ACCESSIBILITY AND REACTIVITY OF CELLULASES IN GLYCERIN CONTAINING SOLUTIONS

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Research in recent years has shown that treatments of cellulose with glycerin containing solutions reduces the swelling properties of fibers. The effects obtained lead to improvements in fabric properties and wear comfort defined by parameters such as stiffness, handle and drape.[1] Short-time enzymatic hydrolysis is used in textile finishing to produce the same effect.[2] The influence of a combined process where enzymatic hydrolysis is conducted in a solution containing glycerin has not been studied so far.

In this study we tested enzymatic hydrolysis of lyocell and viscose fabrics in presence of glycerin mixtures (up to 40% glycerin in water). A commercial available total crude acid cellulase from *Trichoderma reesei* was used. The parameters characterized were weight loss in fabrics, quantities of reducing sugars produced and degrees of protein loss in liquor during treatment, as well as fabric properties like water retention value.

Cellulases are multi enzyme complexes wherein the main hydrolytic activities are due to endocellulases, cellobiohydrolases, and beta-glucosidases. Each main activity can be represented by standardized activity tests. Filter paper activity represents the synergistic activity of all cellulolytic active components. The activity test on carboxymethylcellulose monitors mainly the activity of endocellulases and the activity test on Avicel — a highly ordered form cellulose — shows cellobiohydrolase activity. After characterization of pH and temperature optima of treatment mixtures, the described activity tests were performed and hydrolysis rates were determined. An approximation of Michaelis-Menten kinetics was calculated. Examinations of K_m and v_{max} are only

valid for single enzyme examinations with first order reactions. However, this simplified model for the complicated synergistic action of cellulases was chosen to determine if changes in hydrolysis rates due to glycerin derive from changes in fiber structure or from the enzyme. The tests performed with cellulases showed that the data obtained was reproducible and calculations with Michaelis-Menten kinetics resulted in approximations of nominal K_m and v_{max}. Distinct trends in values could be observed only in treatments with mixtures containing up to 20% glycerin for tests with Avicel, 10% glycerin for tests with carboxymethylcellulose, and 2.5% glycerin for tests with filter paper.

It was found that with increasing amount of glycerin in mixtures, there was a decrease in the catalytic activity of cellulases. The effect of glycerin amount differed with fiber type: there appeared no discernible hydrolysis of lyocell fabrics in solutions containing more than 10% glycerin, while hydrolysis of viscose fabrics appeared to cease in solutions containing more than 20% glycerin. On measuring cellulase activities it was found that the nominal v_{max} decreased for all substrates with increasing glycerin concentration. The nominal K_m first decreased then increased with increasing amount of glycerin in solutions. These results indicate that at low glycerin concentrations, there is an enhancement of enzyme-substrate binding but a reduction in turnover number. At higher glycerin concentrations, there is a decrease in both enzyme-substrate binding and turnover number. There were no differences observed in trends of change in activity with increasing glycerin content among the different enzyme components, but the rate of change in activity with increasing glycerin content differed among the various components. The glycerin was found to exert a stronger influence on the enzymes than on substrate structure.

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