Effect of pH, Temperature and Acid Source on Hot Acid/Chlorine Dioxide Bleaching of Eucalyptus Pulps

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ABSTRACT

The influence of hexauronic acids (HexAs) and Lignin-Carbohydrate Complexes (LCC) that the hexauronic acid associate with, has raised the awareness of acid pretreatment on the delignification and bleaching of eucalyptus pulps with oxidants such as chlorine dioxide, particularly in hot acid/chlorine dioxide stages. If oxygen delignification is practiced prior to multi-stage bleaching of eucalyptus pulps (which is common in many South American mills), then the pre-treatment conditions would have to be even more rigorous to have an effective bleaching to reach target pulp brightness and properties because of the lack of free phenolic groups in the lignin macromolecular structure in these hardwood pulps that affects delignification and brightening. The acid pretreatment conditions in hot chlorine dioxide stage while conducive to the removal of Hex'As, adversely affects acid hydrolysis of cellulose, resulting in yield and viscosity losses. Acid hydrolysis of glycosidic bonds in cellulose is a pH-dependent reaction and the rate of hydrolysis depends on the type of acid used and the temperature employed; protic acids like sulfuric acid and hydrochloric acid initiate acid hydrolysis differently than aprotic acids like acetic acids. Therefore, the nature of acid employed is critical in determining the rate kinetics of lignin removal and cellulose degradation in hot acid/chlorine dioxide stages. In this paper, the effect of pH, temperature and acid source on the rate kinetics of lignin removal and cellulose degradation in eucalyptus pulp during hot acid /chlorine dioxide delignification is reported and the consequences in improving pulp brightness and properties during multi-stage bleaching is discussed. Two acid sources, hydrochloric and sulfuric acid, both are protic acids, three temperature conditions (85ºC, 90ºC and 95ºC) and five reaction times (15, 30, 60, 90 and 120 minutes) are chosen to study the rate kinetics of lignin removal and cellulose degradation in hot acid/chlorine dioxide stages.