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Ph.D. thesis (2018-2022)
LGP2 (N. Marlin; G. Mortha)

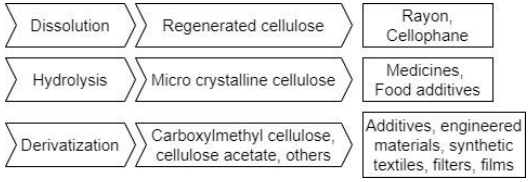
Novel use of hydrogen peroxide to convert bleached kraft pulp into dissolving pulp and microfibrillated cellulose

Nouvelle utilisation du peroxyde d'hydrogène pour convertir la pâte kraft blanchie en pâte à dissoudre et en cellulose microfibrillée.

Context

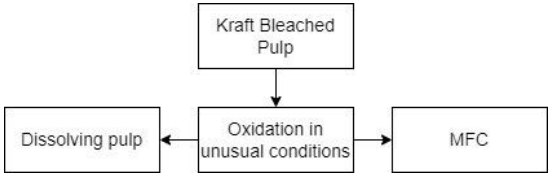
Dissolving Pulp

- Increasing market in order to replace petroleum-based polymers, plastics and textile fibres.
- Until today, is mainly produced by the Prehydrolysis Kraft (PHK) and Acid Sulphite (AS) processes. ***But, not Kraft.***
- Main applications of dissolving pulps:



DRAWBACKS: Current ways of production are very polluting and/or depolymerize cellulose.

Objectives: 2 main products



Microfibrillated Cellulose (MFC)

Provides new functionalities and potential applications to cellulose in suspension or in the solid state. But, *Manufacturing challenges*

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Methods

Six cellulosic substrates were studied and *unconventional* conditions were used for the *oxidation trials with* H_2O_2

Characterization

Cellulose DP_v, Molar Mass Distribution, %ISO Brightness, cellulose crystallinity, sugar content and pulp morphology.

Development of a Method

The Dissolving ability was monitored by Dynamic Light Scattering (DLS) along the derivatization of cellulose, a method proposed to avoid using CS_2 as in the commonly used method, FOCK TEST.

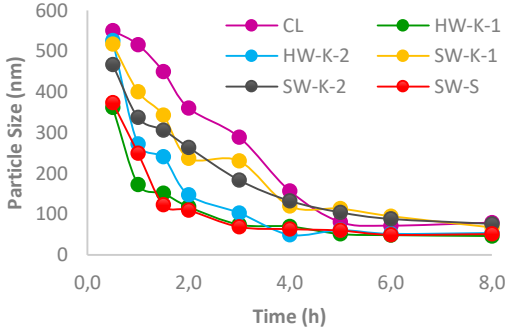

Figure 1. The average particle size observed during cellulose dissolution using DLS in the reference cellulosic substrates.

<u>The method</u> presented good ability and repeatability to differentiate the reactivity of various cellulosic substrates.

Yet, it did not correlate with the Fock Test when comparing different substrates.

Results

Oxidations with H_2O_2

At the end of the derivatization reaction, the samples are ready for HPSEC analyses to obtain MWD and PDI. *Advantage of the method.*

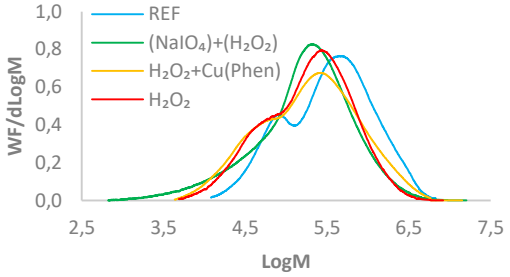

Figure 2. MWD after oxidation of HW-K-2

For all cases, cellulose DP_v was affected after oxidation. A more uniform MWD profile was observed when applying $(NaIO_4)+(H_2O_2)$ oxidative system (Fig.2). Desirable purity and viscosity ranges were achieved for dissolving pulp applications.

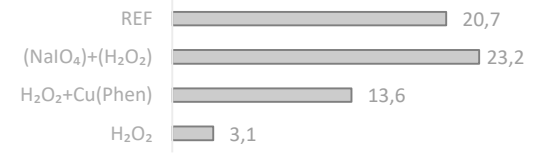

Figure 3. Energy consumption (MWh/t) for MFC production.

Compared to the reference pulp, 58% less energy was required for MFC production when using H_2O_2+Cu(Phen) oxidation, with similar characteristics to the best conditions obtained with $(NaIO_4)+(H_2O_2)$ system.

Biochip

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