Use of lignin to improve wood durability

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INTRODUCTION

To propose an ecological and environmental friendly alternative to biocides used in wood preservation treatment, lignin was employed to impregnate beech and Scott pine wood samples. Different lignins were produced from black liquor, a by-product of chemical pulp industry. After the Kraft lignin production optimization, lignins were first selected for their antifungal effect on blue strain, white-rot and brown-rot fungi. Softwood (Scott pine) and hardwood (beech) samples were impregnated with the selected lignins to show the efficiency of lignin treatment as wood protection to improve durability. .

Motivations

- Wood species with low durability: Can not be used without **biocide** treatment

⚠ Fr and EU Regulation !

- **Thermic treatments or acetylation** of wood: improve durability, but weakening of the wood (<mechanical properties)
- **Recycling of wood waste** limited by preservative agents

➡ Lignin Use: Antioxidant / fungicide properties
Could be modulated and improved before reintroduction in wood

Objectives

➢ To develop an original and innovative methodology to produce, functionalize and reintroduce lignin and lignin derivative to modify wood and increase its durability.

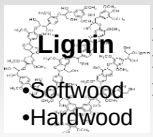
➢ To develop technical approach to wood treatment at short (pallet) and long term (construction) to facilitate the wood products end-life management (recycling, energy production,…)

Lignin production:

Production of lignins in InTechFibres lignin platform

Kraft Lignin

Technical approach:



➢Purification
➢Modification
➢Fractionation

Model molecules

Screening
Radial growth method

Wood treatment
Lignin impregnation

Biologic tests:
Evaluation of the treatment effect on the fungal development

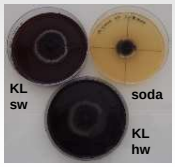
Radial growth method
Estimation of the wood weigth loss

Ecotoxicity

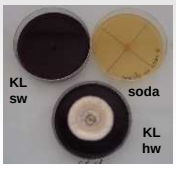
Lignin effect on fungal growth

Tested by the radial growth method : Lignin in powder, diluted at 1% w/v in malt/agar medium at final pH =5

Auréobasidium pullulans

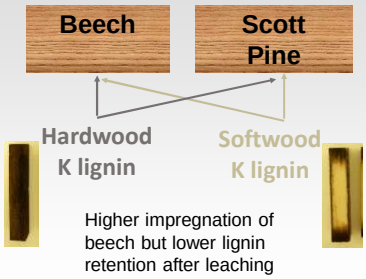


Coniophora puteana



- ➢ Soda: growth inhibition
- ➢ Softwood (Sw) and hardwood (Hw) Kraft lignins: reduce the growth of bluestrain fungi
- ➢ Softwood lignin: totally inhibit the white rot fungi (wood decay fungi)

Improving wood durability by lignin impregnation



Higher impregnation of beech but lower lignin retention after leaching

- ➢ Optimisation of the wood impregnation:
  - Lignin concentration
  - Impregnation cycles (vacuum and vacuum/pressure)
  - Duration
- ➢ Leaching: follow-up of release in water
- ➢ Analysis of wood weight loss after contact with fungi

Wood	Lignin	Weight loss (% m/m)
Scott Pine	- (Control)	22.7
	Soda	3.7
	Sw	6.9
	Hw	0.8
Beech	- (Control)	19.7
	Soda	16.1
	Sw	20.8
	Hw	22.2

➡ Lignin are effective as preservation agent

CONCLUSION

Despite of beech wood more impregnable and its higher lignin concentration, treatment of Scott pine wood samples was more effective after leakage. Wood weight looses, brought about fungal development, were significantly decreased if wood samples were treated with lignin. For Scott pine wood samples treated with hardwood lignin, a mass loose below 1% was measured which proved a good efficiency of lignin treatment as wood protection to improve durability.

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