Exploring structure and deformation mechanisms of plant fibres

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ABSTRACT

First tensile tests on single plant fibres date back to the fifties of the last century. Since then, a large variety of different fibre isolation and testing techniques have been developed. With regard to their commercial relevance the main focus has been on the properties of pulp fibres of wood (e. g. Jayne 1959; Duncker and Nordman 1965, Page et al. 1972, Groom et al. 2002a). Over the years important information has been gained on how tensile properties and deformation behaviour are influenced by the selected tree species (Jayne, 1960), structural features, such as. microfibril angle (Page and El-Hosseiny, 1983) or the fibre location within the tree (Groom et al. 2002a; Groom et al 2002b; Mott et al. 2002). In order to study the natural structure-function relationships of plant fibres as well as the mechanical design of cell walls, Burgert et al. (2002) introduced a fibre preparation technique based on a mechanical isolation which retains the matrix macromolecules. By applying in-situ methods which combine fibre tensile testing with nano- and microstructural characterisation techniques (e. g. light microcopy, scanning electron microscopy, X-ray scattering and Raman spectroscopy) specific deformation patterns of the cell walls were elucidated (Gierlinger et al. 2006; Keckes et al. 2003; Thygesen et al. 2007; Eder et al. 2008). In this talk we intend to give an overview about distinctive structure-property relationships of plant fibres and current knowledge about deformation mechanisms in cell walls derived from in-situ fibre testing methods.

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