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Formulating Coatings for Improved Energy Efficiency of Buildings

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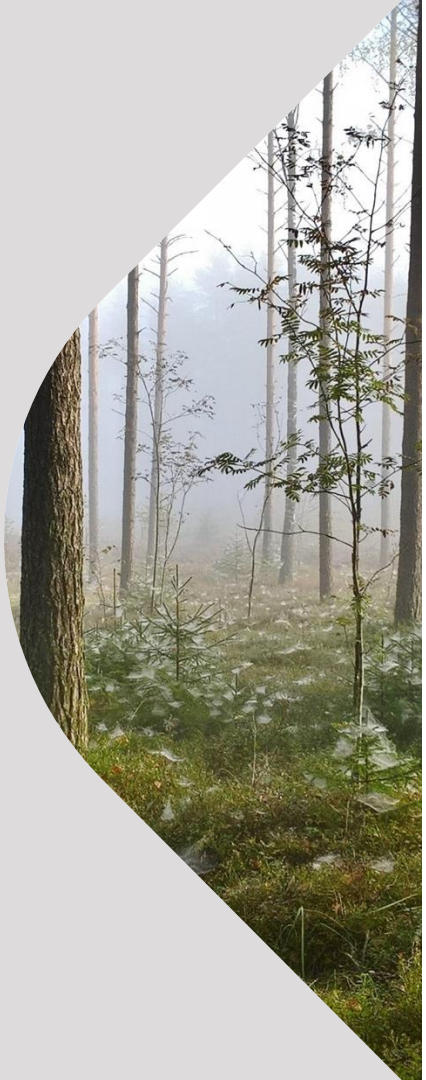
Background

Sustainability targets and changing climate are creating new challenges for buildings

Increasing need to find ways of improving the energy efficiency of buildings

Development of functional coatings can be important part of the solution



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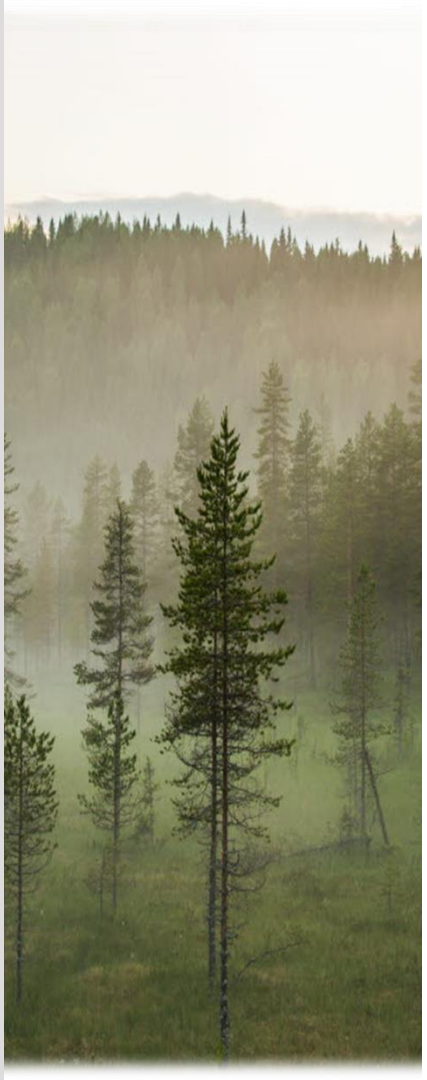
The revised Energy Performance of Buildings Directive (EPBD) sets the buildings sector on the path towards full decarbonization by 2050

Agenda

- Key properties, raw material selection and formulating
- Performance - thermal insulation and solar reflectivity
- Elongation, tensile strength and water absorption
- Other applications and some real life examples
- Summary



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Key properties – what is needed

Thermal coatings = Coating with ability to insulate and/or reflect sunlight

MECHANICAL

- Elongation
- Tensile strength
- Adhesion
- Hardness
- Abrasion resistance
- Dimensional stability

FUNCTIONAL

- Thermal conductivity
- Thermal resistance
- Total solar reflectivity
- QUV resistance
- Dirt pick-up resistance
- Water resistance
- Chemical resistance

APPLICATION

- Rheology profile
- Application behavior
- In-can stability

Focus on Binders: CHP 517 / CHP 556

CHP 517

- Styrene Acrylic copolymer
- High Solids at 60 %
- Good water and Alkali resistance
- Elastic film build, Tg -2 ˚C

CHP 556

- Acrylic
- High Solids at 60 %
- Excellent for manufacturing high solid paints
- Tg 22 ˚C

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Compatibility is Key to Functionality

Formulating examples

PM 20 µm + Aerogel

Water	22,00
Cellulosic thickener	0,30
Ammonia 25 %	0,10
Dispersant	0,35
Defoamer	0,20
Biocide	0,15
Opacity pigment	2,50
Titanium dioxide	7,50
GCC 2 µm	4,50
GCC 10 µm	4,50
CHP 517	45,00
Polymeric microspheres 20 µm	5,00
Aerogel	5,00
Defoamer	0,10
Propylene glycol	0,40
HEUR thickener	0,50
Water	1,90
	100,00

PM 20 µm + Fumed silica

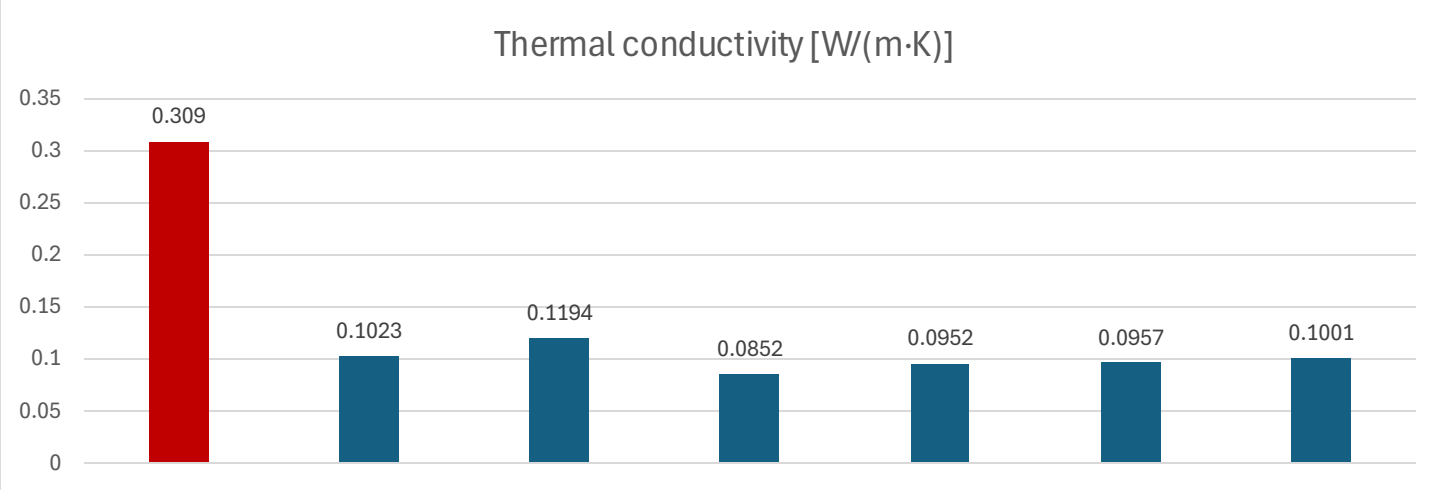
Water	28,05
HEUR thickener	0,50
Ammonia 25 %	0,10
Dispersant	0,35
Defoamer	0,10
Biocide	0,15
Opacity pigment	2,00
Titanium dioxide	6,00
GCC 5 µm	4,00
Polymeric microspheres 20 µm	10,00
Fumed Silica	3,00
CHP 517	45,00
Propylene glycol	0,50
Defoamer	0,05
HEUR thickener	0,20
	100,00

PM 100 µm + Fumed Silica

Water	30,60
HEUR thickener	0,50
Ammonia 25 %	0,10
Dispersant	0,35
Defoamer	0,10
Biocide	0,15
Opacity pigment	2,00
Titanium dioxide	7,00
Barium Sulphate	6,00
Fumed silica	2,50
Polymeric microspheres 100 µm	5,00
CHP 517	45,00
Propylene glycol	0,50
HEUR thickener	0,20
	100,00

Thermal Conductivity

Indicates material's ability to conduct heat

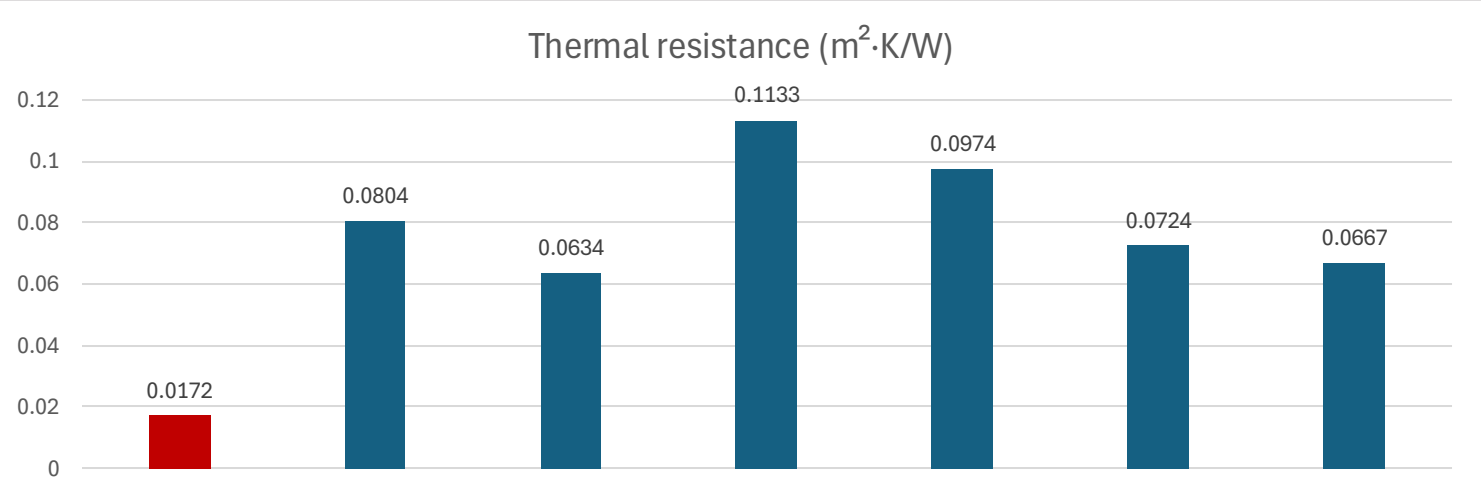


	Flexible roof coating reference, no functional fillers	10 wt % PM 20 µm + 3 wt % Fumed Silica	8 wt % PM 20 µm + 2,5 wt % Fumed Silica	5 wt % PM 20 µm + 5 wt % Aerogel	8 wt % PM 20 µm + 2 wt% Aerogel + 1 wt % Fumed Silica	5 wt % PM 100 µm + 2,5 wt % Fumed Silica	5,7 wt % PM 20 µm + 1,4 wt % PM 100 µm + 2,5 wt % Fumed Silica
Density (kg/m^3)	1518	636	721	526	584	642	667

Test method: Guarded hot plate, ISO 8302:1991
Test standard: EN 12664:2001

Thermal Resistance

Indicates material's ability to resist heat flow



	Flexible roof coating reference, no functional fillers	10 wt % PM 20 µm + 3 wt % Fumed Silica	8 wt % PM 20 µm + 2,5 wt % Fumed Silica	5 wt % PM 20 µm + 5 wt % Aerogel	8 wt % PM 20 µm + 2 wt% Aerogel + 1 wt % Fumed Silica	5 wt % PM 100 µm + 2,5 wt % Fumed Silica	5,7 wt % PM 20 µm + 1,4 wt % PM 100 µm + 2,5 wt % Fumed Silica
Density (kg/m³)	1518	636	721	526	584	642	667

Test method: Guarded hot plate, ISO 8302:1991
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In-house methods for evaluating insulation potential

500 µm wet film applied, drying over night. MFFT device heated to 70 ˚C and then heat kept at 70 ˚C for 2 hours before measurement

	Surface temperature after 2 hours ˚C
3 wt % Fumed Silica + 10 wt % Polymeric microspheres 20 µm	**50**
4 wt % Aerogel + 6 wt % Polymeric microspheres 20 µm	**50**
Flexible roof coating without insulating or reflecting functionality	**57**

As expected, measuring dry density of the coating gives very good indication of the insulation potential

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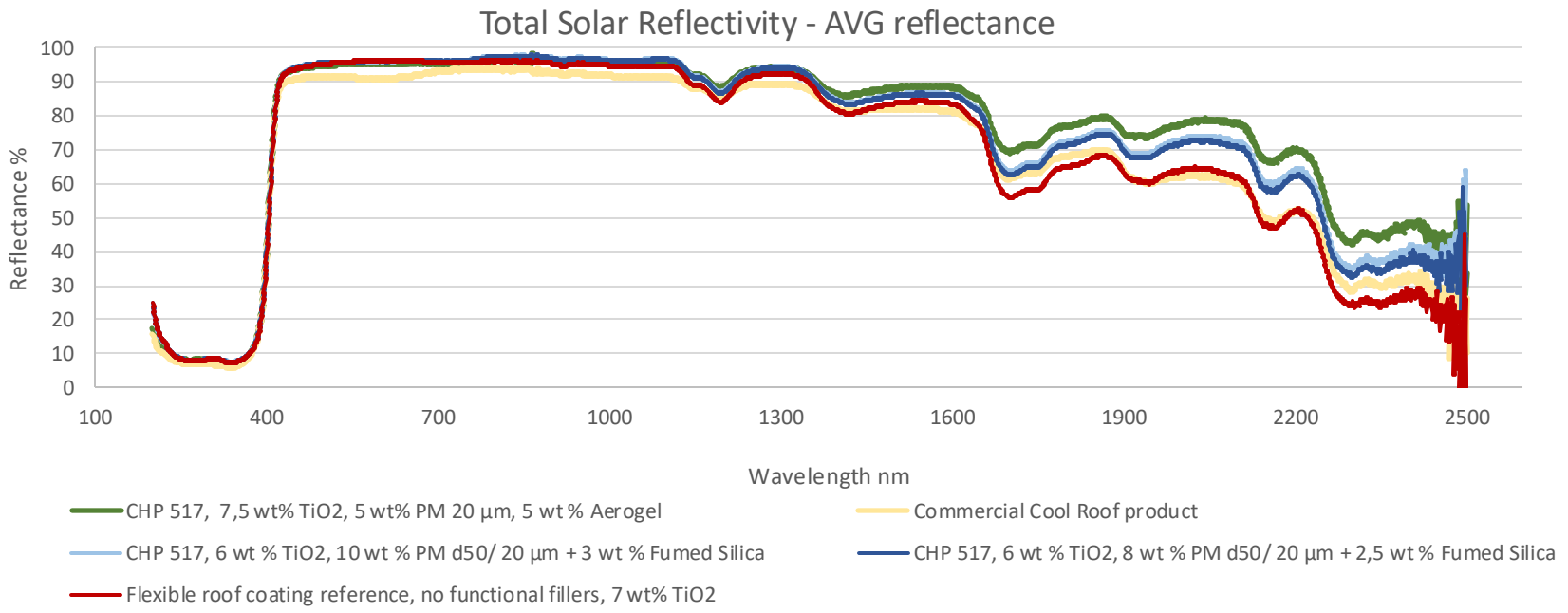
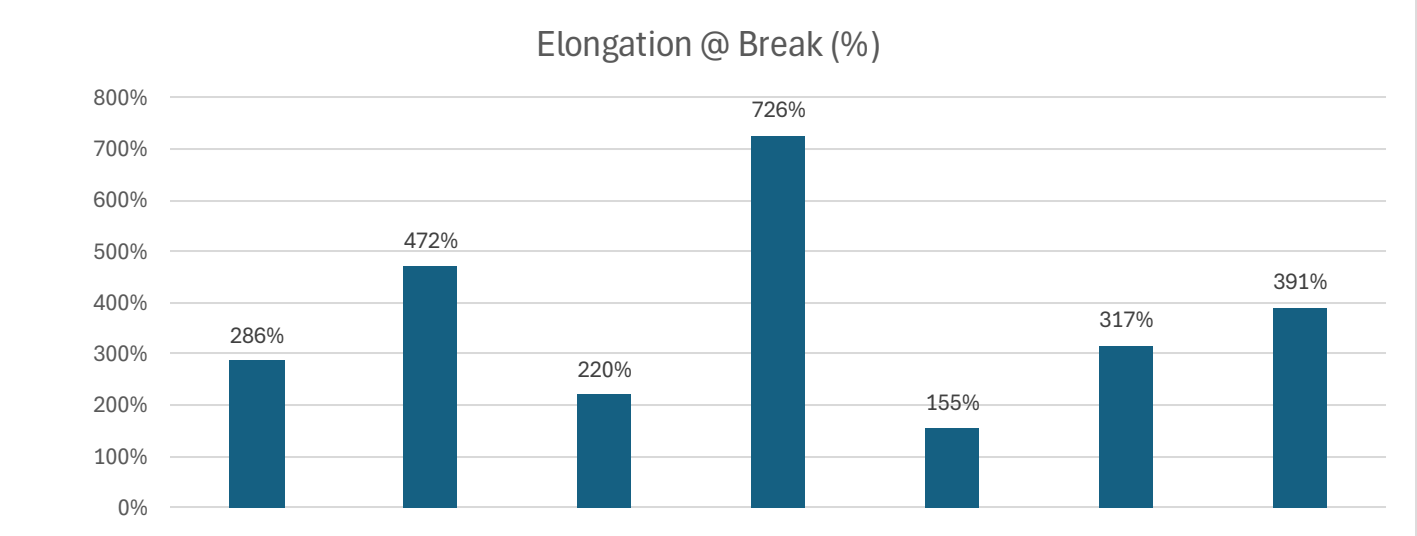
Total Solar Reflectivity



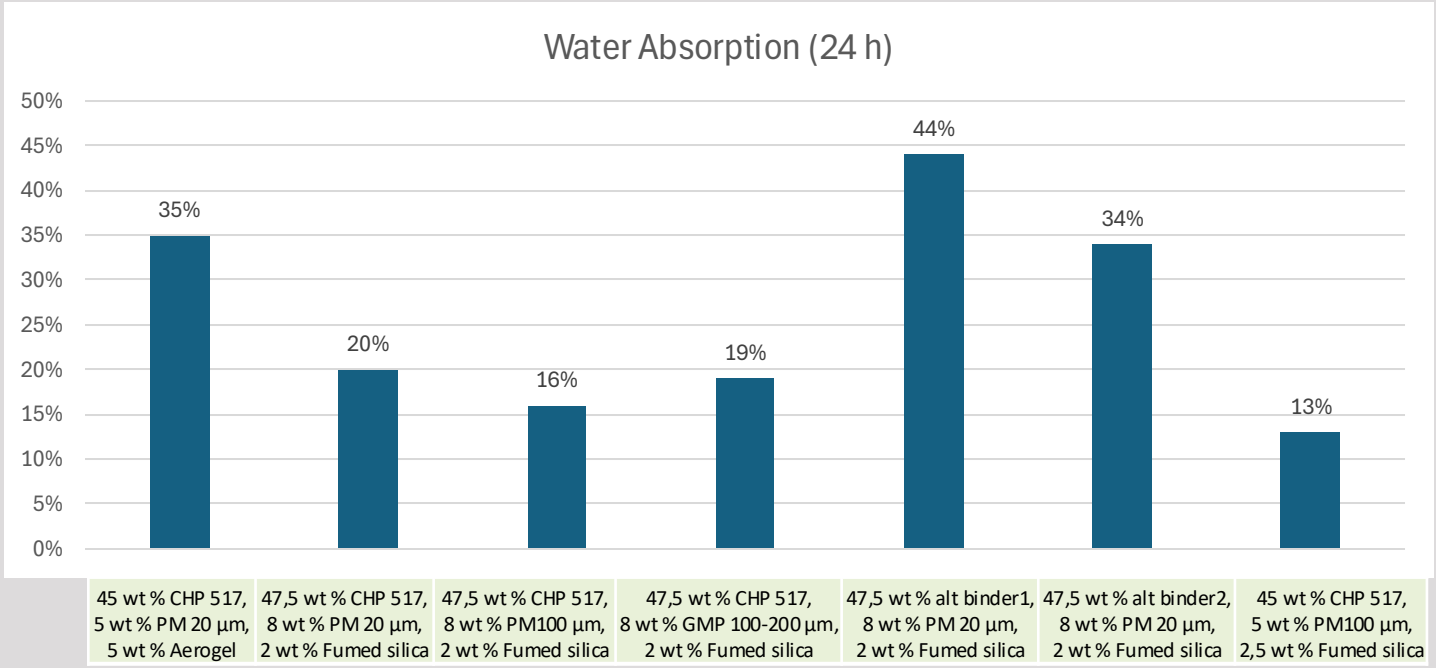
NIR range at 700-2500 nm is affecting most to the heating of buildings

Elongation & Tensile Strength



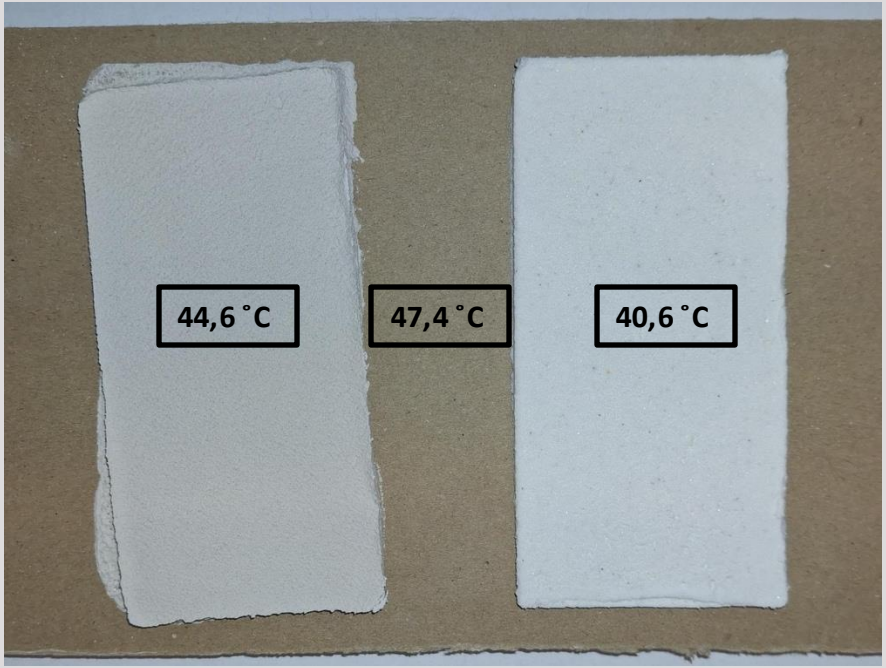
	45 wt % CHP 517, 6 wt % PM 20 µm, 4 wt % Aerogel	47,5 wt % CHP 517, 8 wt % PM 20 µm, 2 wt % Fumed silica	47,5 wt % CHP 517, 8 wt % PM 100 µm, 2 wt % Fumed silica	47,5 wt % CHP 517, 8 wt % GMP 100-200 µm, 2 wt % Fumed silica	47,5 wt % alt binder 1, 8 wt % PM 20 µm, 2 wt % Fumed silica	47,5 wt % alt binder 2, 8 wt % PM 20 µm, 2 wt % Fumed silica	45 wt % CHP 517, 5 wt % PM 100 µm, 2,5 wt % Fumed silica
Tensile Strength (N/mm)	1,2	2,1	1,5	2,2	1,5	1,3	1,3
Elong. @ Break (%)	286 %	472 %	220 %	726 %	155 %	317 %	391 %
Stress @ Break (N/mm²)	0,5	1,1	0,6	1,4	0,4	0,9	0,8

Water absorption



Thermal Plasters

	STANDARD PLASTER	CHP 517 – THERMAL PLASTER
Application thickness	5,0 mm	4,7 mm



Insulation test

1. Plasters applied on plasterboard with mold
2. Heat source below heated to 65 ˚C and kept there for one hour
3. Measurements with IR thermometer

Cooling pavement / Functional Road Marking

Target: Develop reflecting and thermal resisting coatings that can stand traffic and heavy wear

Water	23,05
HEUR thickener	0,50
Ammonia 25 %	0,10
Dispersant	0,40
Defoamer	0,10
Biocide	0,15
Opacity Pigment	2,00
Titanium Dioxide	7,00
Feldspar	10,00
Polymeric microspheres 20 µm	8,00
CHP 556	45,00
Fumed Silica	3,00
Propylene glycol	0,50
HEUR thickener	0,20
	100,00

SFS-EN ISO 7784-2 Taber Abrasion → 51 mg lost

Dry density → 930 kg/m^3

Specialty primer

CHP 589

- Developed as a bitumen primer
- Outstanding sealing properties
- Solids 55%
- Tg 13 °C

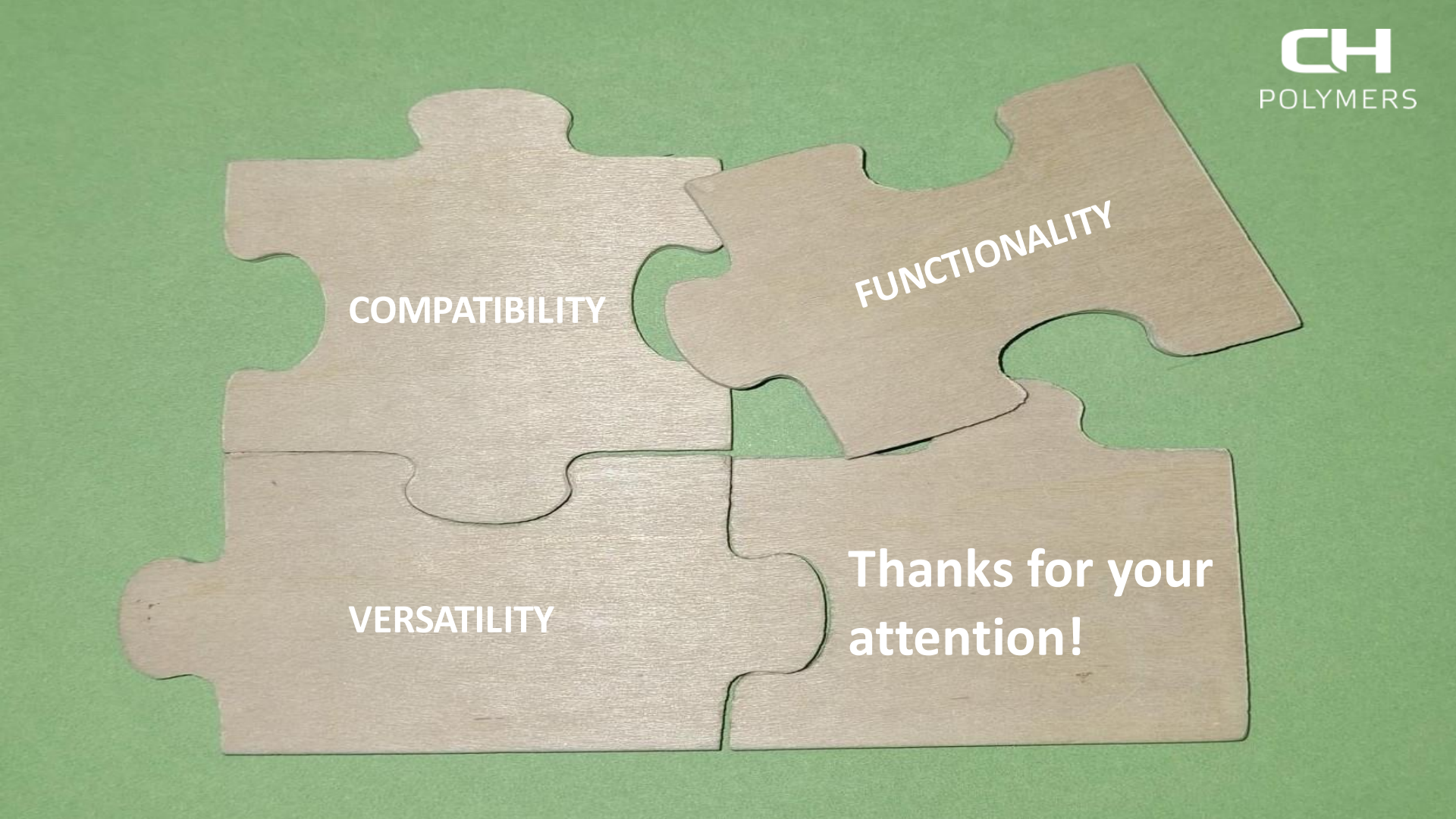
Real life examples

CHP 517

- Insulating coatings for construction elements eg pipes, boards
  - Equivalent λ value to Rockwool at same thickness
- Insulation coatings for roofing
  - Reduced surface temperature: customer tests max -36°C
  - Reduced heat transmission: interior temperature decreased by 5 -7 °C (customer data)
  - Reduced cooling energy: 20% cost saving in summer months (customer data)
- Other: cork stucco, warm walls, rail, solar farms

CHP 556

- Horizontal surfaces
  - Road marking (functional)
  - Cool pavements
  - Balconies, playgrounds, recreational areas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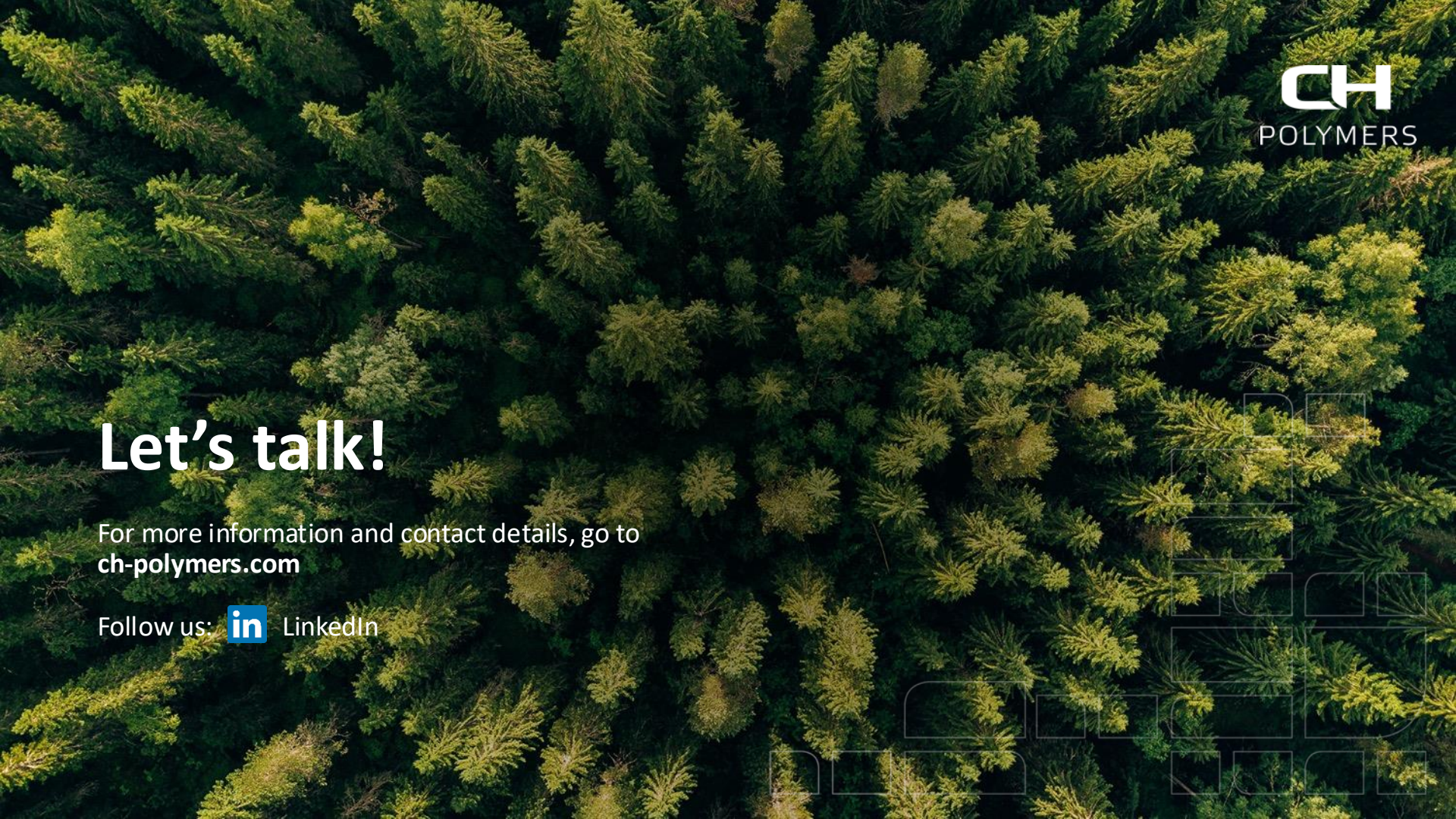
COMPATIBILITY
FUNCTIONALITY
VERSATILITY
Thanks for your attention!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