Reduced Recalcitrance and Improved Pulp Properties in Eucalypt Woods Pretreated with White-Rot Fungi and Mild Alkali

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Abstract

Eucalyptus globulus (EGB) is well suited for kraft pulping due to its physicochemical properties, whereas more recalcitrant woods require harsher thermochemical conditions to attain identical delignification levels. The pulp and paper industry is increasingly seeking solutions to efficiently explore recalcitrant feedstocks while reducing chemical usage during pulping and bleaching. The present work aimed at assessing whether biological and mild alkali pretreatments are able to reduce eucalypt wood recalcitrance and increase kraft pulping and bleaching efficiency. EGB, Eucalyptus nitens (ENT), and Eucalyptus urograndis (EUG) woodchips were pretreated with white-rot fungi (WRF) and/or 0.1 M NaOH. Results suggested that these pretreatments mainly act by breaking ester bonds involved in cell wall polymer cross-linking, promoting deacetylation, lignin detachment, increased cellulose accessibility, and woodchip impregnation during pulping. Combined WRF and mild alkali pretreatments substantially reduced wood recalcitrance and improved pulp properties. Residual lignin content (K#) was reduced by up to 9% in EGB, 15% in ENT, and 16% in EUG, whereas ClO2 consumption during bleaching was reduced by up to 16% in EGB, 19% in ENT, and 13% in EUG. These pretreatments can substantially reduce chemical requirements and lead to higher relative yields, ultimately reducing costs and environmental impacts of kraft pulping and bleaching.