



COST Action FP1407 2nd Conference
**“Innovative production technologies and
increased wood products recycling and
reuse”**

FP1407

ModWoodLife

**Esterified lignin as hydrophobic
agent for use on wood products**

**René Herrera, Oihana Gordobil, Rodrigo
Llano-Ponte, Jalel Labidi**

Environmental and Chemical Engineering Department
University of the Basque Country
Plaza Europa 1. Donostia-San Sebastian, Spain.
[email:jalel.labidi@ehu.eus]



OVERVIEW

- ▶ *Lignin as a raw material and isolation method*
- ▶ *Lignin modification: esterified lignins*
- ▶ *Characterization of lignin ester derivatives*
- ▶ *Wood veneers treatments with esterified lignins: press molding and immersion method*
- ▶ *Characterization of treated wood veneers: Water and oil repellence, surface energy, and optical properties*

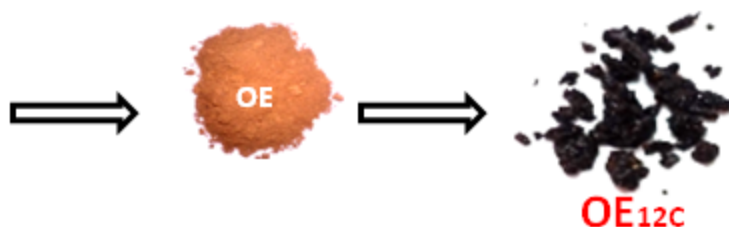
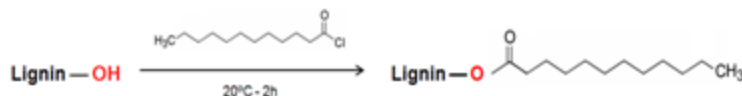
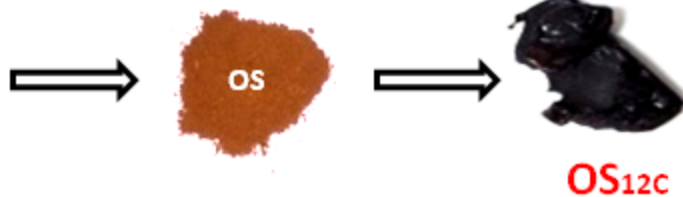


OVERVIEW

ISOLATION

ESTERIFICACION

APPLICATION



COATING (Press molding)



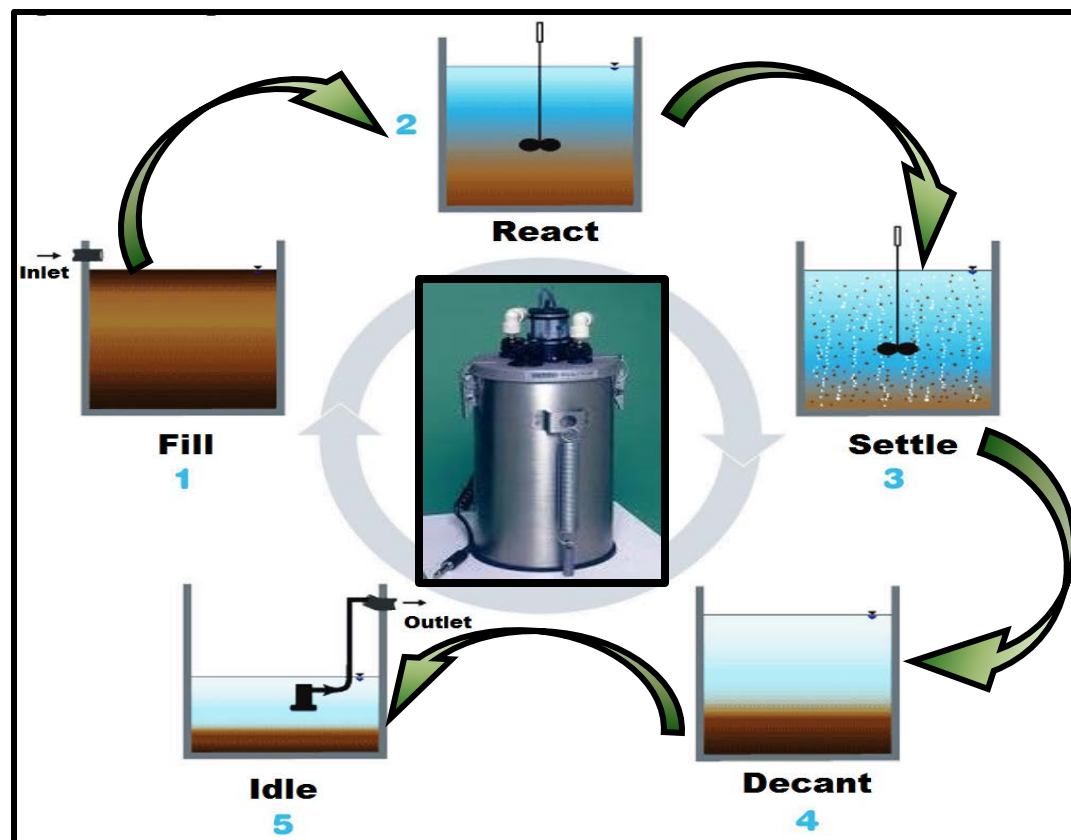
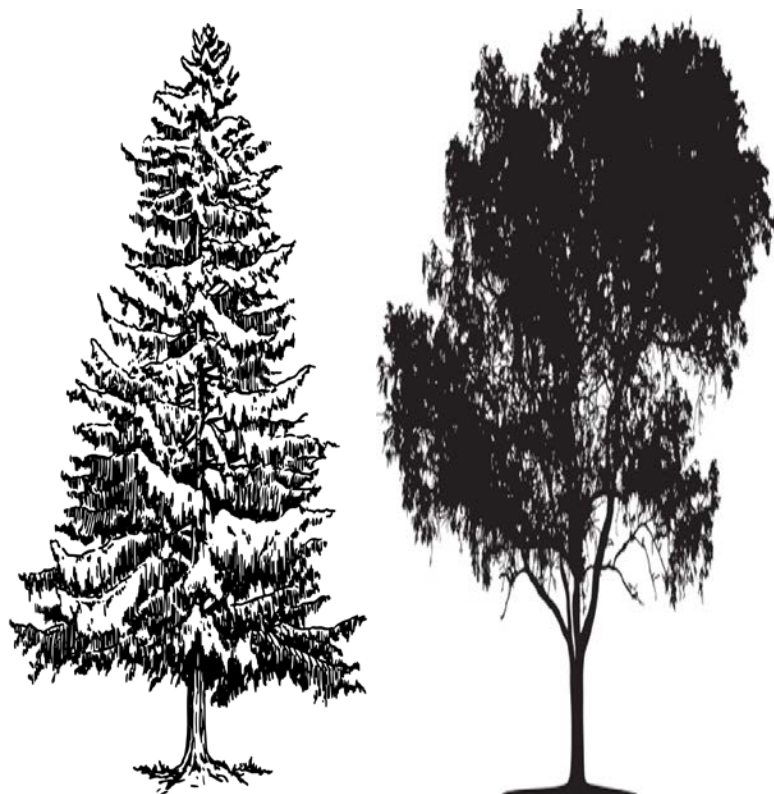
Wood veneers

IMMERSION





LIGNIN ISOLATION



Lignins were extracted by organosolv process from raw materials. The extractions were carried out in a 4 L pressure (20 bar) batch reactor with constant stirring and control of pressure and temperature.



LIGNIN ESTERIFICATION

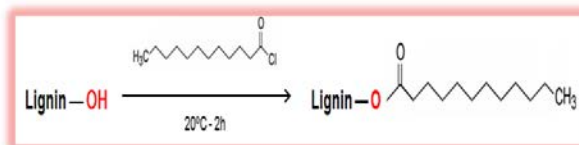
Esterification procedure was performed at 20 °C for 2h with 0.5 g of lignin dissolved in 15 mL of DMF and dodecanoyl chloride (0.9 mL) and pyridine (2.75 mL) as catalyst. Afterwards, the solution was poured into 650 mL of 2% ice-cold hydrochloric acid. The precipitate was filtered and washed with distilled water and ethanol.



Spruce lignin



Eucalyptus lignin

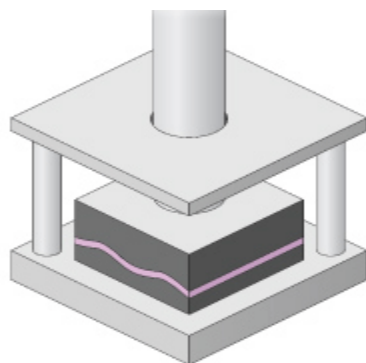


Esterified lignins



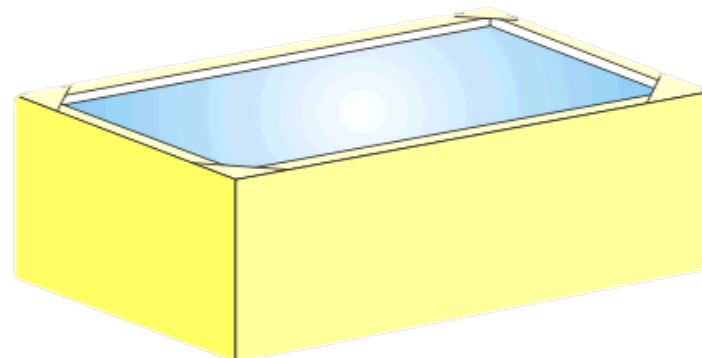
WOOD VENEER TREATMENTS

PRESS MOLDING (COATING)



Press molding (90 °C/100 bar and 100 °C/200 bar). Set at 2min and a dosage of 0.002g/cm²

INMERSION IN PRODUCT

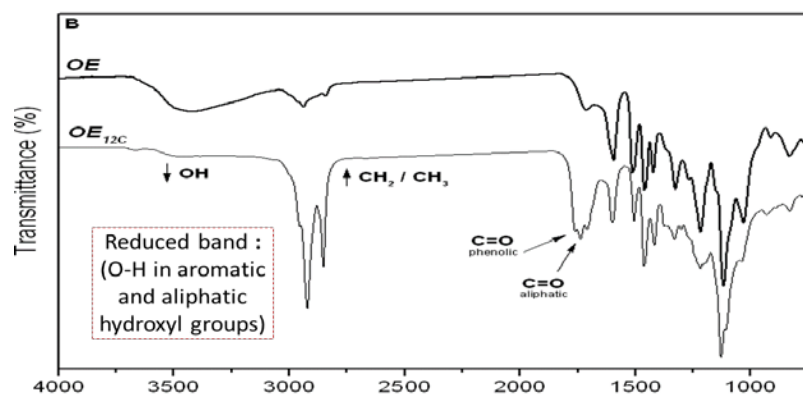


Immersion of veneers at different times (2, 4, 8,...,72 h) with acetone and esterified lignins (0.5 wt%) at room temperature

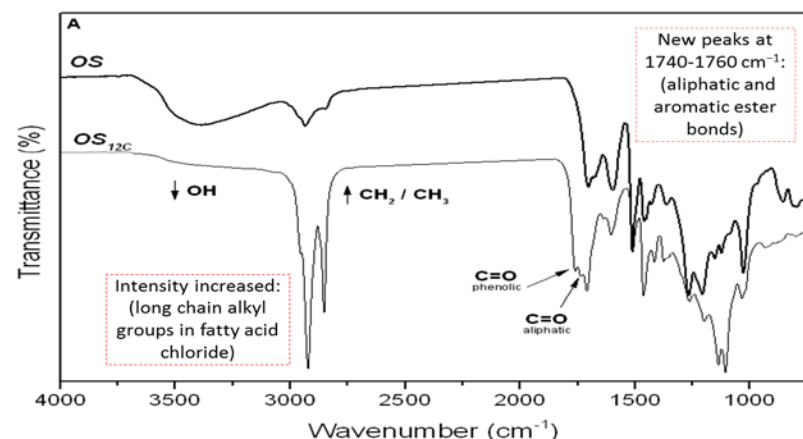


CHARACTERIZATIONS

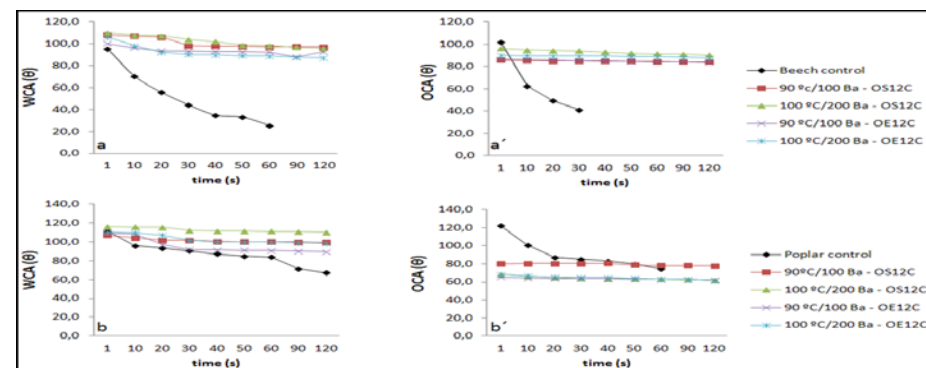
ESTERIFICATION PROCESS



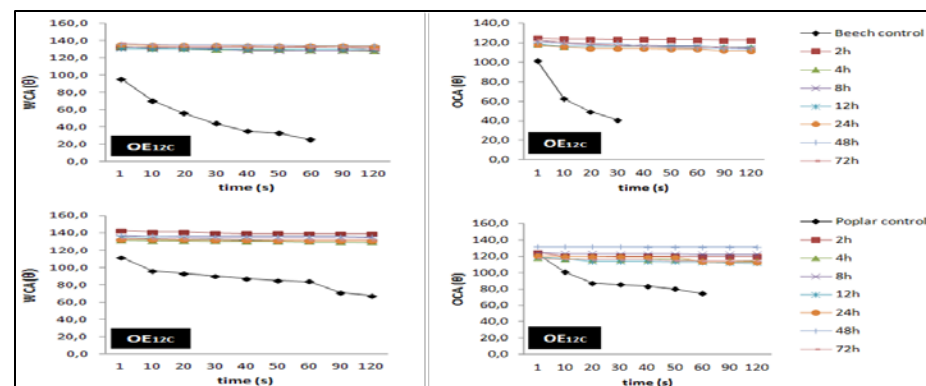
FTIR SPECTRA



PROPERTIES AFTER TREATMENTS



WATER AND OIL REPELLENCE





SUMMARY

- The esterification process at short time and room temperature was successful to synthesize lignin ester derivatives, which would be used as hydrophobic agent on wood products.
- A stable and high hydrophobic and oleophobic behavior on treated veneers was observed.
- The immersion method provided higher and more stable dynamic contact angle for water and oil which remained practically unchanged over time.



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Esterified lignin as hydrophobic agent for use on wood products

René Herrera, Oihana Gordobil, Rodrigo Llano-Ponte, Jalel Labidi
Environmental and Chemical Engineering Department
University of the Basque Country
Plaza Europa 1. Donostia-San Sebastian, Spain. [email:jalel.labidi@ehu.es]

BACKGROUND AND PROCEDURE

Raw material

Lignin is one of the most available natural polymers on earth. Nowadays is a challenge obtain certain uses of it, such as raw material in the timber industry and in this case as hydrophobic agent for wood protection.

WHY? Due to its chemical structure based on three phenylpropane units: (p-hydroxyphenyl) (H), guaiacyl (G) and syringyl (S), which are bound to each other via ether and C-C linkages and could be substituted with numerous functional groups like methyl, phenolic and aliphatic hydroxyl groups.

Isolation

Lignins were extracted by organosolv process from raw material. The extractions were carried out in a 4 L pressure (20 bar) batch reactor with constant stirring and control for pressure and temperature.

Application of products on wood

COATING (Press molding)

Press molding (90 °C/200 bar and 100 °C/200 bar), set at 2min and a dosage of 0.002g/cm².

IMMERSION

Immersion of veneers at room temperature in a solution of acetone and esterified lignins (0.5 wt%) at different times (2, 4, 8, 12, 24, 48 and 72 h).

Esterification

The esterification procedure was performed with 0.5 g of lignin dissolved into 15 mL of DMF plus pyridine (2.75 mL) as a catalyst. The reaction was conducted at 20 °C / 2h, finally the solution was poured into 650 mL of 2% ice-cold hydrochloric acid.

RESULTS AND DISCUSSION

Esterification process

FTIR spectra of esterified lignins confirmed that the esterification process was successful at studied conditions. This modification is highlighted for its short period of time without using temperature.

Properties of treated veneers

Water and oil repellence

Optical appearance

Table 3. Moisture content and thickness of control veneers and treated veneers.

Sample	Product	Treatment	Moisture content ^a	Thickness (mm)
Beech	Control	Control	6.47(0.56)	1.07(0.01)
	Coating	2.2hr(0.45)	3.8(0.15)	1.07(0.01)
	Coating	2.4hr(0.18)	2.6(0.06)	1.07(0.01)
Poplar	Control	Control	7.2(0.45)	1.07(0.01)
	Coating	2.4hr(0.18)	3.8(0.15)	1.07(0.01)
	Coating	2.4hr(0.18)	3.8(0.15)	1.07(0.01)
Spruce	Control	Control	7.2(0.45)	1.07(0.01)
	Coating	2.4hr(0.18)	3.8(0.15)	1.07(0.01)
	Coating	2.4hr(0.18)	3.8(0.15)	1.07(0.01)

SUMMARY

- The esterification process at short time and room temperature was successful to synthesize lignin ester derivatives to use as hydrophobic agent on wood products.
- A stable and high hydrophobic and oleophobic behavior on treated veneers was observed.
- The immersion method provided the highest and more stable dynamic contact angle for water and oil which remained practically unchanged over time.
- The color change on treated veneers was visually appreciable, especially in the case of coated woods which could add an aesthetic contribution to lighter species.

ACKNOWLEDGEMENTS

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