Fracture mechanics of paper using cellulose from cow dung

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Abstract

Waste streams provide an attractive alternative to virgin sources of biomass in the pulp and paper industry due to their lower economic and environmental costs. In most of Europe, livestock manure has been largely overlooked as a potential feedstock on an industrial scale. Furthermore, engaging with green technologies may enable farmers to offset their carbon footprint. A process was developed to extract purified cellulose fibres from bovine faecal matter. A method for producing (hand-crafted) paper was developed and the potential for supplementing standard wood-based pulp with the manure-derived cellulose pulps was explored. Various mechanical test were used to assess the mechanical suitability at supplementation ratios of 0-100%, including tear resistance, tensile strength and creep recovery. Tensor mechanics were used to mathematically approximate uniaxial tension of a strain-hardening, elastic material. This model was found to fit the data well, meaning stress-strain responses could be reliably generated from a few key empirical parameters. Significant differences were observed between wood-based and manure-derived pulps in terms of the fracture mechanics. The data suggests that manure-derived cellulose may be suitable as a partial replacement for traditional wood-based pulps.

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