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Business Finland Co-Innovation project
VTT Technical Research Centre of Finland Ltd (VTT)
Tampere University of Applied Sciences Ltd (TAMK)

100% biobased acoustic panel

VTT BeLight project team and Antti Fredrikson, Aisti

Background

Current acoustic sound absorbing materials are based on mineral wool materials or open-cell plastic foams. Foam forming of self-bonding cellulose fibres enables the production of fully biobased, porous and thick panels for acoustics control.

Objective

To demonstrate the potential of foam formed material made from chemi-mechanically defibrated wood pulp over the current acoustic materials made from non-renewable raw materials.

Approach

Large 600x1200x25 mm sized acoustic panels were made from softwood CTMP pulp. The acoustic properties were measured in reverberation room to assess the sound absorption classification. Comparative sound absorption measurements with selected commercial reference materials were performed with impedance tube method.

Results

a) b)

Figure 1. a) Foam formed sound absorbing panel for controlling room acoustics. b) A row of wire mesh bottom moulds for making large panels filled with fibrous foam, top view.

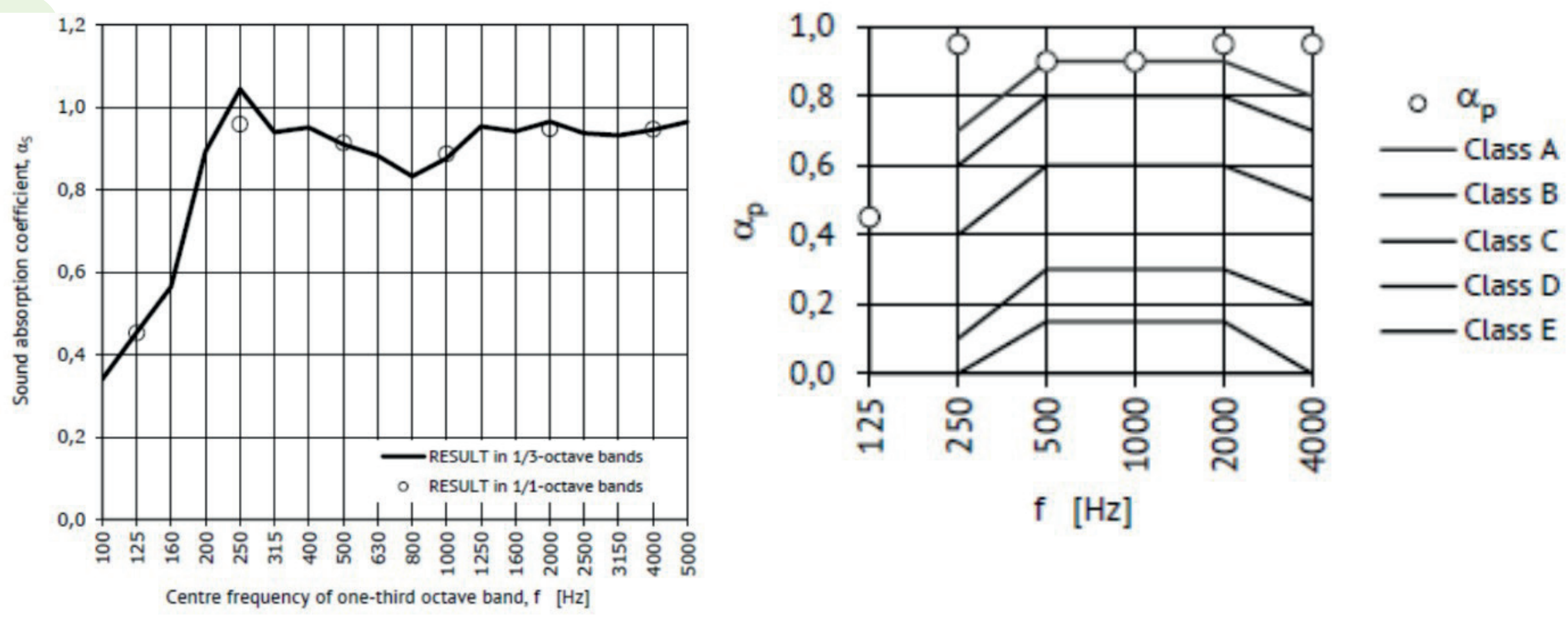


Figure 2. Sound absorption coefficient α_s was measured within 100–5000 Hz according to ISO 354:2003. Sound absorption class was determined according to EN ISO 11654:1997. The weighted sound absorption coefficient α_w was 0.95 and the sound absorption class for the specimen was A. Type E200 mounting (175 mm air gap behind the specimen), specimen area 10.6 m².

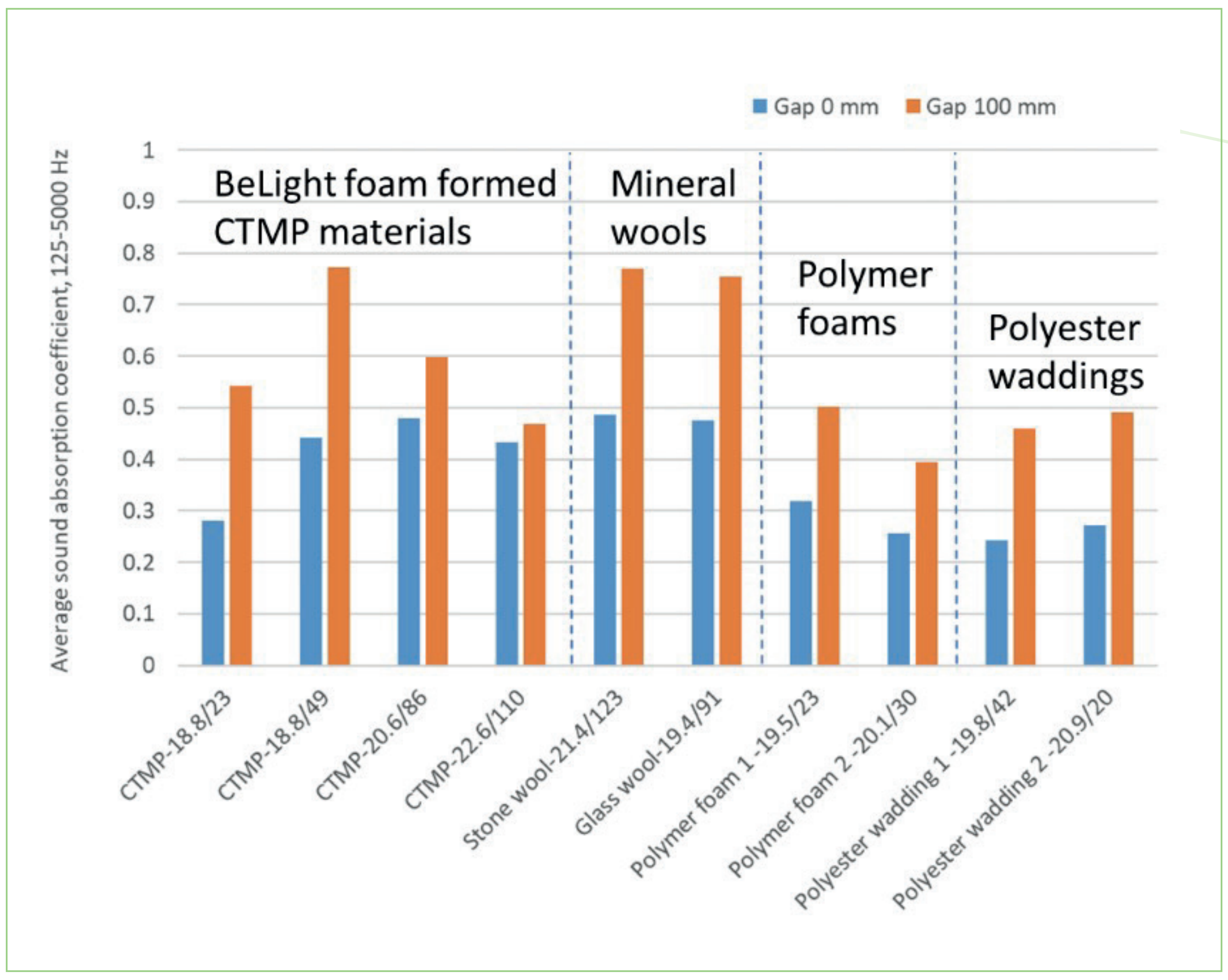
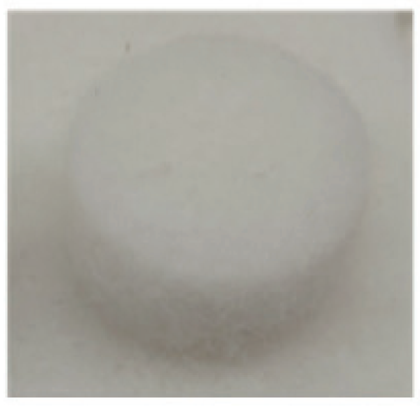
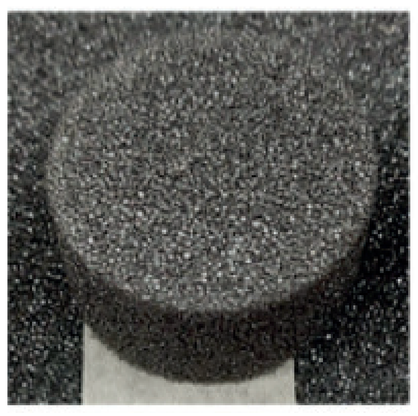


Figure 3. Comparison of 100% CTMP material to various commercial reference materials. Acupro impedance and absorption measurements (ISO 10534-2), average sound absorption coefficient. Sample code: Material name - Thickness in mm/Density in kg/m3.

Stone wool



Polyester fibre wadding



Open cell polymer foam

CTMP fibre foam

Conclusions

The solution provides a long-term recyclable carbon storage, replacing the current non-renewable materials used in sound absorbing applications.

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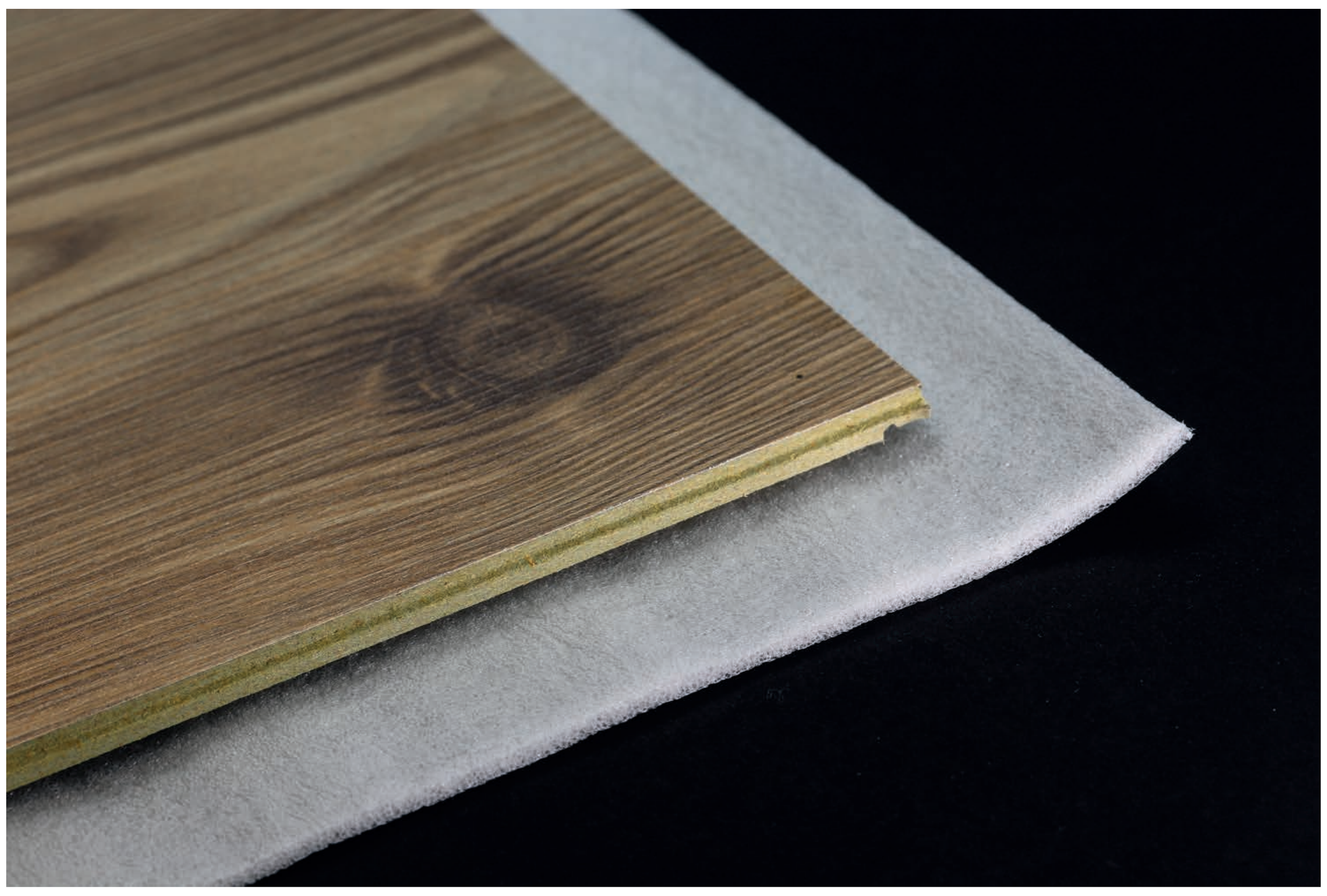
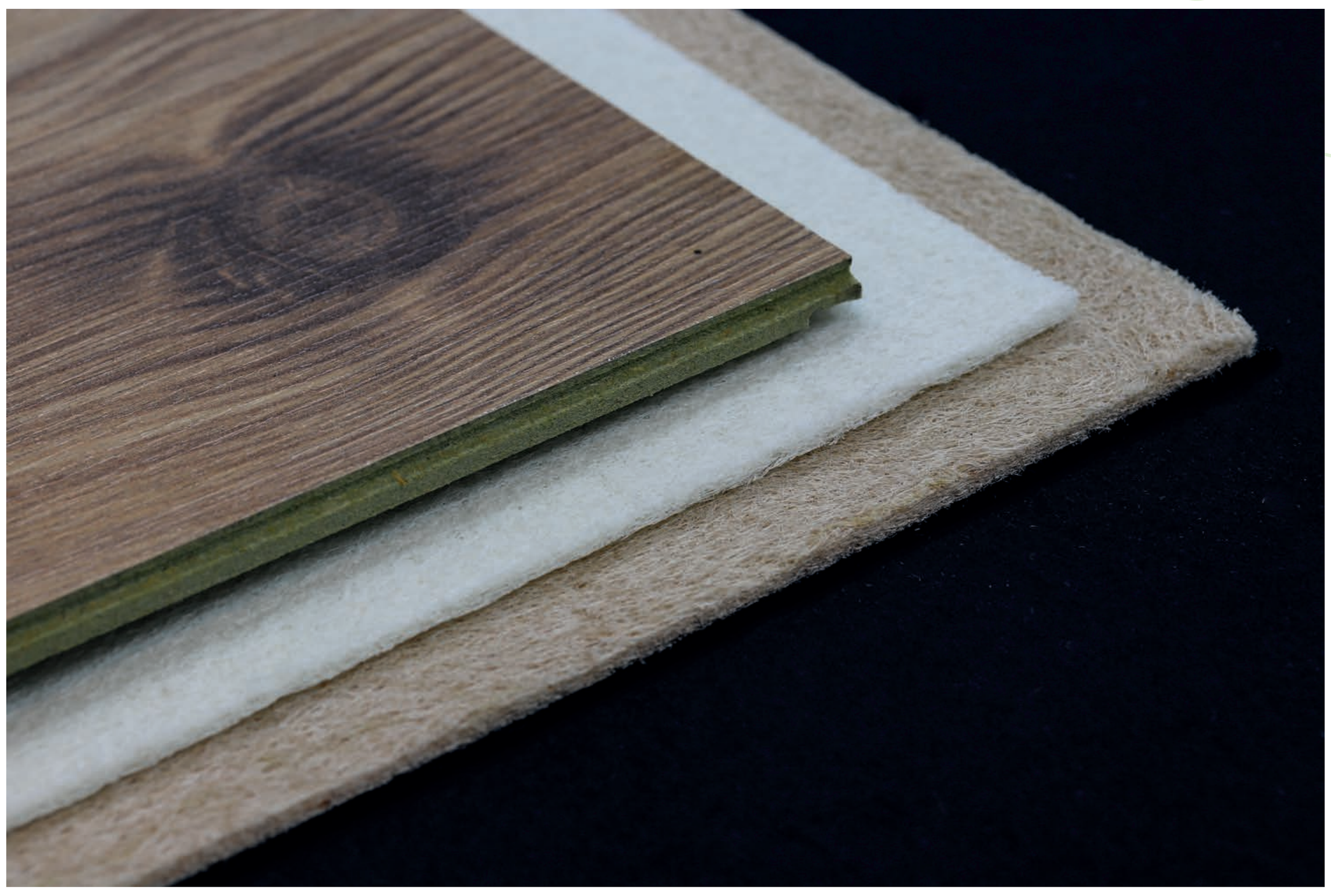
Sustainable flooring underlayment

VTT BeLight project team and Tilo Hildebrand, Selit





VTT demonstrated biobased, recyclable or compostable alternatives for flooring underlayment together with Selit and BeLight project partner NMC Cellfoam.

Background:

Flooring underlayment is a thin layer of material such as fiber, felt, rubber or foam which is put under the flooring such as laminate or parquet. The 2 to 5 mm thin material layer acts like a cushion, reduces impact sound, insulates and reduces the wear of the flooring.

Objective:

One objective in the BeLight project was to demonstrate sustainable solutions for flooring underlayment materials and to evaluate their performance.

Results:

Table 1 shows the most important flooring underlayment material properties and results of the BeLight materials together with typical values for currently used materials.

Table 1. Testing results of flooring underlayment properties.

	Thickness	Compressive strength @0.5 mm	Density	Grammage	Punctual conformability	Thermal stability*, range @MD	Thermal stability*, range @CD
	mm	kPa	kg/m3	g/m2	mm	%	%
Bio-PE foam	3.5	3	57	200	3	2.98	3.14
Bio-PBSA foam	0.9	1100	279	251	0.7	2.89	1.24
Bio-PBS foam	1.3	1060	311	404	0.7	1.13	0.7
CAP foam	3.1	6	70	216	2.2	0.4	0.51
BSKP fibre foam	2.3	13	78	179	1.3	0.38	0.41
BSKP fibre foam	5.1	6	58	294	4.1	0.65	0.58
General range of underlayment materials	1-5	70-1000	30-200		>0.5-4	0.2-1	0.2-1
						* tested at 80°C and 23°C	* tested at 80°C and 23°C

Conclusions:

Bio-PE could be used in some applications. It is bio-based and can be recycled similarly to petroleum based PE.

PBS and **PBSA** are rubbery-like and might be good materials for underlayment purposes. The samples were too thin for proper measurements. Nice haptic and nice touch and feel. Both are something new and interesting.

CAP is interesting. More uniform foam needed.

Fiber foams are really soft (kraft fibres). Properties are different from the polymer foams and they perform differently. Punctual conformability and density are comparable with polymer foams. Good thermal properties. Difficult to cut. The fibre bonding needs improvement. Interesting material. Something new.

Acoustic properties are critical and they should be measured.

PBS and **PBSA** (Poly(butylene succinate) and Poly (butylene succinate-co-adipate)), biobased thermoplastic, flexible and compostable

BioPE I'm Green (bio-polyethylene), biobased thermoplastic, recyclable

CAP (cellulose acetate propionate), wood-based thermoplastic, tough and recyclable-ready

BSKP (Bleached cellulose kraft pulp), biobased, compostable, recyclable

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Sustainable thermal insulation bag

VTT BeLight project team, Maiju Hietala, Brightplus and Esa Torniainen, Paptic

VTT demonstrated biobased, recyclable or compostable alternatives for thermal insulation bags together with BeLight project partners Brightplus and Paptic.

Background: Thermal insulation bags are used for food and beverage transportation. A thermal insulation bag keeps food or beverages frozen or hot e.g., during transportation.

Thermal insulation bag solutions are usually multilayer plastic bags with a polymer foam as an insulating layer. Thermally insulated bags are often produced using polyethylene. The markets for this type of bags are constantly growing and at the same time there is a need for more sustainable solutions.

One objective in the BeLight project was to demonstrate more sustainable solutions for thermal insulation bags.

Result: We demonstrated three different approaches: a wood cellulose based recyclable solution for recycling in the cartonboard stream, a biopolymer based compostable solution and a bio-based monomaterial solution for recycling.

Figure 2: In the biopolymer based compostable thermal insulation bag demonstration, the thermal insulation is a thin extrusion foamed PBSA foam and film, and the cover is a PBSA coated kraft paper (the extrusion coating was performed in the Package Heroes –project). PBSA (Poly(butylene succinate-co-adipate)adibate)) is a bio-based, flexible and home compostable thermoplastic material.

Figure 1: In the cellulose fibre based recyclable and compostable thermal insulation bag demonstration, the thermal insulation is a thin foam formed wood cellulose fibre foam and the cover is a material provided by Paptic. The whole bag can be put into a cardboard recycle bin.

Figure 3: Monomaterial insulation bag is a multilayer structure of thin and flexible extrusion foamed biobased Brightplus LOIMU material. Thermoplastic monomaterial solutions will be easy to recycle in the future. LOIMU is bio-based thermoplastic polymer which is suitable for recycling.

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Thin and light biobased protective packaging material

VTT BeLight project team, Minna Hätönen Tikkurila and Oskari Mäkimartti Brightplus

Background

Thin extruded plastic foams are put between painted timber product surfaces when they are stacked for shipment. After use, these materials are typically put to waste. The protective material should not make markings to the still soft paint surface even under significant loading. There is also an increased risk that the material ends up in nature at the construction site.

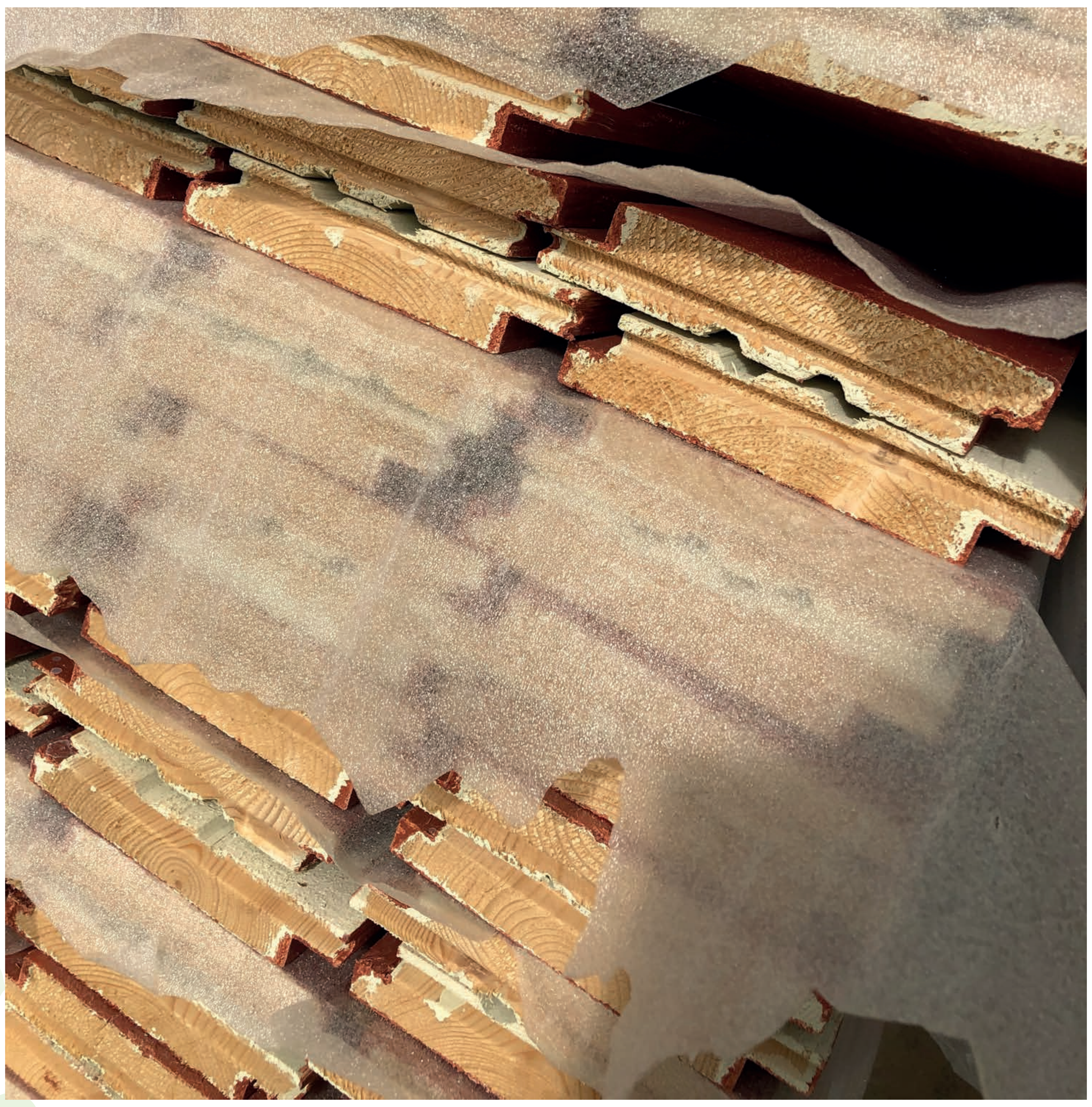

Figure 1. Painted timber stack ready for shipping. Photo by Tikkurila.

Objective

To test thin lightweight biobased polymer and fibre materials to replace oil-based plastic protective materials.

Approach

Different biobased polymers, bio-PE (polyethylene), PBS (polybutylene succinate) and CAP (cellulose acetate propionate) were extrusion-foamed at VTT Tampere and cellulose fibre materials were foam-formed in laboratory at VTT Jyväskylä. Thickness and density of biopolymer foams varied between 1.3-3.5 mm and 60-300 kg/m3. 1 mm thick fibre foam with density ~58 kg/m3 was surface treated with Brightplus' biodegradable additive. Amount of additive was 2.5 g/m2 on both sides (~8% of total material weight). A stacking test with painted birch veneer samples was conducted by Tikkurila.

Results

Thin biopolymer foams and cellulose fibre foams with surface bonding additive are shown in Fig 2.

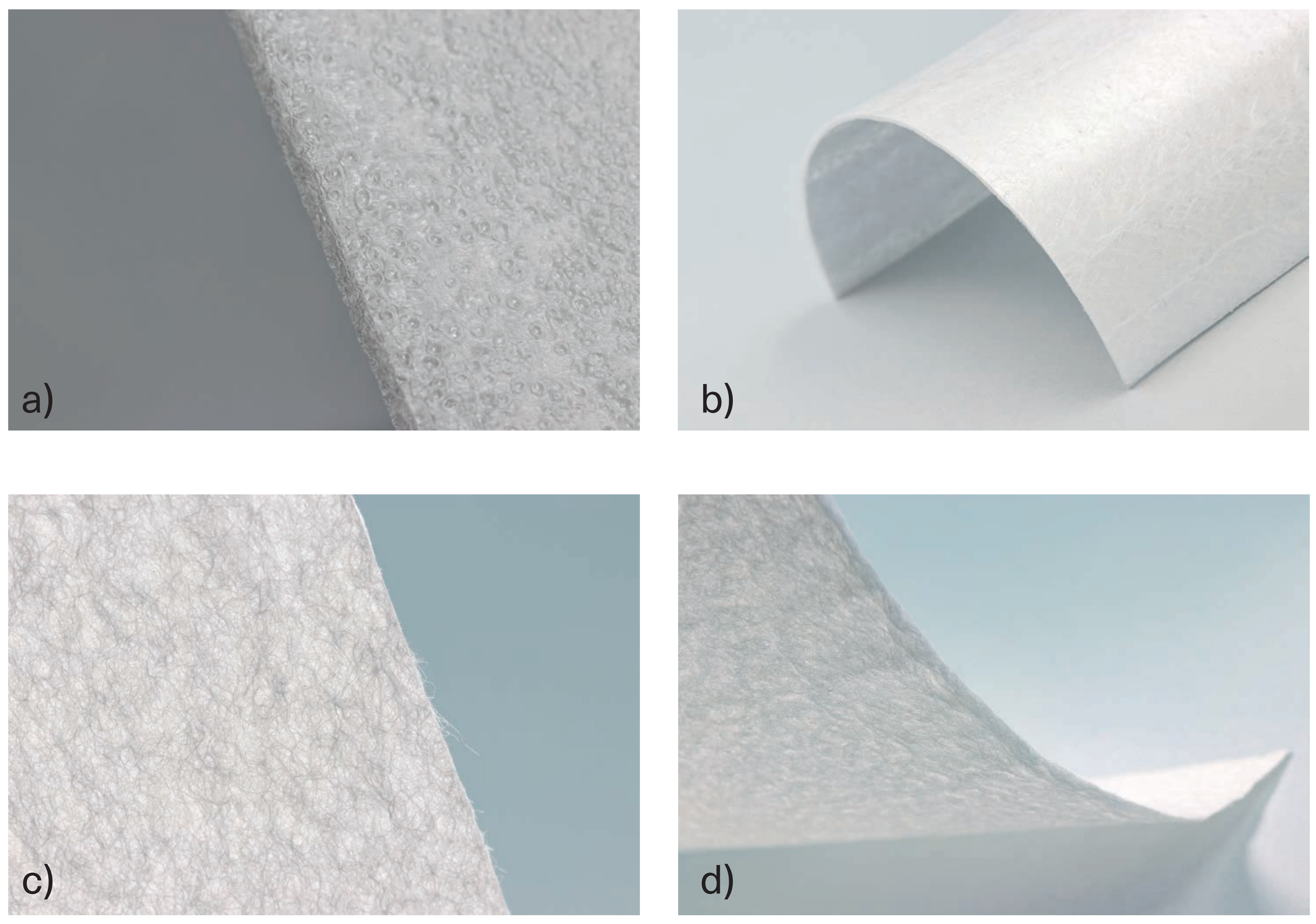

Figure 2. a) Bio-PE foam b) CAP-foam and c) and d) surface treated cellulose fibre foam.

Best stacking test result (0 =no sticking) was obtained with bio-PE-foam and surface treated fibre foam, see Table 1.

Table 1. Stacking test results. 0 = no sticking, 1= sticks but releases, no markings in paint, 2=sticks, difficult to release, small marking, 3= sticks, difficult to release, clear marking. PE= polyethylene, PBS= polybutylene succinate and CAP= cellulose acetate propionate.

Sample	Stacking grade	Biobased	Biodegradable	Recyclable
Fibre foam	3	x	x	x
Fibre foam - surface treated	0-1	x	x	x
Bio-PE-foam	0	x		x
Bio-PBS-foam	1	x	x	
CAP-foam	1-2	partly		x
Currently used material	1			x

Conclusions

Thin and light biobased foam materials performed well in the protection of painted timber product stacks. The surface strength of fibre foams was efficiently improved by a biodegradable additive.

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