Oxidation of lignin in hemp fibres by laccase: effects on mechanical properties of hemp fibres and unidirectional fibre/epoxy composites

Laccase activity catalyzes oxidation and polymerization of phenols. The effect of laccase treatment on the mechanical properties of hemp fibres and hemp fibre/epoxy composites was examined. Laccase treatment on top of 0.5% EDTA + 0.2% endo-polygalacturonase (EPG) treatments increased the mechanical properties of hemp fibres and fibre/epoxy composites. Comparing all fibre treatments, composites with 0.5% EDTA + 0.2% EPG + 0.5% laccase treated fibres had highest stiffness of 42 GPa and highest ultimate tensile strength (UTS) of 326 MPa at a fibre volume content of 50%. The thermal resistance of hemp fibres increased after laccase treatments, as the maximum degradation temperature increased about 5 °C. Oxidation of phenolic hydroxyls in lignin by laccase was observed. Cross-linking of hydroxycinnamates by laccase was not observed. We suggest that the increased mechanical properties of laccase treated hemp fibres and their composites were due to laccase catalyzed polymerization of lignin moieties in hemp fibres.

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