YEAR BOOK 2021
Post-doctoral researchers

Laboratory of Pulp and Paper Science and Graphic Arts

A joint research unit CNRS – Grenoble-INP (UMR 5518)

Hélène CURMI
Post-doc (2019-2021)
LGP2 (C. Chirat; D. Lachenal)

Study of the degradation of the black liquor components during its hydrothermal treatment

Etude de la dégradation des composants de la liqueur noire lors du traitement hydrothermal

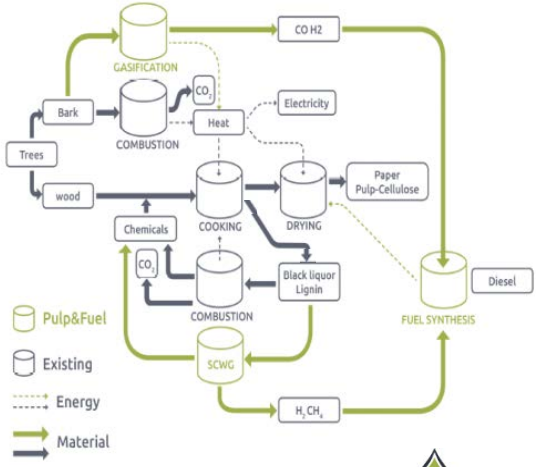
Context

Transport sector

- **25%** of EU **greenhouse gas emissions**
- **95%** of **fossil** fuel
- EU objective : **10%** alternative fuels in 2020

- Limitations in biomass availability
- Avoid indirect land use change effects
- Need for **advanced** and **sustainable biofuels**

Valorize pulp and paper mill residues into biofuels thanks to gasification



10 Partners from 4 countries
Oct 2018 – Sept 2022
Budget **4.9 M€**

PULP&FUEL
pulp and paper industry waste to fuel

This project have received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 818011.

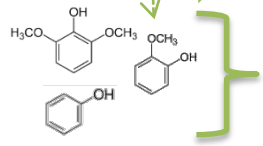
Objective

Post-doc objective:

Study of the degradation of the black liquor components during its hydrothermal treatment

- Understand and identify lignin depolymerization steps
- Looking for interesting phenolic compounds

Lignin → **SCWG*** → H_2, CO_2, CH_4

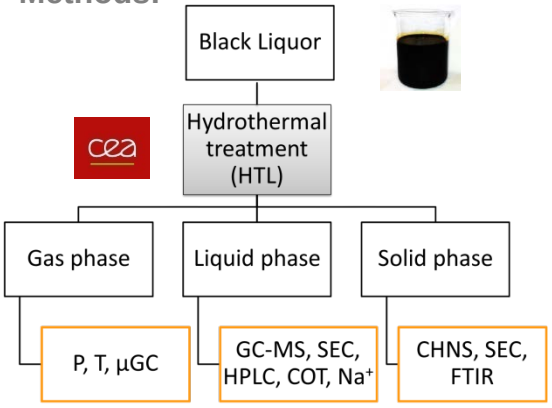


To replace petroleum based compounds

*** Supercritical Water Gasification**

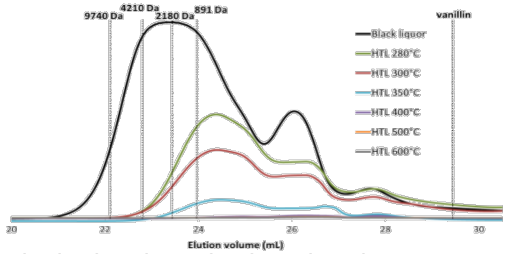
Critical point : 374°C ; 22.1 MPa

Methods:



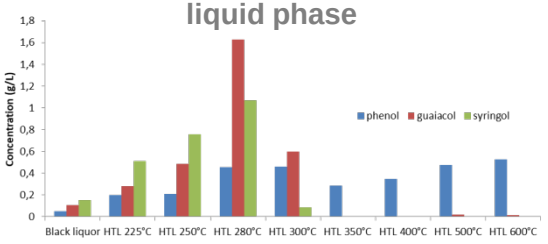
Results

Size Exclusion Chromatography of liquid phase

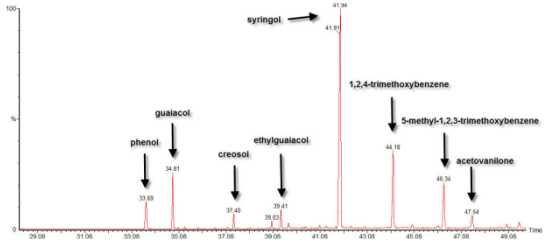


- Lignin depolymerization already occurs at low temperature

Search for molecules of interest in liquid phase



- **280°C** is the optimal temperature
- A yield of **55g per kg** of lignin in black liquor has been achieved



- Other compounds have also been extracted

Clémentine Darpentigny
Post-doc (2020-2022)
LGP2 (Evelyne Mauret, Alain Dufresne)

Formulation and process optimization of multilayer papers

Optimisation de la formulation et des procédés de production de papiers multicouches

Context

Cotton fibres: environmental and ethical concerns

Eucalyptus fibres: a hardwood source present in Europe

Comparison of fibre production impact
Life cycle analysis

Improvement of paper properties

Cellulose nanofibrils (CNFs)

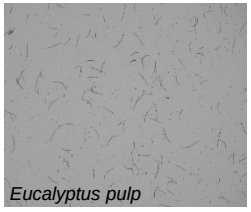
- Bio-based and renewable
- Versatile
- Good mechanical properties
- Commercial availability

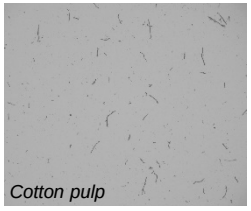
Industrial group collaboration

Methods

Raw materials characterization

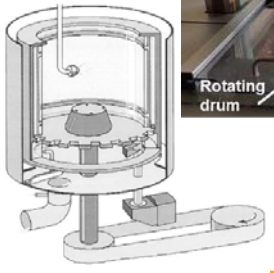
Refining degree, fibre morphology (MorFi), water retention value

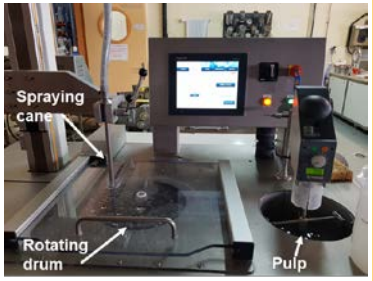




Paper formation

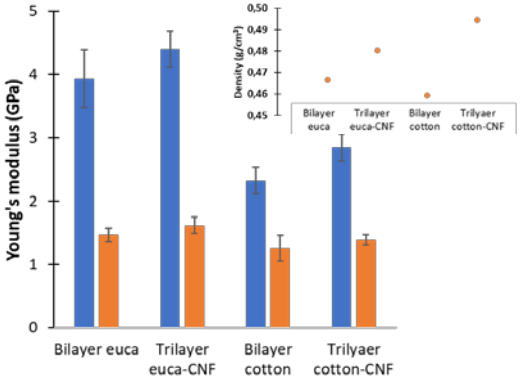
Static former (Rapid-Kothen)
Multilayer papers of eucalyptus or cotton pulp & CNFs using dynamical handsheet former





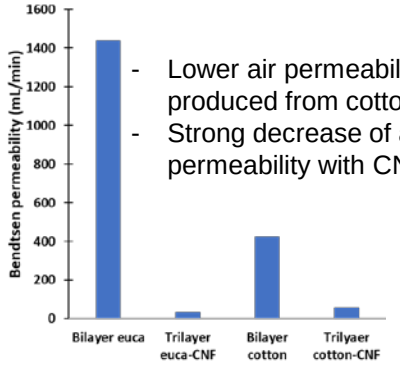
Results

Mechanical properties



Increase of Young's modulus with CNFs

Air permeability



- Lower air permeability for paper produced from cotton pulp
- Strong decrease of air permeability with CNFs

Internal cohesion force

- Eucalyptus > cotton
- ↘ with intermediate layer of CNF

Claire MONOT
Post-doc (2020-2021)
LGP2 (N. Marlin; G. Mortha)
CTP (A. Burnet)
FCBA (D. da Silva Perez)

Production of dissolving pulp by a DES-based process

Production de pâte à dissoudre par un procédé à base de solvants Eutectiques Profonds (DES : Deep Eutectic Solvents)

Context

DES cooking

- DES: mixture of 2 non toxic, cheap and natural compounds which is liquid at ambient temperature
- Compared to kraft cooking:
  - Decrease of energy consumption and CO_2 emissions
  - Decrease of mechanical properties (↘ hemicelluloses)

Dissolving pulps

- Growing market
- Using energy-consuming and CO_2-emitting processes
- Need small hemicelluloses content and high brightness

Objectives

Production and bleaching of DES pulps in order to produce dissolving pulps using less energy than a conventional process

Funded by INSTITUT CARNOT PolyNat

In collaboration with CTP and FCBA

ctp centre technique du papier

FCBA INSTITUT TECHNOLOGIQUE

Methods

DES cooking development

Modification of parameters:

- Wood humidity
- Cooking time
- Temperature
- H-factor
- Autoclave filling rate
- Pulp washing

Bleaching sequence development

- Classical stages: D, E_P, E_{OP}, O, P, Z
- Modified D stage (D_{alk}: alkaline D stage)

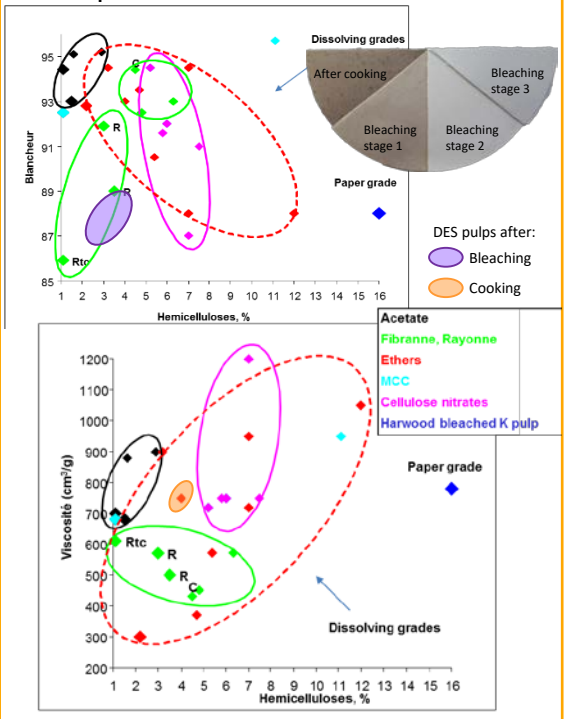
Pulp analyses and extracted lignin characterization

- Kappa number
- Degree of polymerisation of cellulose
- Saccharides rates
- Brightness
- UV-visible spectroscopy of lignin

Results

Pulp properties

- Just after cooking, the hemicelluloses content is already in the range required for dissolving pulps
- Adequate brightness after bleaching sequence



Brightness and viscosity versus hemicelluloses content for different types of dissolving pulps