NATIONAL INSTITUTE OF CHEMISTRY

RAZISKAVE – RABA LESA TUDI V ELEKTRONIKI

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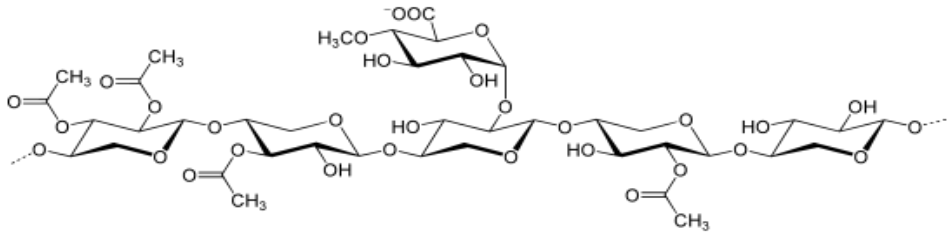
National Institute of Chemistry
Department of Catalysis and Chemical Reaction Engineering

Spletna konferenca "Les, material sedanjosti in prihodnosti – prednosti in izzivi"

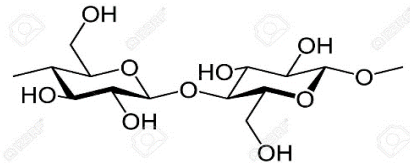
GREEN-LOOP ESTELLA HyPELignum M_W C_{OH} δ

Bio-refinery concept

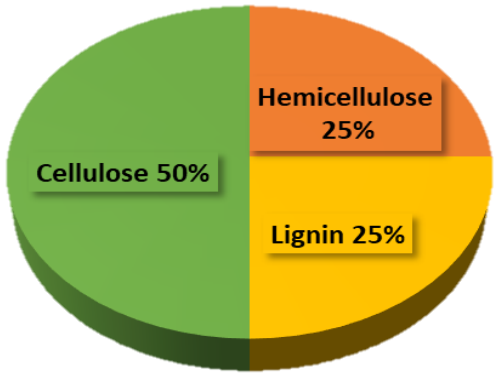
Lignocellulosic biomass

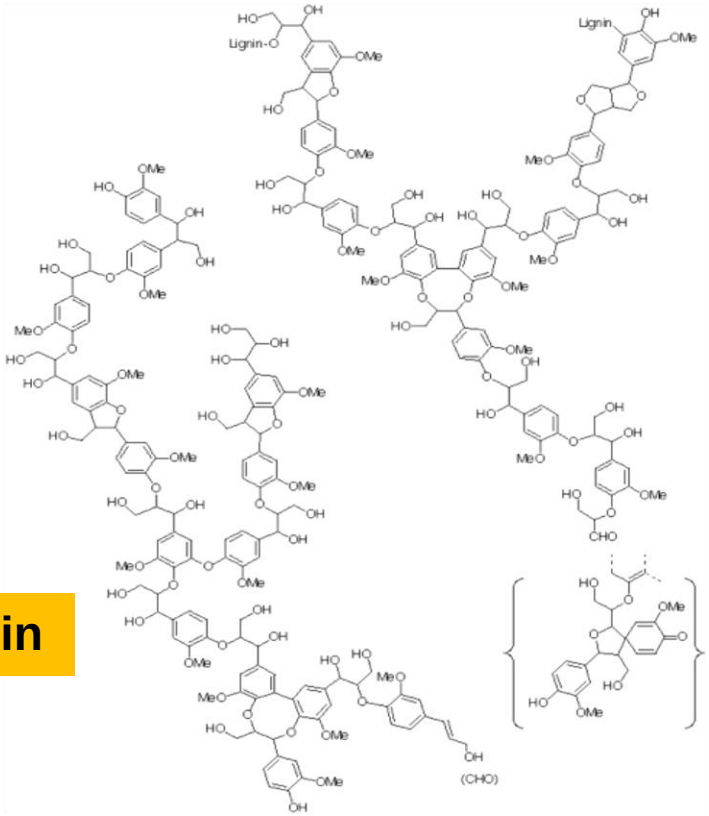


Hemicellulose



Cellulose

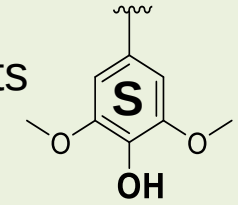


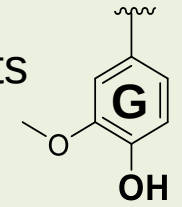


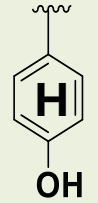
Lignin

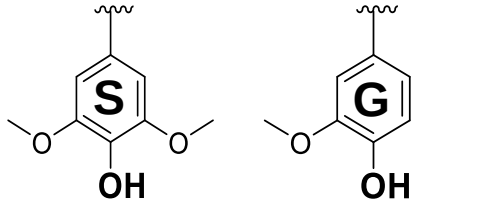
Structural differences between plant species

Phenolic units

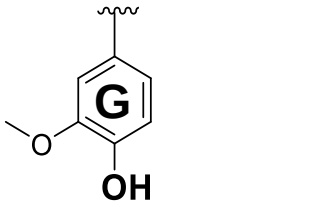
Syringyl units 

Guaiacyl units 

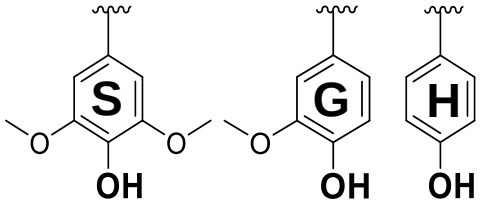
p-coumaryl units 



Hardwood



Softwood



Herbaceous

Lignocellulosic biomass fractionation

Aqueous organic solvent

T, catalyst

Organosolv process

Solid

Cellulose-rich RESIDUE

Black liquor

Water

Solid

LIGNIN

Liquid

HEMICELLULOSE

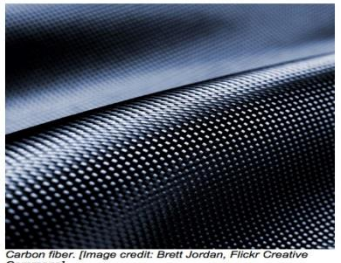
Lignin applications

Antioxidant

https://www.acs.org/content/acs/en/pressroom/presspacs/2016/acs-presspac-june-8-2016/lignin-from-plants-boosts-the-effectiveness-of-sunscreen.html

Lignin acts as a free radical scavengers;
Lignin's natural antioxidants properties provides use in cosmetics and topical formulations.

Carbon fibers



Carbon fiber. [Image credit: Brett Jordan, Flickr Creative Commons]

https://www.nics.tennessee.edu/carbon-fiber

Native lignin or industrial lignin can be used for carbon fibers

Board binder

https://www.wur.nl/en/show/Biobased-coatings-and-binders-for-wood.htm

Lignin along with a diisocyanate used for production of fiberboards, particle boards, wood fiber insulation boards, etc.

Foams

https://lsre-lcm.fe.up.pt/projects/44

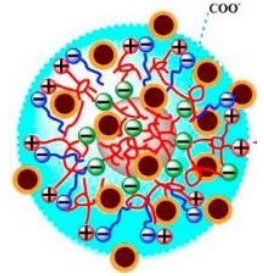
Lignin based rigid polyurethane foams are excellent in flame retardance

Dispersants

https://www.ncbi.nlm.nih.gov/pubmed/29642602

Chemically modified lignin has been used as a dispersing agents, complexing agent, flocculent, thickener or auxiliary agents for coatings, paints or adhesives.

Controlled release

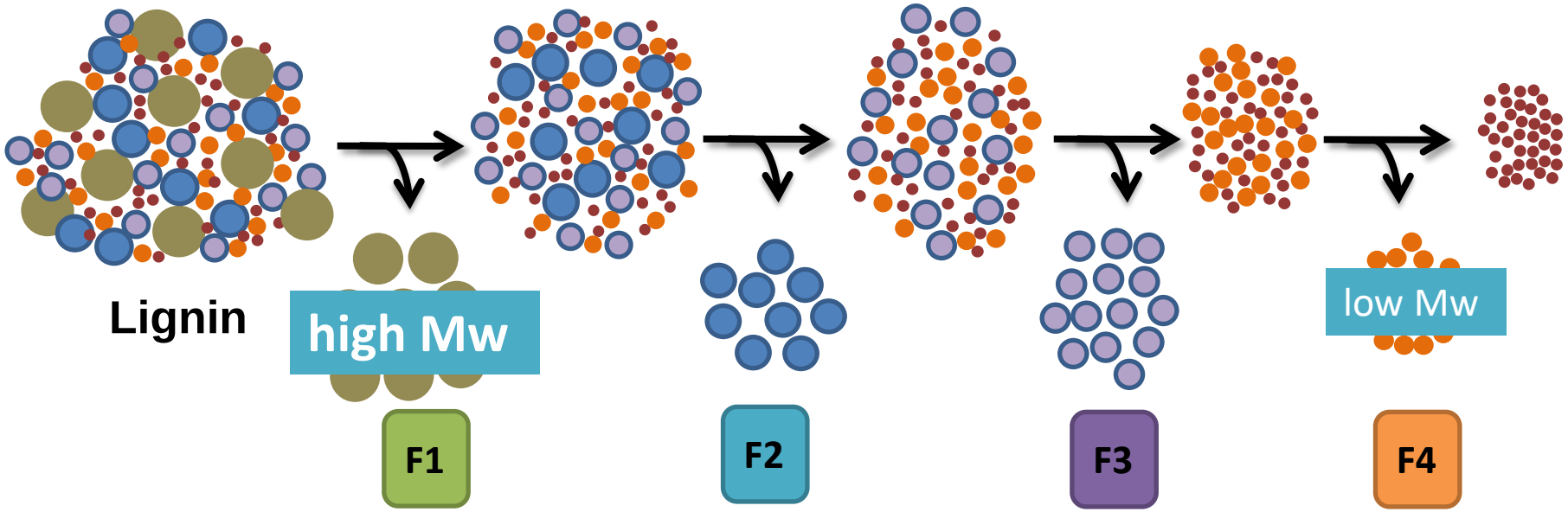


https://www.sciencedirect.com/science/article/abs/pii/S138589471731166X

pH-responsive lignin-based complex micelles as oral drug delivery carriers

Lignin fractionation

How does fractionation enhance lignin valorization?



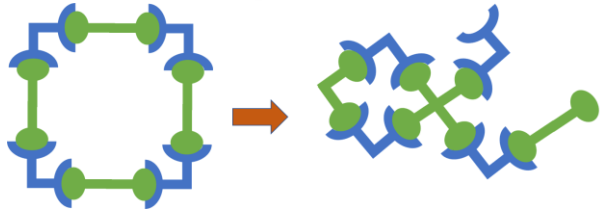
Improve flame retardancy of the material

GREEN-LOOP

Improved properties of the polymeric material

ESTELLA

HyPELignum



GREEN-LOOP

Sustainable manufacture systems towards novel bio-based materials

GREEN-LOOP solutions

- Design and optimize 3 innovative bio-based materials and components for industrial sectors: construction, packaging, food, beverage, appliances and tooling.
- Multifunctional panels rubber panels with fire resistance and vibrational applications;
- Bioplastic bottle closures for oil and fruit juice;
- Wood composites bearings for plastic injection machines.

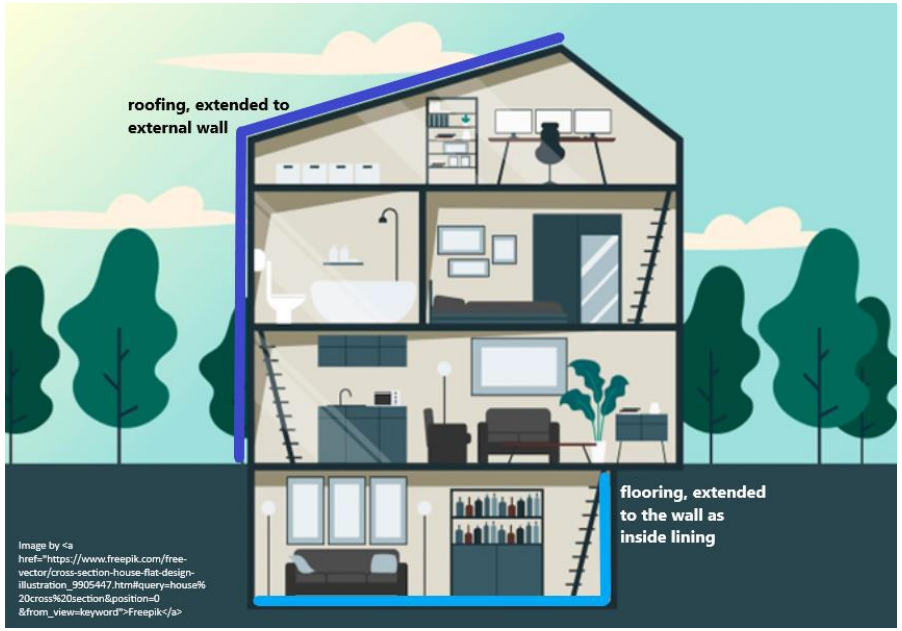


Figure 1. Schematic drawing of the intended installation of the bio-rubber based products.

https://www.greenloop-project.eu/en/home/

ESTELLA

DESign of bio-based Thermoset polymer with rEcycLing capabiLity by dynAmic bonds for bio-composite manufacturing

Challenge

- Thermoset polymeric composites are widely used in almost every industrial sector, where both lightness and great mechanical performance are required.
- However, due to their crosslinked microstructure, thermoset composites cannot be reprocessed or recycled, which means that after their useful life disposal is usually the only alternative.
- At the end of their life, most thermosetting composites end up burned or accumulated in landfills, leading to health and environmental problems.

ESTELLA

DESign of bio-based Thermoset polymer with rEcycLing capabiLity by dynAmic bonds for bio-composite manufacturing

ESTELLA solution

- Design of novel bio-based epoxy resins with inherent recyclability capabilities thanks to the introduction of Covalent Adaptive Network (CAN) in the original epoxy structure.

- CAN will provide the thermosetting epoxy resin with the ability to respond to certain stimulus that change the state of its microstructure and thus, the ability to be reprocessed/re-polymerized (return to original monomers and fibres).

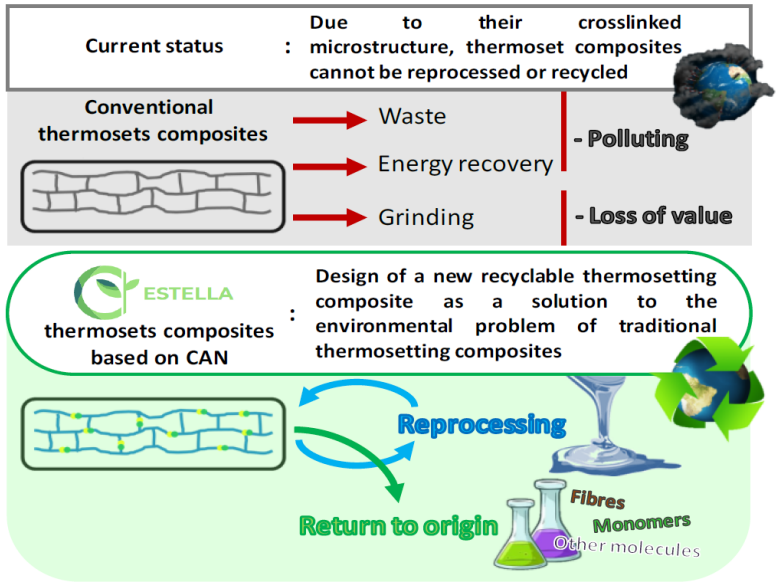


Figure 1. Scope of the ESTELLA project.

https://estellaproject.eu/

ESTELLA

DESign of bio-based Thermoset polymer with rEcycLing capabiLity by dynAmic bonds for bio-composite manufacturing

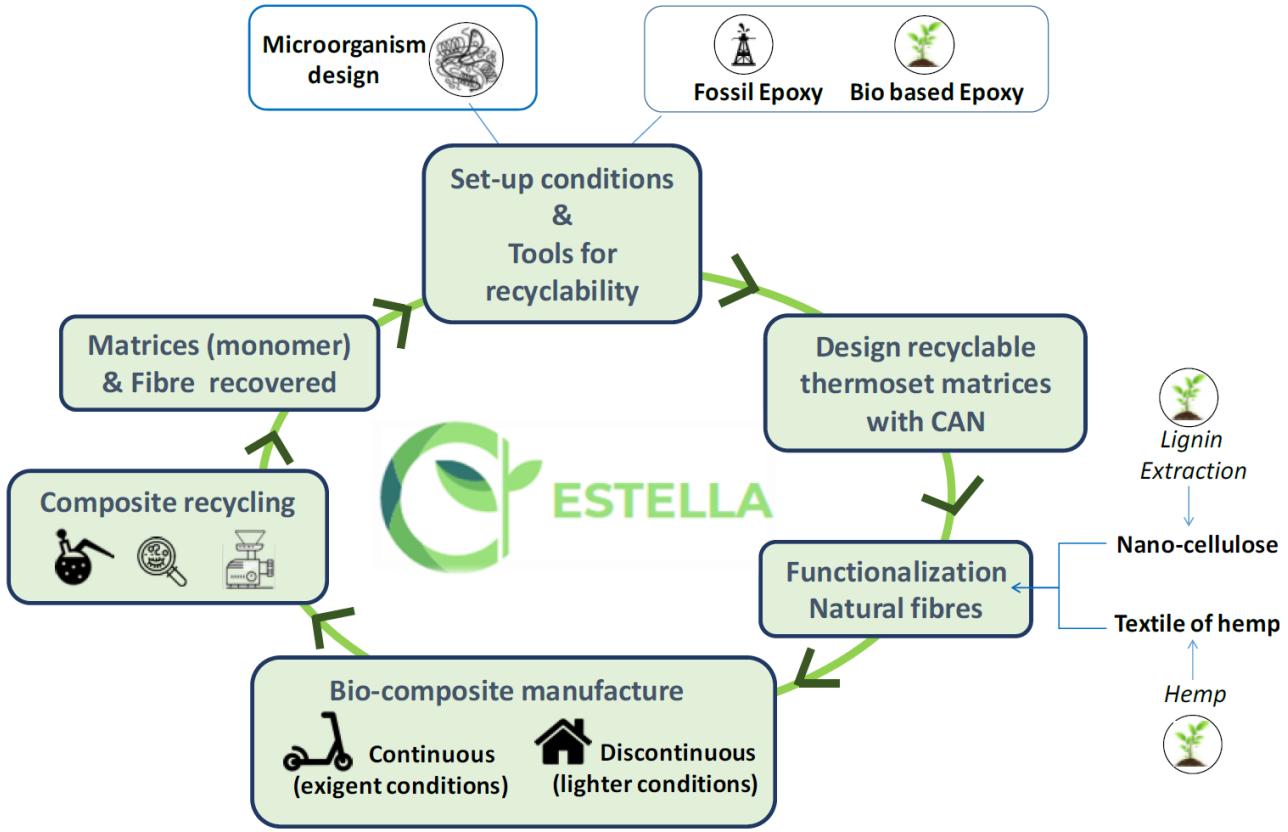


Figure 4. ESTELLA's methodology scheme.

https://estellaproject.eu/

ESTELLA

https://estellaproject.eu/

HyPELignum

Exploring wooden materials in hybrid printed electronics: a holistic approach towards functional electronics with net zero carbon emissions

Challenge

- Currently, electronics are responsible for heavy pressure on our environment in the form of, for example, need for scarce and environmentally impacting resources, high energy and resource demanding manufacturing processes and large disposal rate.

Ambition

- Demonstrate that manufacturing of electronics with net zero carbon emission is achievable by implementing a holistic approach, centered on additive manufacturing and wooden and wood derived materials.

- Explore wooden and wood derived materials in additive manufacturing of electronics are various.

https://www.hypelignum.eu/

Exploring wooden materials in hybrid printed electronics: a holistic approach towards functional electronics with net zero carbon emissions

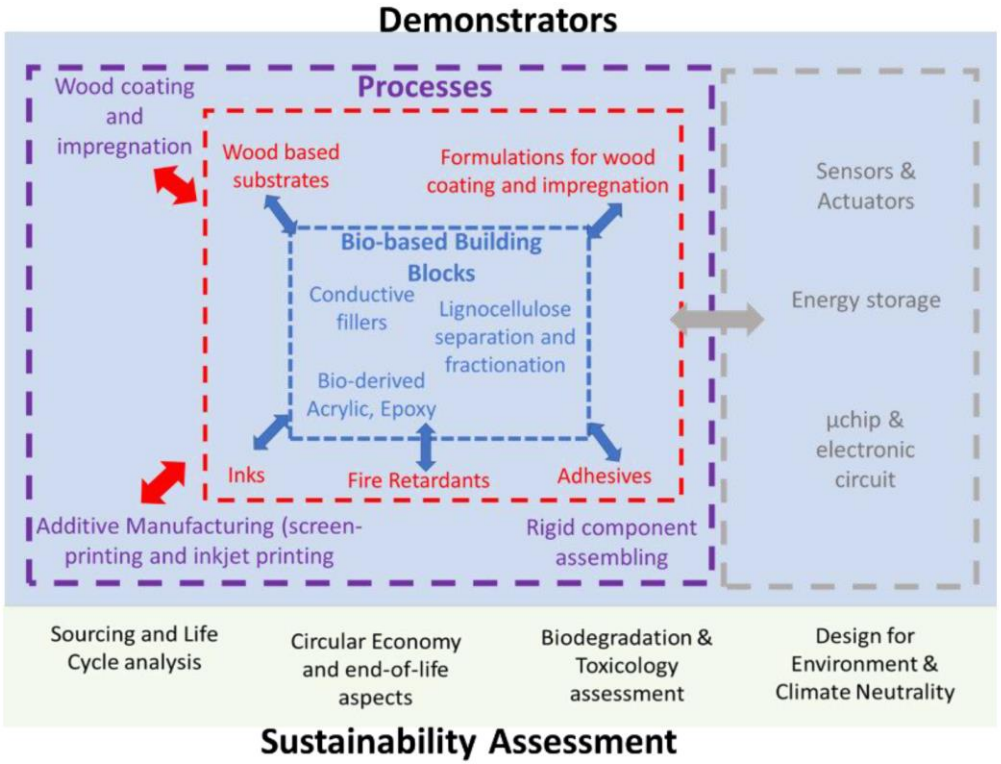


Figure 5. Pictorial representation of the activities within the three main blocks of work (bio-based building blocks, processes, demonstrators and sustainability assessment), and the relations between these aspects in HYPELIGNUM.

https://www.hypelignum.eu/

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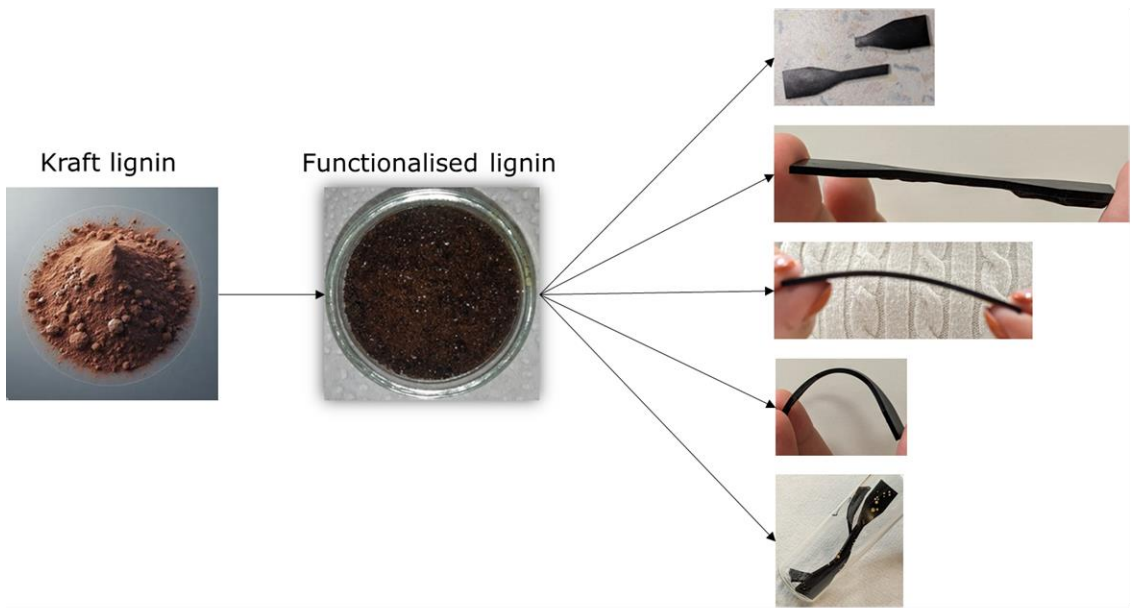
National Institute of Chemistry

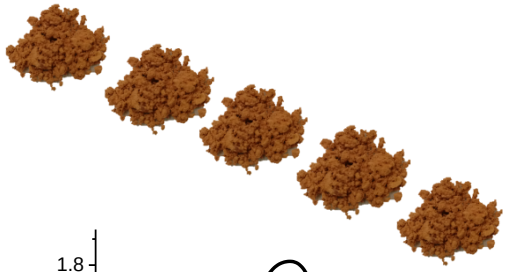
- Prepare reprocessable epoxy resins based on lignin and/or lignin monomers for different applications

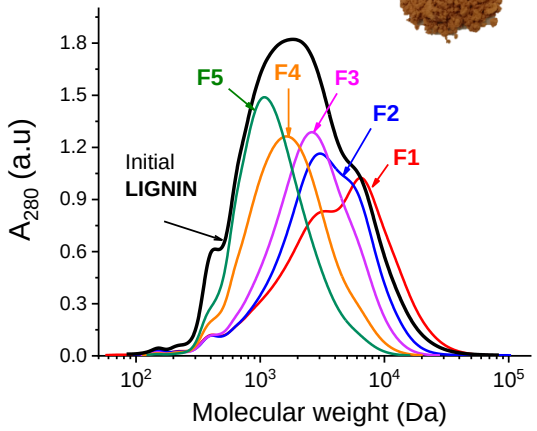


Conclusion

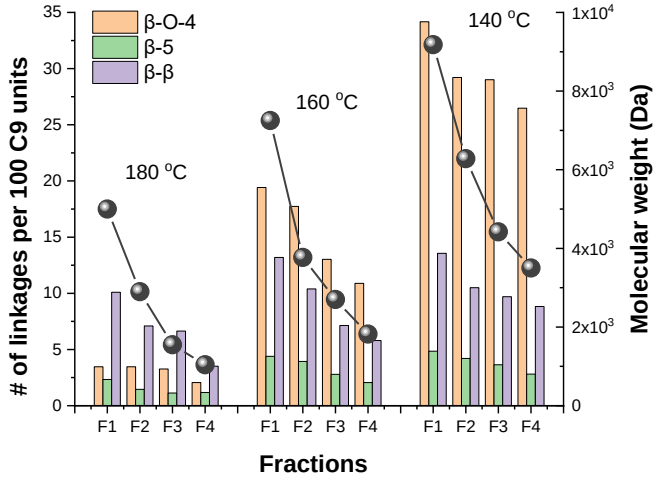
Black liquor

Fractionation

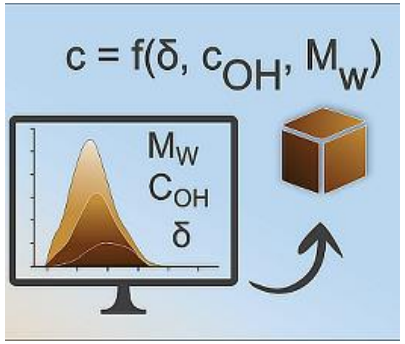




Relationships



Mathematically described process



Javna agencija za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije
Horizon Europe
GREEN-LOOP
ESTELLA
HyPELignum