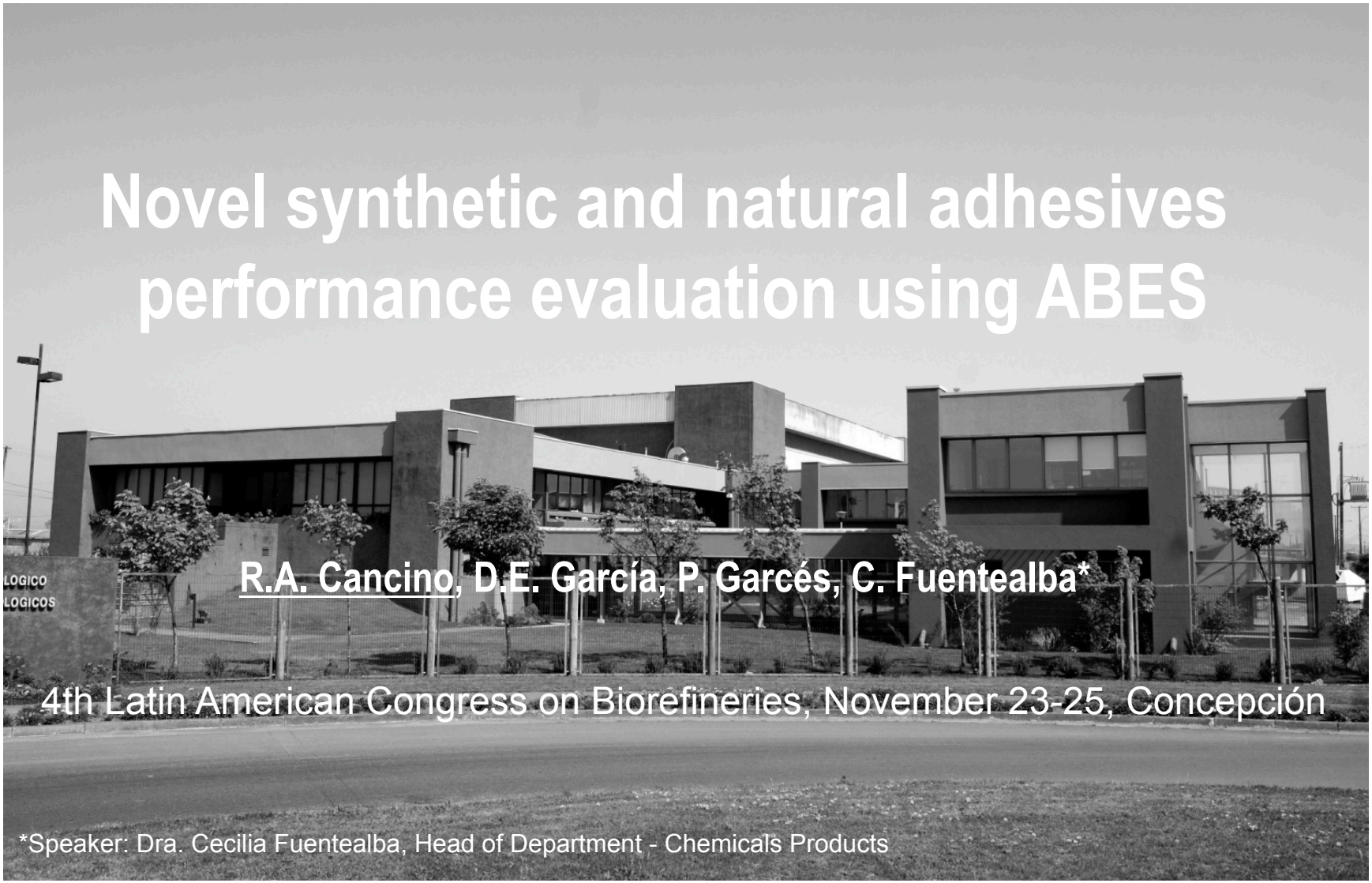
Novel synthetic and natural adhesives performance evaluation using ABES



R.A. Cancino, D.E. García, P. Garcés, C. Fuentealba*

4th Latin American Congress on Biorefineries, November 23-25, Concepción

*Speaker: Dra. Cecilia Fuentealba, Head of Department - Chemicals Products

Summary

- Introduction
- What is ABES?
- Improvement on ABES test response
- Experimental test with ABES
- Conclusion

Introduction

Adhesives development

Egyptian period
3.500 AC

Natural adhesives

Minimal requirements

After World war II
1945

Synthetic adhesives

High requirements

- High demand
- Humidity resistance
- Durability

Nowadays..

Natural and synthetic adhesives

Increase in applications, different fields, higher requirements

Unthinkable characteristics and properties

Introduction

Adhesives development

Wood board industry

Development of natural adhesive systems

Adaptation to the traditional process or new technologies and requirements

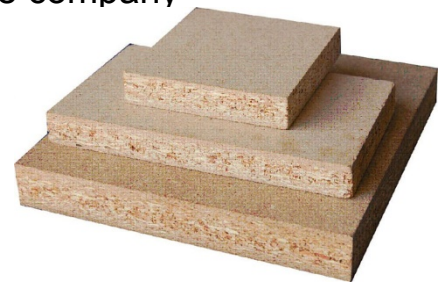
Challenges

Requirements

Synthetic adhesives from fossil sources

- Environmental aspect
- Human health
- High fluctuation of the price of fossil raw material to produce adhesives
- Image of the company






Introduction

Adhesives development

Laboratory scale

Not easy task !

- Synthesis of the resin
- Reactivity
- Different formulation
- Temperature and time
- Etc..

Pilot scale

Adhesives must be tested elaborating wood boards and evaluating them mechanically and physically, according to established standards.

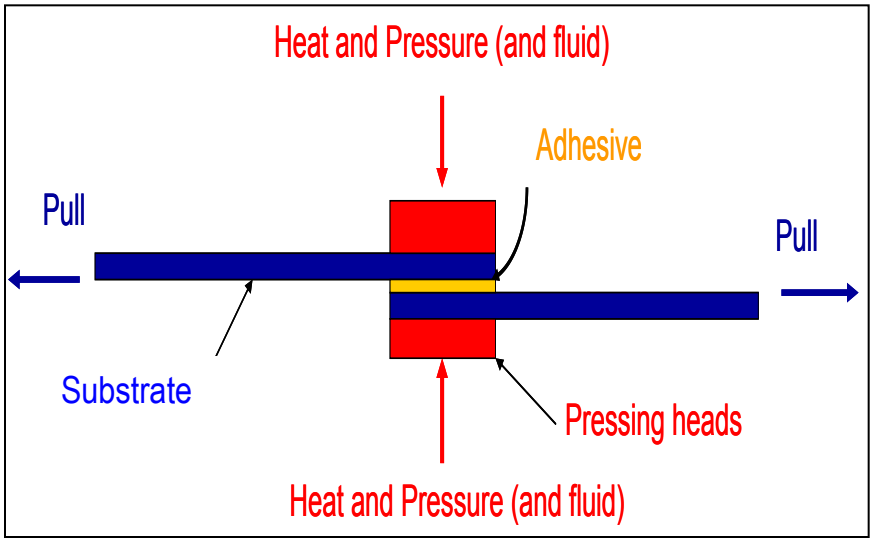
- Higher quantities of adhesive
- Higher number of boards to obtain accurate results
- Higher cost of resources
- Higher experimental error

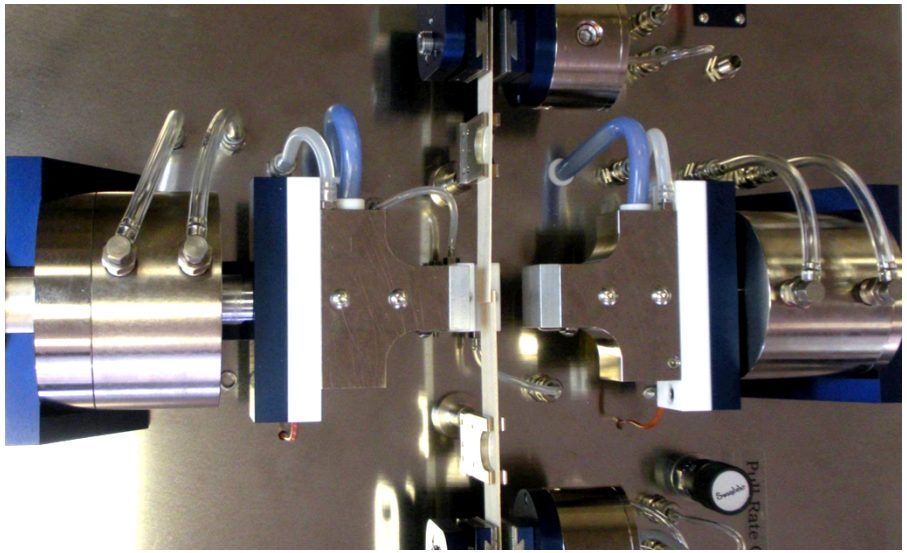
Industrial scale

What is ABES

Automated Bonding Evaluation System

ABES is a desktop instrument "developed by Philip Humphrey", US patent 5,170,028, 1993" where is possible to evaluate the kinetics of adhesion.





- In this, miniature bonds are formed under highly controlled conditions at a variety of pre-selected isothermal temperatures and pressing times and immediately thereafter destructively tested in shear mode.

IMPROVEMENT ABES TEST RESPONSE

ABES - Automated Bonding Evaluation System

It was proposed to evaluate the following parameters, based on the principles of ABES:

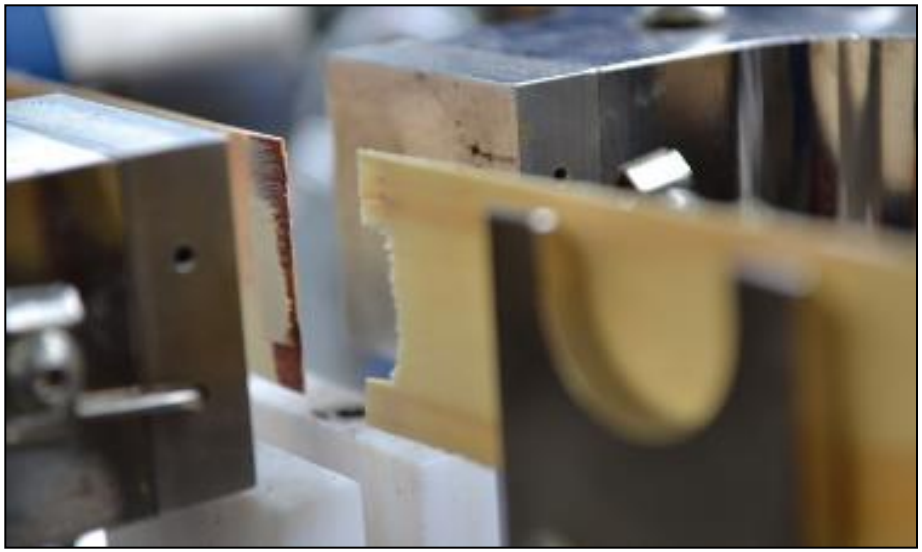
- **Effect of increasing the overlapped area**
- **Effect of catalyst on adhesion performance**
- **Effect of press temperature**
- **Effect of process time**
- **Several commercial and natural adhesives.**

ABES - Automated Bonding Evaluation System

EXPERIMENTAL

Samples:

- ***Pinus radiate* wood**
- **Thickness of 0,7 mm cut into 117 mm×20 mm.**
- **Wood veneers were stored at 20°C and relative humidity of 53% prior testing.**



New overlapped area of 4 mm^2 compared with the standard of 1 mm^2 was carry out.

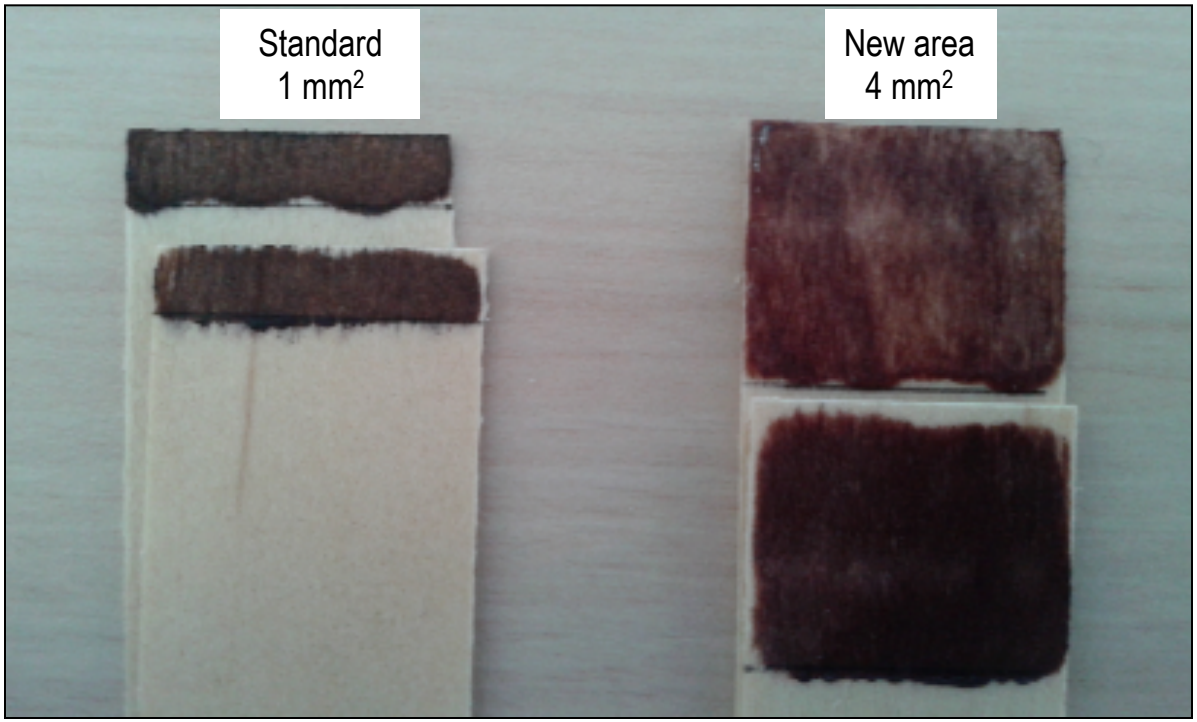
ABES
Automated Bonding Evaluation System

General ABES testing characteristics.

Parameter	Value
Adhesive, type	Commercial PF and tannin*
Thickness, mm	0,7
Press temperature, °C	135 y 150
Press time, s/mm	12 - 600
Spread rate, g/m^2	180
Substrate	Strips of radiate pine

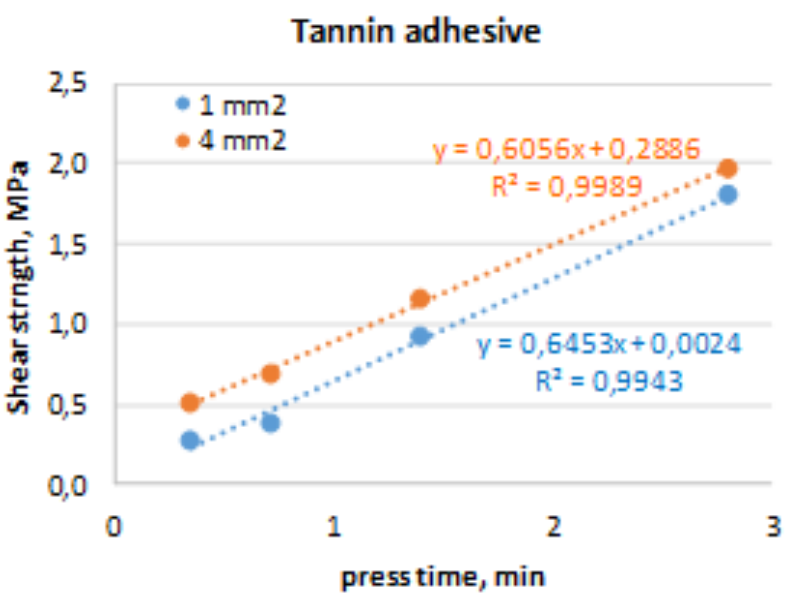
*Tannin adhesive formulation developed in UDT used for plywood manufacture.
PF: Phenol Formaldehyde

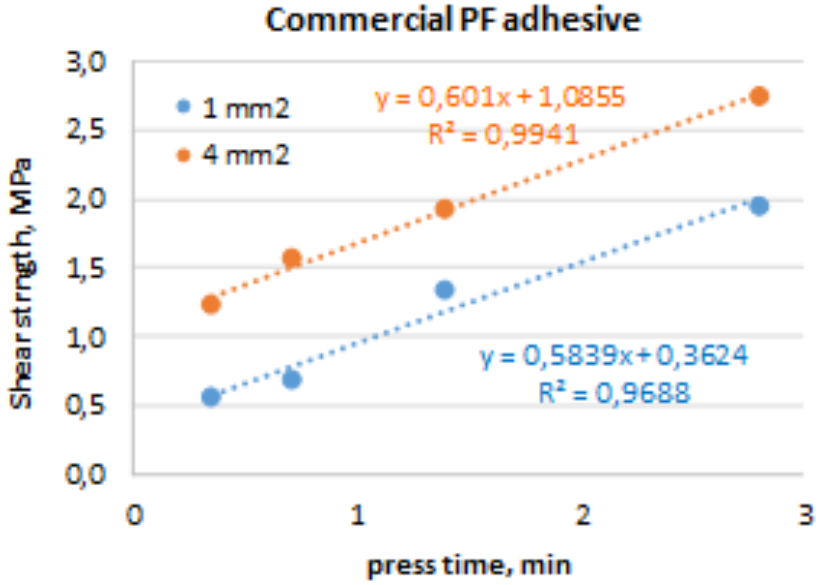
Improve ABES response with new evaluation area.



ABES Testing with different area

ABES response when the area was increased





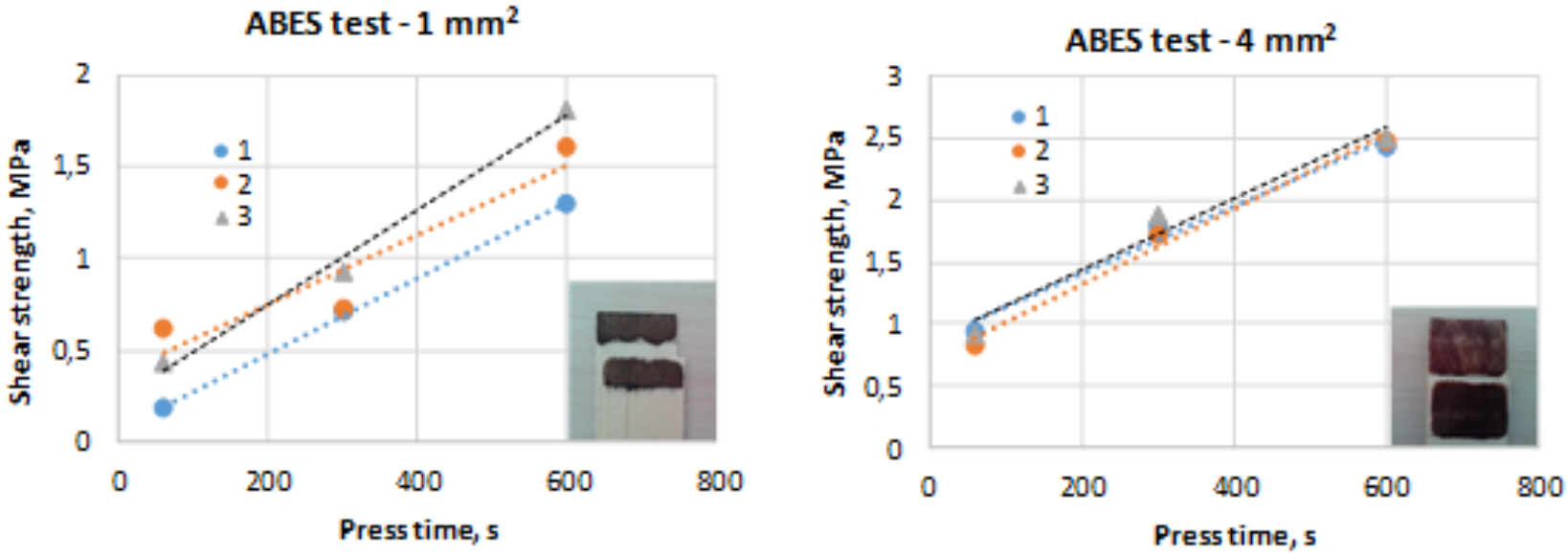
ABES comparison with different areas for two adhesive systems
(Press temperature of 135 °C)

- **A parallel response of the ABES test was obtained when a higher area was used for both adhesive systems evaluated.**

- **The shear strength increased with higher area**

ABES

Improve ABES response with new probes area.

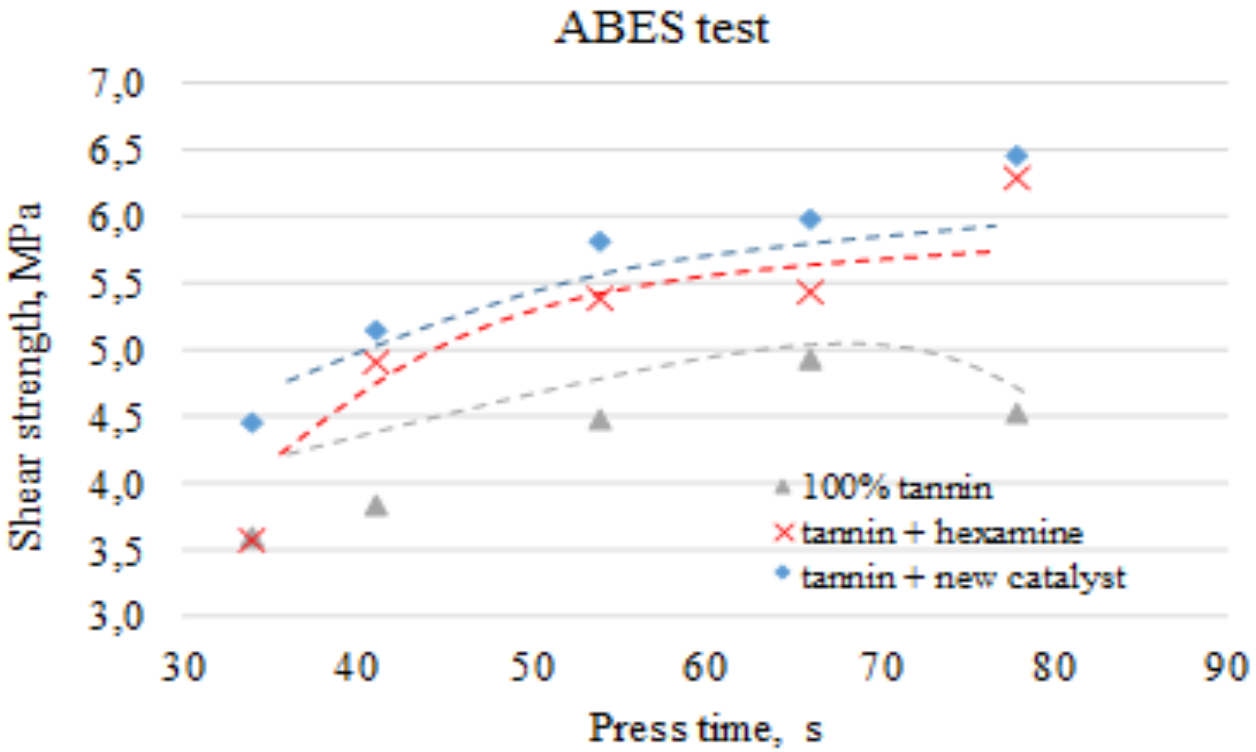


ABES comparison with different with repeated tests.

- **Consistent response of the ABES test when higher area was used.**
- **The new area for evaluation is a good alternative for developing ABES test for adhesives and substrate evaluation.**

ABES

Effect of the type of crosslinker agent.



Adhesive systems based on tannin with and without hexamine and catalyst.

Hexamine and the new "catalysts" were evaluated over tannin-based adhesive performance.

ABES

Effect of the content of crosslinking agent.

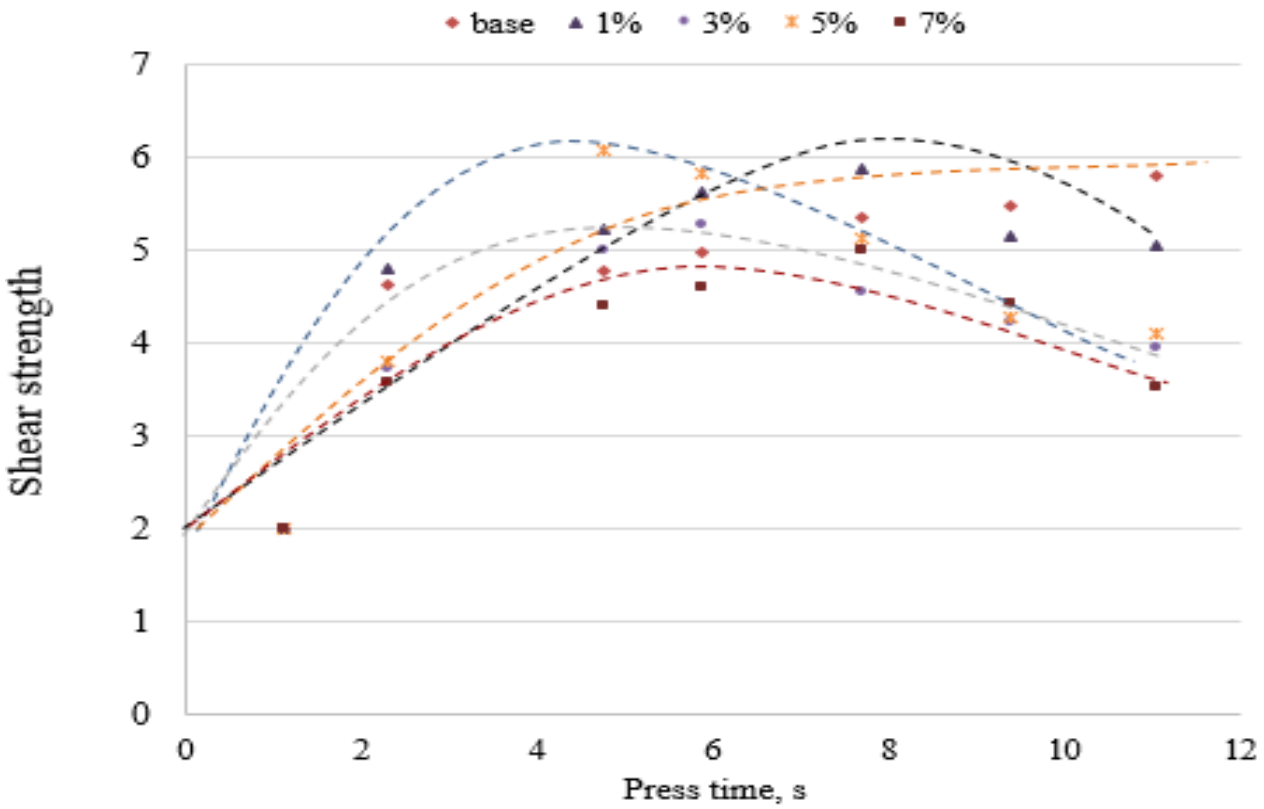


Figure 7. ABES evaluation for different catalyst content in the new tannin adhesive

The different curves show changes in slopes and also in the maximum strength value achieved. This is useful to choice quickly the best content of crosslinker.

Effect of the Press temperature

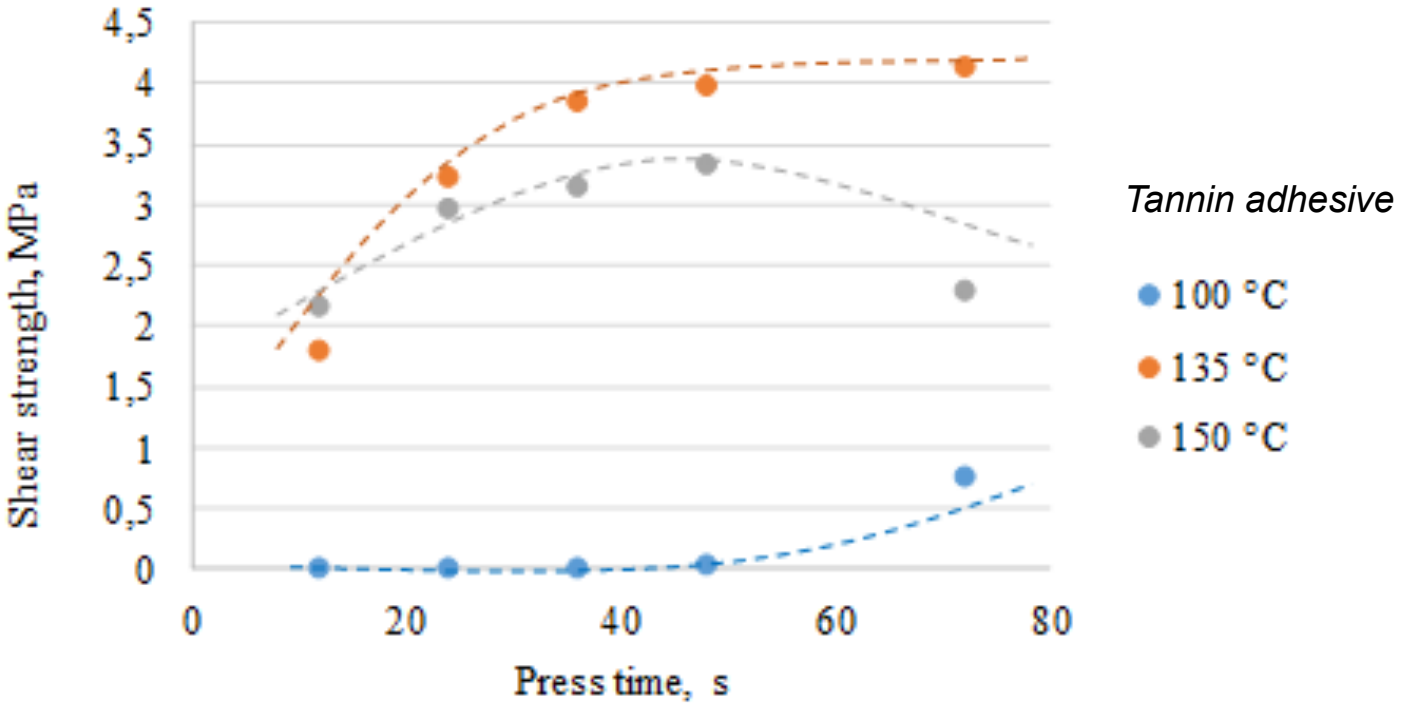
Table 2. ABES test conditions for new tannin adhesive.

Parameter	Value
Adhesive, type	Tannin*
Thickness, mm	2.6
Press temperature, °C	100, 135 and 150 °C
Press time, s	12 to 72
Spread rate, g/m²	180
Substrate	radiata pine strips

*Tannin adhesive formulation developed in UDT used for plywood manufacture.

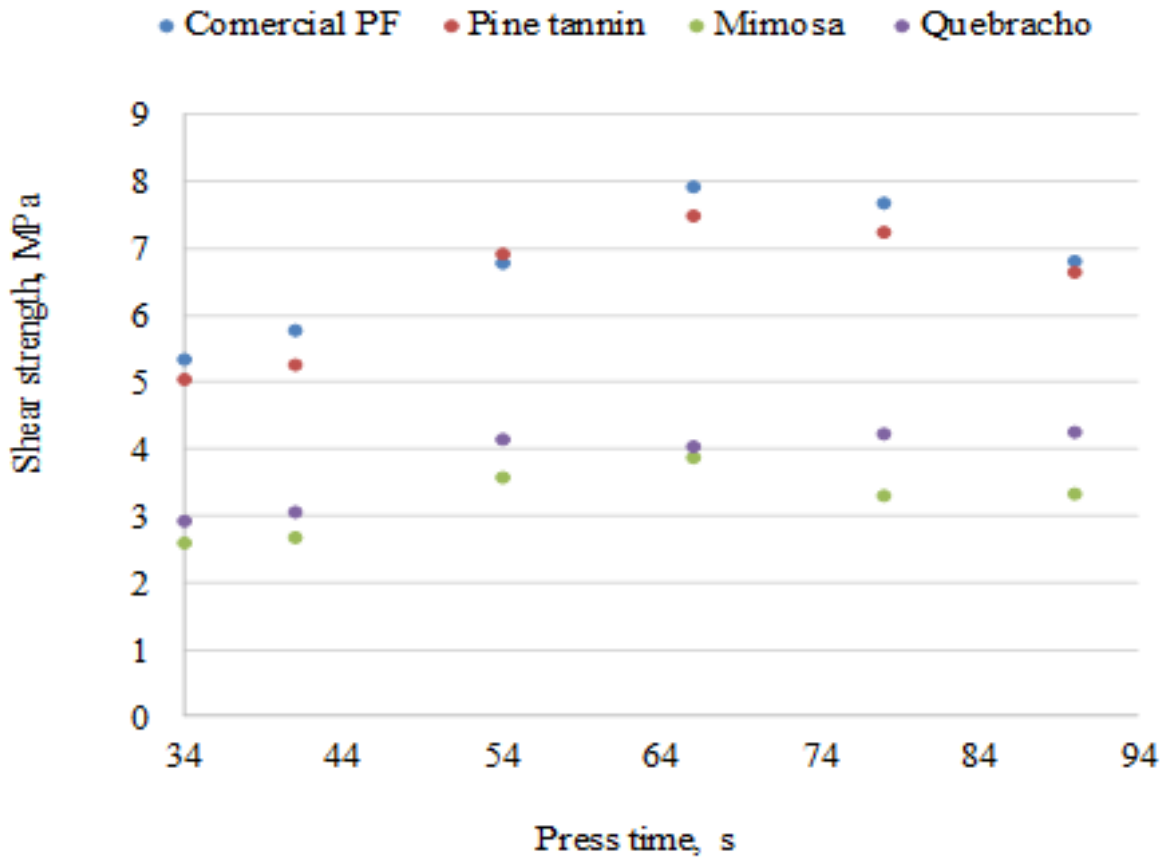
ABES

Effect of the Press temperature



- The shear strength developed is faster at higher temperatures
- Adhesives with different curing behaviours can be tested with ABES

Effect of tannin type on adhesive performance



- Comparative analyses for commercial PF resin with adhesives based on different tannin sources (*radiata* pine, mimosa and quebracho).
- Radiata pine tannin and the commercial PF adhesive shows similar behavior.

Novel synthetic and natural adhesives performance evaluation using ABES

CONCLUSIONS

- ABES instrument is a useful predictive tool for adhesive performance evaluation.
- ABES is an alternative to optimize time and resources for research and development in the adhesives field.
- ABES covers a wide range of formulations and substrates in less time to identify the promising formulations.

Thanks for your attention!

c.fuentealba@udt.cl
r.cancino@udt.cl