CELLULOSE PULP REFINING WITH ENZYMATIC PRE-TREATMENT FOR TISSUE PAPER MANUFACTURING

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ABSTRACT

Tissue Paper considered here is a product based on cellulose fibres, aimed to personal care and cleaning, such as toilet paper, handkerchiefs, towels, and napkins. Tissue Paper and Packaging Paper are two products that have considerably increased world demand for cellulose fibres, especially pulps from eucalyptus, whose production is dominated by more than 97% in Brazil. Much has been developed in manufacturing technology and in the final quality of these products over twenty years. However, energy consumption continues to be intensive in its manufacture. Reducing energy consumption has been of particular interest in the pulp and paper industry, due to cost control and scarcity of fossil fuels. The conventional mechanical refining treatment of cellulosic pulp, to obtain specific physical properties in the finished paper, through structural modification of the fibres, represents an energy-intensive process that requires minimization. The present work evaluates that potential energy, environmental and quality benefits for the product can be expected from the use of refining with enzymatic pre-treatment of cellulosic fibres in the production of tissue paper. Additionally, environmentally coherent solutions are sought that result in improvements in the quality of the paper product, for which enzymatic treatments can produce important benefits. The work explains the importance of refining as a stage in paper production, its principles, and its effects on the properties of cellulosic fibres, and therefore, on Tissue Paper. The main scope of the work is the description of the mechanisms of enzymatic refining, in partial or total replacement of mechanical refining, and the effects on the properties of the finished paper. For a better understanding of the scope, standardized testing procedures for Tissue Paper are described and the behaviour of these properties in an enzymatic refining process is analysed. As an example, it is presented here enzymatic refining of bleached eucalyptus pulp, never dried, aimed to evaluate the effects of commercial cellulases on the surface of fibres, as well as the impact of these effects during refining. After enzymatic pre-treatment performed in the laboratory under controlled conditions, the dried pulps were refined in PFI mill at various energy levels and the results were evaluated by physical-mechanical tests performed on handsheets. The data analysis shows that the dry fibre treated with one of commercial enzyme obtains values of tensile strength 31% higher and values of Scott Bond test 21 % higher than original pulps, both without mechanical refining. The dried fibre pre-treated with cellulase and refined in a PFI mill shows by design of experiments and surface response analysis that it was possible to obtain a value of Scott Bond 100 lb.ft/in² with a specific energy consumption 36% lower and a value of tensile strength 70 kNm/kg with a specific energy consumption 57% lower comparing to PFI mill refining without enzymatic pre-treatment . All results are illustrated by images of scanning electron microscopy (SEM), which showed an increase in the level of external fibrillation of fibres treated with enzymes.

Keywords: Energy Consumption, Enzymatic Refining, Papermaking, Physical Properties, Tissue Paper