

MORPHOLOGICAL AND STRUCTURAL MODIFICATIONS INTRODUCED BY XYLANASE-ASSISTED BLEACHING ON EUCALYPT PULP FIBRES

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ABSTRACT

The commercial application of the xylanase-assisted bleaching technology has emerged as a response from the Pulp and Paper Industry to the ever-increasing environmental regulations and to comply with internal environmental performance indicators of the mill. This derives mainly from the use of chlorine dioxide to bleach pulp to high brightness values, necessary for the production of high-quality printing and writing paper. Despite its high bleaching efficiency, chlorine dioxide generates some organochlorinated compounds (AOX). The search for "greener" alternatives included the use of oxygen delignification and the enzymatic technology. This biobleaching approach has found relative success on commercial scale, by having been found to allow the decreased use of chlorine-based bleaching agents, and thereby to reduce the load of AOX in the mill treatment plant and enabling operational efficiency and environmental benefits.

The results presented here are not especially directed towards the evaluation of the bleach-boosting ability of xylanase, which is something already extensively described by a number of previous studies. Instead, it is rather a more fundamental approach on the action of this enzyme on pulp, that could ultimately help to understand the physical and chemical phenomena that justify its benefit and their foreits use on an industrial scale. Therefore, on one hand, this work attempted to confirm the bleaching benefit of treating oxygen-delignified eucalypt kraft pulp with a commercial endo-xylanase, in terms of its ability to reduce the usage of traditional chemical bleaching agents in a typical ECF (elemental chlorine-free) bleaching sequence (OXDEpDD modified sequence). On the other hand, some of the most relevant morphological and structural modifications introduced by the enzymatic treatment on pulp were assessed.

Regarding savings with chemical bleaching agents, the conditions used in the xylanase treatment allowed to reduce the loads of chlorine dioxide and sodium hydroxide during the bleaching sequence by 20 and 10 %, respectively. Although no significant changes in fibre morphology were identified through fibre testing assays, a SEM analysis revealed some external fibrillation taking place on xylanase-treated fibres. Additionally, a novel enzymatic peeling analytic methodology provided interesting information concerning the distribution of xylan molecules inside the cell walls of the fibers, namely that both their amount and integrity are decreased following xylanase action. Furthermore, the X treatment was seen not to degrade the cellulose fraction of pulp and did not impair the papermaking quality of the bleached pulp.

Keywords: Chlorine dioxide savings, ECF biobleaching, eucalypt kraft pulp, green industry, xylanase

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