

ORIGINAL PAPER

Relationship between the decrease of degree of polymerisation of cellulose and the loss of groundwood pulp paper mechanical properties during accelerated ageing

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During natural ageing, paper undergoes colour changes and becomes brittle. It is mainly due to the degradation of cellulose, the main component of paper fibres. From the viewpoint of conservation/protection of paper-based information carriers, as well as of the utilisation of secondary fibres, knowledge of the impact of a decrease of the degree of polymerisation (DP) of cellulose on mechanical properties of paper becomes of key importance. In this paper, correlations between the decrease of DP of cellulose and the loss of paper folding endurance (FE) using three model samples (pure cellulose, groundwood pulp paper, and degraded groundwood pulp paper) at accelerated ageing were investigated. The existence of such correlations between DP and FE is supported by experimental results; the correlations are linear for pure cellulose and groundwood pulp paper ageing, while exponential correlation was observed in case of degraded groundwood pulp paper. The results indicate that the rate of paper degradation can be evaluated by means of the rate of glycosidic bonds breaking in cellulosic polymer chains both for cellulose and groundwood pulp paper.

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Introduction

Paper, as a traditional carrier of information, is still of historical, cultural, and communication significance. During its natural ageing it loses its mechanical/strength characteristics and becomes brittle and yellowish. These phenomena result from the degradation processes causing destruction of paper fibres and changes in the interfibre interactions in paper.

From the viewpoint of conservation/protection of paper-based information carriers, as well as of the utilisation of secondary fibres, knowledge of the impact of a decrease of the degree of polymerisation (DP) of cel-

lulose on the utility properties of paper during its ageing becomes of key importance. The structure of this natural polymer determines both its function, acting as a part of plants and woody species (construction and support), and its importance as a fundamental component of paper fibres.

Natural ageing of paper is a consequence of the combination of several mechanisms depending on specific conditions known as external (e.g., humidity, temperature, presence of emissions and radiation) and internal (e.g., kind of fibre, paper acidity) factors. Degradation of macromolecular chains in cellulose occurs by several mechanisms (acid and alkaline hydrolysis, thermal oxidation, photooxidation). Depending on

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