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Contextualisation

Project: R2U Technologies | modular systems

Project goal: Develop elegant, flexible, and sustainable construction solutions

Research focus: Use of natural materials, such as wood, as a structural element in modular facades

Challenge: Wood's susceptibility to environmental degradation for long-term durability and performance

Research motivation: Investigate protective treatments and surface coatings aimed at increasing resistance to weathering factors to enhance wood's resilience in building applications by artificial ageing

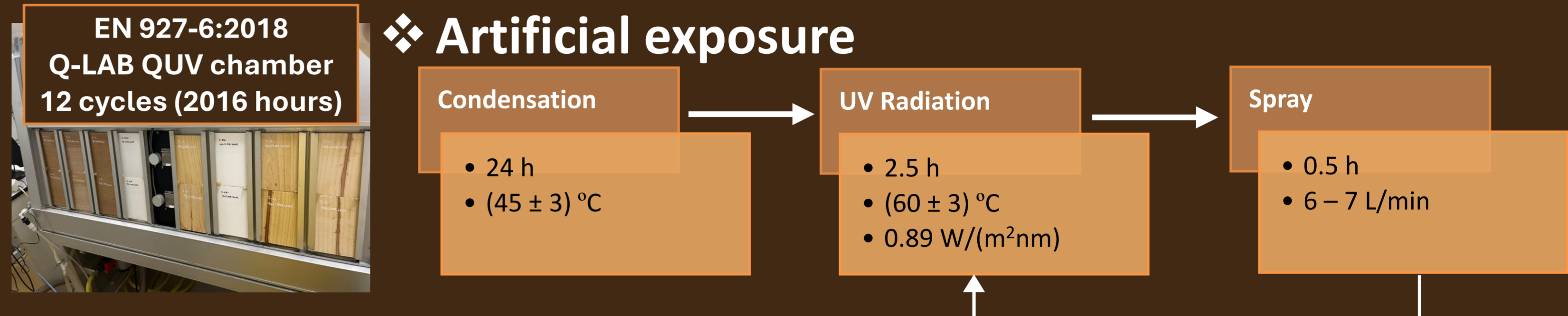
Evaluation criteria: Visual changes, colour change, gloss retention, chalking, adhesion, and wettability

Experimental

Wood type & Coatings

	V		EB		DLB		SL	
	Acrylic resin	Water-based polyurethane coating	Acrylic-emulsion resin (2 coats)	Acrylic-polyurethane resin (2 coats)	Acrylic resin	Acrylic resin (2 coats)	Acrylic resin	Water-based polyurethane coating
<i>Pinus sylvestris</i>	×	×	×	×				×
<i>Eucalipto globulus</i>	×	×			×	×	×	×
<i>Quercus robur</i>	×	×			×	×	×	×
<i>Pinus radiata</i>	×	×	×	×				×

Artificial exposure



Characterisation

Wettability to water

(before exposure)

Near-hydrophobic behaviour (80° – 90°)

	<i>Pinus sylvestris</i>			<i>Eucalipto globulus</i>			<i>Quercus robur</i>			<i>Pinus radiata</i>		
	V	EB	SL	V	DLB	SL	V	DLB	SL	V	EB	SL
Contact angle (°)	82.07	87.08	89.05	82.28	82.61	89.47	83.54	84.37	88.07	84.05	93.56	87.97
SD (°)	1.42	2.98	0.91	1.34	1.74	5.08	5.85	2.15	1.24	1.06	0.95	1.20

Adhesion – Cross-cut test

(before exposure)

Degree 0 – 2 (affected area ≤ 15%)

Degree 0 – 1, for all species vs. coatings
None of the squares of the lattice is detached - Detachment (< 5%) of small flakes of the coating at the intersections of the cuts

Except Degree 2, for *Pinus sylvestris* with SL coating and *Pinus radiata* with V coating
The coating has flaked along the edges and/or at the intersections of the cuts (5% < detachment ≤ 15%)

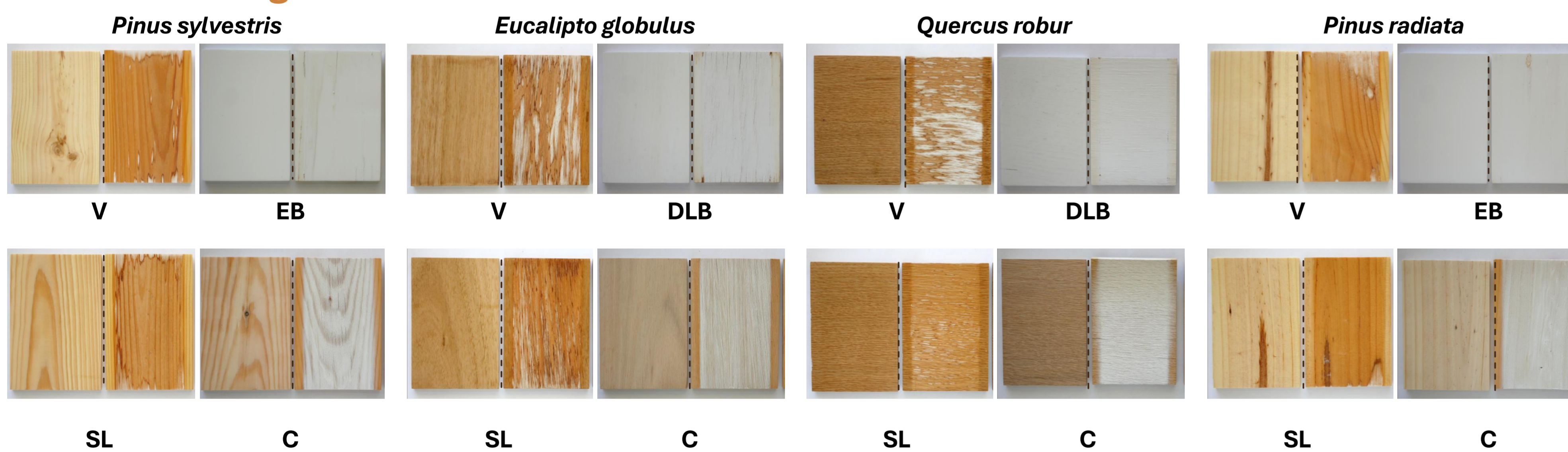
Chalking

(before and after exposure)

No chalking (< 10%)

No perceptible alterations for all species vs. coatings

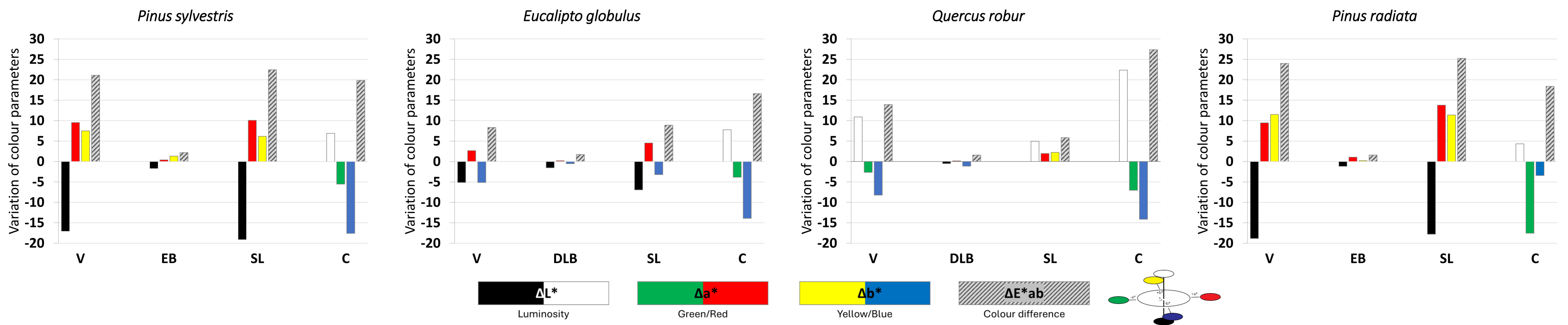
Visual changes



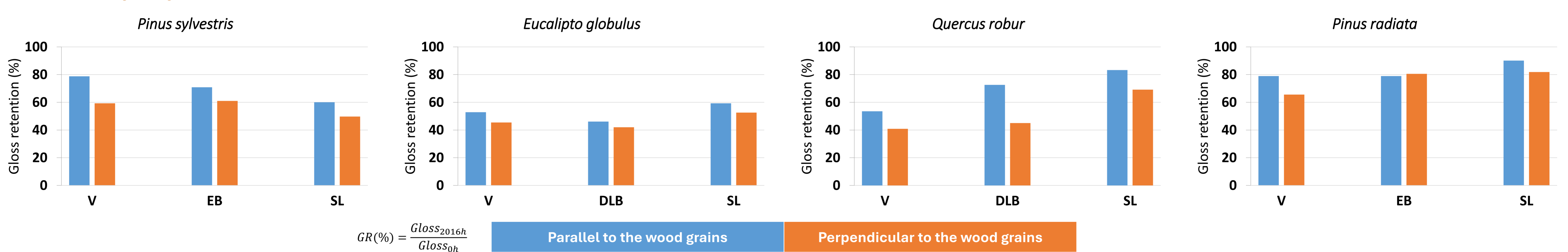
Left panel: before exposure | Right panel: after 2016 h of exposure
C stands for no coating

Substrate/Coating	Cracking	Flaking	Staining	Blistering
<i>Pinus sylvestris</i> V	✓	✓	✓	
<i>Pinus sylvestris</i> EB	✓	✓	✓	✓
<i>Pinus sylvestris</i> SL	✓	✓	✓	
<i>Pinus sylvestris</i> C	✓			
<i>Eucalipto globulus</i> V	✓	✓	✓	✓
<i>Eucalipto globulus</i> DLB	✓	✓		
<i>Eucalipto globulus</i> SL	✓		✓	✓
<i>Eucalipto globulus</i> C	✓			
<i>Quercus robur</i> V	✓	✓	✓	
<i>Quercus robur</i> DLB	✓	✓	✓	
<i>Quercus robur</i> SL	✓	✓	✓	
<i>Quercus robur</i> C	✓			
<i>Pinus radiata</i> V	✓	✓	✓	✓
<i>Pinus radiata</i> EB	✓	✓	✓	✓
<i>Pinus radiata</i> SL	✓	✓	✓	✓
<i>Pinus radiata</i> C	✓			

Colour change



Gloss (60°) retention



Final remarks

- Initial wettability results indicate partial wettability of the surface with a tendency toward hydrophobic behaviour ($\theta \geq 90^\circ$)
- All species vs. coatings underwent visual changes associated to the degradation of the coating and/or substrate, with *Pinus sylvestris* and *Pinus radiata* showing more extensive alterations overall
- Eucalipto globulus* and *Quercus robur* show greater colour stability compared to *Pinus sylvestris* & *Pinus radiata*, particularly with the DLB and SL coatings
- EB or DLB coatings show lower colour variation than V and SL coatings after exposure
- All *Pinus radiata* coatings show the highest gloss retention
- Wettability and adhesion tests after exposure are being carried out
- The results contribute to the development of optimised modular facade systems, supporting the broader integration of natural materials in modern construction

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