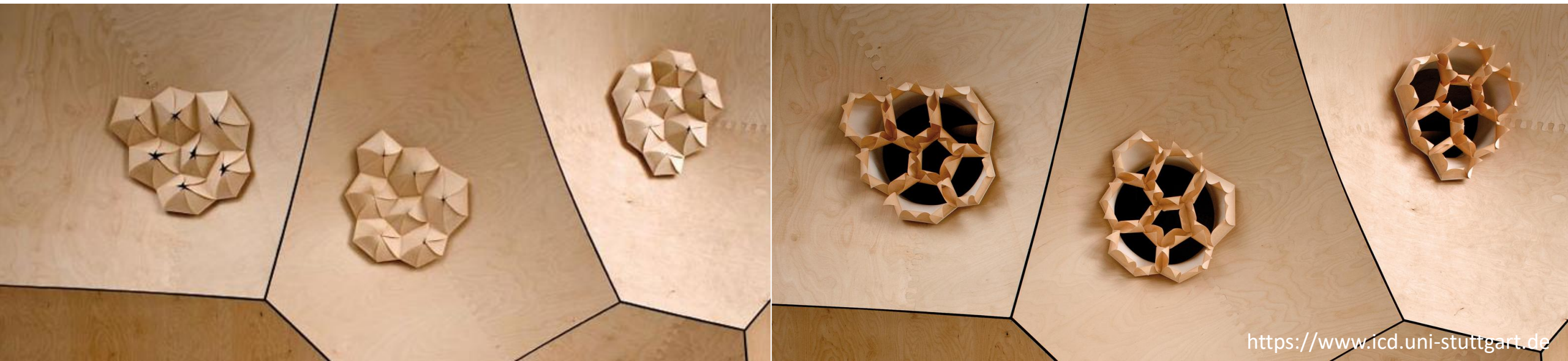


IL DECOMPENSATO: innovazione e comportamento attivo

Silvana Calvano
(silvana.calvano@unito.it)



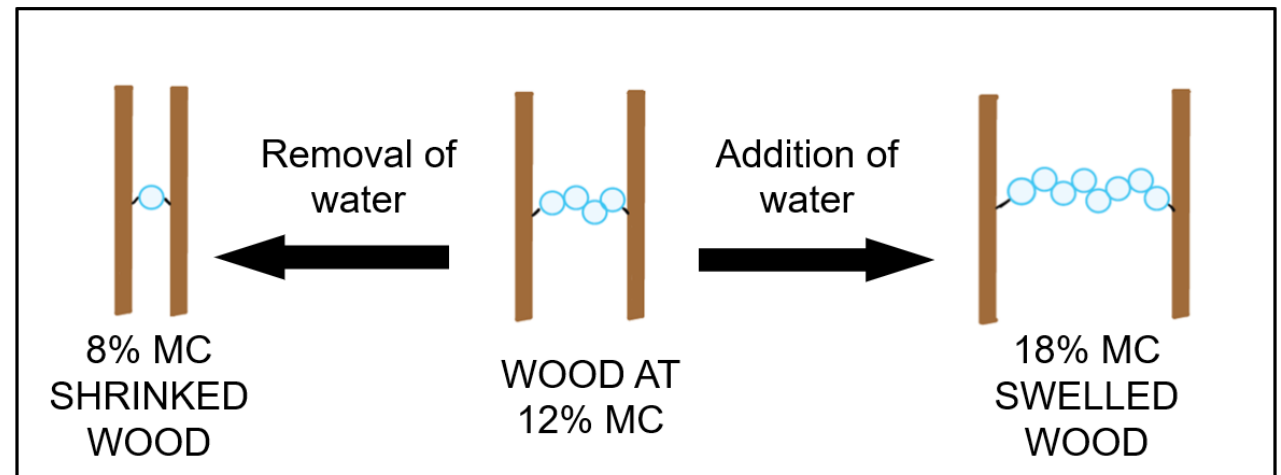
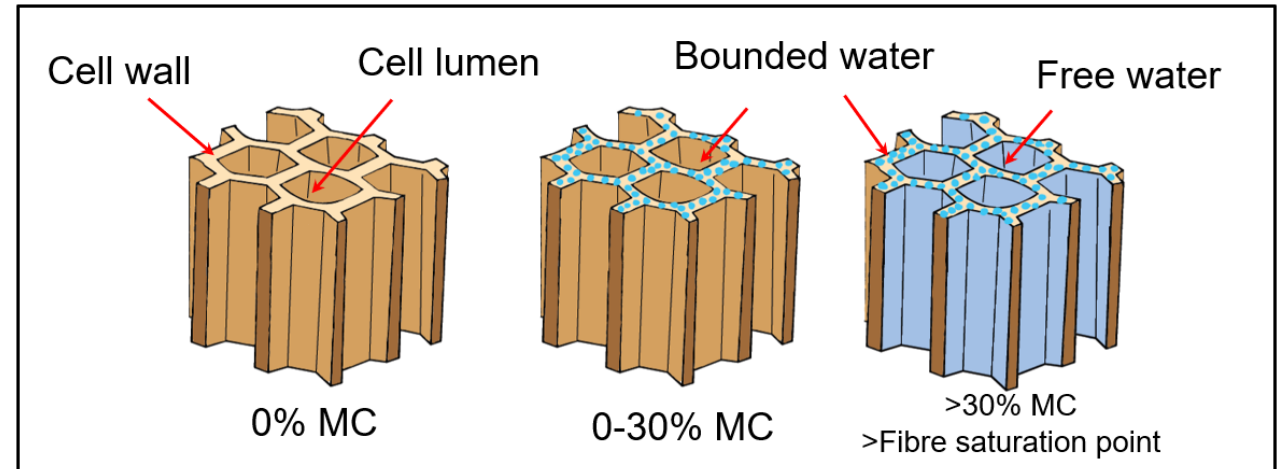
1 IL COMPORTAMENTO ATTIVO DEL LEGNO

Igroscopicità

Il legno regola il proprio contenuto di umidità per adattarsi alle condizioni ambientali circostanti, con conseguenti variazioni dimensionali

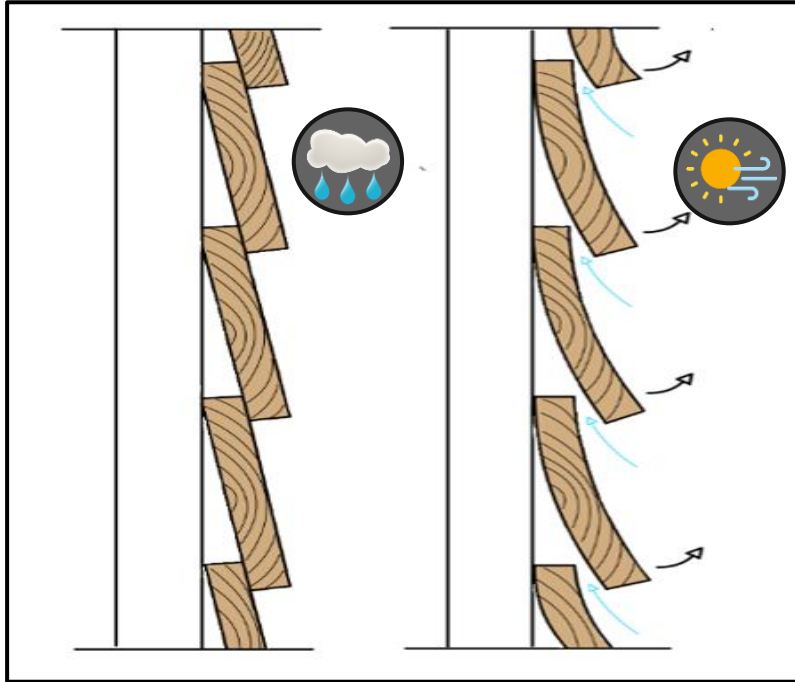
Anisotropia

Le variazioni minime in direzione assiale, più marcate in direzione radiale e massime in direzione tangenziale



1 IL COMPORTAMENTO ATTIVO DEL LEGNO

Applicazioni storiche



www.storfjordnytt.no

1 IL COMPORTAMENTO ATTIVO DEL LEGNO



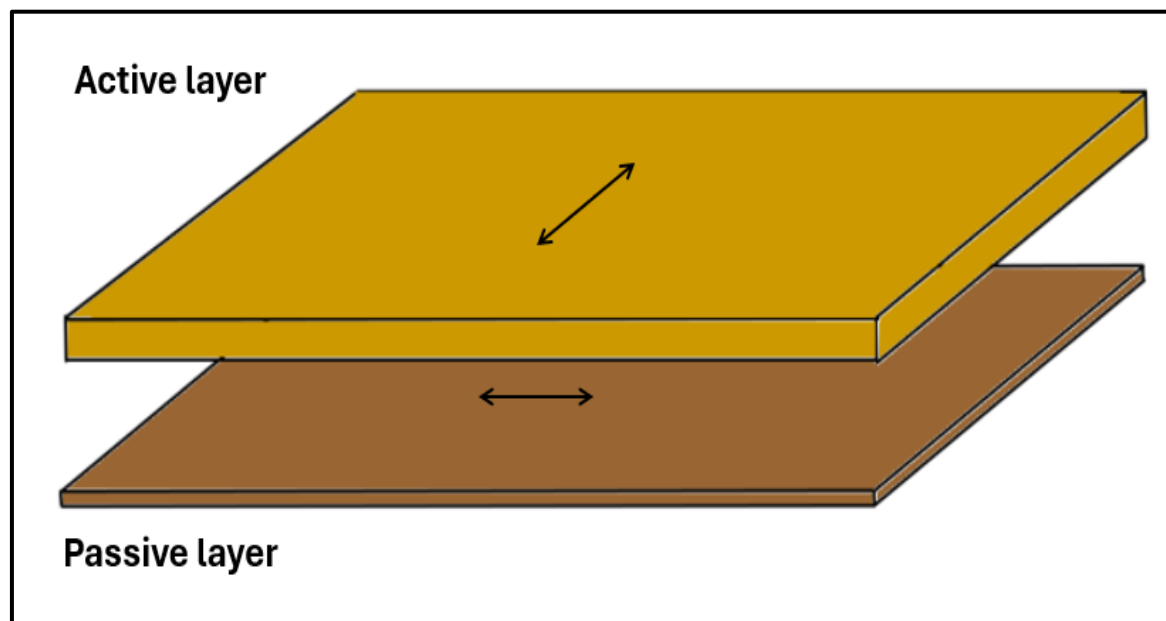
www.smithfieldtimber.co.uk





CAMBIO DI PROSPETTIVA: da limite a nuova opportunità

2 IL DECOMPENSATO

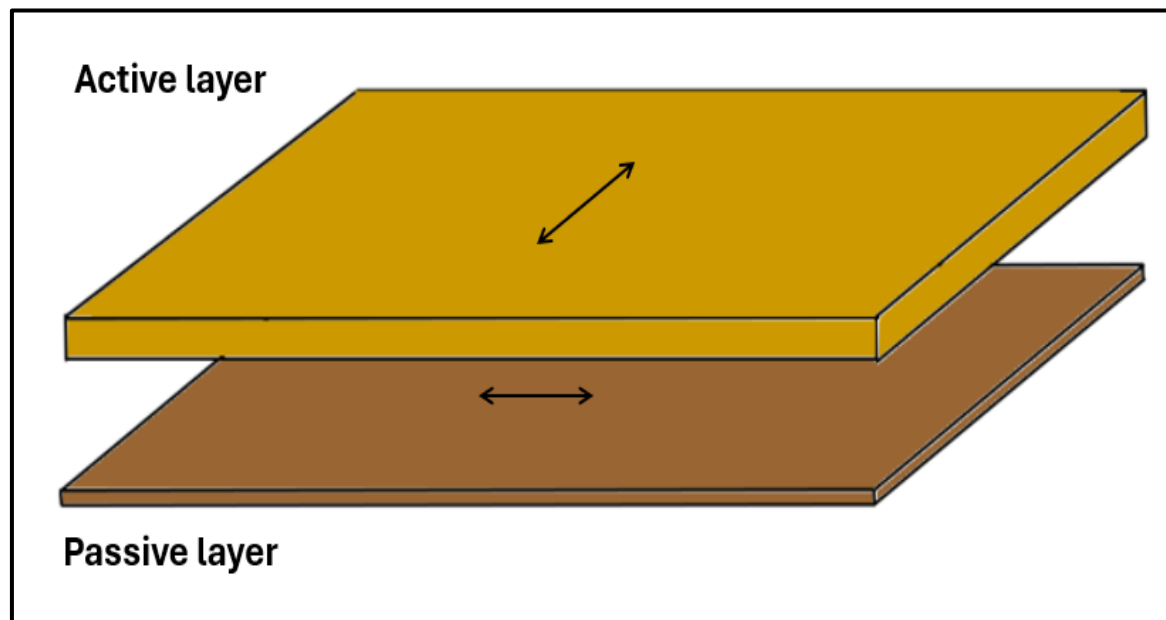


SECCO



UMIDO

2 IL DECOMPENSATO



Materiale

Differisce in base al ruolo funzionale dello strato

Orientamento strati

Cross-grain orientation

Spessore strati

Relazione inversa tra spessore e reattività

Incollaggio

Resistente e flessibile

3 RICERCA SPERIMENTALE

Obiettivi dello studio

Valutare l'idoneità del legno di pioppo (clone 'I-214') come strato attivo del decompensato



Strategia innovativa e alternativa per la valorizzazione del legno di pioppo


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ELSEVIER



Active behavior of poplar wood bilayers in response to changes in relative humidity

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ABSTRACT

Hygromorphic wood bilayers are innovative active systems consisting of two thin wood layers bonded together with grain perpendicular to each other. The active layer, highly responsive to changes in relative humidity, induces curvature; the passive layer, less responsive, regulates the deformation. Until now, research has focused on active layers made of mid-high density woods in search of high responsiveness. However, low-density woods can be suitable for applications that require limited curvature, or for varying the composition of bilayer panelling. In this study, rotary cut veneers of poplar (*Populus x canadensis* clone 'I-214') wood, an important low-density wood for the plywood industry, were used for the active layers. Beech (*Fagus sylvatica* L.) veneers were also tested for comparison. Cherry (*Prunus avium* L.) quarter cut sliced veneers were always used for the passive layers. Bonding was realized by one-component polyurethane (PUR) or two-component polyvinyl acetate (PVA) adhesive. The specimens were subjected to 24 h adsorption and desorption, and to 144 h cyclic testing, monitoring moisture content and curvature. Two-way ANOVA showed that curvature change of beech bilayers was significantly higher; nonetheless, the degree of curvature of poplar ones can be considered suitable for various applications. Cherry veneers proved suitable for passive layers. The PUR adhesive enabled greater curvature than the PVA one, which can be attributed to the stiffer bonding formed. Overall, this study offers new knowledge on the behaviour of active layers made with low-density woods, which can support future modelling and development of active products.

3 RICERCA SPERIMENTALE

Perché il legno di pioppo?

- **Bassa densità** ($342 \pm 10 \text{ kg/m}^3$)
- Importante legno per la **produzione di compensato**
- **Eccellenza nazionale**, con forte riconoscimento internazionale
- Ruolo strategico nel **settore legno-arredo**
- **46,000+ ha**, pari al 47.7% della superficie forestale italiana

(Cesaro et al. 2019)

Legno di Pioppo

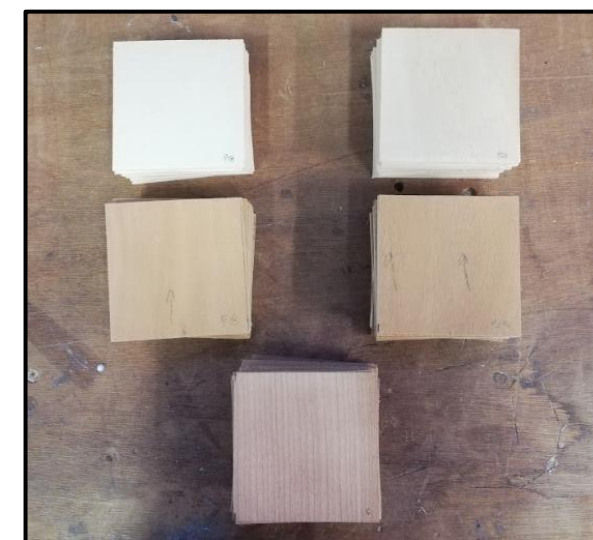
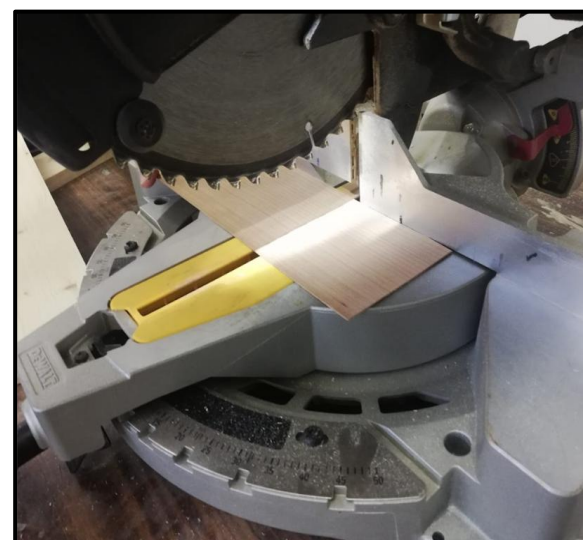
(*Populus x canadensis* clone 'I-214')



3 RICERCA SPERIMENTALE

Materiali e metodo

- **Active layers:** sfogliati di **pioppo** e **faggio** (1.8 mm)
- **Passive layers:** tranciati di **ciliegio** (0.5 mm)
- **Adesivo:** PUR o PVA
- **10 x 10 cm** layers
- **No difetti**
- **Direzione ortogonale** della fibratura

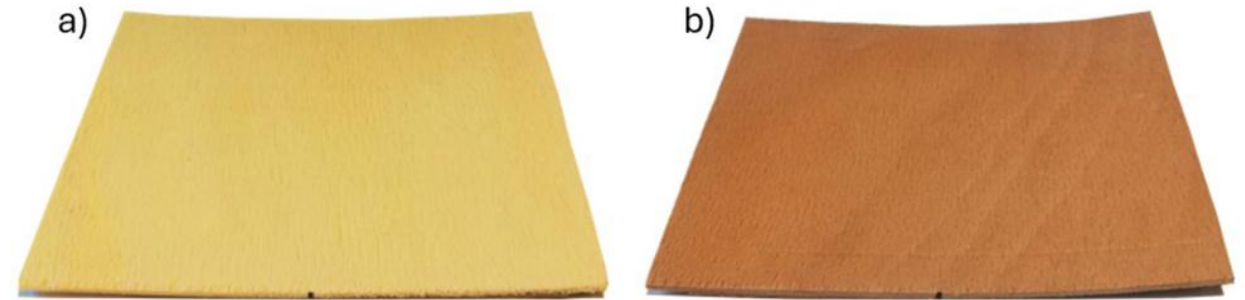


3 RICERCA SPERIMENTALE

Materiali e metodo

- **Active layers:** sfogliati di **pioppo** e **faggio** (1.8 mm)
- **Passive layers:** tranciati di **ciliegio** (0.5 mm)
- **Adesivo:** PUR o PVA
- **10 x 10 cm** layers
- **No difetti**
- **Direzione ortogonale** della fibratura

ACTIVE LAYERS



PASSIVE LAYER



3 RICERCA SPERIMENTALE

Materiali e metodo

Ciclo di adsorbimento

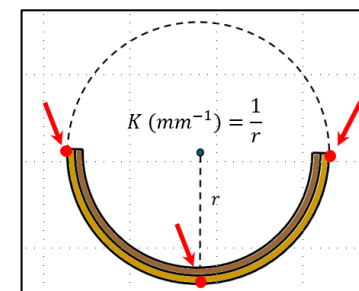
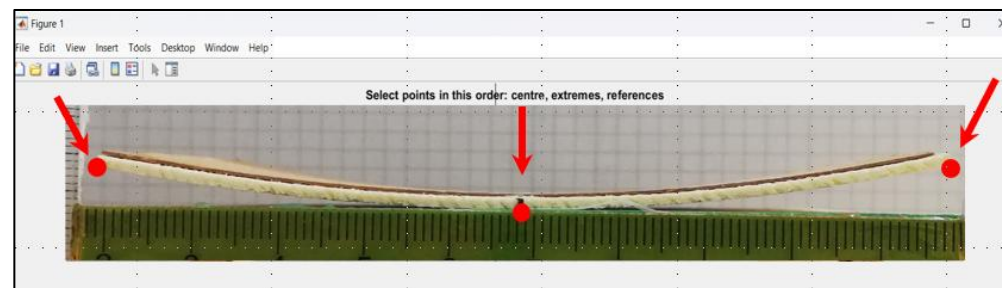
($T = 20^{\circ}\text{C}$ e $\text{RH}: 30 \rightarrow 80 \%$)

Ciclo di desorbimento

($T = 20^{\circ}\text{C}$ e $\text{RH}: 80 \rightarrow 30 \%$)

Prove cicliche ($T = 20^{\circ}\text{C}$ e $\text{RH}: 40 \leftrightarrow 60 \%$)

Peso e curvatura (K) monitorati ogni 0, 1, 2, 3, 4, 6, 8 e 24 h dal cambiamento di RH.



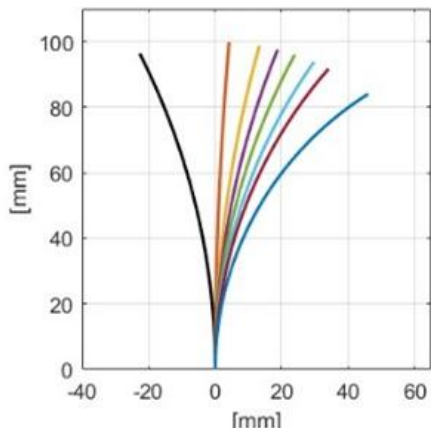
Ciclo Adsorbimento

RH: 30 → 80 % and T = 20°C

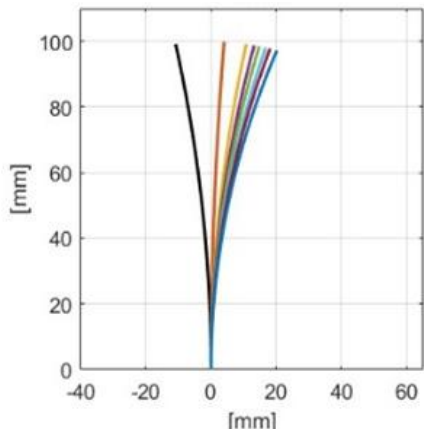
Ciclo Desorbimento

RH: 80 → 30 % and T = 20°C

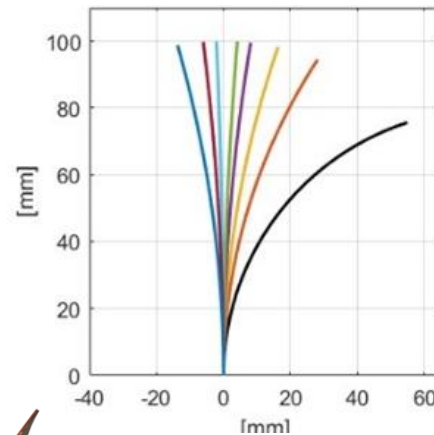
Faggio - Vinilica



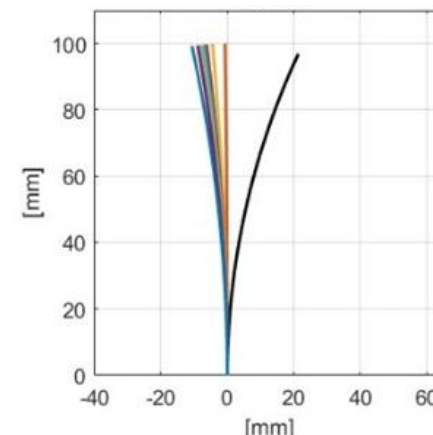
Pioppo - Vinilica



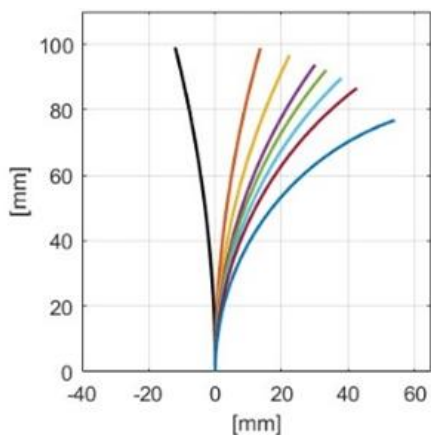
Faggio - Vinilica



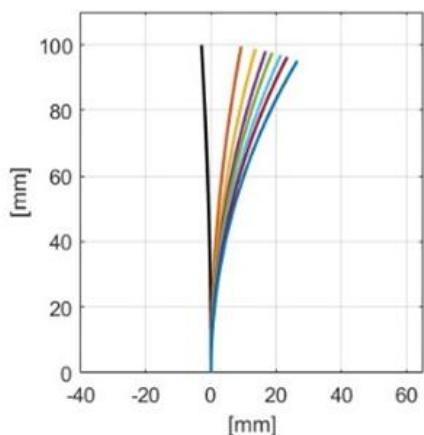
Pioppo - Vinilica



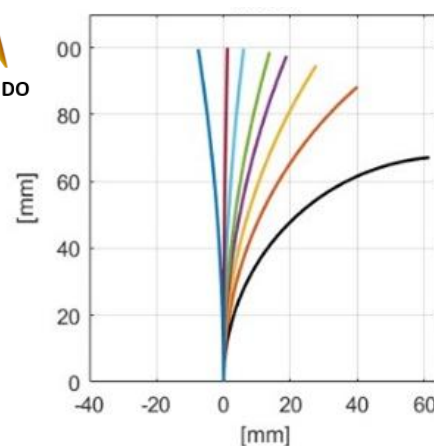
Faggio - PUR



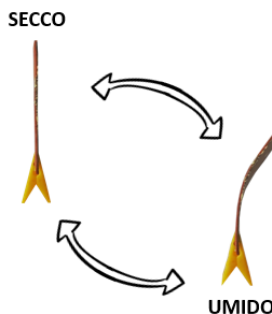
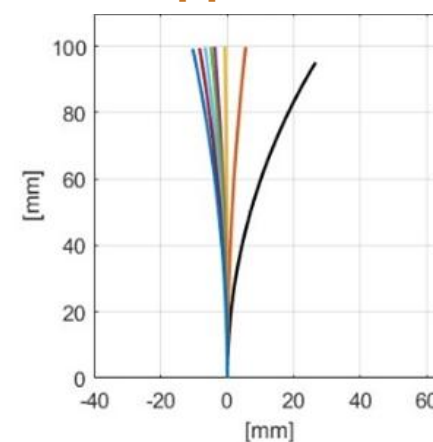
Pioppo - PUR



Faggio - PUR



Pioppo - PUR

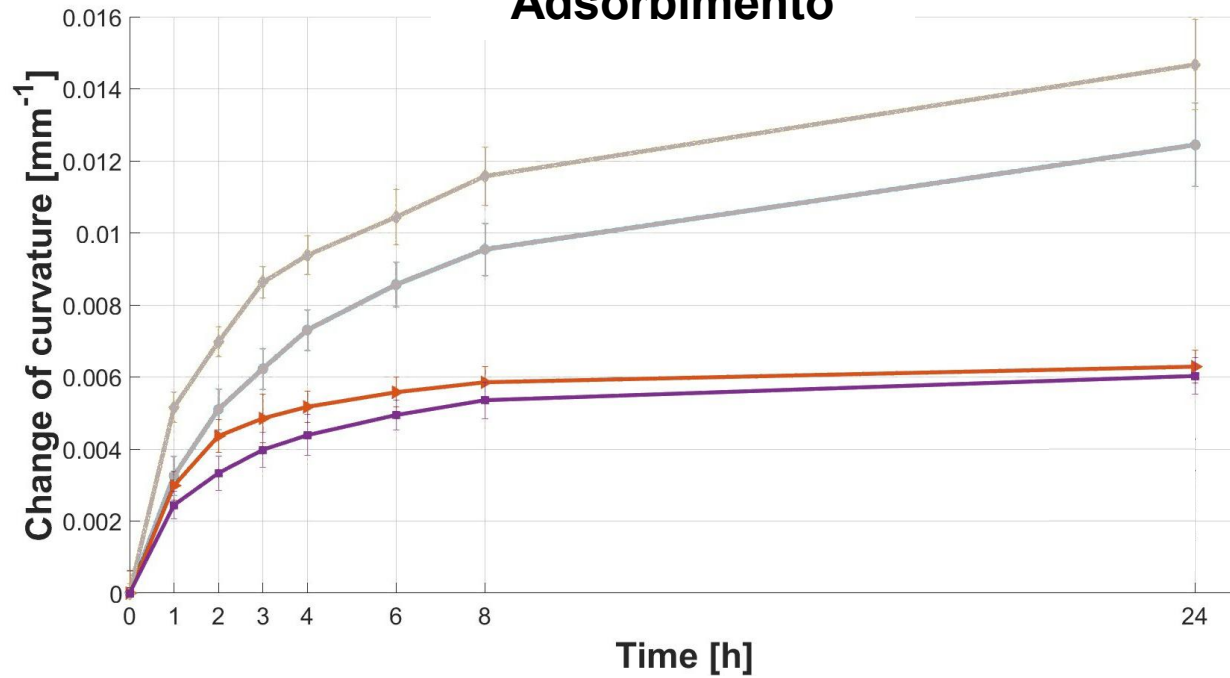


3 RICERCA SPERIMENTALE

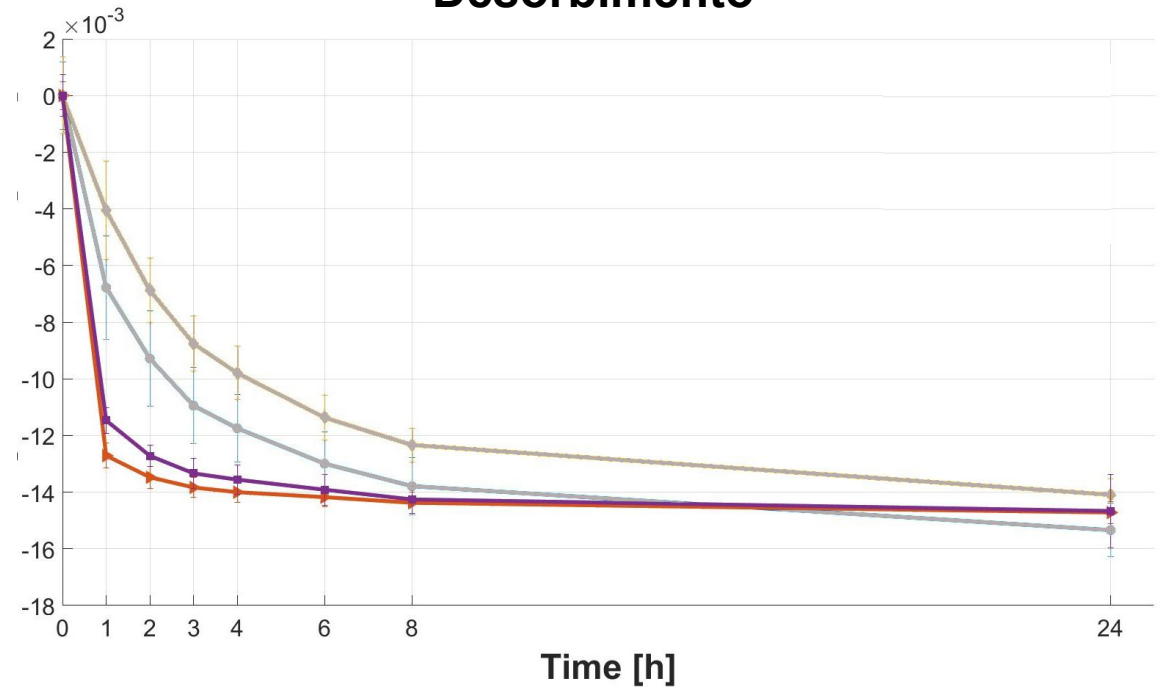
Risultati

- Faggio - Vinilica
- ▶ Pioppo - Vinilica
- ◆ Faggio - PUR
- Pioppo - PUR

Adsorbimento



Desorbimento

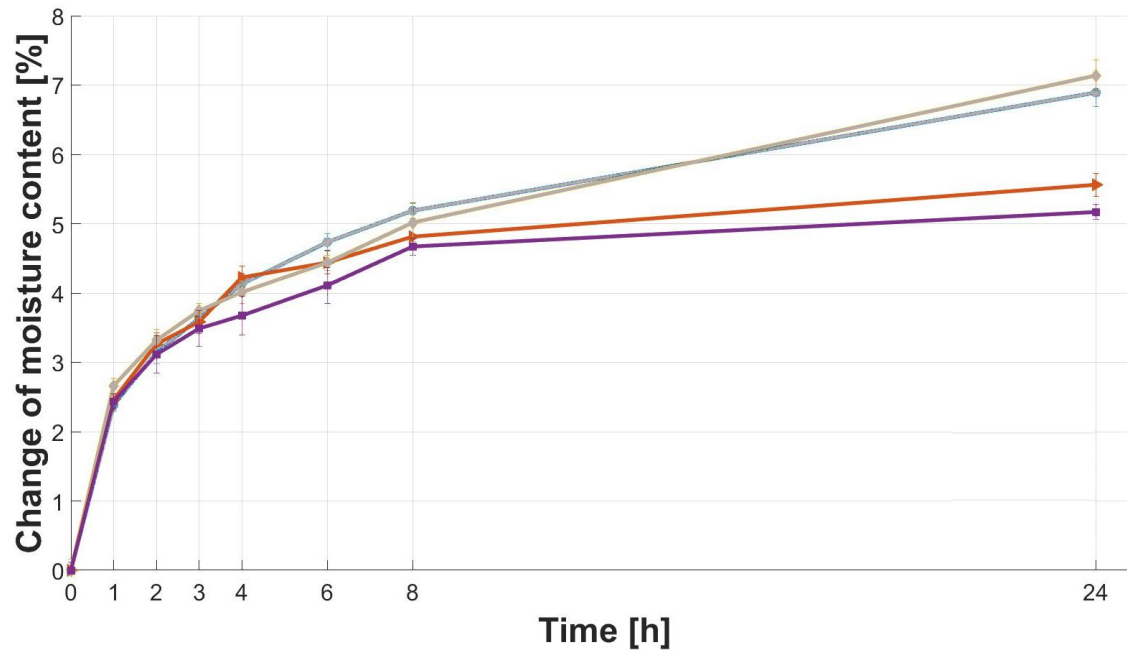


3 RICERCA SPERIMENTALE

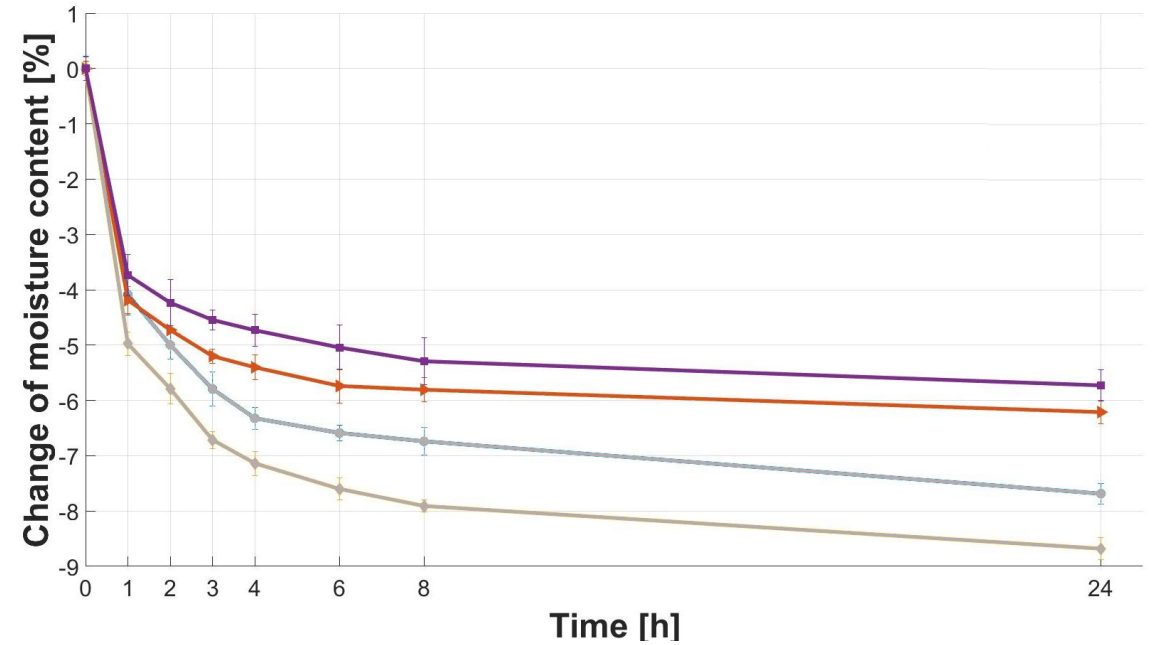
Risultati

- Faggio - Vinilica
- ▶ Pioppo - Vinilica
- ◆ Faggio - PUR
- Pioppo - PUR

Adsorbimento



Desorbimento

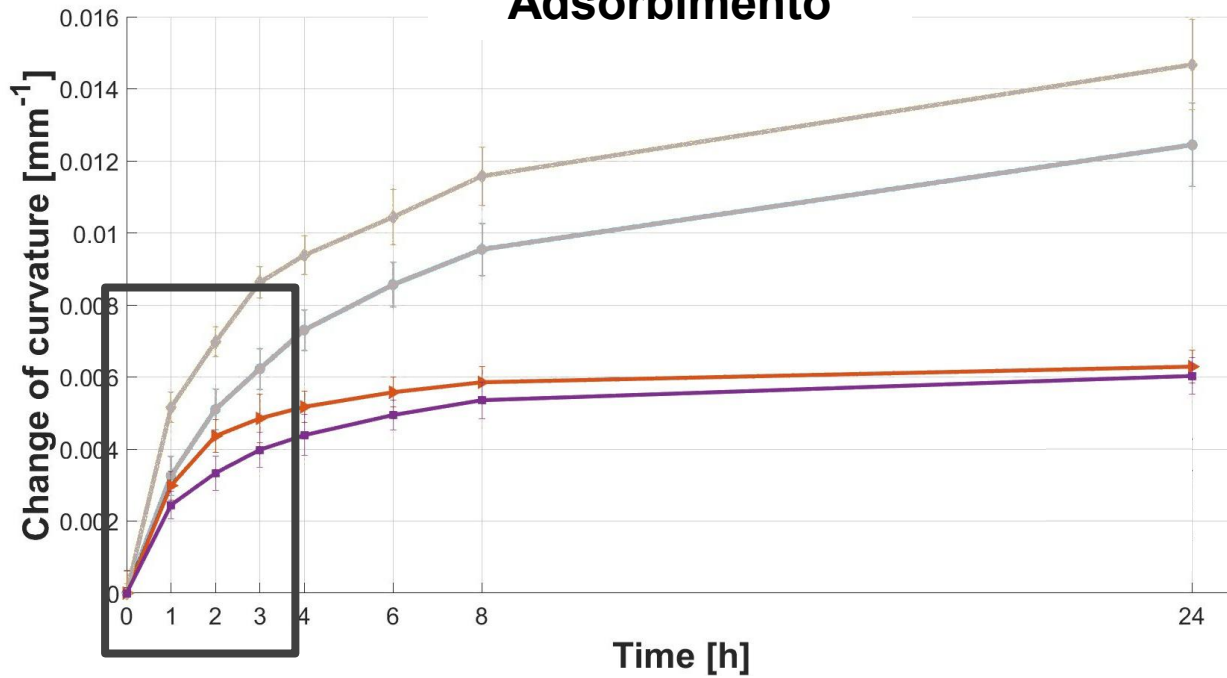


3 RICERCA SPERIMENTALE

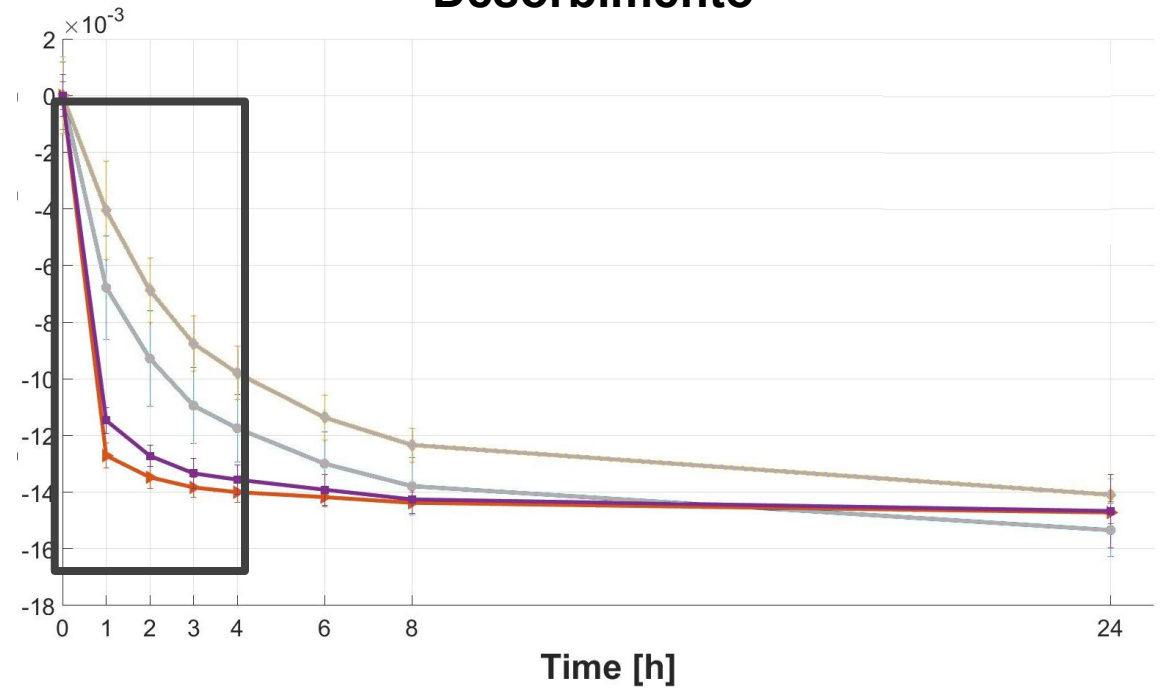
Risultati

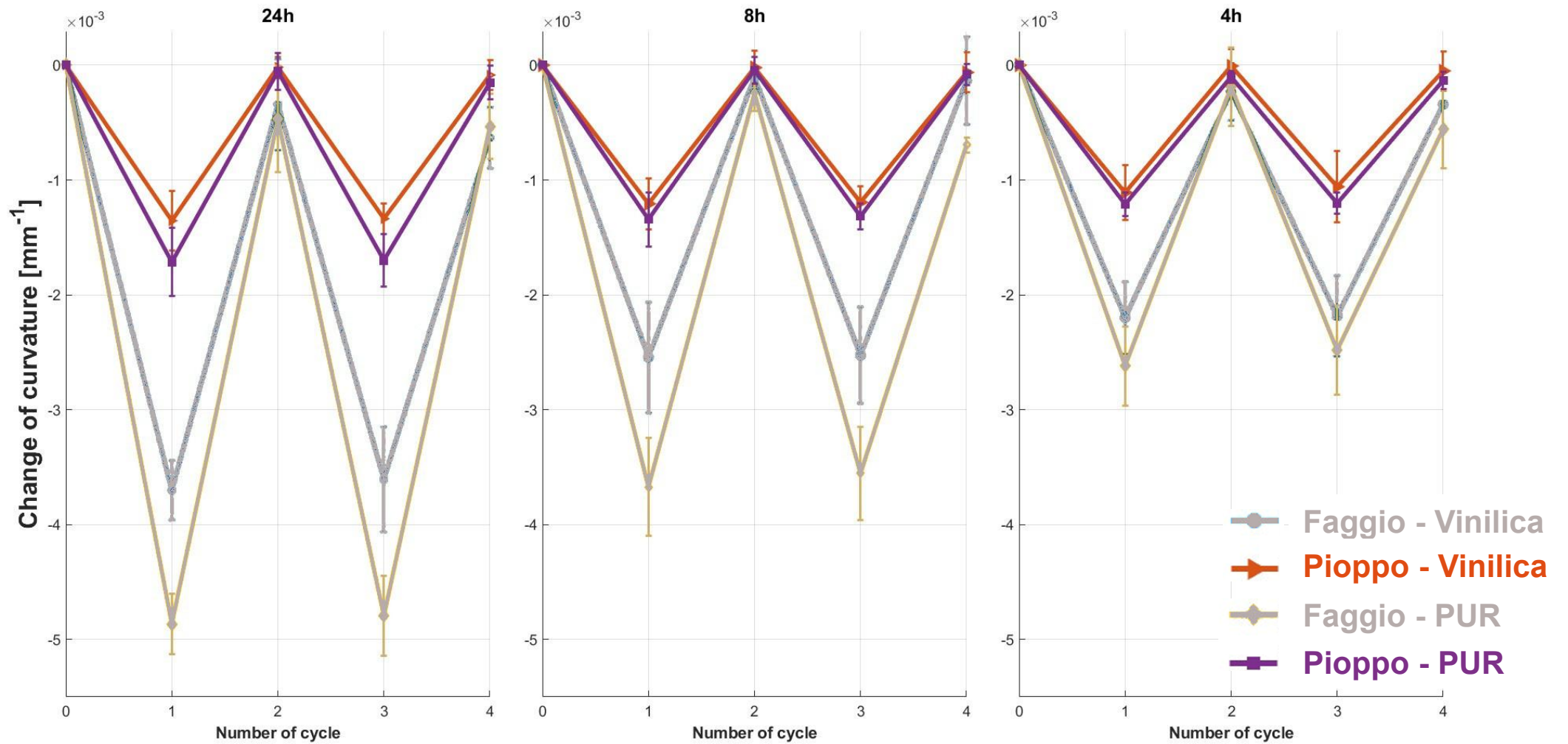
- Faggio - Vinilica
- ▶ Pioppo - Vinilica
- ◆ Faggio - PUR
- Pioppo - PUR

Adsorbimento



Desorbimento





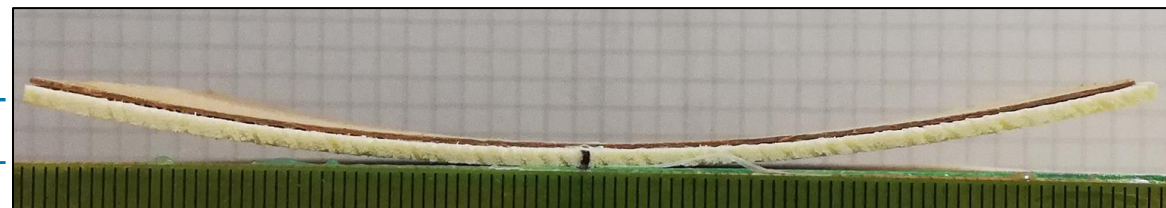
CICLO DI ADSORBIMENTO

t= 24 h



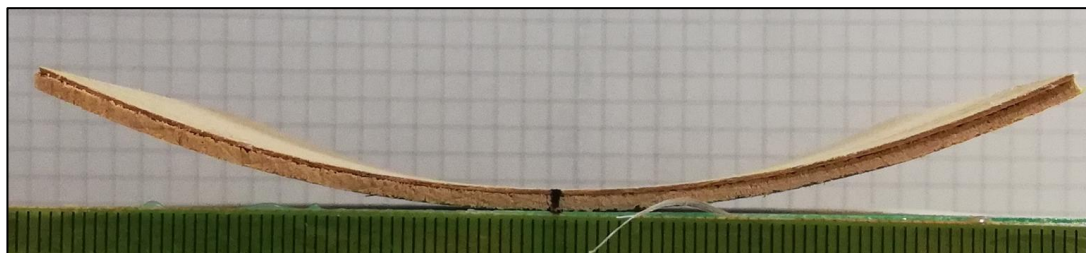
Faggio - PUR

12.7 mm



4.9 mm

Pioppo - PUR



Faggio - Vinilica

10.1 mm



4.6 mm

Pioppo - Vinilica

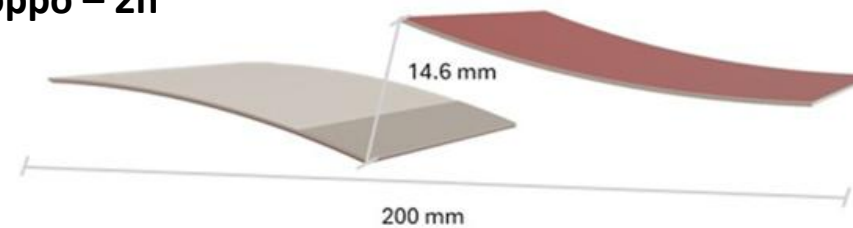
4 POSSIBILI APPLICAZIONI



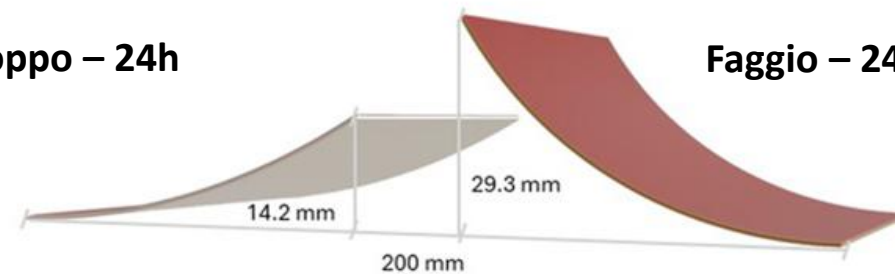
Fig. 6: The “unplywood” panels fixed to the false ceiling.

Bianconi et al. 2022 -DOI:[10.37947/ipbe.2022.vol2.1](https://doi.org/10.37947/ipbe.2022.vol2.1)

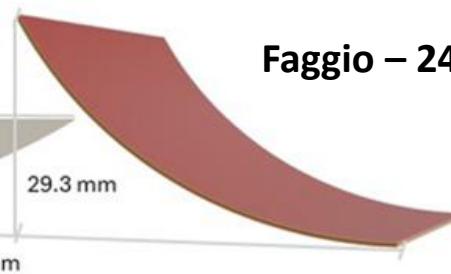
Pioppo – 2h



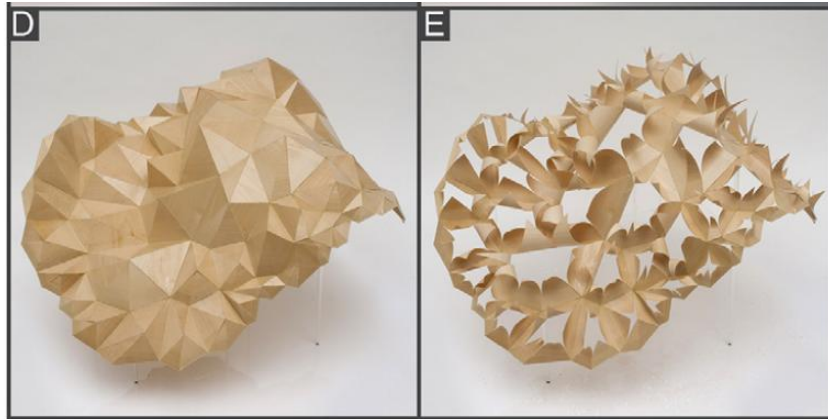
Pioppo – 24h



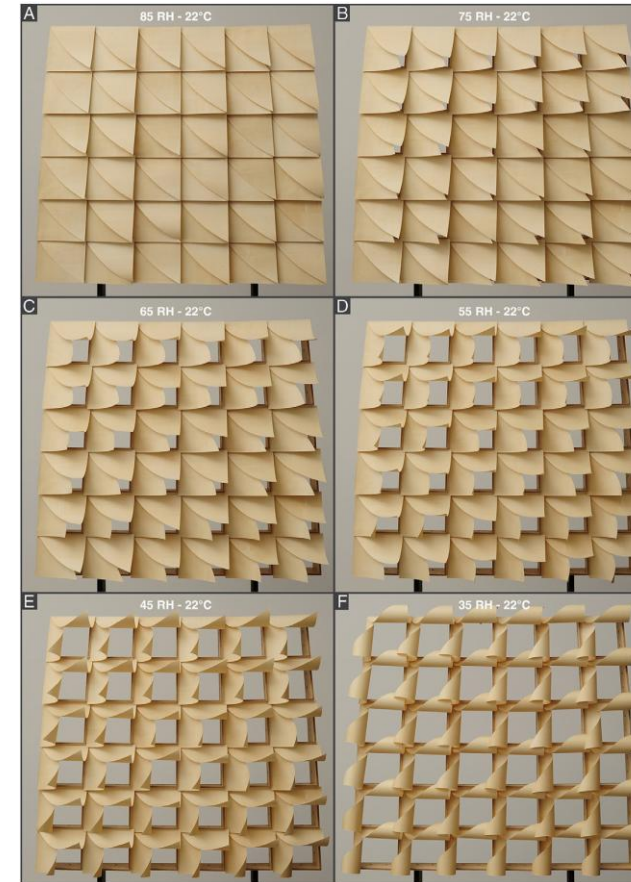
Faggio – 24h



4 POSSIBILI APPLICAZIONI



HygroSkin: Meteorosensitive Pavilion - www.icd.uni-stuttgart.de



Reichert et al. 2015 -DOI:10.1016/j.cad.2014.02.010

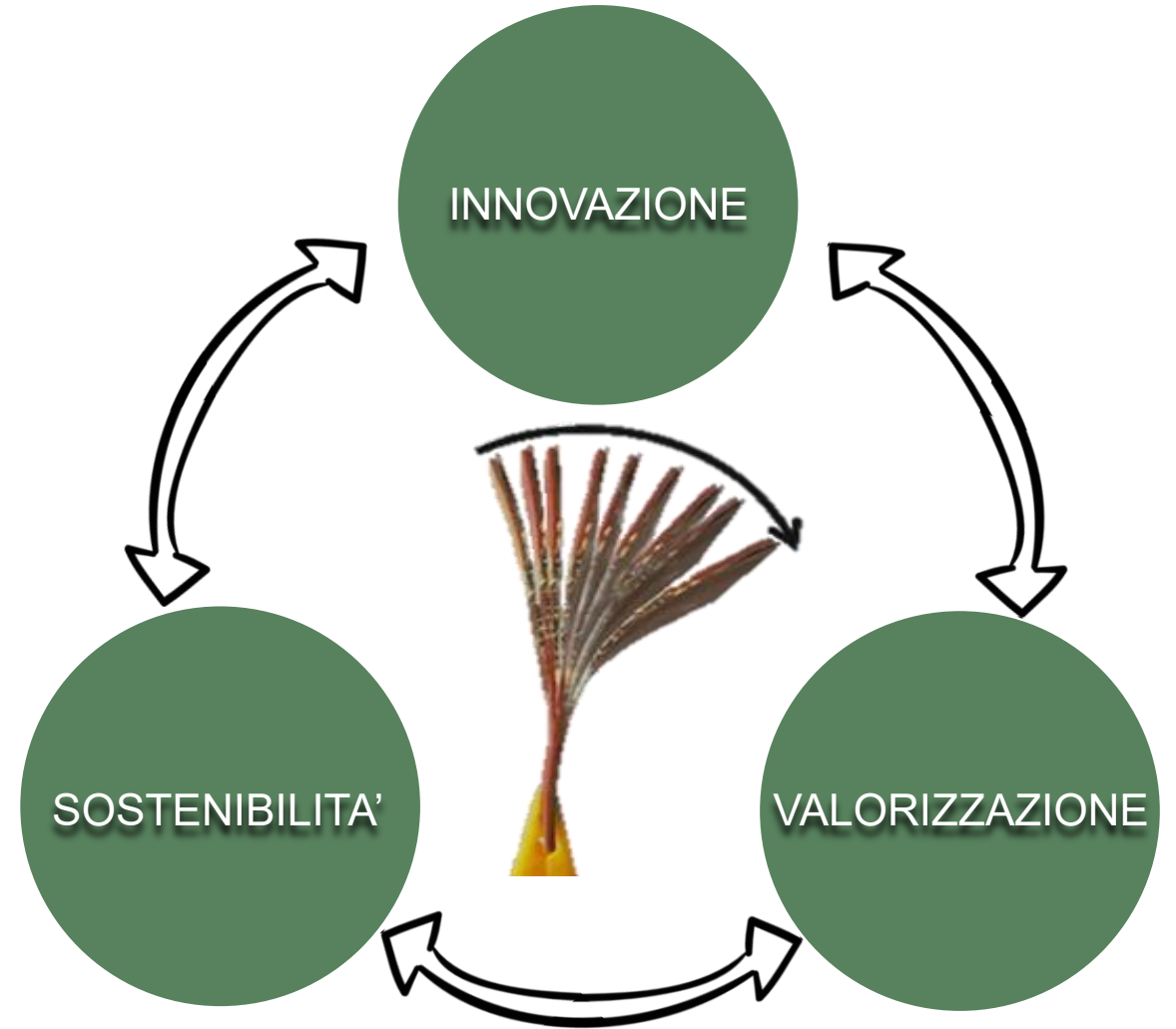
5 PROSPETTIVE FUTURE

- Technological Readiness Levels (TRL) bassi
- Ottimizzazione della performance
- Validazione in ambiente reale



CONCLUSIONE

- Prodotto innovativo per la valorizzazione del legno locale
- Interessanti opportunità per lo sfogliato di pioppo
- Necessità di ulteriori studi



GRAZIE PER LA VOSTRA ATTENZIONE!

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