CAN WOOD BIOMASS CLEAN YOUR CLOTHES ?

EXPLORING LIGNIN VALORIZATION THROUGH CHEMICAL FUNCTIONALIZATION

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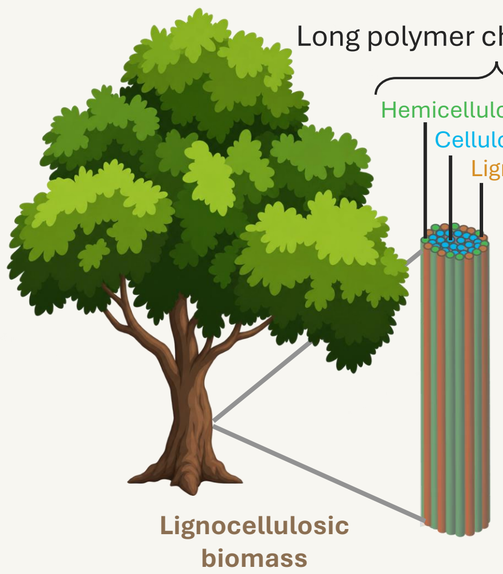
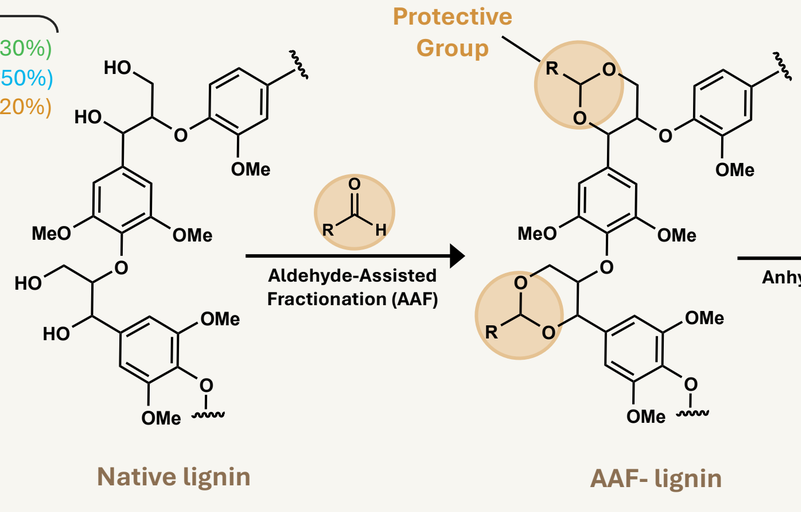
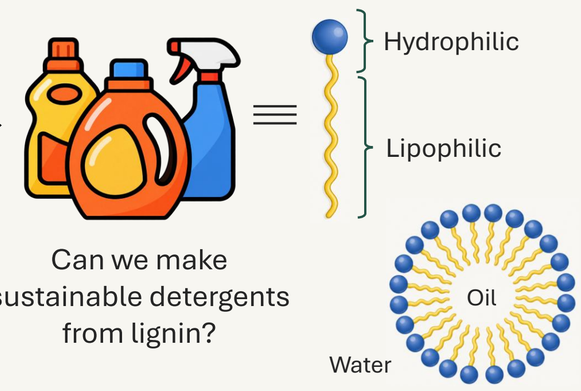
Introduction





- Detergents rely on surfactants (i.e. molecules with a hydrophilic head and a lipophilic tail) to wash away stains
- The majority of these cleaning agents are still derived from non-renewable resources.



Can we make sustainable detergents from lignin?

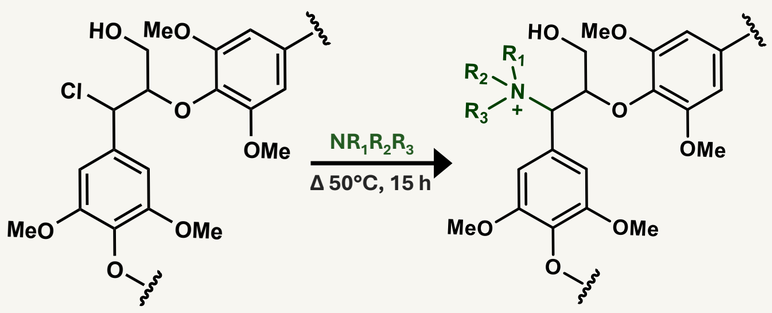
Results and Discussion

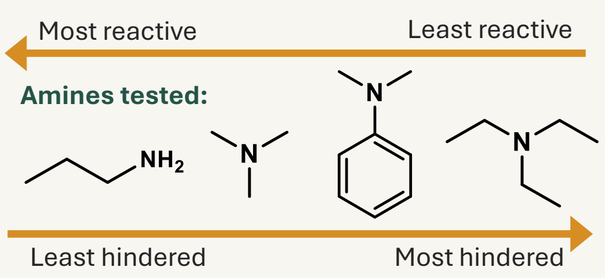
Functionalization of Cl-Lignin using Amines

Methodology:

1. **Lignin preparation:** Extraction (AAF) and chlorination of lignin from wood
2. **Amine functionalization:** Reaction with primary, secondary and tertiary amines
3. **Characterization:** Identification of reaction products using NMR spectroscopy and gas chromatography

General amination reaction:





Characterization of products:

NMR was used to identify the structure of the products by comparing the signals before and after the reaction. **HSQC provides a 2D map linking each hydrogen signal to the carbon atom it is directly bonded to.**

→ Amination of Cl-lignin with NMe_3 was successful and is shown in HSQC spectrum

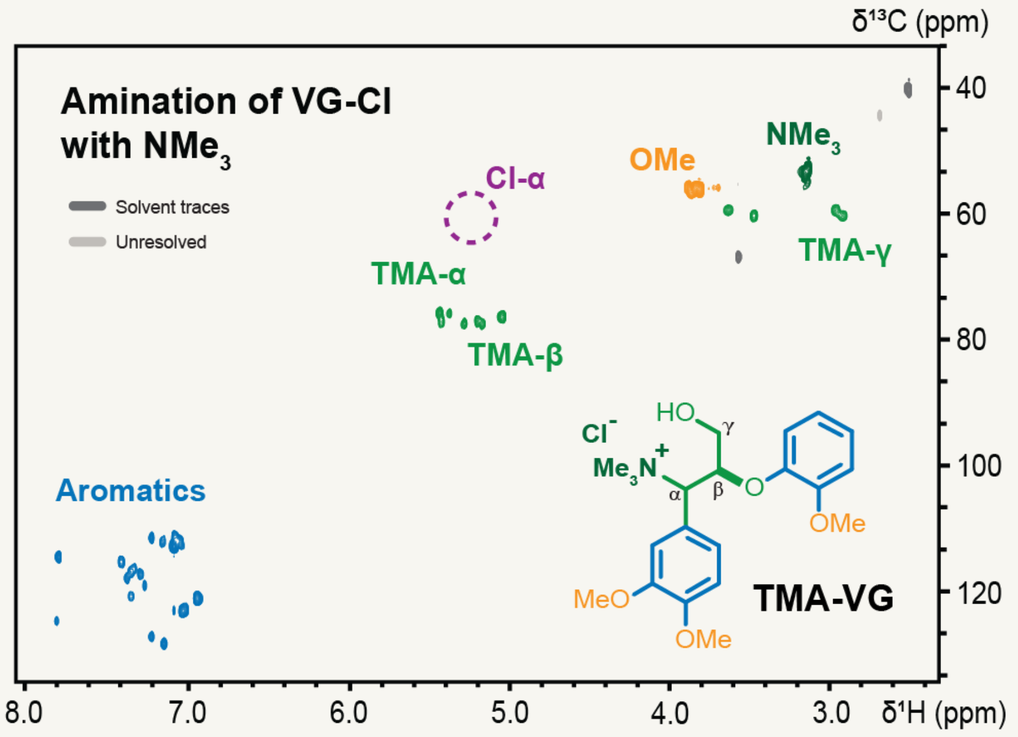
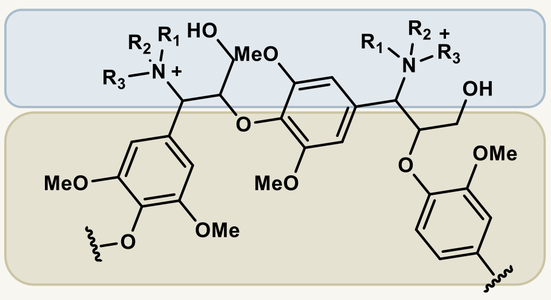


Figure: *HSQC spectrum of the Cl-Lignin model compound (Cl-VG) post-amination with NMe_3 (TMA)*

TMA-Lignin, a bio-based surfactant?

➔Tertiary amines were used to introduce a positive charge to the lignin polymer



Charged + hydrophilic region

Neutral + hydrophobic region

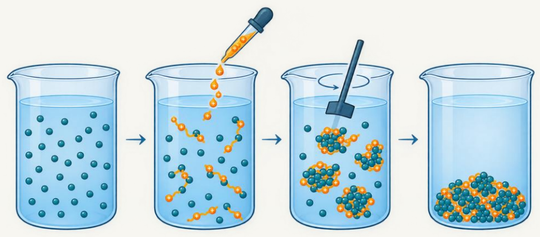
Amphiphilic structure

Polymer is insoluble in water ➔ Limited potential as a detergent

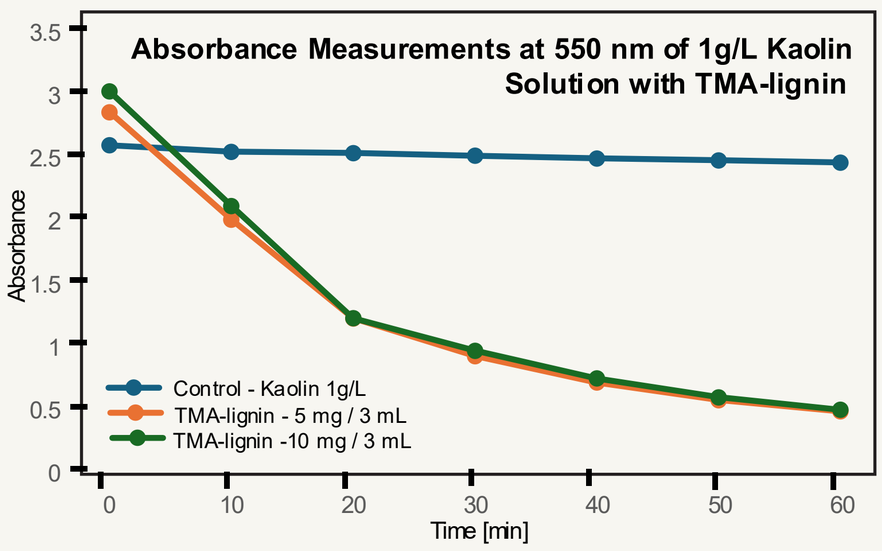
Unexpected application:

- Bacterial membranes are often negatively charged
- The synthesized compound can be used as a **flocculant** for water purification

How does flocculation work?



TMA-Lignin, a flocculant for water treatment



Absorbance ↓ **Turbidity ↓** **Water clarity ↑**

Control solution after 60 min:

Kaolin + flocculent after 60 min:

➔ Large potential for water-treatment applications

Conclusion

01 - Amination

NMe_3 enabled efficient amination of Cl-lignin and gave the highest substitution

02 – Flocculation

Aminated lignin showed flocculating properties, highlighting its potential for water purification

Future work?

Optimize amination conditions to maximize yield and test flocculating properties on real water samples

Questions ?

Let's connect!