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Ph.D. thesis (2023-2026)
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Clean process for dissolving wood cellulose for the production of textile yarn

Procédé propre de dissolution de cellulose de bois pour la production de fil textile

lgp²

Biochip

Context

Dissolving pulps
- Expanding market for dissolving pulp (textile production, cellulose derivatives and nanocellulose)
- Wood pulp or cotton linters with high cellulose content (>90 %) and distinct properties
- Main methods to obtain dissolving pulps: Kraft pre-hydrolysis (PHK), and acid bi-sulphite (AS)

Regenerated cellulose
- Chemically modified cellulose deriving from dissolving pulps or cotton linters
- Cellulose derivatives that can be obtained: viscose, lyocell, cupro and acetate

Natural fibers
- Viscose: polluting production process (use of CS_2)
- Lyocell – Cupro: expensive production processes
- Cotton: high consumption of water, demand for more arable land, use of pesticides

Synthetic fibers
- Fossil-based derivatives
- 64 % of the global fiber market
- Release of microplastics even if recycled

Objectives

Optimization of cellulose oxidation and dissolution to produce textile yarns

- Optimization of $NaIO_4$ – $NaClO_2$ oxidations to produce oxidized cellulose with high amount of COOH groups and without severe degradation of DPv
- Enhancement of cellulose dissolution in alkaline medium
- Increase cellulose accessibility by using pre-treatments (mercerization, mechanical refining, high consistency mixing)
- Recycling of $NaIO_4$, replacement of $NaClO_2$ to chlorine free oxidant
- Regeneration of dissolved cellulose to yarns with properties comparable to viscose yarns
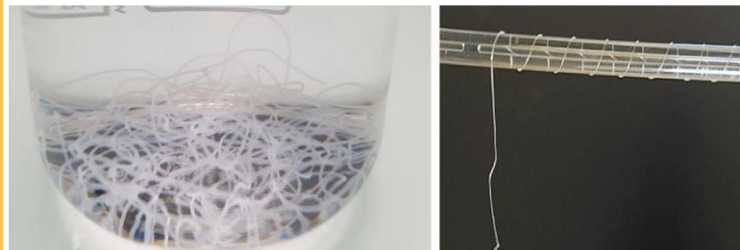
Methods

Two-step oxidation, $NaIO_4$ – $NaClO_2$

AGU unit → Di-aldehyde cellulose (DAC) → 2,3-dicarboxy-cellulose (DCC)
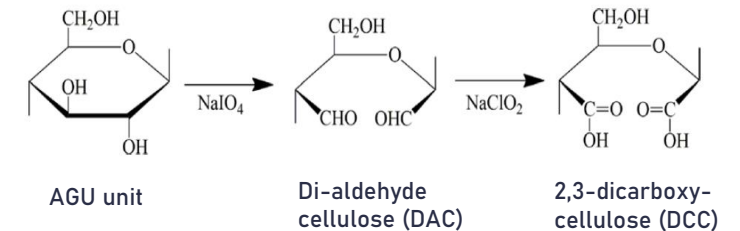
Cellulose dissolution

Regeneration of dissolved cellulose to yarns

Chacterization methods :
- Carbonyl (HCO) measurement by titration
- Carboxyl (HCOOH) content by conductometric titration
- Viscosity – degree of polymerization (DPv) of the oxidized cellulose
- Dissolution yield