Napkins

Building
- Wallcoverings
- Roofing underlays
- Flooring underlays

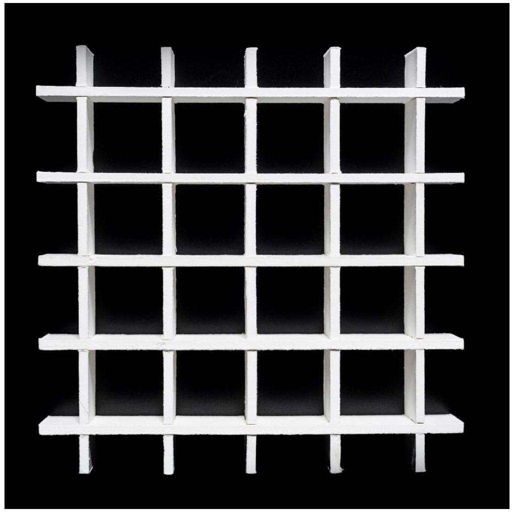
Highly porous materials
- Thermal insulation
- Sound absorption
- Packaging

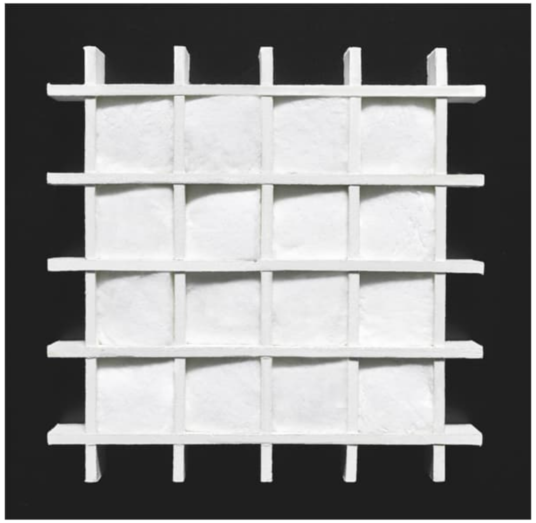
Geotextiles

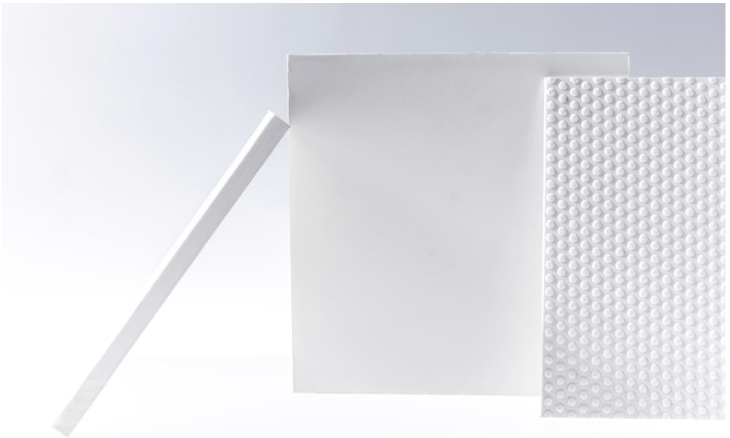
New solutions

Architecture:

Foam Filled Grid Structure
Laminated structures for interior







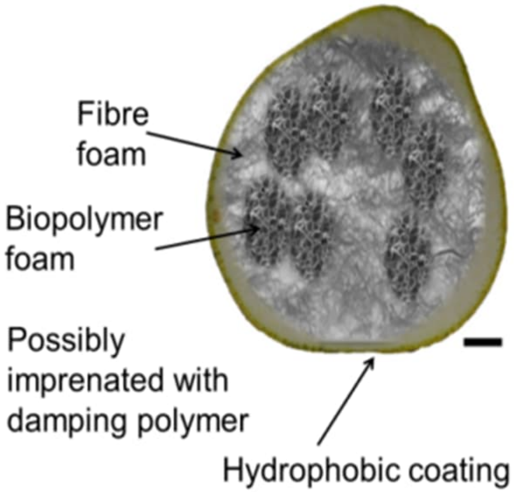
Interior element structures from cellulose and nanocellulose. Chip board strength with half of its thickness*. Easy to form in shapes when wet. Excellent machineability.
Researched by Vesa Kunnari, Jaakko Pere (VTT), and Heidi Turunen (design, Aalto university).

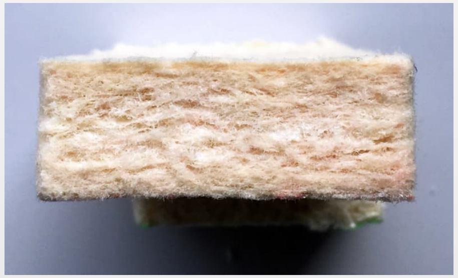
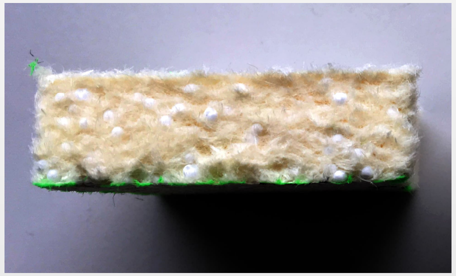
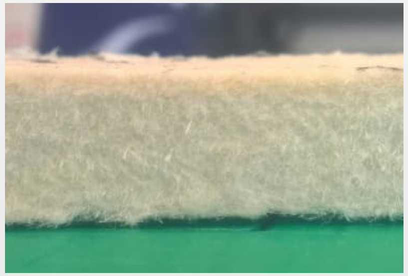
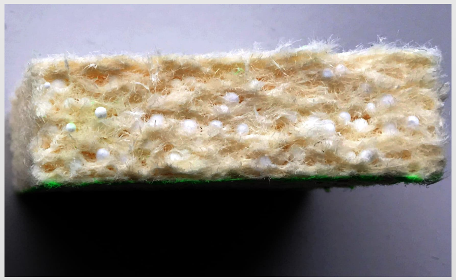
**Bending strength of this novel structure is 28 N/mm², which is higher than the strength of the tested reference materials chip board (8 N/mm²), gypsum board (EH, 10 N/mm²), MDF (26 N/mm²) and softwood plywood (22 N/mm²).*

Photos by Kirsi Kataja and Eeva Suorlahti.

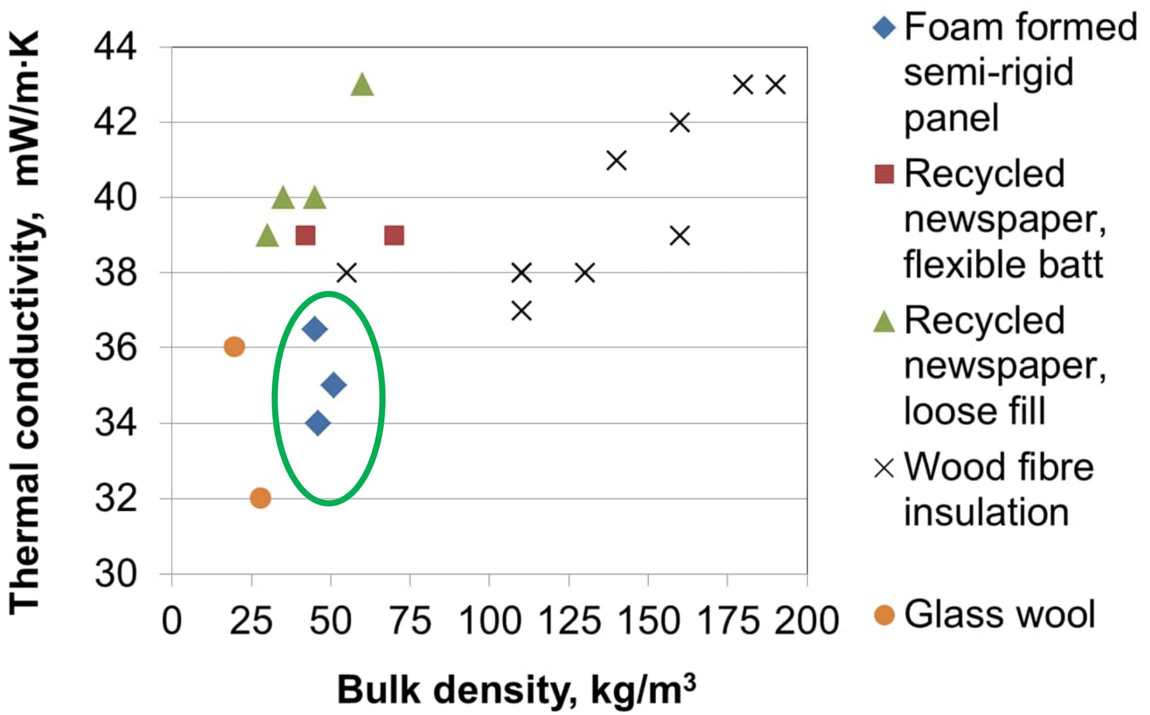
Photo: Eeva Suorlahti

Material and structure combinations



Random fiber network 	EPS particles randomly in fiber network 	Coated random fiber network 
Density gradient in fiber network 	EPS particles in the middle layer 	Mimicked pomelo structure • Density gradient in fiber structure • Bio-PLA particles in outer layer • Coated top ply • Manufacturing in Sept. 2016

Thermal insulation properties are comparable with e.g. glass wool or EPS

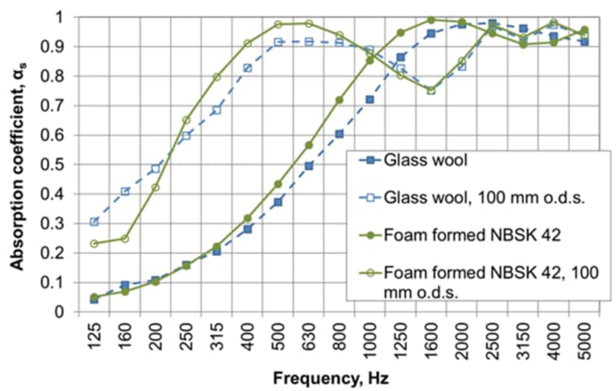


Positioning foam formed materials among the competitors (fibrous insulation materials)

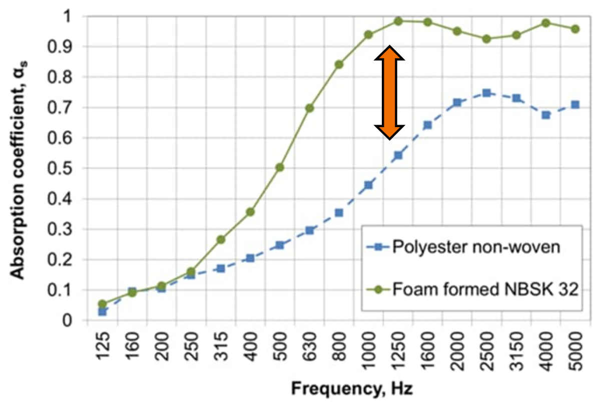
Pöhler, T., *et al.* (2017) Use of papermaking pulps in foam-formed thermal insulation materials. *Nordic Pulp and Paper Research Journal*, *32*(3), 367-374.

Foam formed NBSK materials showed competitive sound absorption efficiency

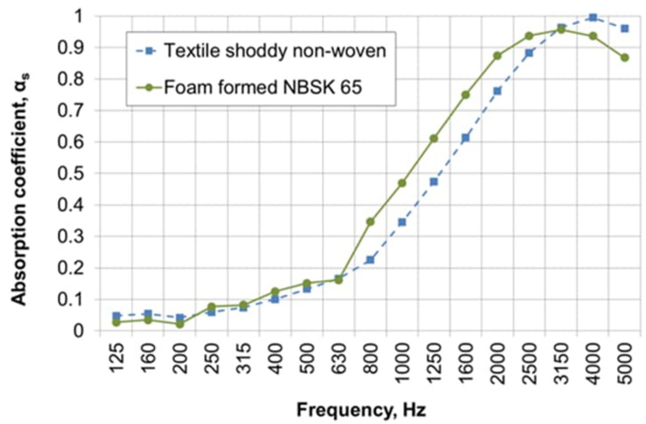
NBSK vs glass wool



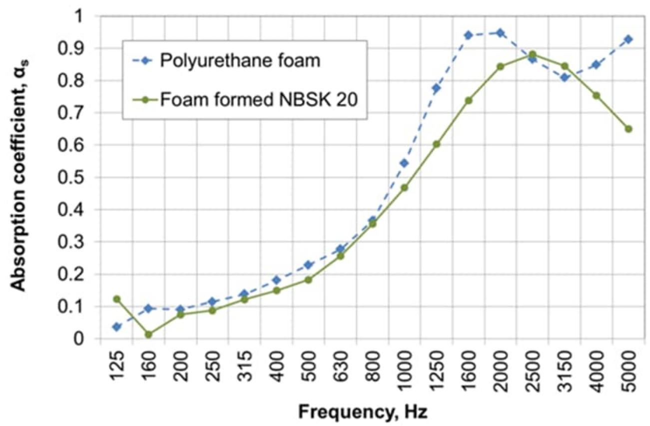
NBSK vs polyester non-woven



NBSK vs textile shoddy



NBSK vs PU foam



Pöhler, T. *et al.* (2016) Benchmarking new wood fibre-based sound absorbing material made with a foam-forming technique. *Building Acoustics*, *23*(3-4).

VTT

Vaahdon sovelluksia

Aisti: mullistaa rakennusmateriaaliteollisuuden vastuullisilla akustiikkalaatoilla

FiberWood: Hengittävät, kierrätettävät ja kompostoituvat rakennusmateriaalit ovat ekologisia vaihtoehtoja mineraalivillalle ja solumuovipohjaisille eristeille ja pehmusteille.

Example: HiPer concept

- Cellulose fibres (short and long) from wood pulp and regenerated fibres, and
- Recyclable thermoplastic binders,
  into a mouldable, high-performance biocomposite that can be processed using existing thermoplastic manufacturing routes.

The concept explicitly aims at drop-in compatibility with current industrial equipment (pressing, thermoforming, moulding), while delivering lower carbon footprint and improved circularity

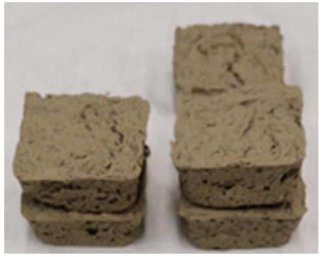
Typical HiPer materials consist of:
- 30–50 % wood pulp,
- ~20 % long cellulose-based fibres (e.g. flax, hemp, cotton, viscose, lyocell),
- 30–50 % thermoplastic binder, melt-reprocessable and recyclable.

Example: Mineral and composite foam forming

A further recent direction is fibre–mineral hybrid foams:

- Foam forming is used to distribute minerals (e.g. clay, gypsum, geopolymer systems) uniformly within fibre networks.
- This enables lightweight, insulating, and fire-resistant composites, with controlled pore size and mineral distribution.

Such approaches are explicitly included in recent construction-focused research plans and pilot activities, where foam forming is combined with moulding and pressing techniques for boards and panels.



Mineral plates:

88–95 % clay, <20% CTMP,

112 kg/m3 – 213 kg/m3.

35.1–39.2 mW/mK.

High fire resistancy

VTT AirLaid Airlaid web forming

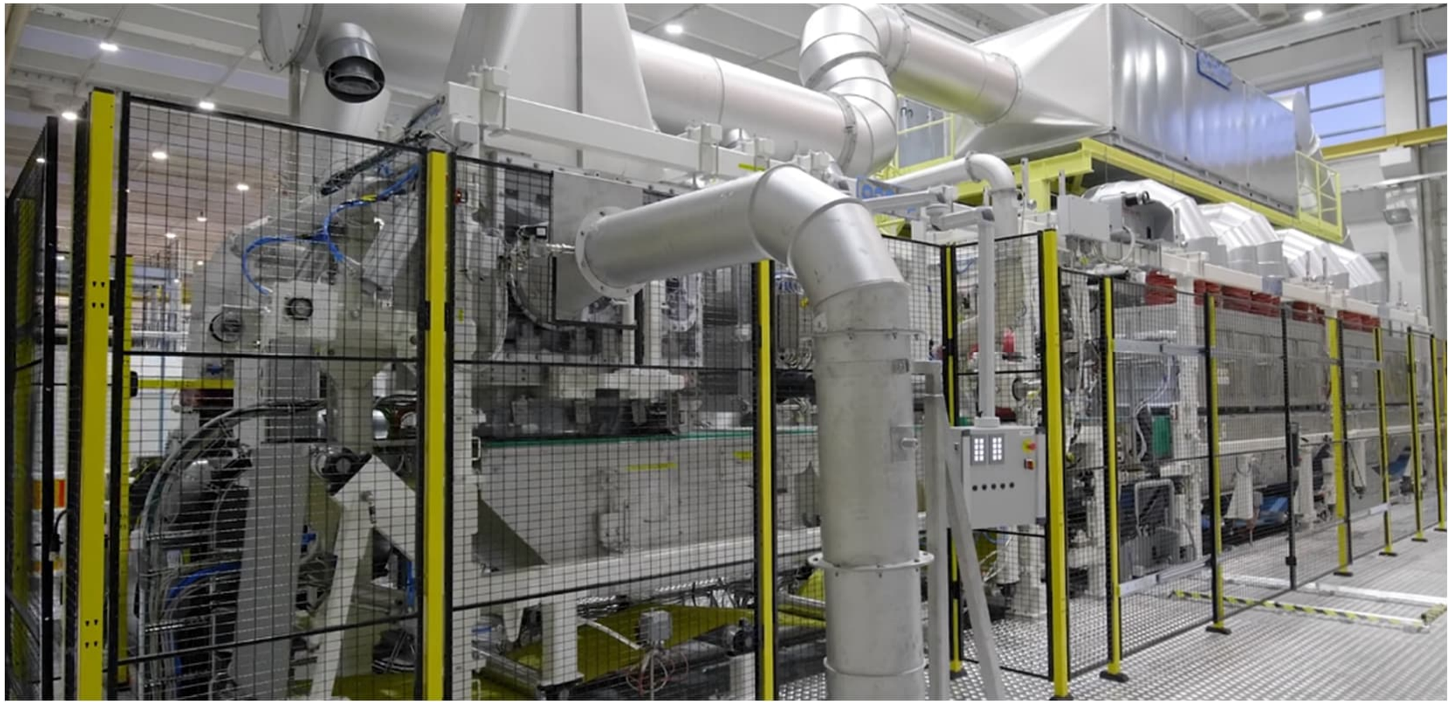
Air laying pilot-line

Raw Materials
- Fluff pulp
- CTMP
- BiCo/PLA binder fibres
- Man-made cellulose fibres
- Pre-opened fibres

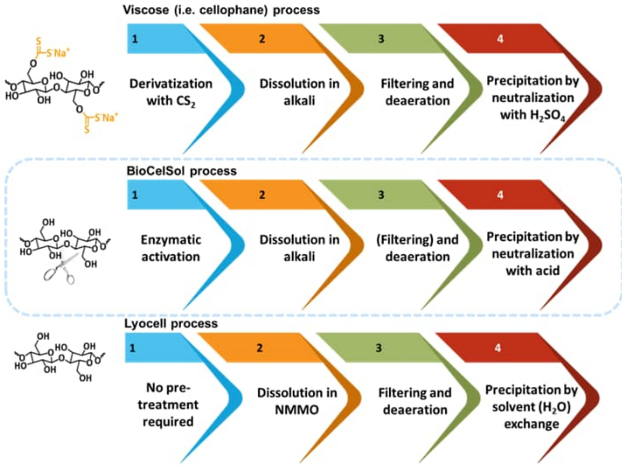
Bonding Methods
- Spray bonding
- BiCo/PLA-fibres
- Foam coating

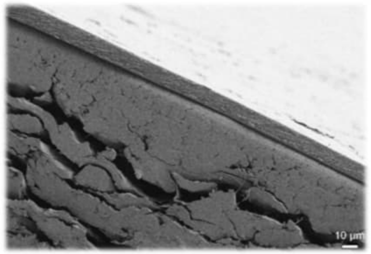
Design parameters

- **Line design speed**: 500 m/min
- **Production speed**: 4–200 m/min
- **Web width**: 700 mm (after edge trim: 600–700 mm)
- **Web thickness**: up to 40 mm
- **Roll diameter at winder**: 1000 mm
- **Hammermill capacity**: 300 kg/h
- **Basis weight range**: 30–1000 g/m²
- **Max air temperature in dryer**: +250°C (electrically heated)
- **Dryer hood length**: 2 × 4 m



Key cellulose technology

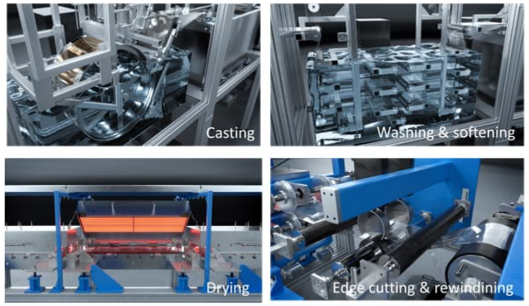




Dissolved cellulose

Films and coatings

Pilot infra for films/coatings

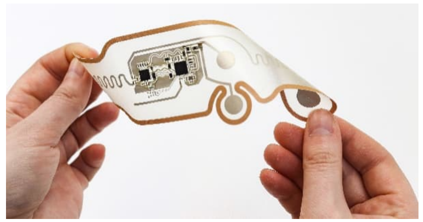


Applications

VTT

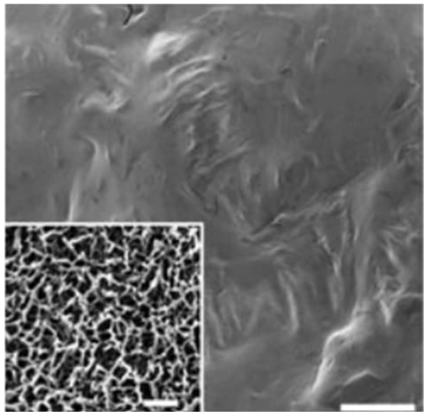
Barrier property	Biocelsol film (~ 20 µm)	Biocelsol coating (~ 10 µm)	Com. ref. (42 µm)
Oxygen, OTR, cc/m2/day @ 23 °C & 50% RH @ 23 °C & 80% RH	2 30	< 0.2 < 2	10 70
Oil/Grease, KIT	12	12	12
Moisture barrier, WVTR, g/m2 /day @ 23 °C & 50% RH	< 5	< 2	63
Water, Cobb 300s, g/m2	20	40	60

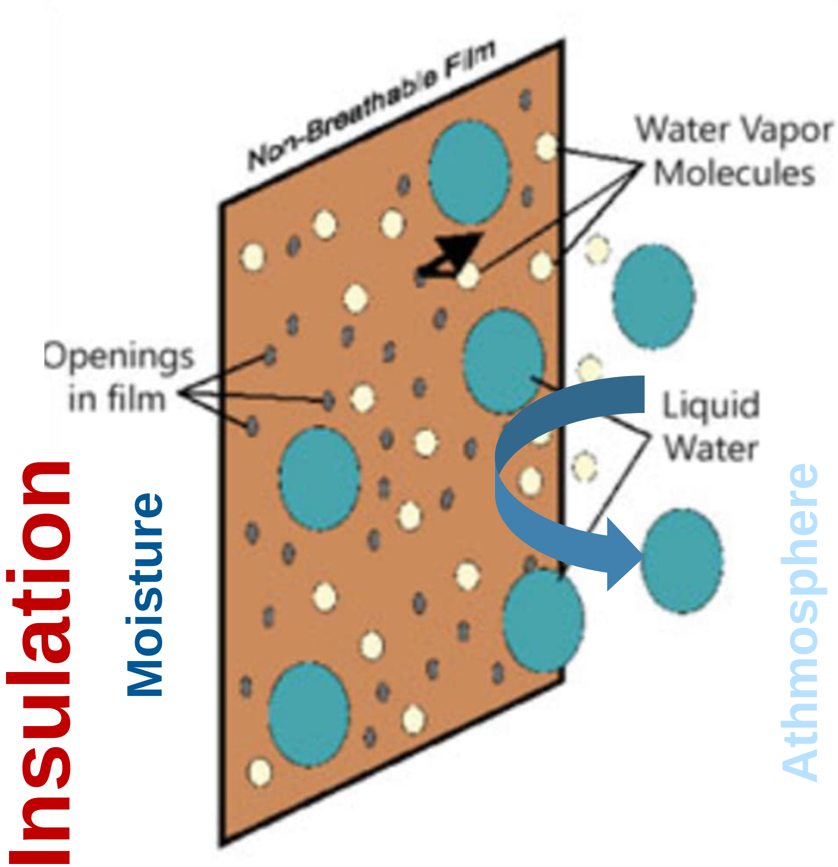
High-performance, renewable, biodegradable, CS_2 free and recyclable films and coatings on carton board that are SUP- and PPWR compliant



Breathable films

- Breathable films allow moisture to evaporate but prevent water as liquid to penetrate through
- The invention is typical used in clothing where human produced sweat and humidity is trasported away from skin even if the outer surface is wet.
- The water vapour transmission is based on steam pressure pushing water molecules trough porosity in the substrate
- The pores should be small enough to block liguid water having surface tension

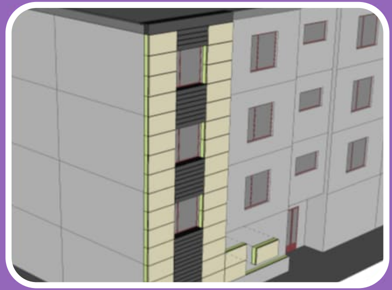




Cellulose (2023) 30:2827–2840

BioReno – Work packages

Tampere University | XAMK South-Eastern Finland University of Applied Sciences | VTT



WP 1: TAU

Thermal insulation solutions for roof structures

Development of exterior thermal insulation solutions for roof structures based on bio-based blown insulation materials

WP 2: XAMK

Insulated facade element concept for external walls

Development and demonstration of pre-insulated facade element-concept, along with engineering data management for microelement design

WP 3: TAU

Interior insulation solutions for external walls

Development and demonstration of nature-based materials and structures for interior thermal insulation of external walls

WP 4: VTT

Sustainable thermal insulation solutions

Development and demonstration of forest-based thermal insulation and vapor barrier materials for renovation and construction

WP 5: Techno-economical and LCA analysis VTT

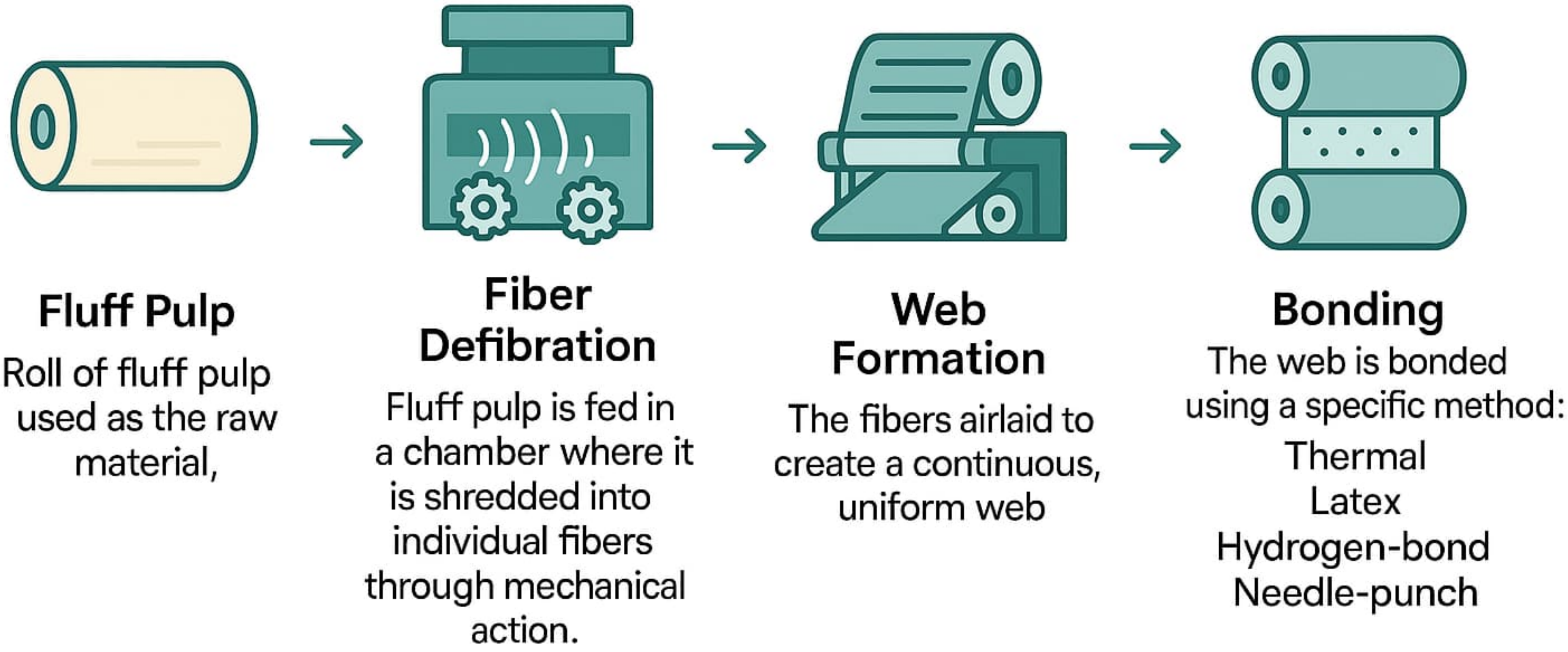
WP 6: Management, dissemination and communication TAU

beyond

the obvious

Ali Harlin
Harri Kiiskinen

Unit operations of airlaid forming technology



Focused Research Questions

- Bonding technology for recyclable airlaid products
- Decreasing energy consumption
- Dry disintegration of fibres
- Application technology for binder chemistry
- Sheet quality of airlaid webs at higher speeds
- Widening the raw-material base
  - Fluff pulp → Pulp sheets, recycled fibres, etc.
- Paperboard for packaging
- Multi-ply webs
- Sustainable nonwovens