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Nano cellulose textile composites: development of nano cellulose fibres

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Abstract

This paper firstly discusses the mechanisms of nano fractionisation of hemp fibres based on their architecture of ultra-structure. The paper then proposes two new processing technologies and develops nano hemp cellulose fibres. The results showed that the nano-architecture of hemp fibres facilitated the nano processing; two new processes were able to produce nano fibres from the basic level of raw hemp materials and to tailor the processing parameters to generate fibres to various levels of particle sizes (e.g. micro to nano). The developed technologies produced fibres having a lateral size of 15-60 nm and length of 150-460 nm with a normal size distribution; however, acidic and alkaline environments resulted in subtle influence on the nano-products, with the acidic medium being more severe with an average of lateral size of 47 nm than the alkaline medium with a lateral size of 54 nm; the final products tended to tangling and agglomeration due to highly developed specific surface although the process was closely related to the particle size and aspect ratio.

***Key words**: Nano hemp fibre, Nano processing, Characterisation, Defibrillation mechanism*

1. Introduction

Nanotechnology (at least one of the dimensions of particles = 100 nm) is considered to be one of the most important technical developments so far this century. Research in nanotechnology is critically important to the emergence of a new generation of composite processes and products. New or enhanced composites with unique properties can be developed using nanotechnology. The technology potentially offers the twin benefits of reductions in energy consumption and greater ability to compete on price against conventional materials such as steel (Fan, 2009). Traditional manufacturing processes use materials from the top downward. Nanotechnology uses materials from the bottom upwards. Its unique benefit is its capability to improve or alter existing materials.

Cellulose can be prepared in the form of nano-crystals with cross sectional dimensions in a range of 2-20 nm (Gao *et al.*, 2008). Almost any cellulosic materials could be considered as potential sources for the isolation of nano-sized cellulosic structures: (1) Cellulosic structures can be excluded from the cell walls of bacteria, such as, Gluconacetobacter xylinus, with cross-sectional dimensions of typically 6 nm by 2 nm (Gindl and Keckes, 2004); (2) Crystalline celluloses have also been found in

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