



Gloria Ifunanya NGENE

Ph.D. thesis (2018-2021)
LGP2 (ROUX, Jean-Claude; LACHENAL Dominique)

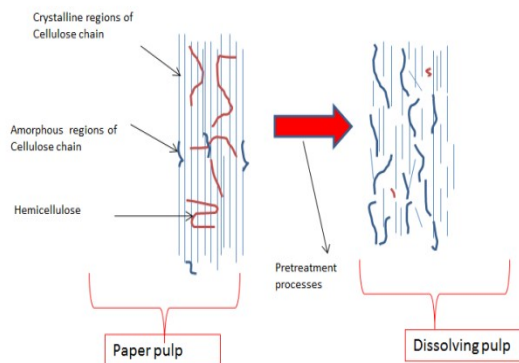
Coupling refining and chemical or enzymatic treatments for the removal of hemicelluloses from paper pulp.

Couplage du raffinage et des traitements chimiques ou enzymatiques pour l'élimination des hémicelluloses de la pâte à papier.

Context

Upgrading paper pulp to dissolving pulp.

- Pure cellulose is a green and sustainable alternative for the production of chemicals and materials.
- Expanding market for dissolving pulp (textile production, cellulose derivatives and nanocellulose).



Challenges

- Elimination of residual hemicellulose and improved reactivity of cellulose to direct dissolution and derivatization.

Proposed solution

- Mechanical treatment (refining) prior to hemicellulose extraction.

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Methods

Mechanical treatment

- Pulp was refined on a valley beater and pfi mill.

- The bedplate is a smooth rotating disk.
- The gap size is fixed.
- The extent of refining depends on the refining revolution.
- It is a high energy low intensity refiner.
- The bedplate is fixed and has some kind of bars and grooves.
- The gap size can be adjusted manually by changing the refining load.
- The extent of refining depends on the refining load and time.
- It imposes a cyclic compression and shear forces on the fibers as they flow through the plate.

a. unrefined pulp
b. Valley beater refined pulp
c. pfi refined pulp

Evolution of fiber characteristics with refining

Sample	Unrefined	Valley beater	PFI
SR	1.0	0.5	0.5
Fiber width (µm)	2.0	2.1	2.2
WRV (%)	0.1	0.1	0.1

- Fines fractionation with the Bauer McNett fiber classifier.

Hemicellulose Extraction

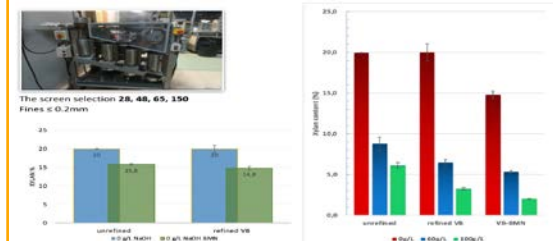
- Cold caustic extraction (CCE) of unrefined and refined pulps at NaOH concentrations of 60g/L and 100g/L.
- Xylanase treatment at 50 U/g and 500 U/g

Characterization techniques

- Morfi, HPAEC-PAD, SEM , 13 C-NMR, GPC-MALLS.

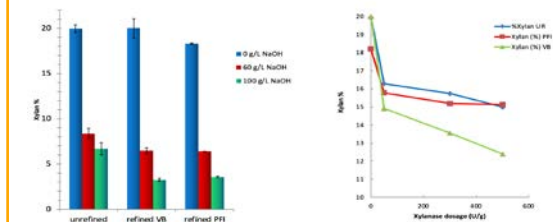
Results

Effect of fines fractionation prior to CCE on xylan extraction



Fines fractionation reduces the initial xylan present in the refined pulp by about **25% prior to CCE**.

Extraction performance depicted by the residual xylan content before and after the CCE and xylanase treatment



- A soda concentration of 100g/L **removes 50% more xylan from refined pulp compared to unrefined pulp.**
- Similar xylan removal performance for both Valley beater and pfi refined pulps to the CCE treatment
- Influence of the refining technology was visible in the xylanase treatment. The best result was obtained with the Valley beater.

