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Anticipatory LCA to promote informed decision-making in bio-based product development

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BIORING
High-performance Biocoatings

Super Bark

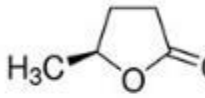
Novel lignocellulose fractionation process for high purity lignin, hemicellulose and cellulose valorization into added value products

FRACTION

Duration: 1 June 2021 to 31 May 2024

https://fraction-project.eu

GVL/WATER FRACTIONATION



- High biomass loading
- Feedstock flexibility
- Mild conditions
- Downstream processing within the solvent
- Closed solvent loop
- Adjustable yield and high purity of streams

Starting trials at lab scale (TRL3), to bench scale (TRL4-5)

CELLULOSE VALORIZATION

- Validation of higher grade cellulose for added value products

LIGNIN VALORIZATION

- Validation of lignin as polyol substitute in PU formulation
- Production of phenolic compounds used in resin synthesis

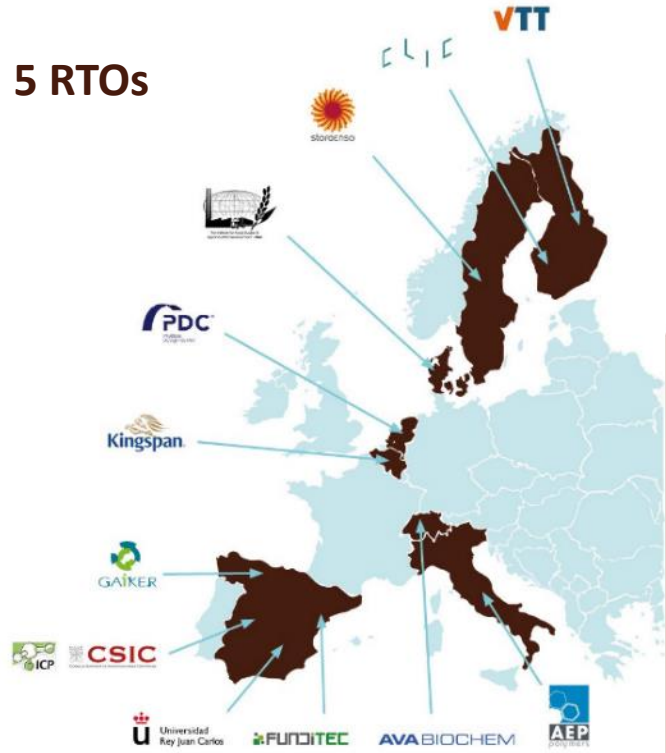
HEMICELLULOSE VALORIZATION

- Direct hexose conversion into lactates
- Pentose conversion into furfural, followed by 3 different chemicals: maleic acid, succinic acid and 1,5-pentanediol
- Hexose conversion into ketoses and fructose for 5-HMF production

2 Large Companies

5 SMEs

5 RTOs



This project has received funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement 101023202. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.

Novel lignocellulose fractionation process for high purity lignin, hemicellulose and cellulose valorization into added value products

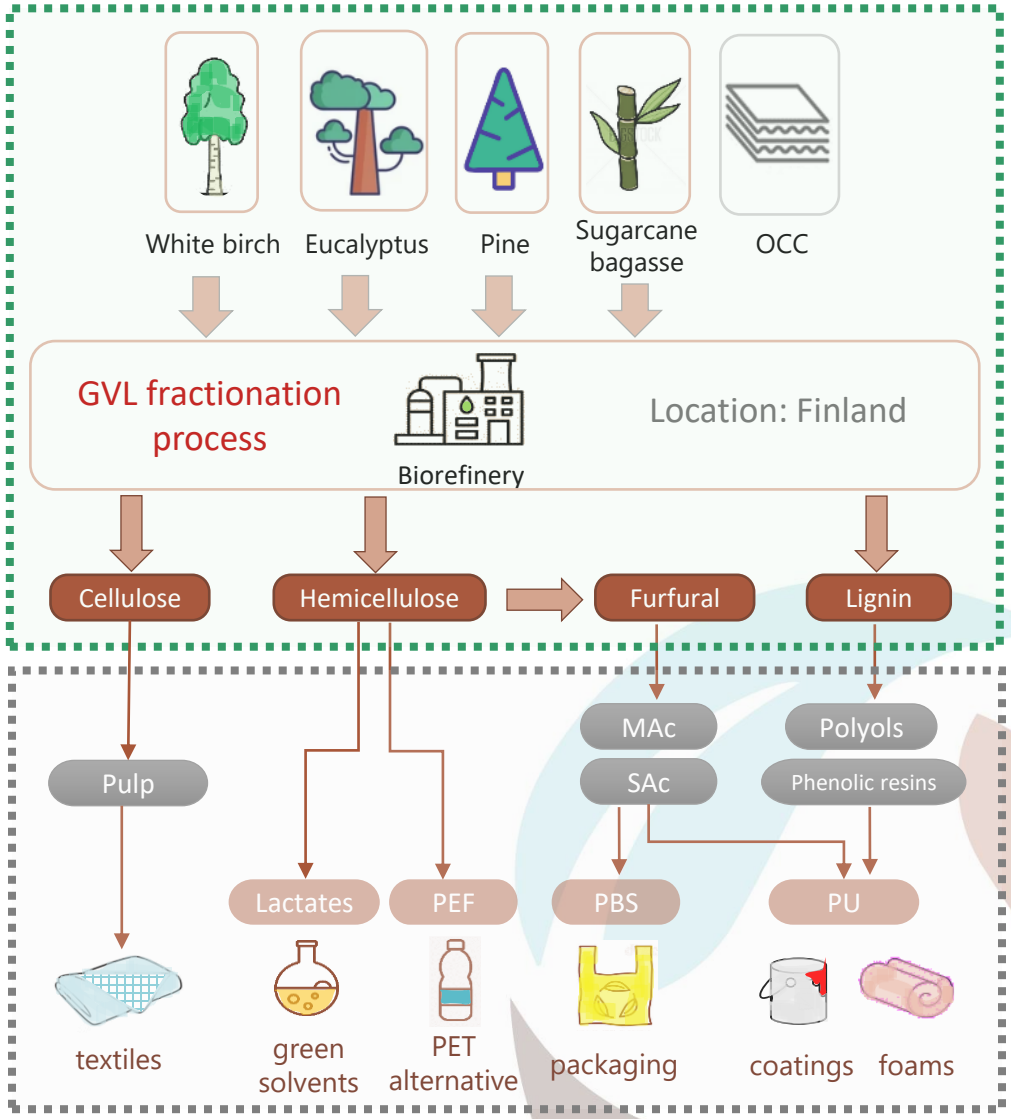
FRACTION

General project objectives:

- Demonstrate a novel lignocellulose biorefinery scheme at TRL 4-5
- Keep a high value cellulose stream
- Obtain high yield and high quality hemicellulose and lignin streams
- Demonstrate the sustainability and techno-economic viability

✓ **TECHNO-ECONOMIC ASSESMENT (TEA)**
✓ **LIFE CYCLE ASSESSMENT (LCA)**

✓ Evaluate each biomass feedstock
✓ Optimise and upscale fractionation process
✓ Model and upscale each downstream process route
✓ Benchmark with market products



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Challenges in the LCA

- **Inventory data collection**

  Multiple processes and sub-processes, at lab-scale or pilot scale
  Scaling and optimisation was done using ASPEN PLUS (for the TEA)
  Scenarios considering different yields and different disposal routes were analysed in the LCA

- **Data gaps**

  Inventories were complex and several chemicals were not found in the Ecoinvent or EF databases.
  For some of them, stoichiometry modelling was performed considering standard synthesis routes. For others, proxies were used based on literature data

- **Allocation**

  Different system limits were used: for the fractionation process (transforming biomass into cellulose, hemicellulose and lignin) the FU was 1 ton of biomass processed. For the intermediate or end-products, the FU was 1 kg of product
  3 allocation approaches were compared: mass, economic and energy allocation

- **Biogenic carbon**

  The EF methodology does not exclude biogenic carbon, hence it was included in the calculations

- **Benchmarks**

  When compared with their conventional (fossil-based) analogues, many bio-based products performed worse in terms of environmental impacts (due to energy-related issues), in particular for some categories such as Climate Change, Land Use or Water Use

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