Institute for Sustainable Process Technology

Wood Delignification Mechanism with Deep Eutectic Solvents (DES)

The potential of DES to promote mild wood delignification has attracted attention for almost a decade. This folder describes the delignification mechanism as elucidated by the ISPT DES Cluster.[1]

More info

1. DES CLUSTER; PROVIDES PROJECT; PRIDES PROJECT

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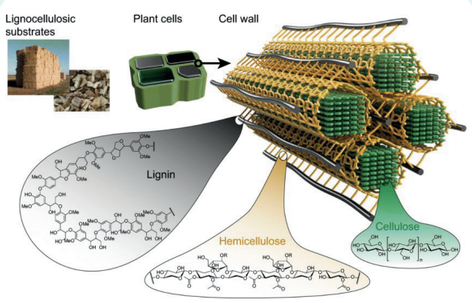
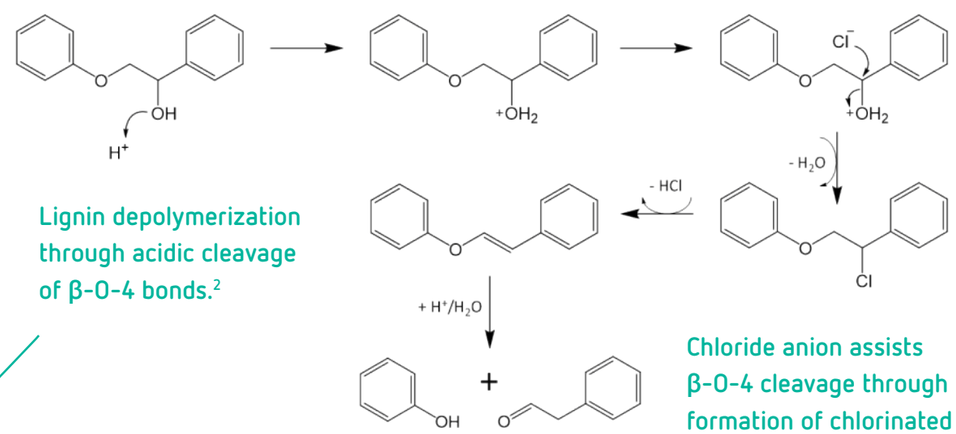
Delignification requires both lignin depolymerization and dissolution



Choline chloride : Lactic acid
1:10

β-O-4 cleavage



Lignin depolymerization through acidic cleavage of β-O-4 bonds.[2]

Chloride anion assists β-O-4 cleavage through formation of chlorinated intermediate species.

Delignification

Lignin dissolution

Fibres

Lignin

- Any acidic DES system can induce β-O-4 bond cleavage (thus delignification) subject to adequate temperature and time conditions,
- Most efficient cleavage with highly acidic systems (eg. pTSA: ChCl),
- Neutral and alkaline DES systems cannot induce lignin depolymerization (though in some cases are good solvents for technical lignins);

- Replacement of Cl^- by Br^- improves β-O-4 cleavage kinetics

- Acidic conditions with presence of chloride anions increases condensation reactions thus damaging the fibres,[3]
- The Lactic Acid : Choline Chloride (10:1) DES generally produces the best results in terms of both delignification and fibre quality preservation, [4]
- The formation of oligomers from Lactic acid on the fibre surface is minimized by the presence of water; [5]

[2] C. Alvarez-Vasco, et al. Green Chem., 2016, 18, 5133–5141.
[3] Da Costa Lopes et al, Green Chem, 2020, 22(8), 2474
[4] Morais et al, ChemSusChem 2021, 14(2), 686
[5] Soares et al, ACS Sust Chem Eng 2019, 7(14), 12485

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This project received funding from TKI E&I with the supplementary grant 'TKI-Toeslag' for Topconsortia for Knowledge and Innovation (TKI's) of the Ministry of Economic Affairs and Climate Policy.

By 2050, we'll have created a circular and carbon-neutral process industry. Together!

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