

THE INFLUENCE OF PREHYDROLYSIS KRAFT CONDITIONS ON PULP FOCK REACTIVITY

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ABSTRACT

Regenerated cellulose is a sustainable material made from renewable resources such as wood pulp, cotton linters and other lignocellulosic materials. Its properties, like biodegradability, versatility, absorbance, and softness make its fibers a natural alternative to synthetic materials from non-renewable resources.

Within renewable resources, dissolving pulp produced by prehydrolysis kraft (PHK) cooking is one of the most sustainable alternatives.

Cotton linters is an excellent source of cellulose, but the water high requirement and the use of insecticides make this route hardly sustainable. For the moment, the sulfite process is often used to produce viscose rayon, but it is a process with some environmental concerns, mainly due to the release of sulfur dioxide into the atmosphere. For this reason, in the last 5 years, PHK cooking kept growing and surpassed sulfite cooking as the main dissolving pulp production from wood. The adaptability to different raw materials and the chemical's higher recovery efficiency are some of the advantages of this process. Additionally, when properly assessed, it allows the removal of hemicellulose and lignin as subproducts and their valorization in line with the biorefinery concept.

In this work, dissolving pulps with different hemicellulose content was produced by the PHK process under different operating conditions. Their sugar composition, including hemicellulose content, kappa number before and after bleaching, final viscosity (cellulose degree of polymerization), crystallinity index, metal content, WRV, etc.) were determined and correlated with the Fock reactivity, which is related to the dissolving potential of the pulps.

Although, the principles underlying Fock reactivity and cellulose dissolution are distinct (Fock reactivity gauges the quantity of free hydroxyl groups available for chemical reactions and cellulose dissolution evaluates the pulp's capacity to dissolve in a specific solvent), under conventional circumstances the higher the Fock reactivity the greater the pulp's propensity to undergo chemical modification, including dissolution.

A prehydrolysis kraft pulp containing less than 2.5% hemicellulose, which was cooked in a flow-through mode, exhibited a higher Fock reactivity than a prehydrolysis kraft pulp produced by batch mode with 5% hemicellulose content (65% vs 52%). To evaluate the impact of hemicellulose content on pulp reactivity, bleached kraft paper pulps, with hemicellulose content of 16.2% were used for comparison.

The potential of recycled pulp was also evaluated. As expected, the Fock reactivity of the original recycled pulp was extremely low due to its high hemicellulose and lignin content. To overcome this expected low reactivity, the recycled pulp was submitted to three successive chemical treatments: an acid stage to remove hemicelluloses, a second stage with NaOH and Na₂S to remove lignin and other contaminants, and a final bleaching stage. After this process, the hemicellulose and lignin contents were reduced to 4% and 1%, at the expense of a yield loss of 32.7%. The final viscosity was in the range of 400–500 cm³/g and the Fock reactivity increased to 35-40%, which requires improvements when compared with the 90% reactivity of industrial dissolving pulps but represents one additional alternative for the integration of these materials in the circular economy.

Keywords: Dissolving pulp, Fock test, Prehydrolysis Kraft, Recycled pulp.