IMPROVEMENT OF CELLULOSE BARRIER PROPERTIES BY DEVELOPMENT OF HYDROPHOBIC COATINGS FOR FOOD PACKAGING

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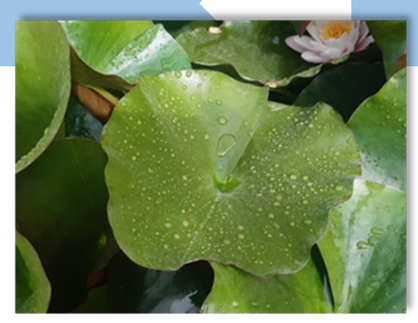
Introduction



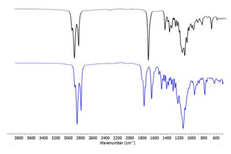
Superhydrophobic coatings have demonstrated significant potential in addressing key challenges and are increasingly being recognized as a promising strategy for reducing contamination and degradation risks in food packaging[1]. Moreover, the incorporation of engineered surface topographies and low-surface-energy materials imparts unique functional properties to cellulosic substrates[2]. This research project, conducted in collaboration with **SACMI**, aims to develop a superhydrophobic treatment for cellulosic surfaces at the laboratory scale, with the goal of scaling it up for industrial application in the production of paper-based packaging. To this end, bio-based additives have been synthesized through esterification reactions between aliphatic and aromatic polyols and fatty acids, resulting in coatings with excellent barrier properties against liquid water.

Dry Compression Molding Technology

- ✓ Less water consuming
- ✓ Efficiency
- ✓ Versatility
- ✓ **Low cycle time**
- ✓ **High productivity**

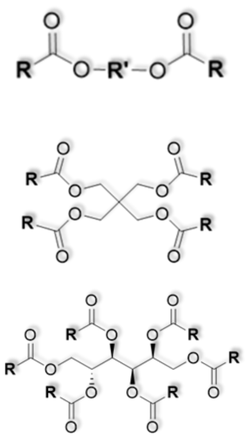
Methods

Additives Synthesis → Structure confirmation → Application on cellulose fibers → Cellulose fibers molding → Investigation on molded objects

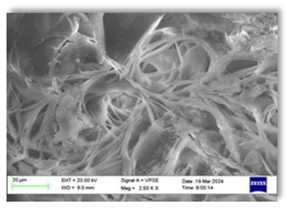




Experimental part

First generation additives (1G)



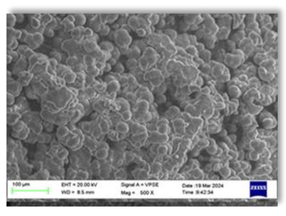
1G-a



1G-a

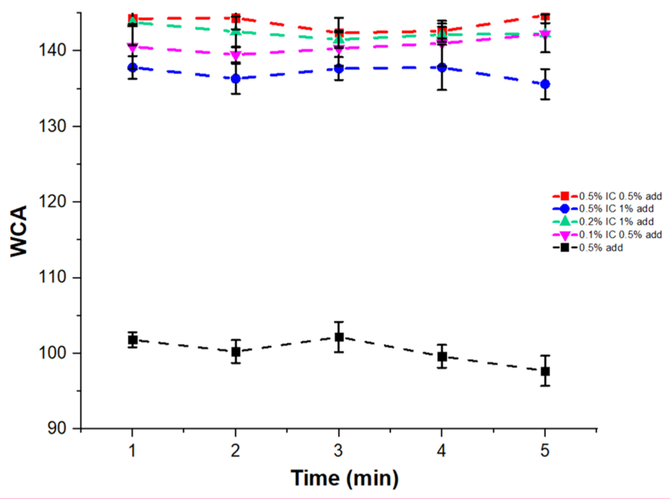
1G-b

1G-c

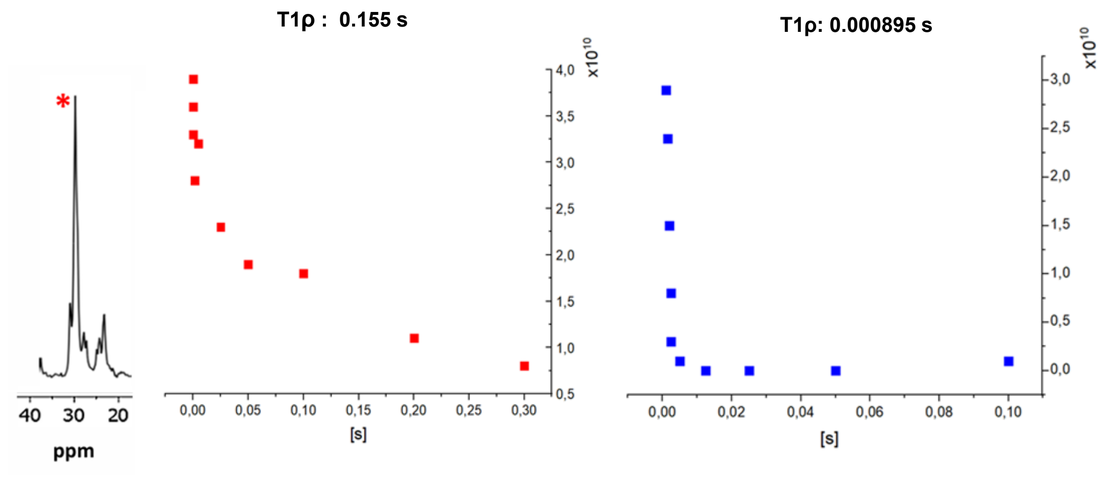


1G-b, 1G-c

1G-b additive combined with an Inorganic Compound (IC)

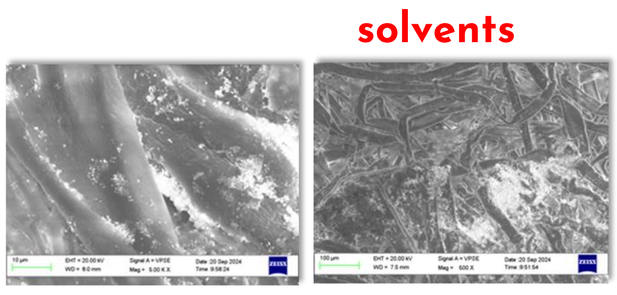


Chemical behaviour Investigation by Solid-State NMR



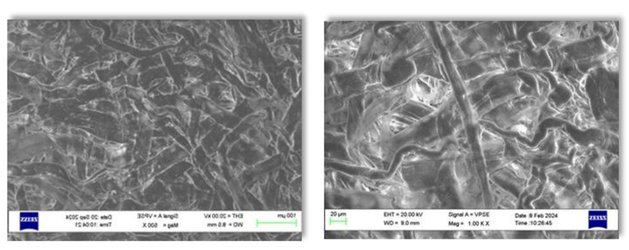
Main Issues due to the Inorganic Compound

The IC is not soluble in water or in organic solvents



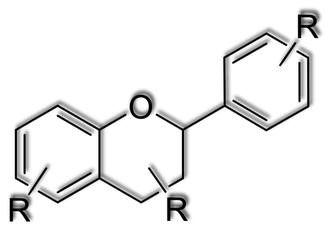
Additive's accumulations after molding

Hydrophobic performances reduced after molding

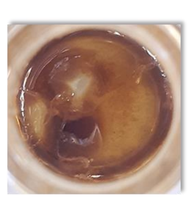


Pristine cellulose fibers in the centre of printed samples

Second generation additives (2G)



2G-a (R)

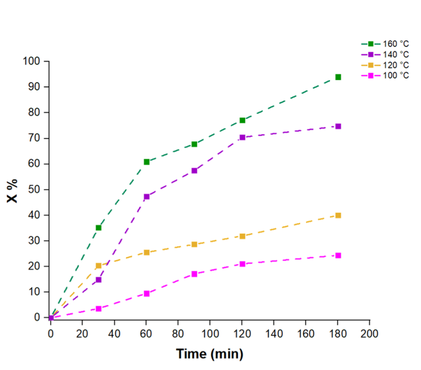


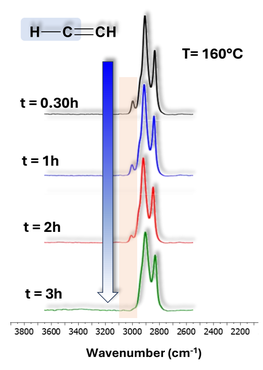
2G-b (R^1)

2G-c (R^2)

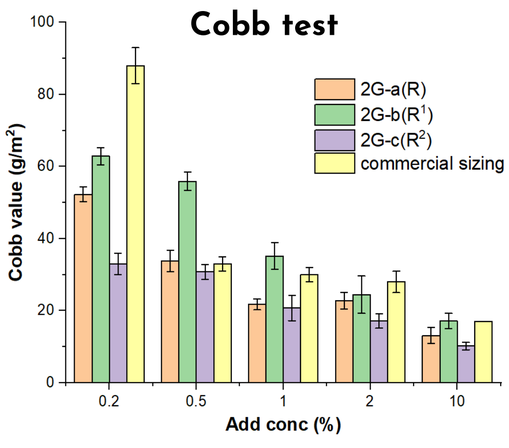
Δ

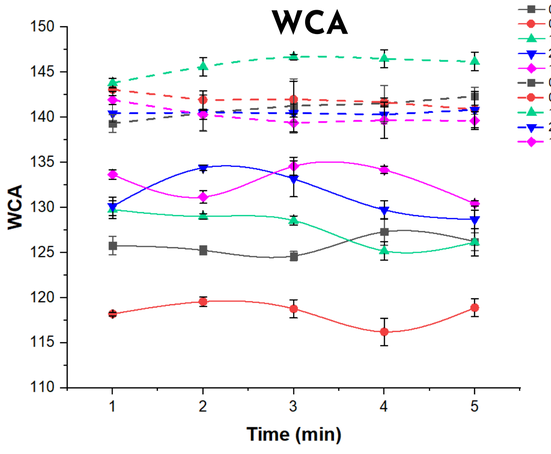
Curing properties of 2G-c (R^2)

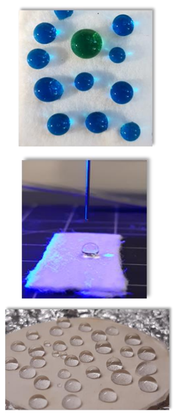




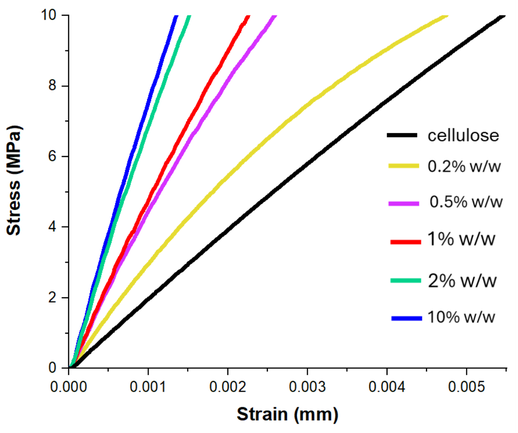
Hydrophobic properties

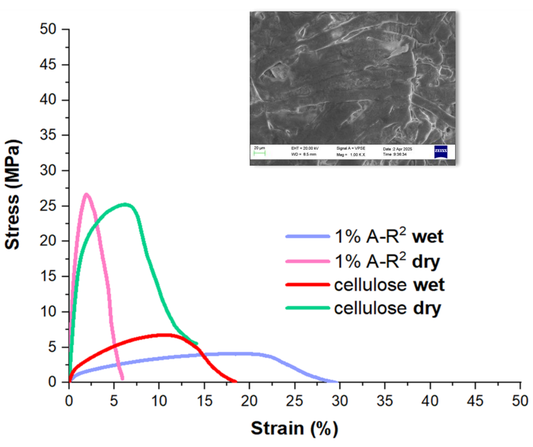




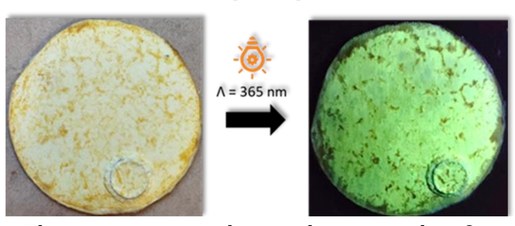


Effect of curing on mechanical properties

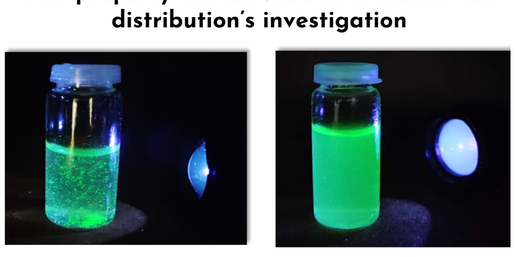




Fluorescent properties



This property can be used as a marker for distribution's investigation

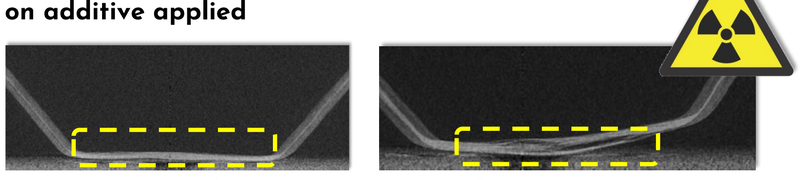


The homogeneity of emulsions was also analyzed by a visual investigation due to fluorescent properties

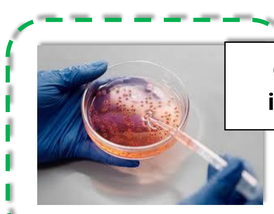
Molded objects and their water uptake

Additivated dry molded cellulose cups

Different absorption of colored water depending on additive applied



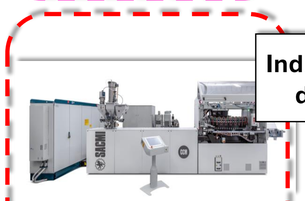
Future Directions



Cytotoxicity investigation

Emulsions' optimization

Compostability and reciclability



Industrial process development

Bibliography

[1] M.Ruzi et al.,Superhydrophobic coatings for food packaging applications: A review, *Food packaging and shelf life* 32; 100823 (2022)

[2] X.Wang et al., Surface modifications towards superhydrophobic wood-based composites: Construction strategies, functionalization, and perspectives, *Advances in colloid and interface science* 326; 103142 (2024)