Accepted Manuscript

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PII: S1359-8368(15)00526-0

DOI: 10.1016/j.compositesb.2015.08.086

Reference: JCOMB 3766

To appear in: *Composites Part B*

Received Date: 18 June 2015

Accepted Date: 31 August 2015

Please cite this article as: Blanchard JMFA, Sobey AJ, Blake JIR, Multi-scale investigation into the mechanical behaviour of flax in yarn, cloth and laminate form, *Composites Part B* (2015), doi: 10.1016/j.compositesb.2015.08.086.

Multi-scale investigation into the mechanical behaviour of flax in yarn, cloth and laminate form

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Abstract:

Due to environmental challenges it is important to investigate potentially more sustainable new materials, including natural fibre reinforced composites. Whilst a number of natural reinforcements show promise there is a concern that laminate properties are too difficult to predict due to the lack of uniformity in natural fibres. The paper quantitatively evaluates the high variability observed at yarn scale, at cloth scale, which shows significant decreases, and at laminate scale, showing comparable variability to synthetic based composites. This demonstrates that natural fibre reinforced composites have reproducible properties at the macroscale level and provides a pathway to application in industry.

Keywords: A. Yarn; A. Fabrics/ textiles; A. Laminates; B. Mechanical properties; Natural fibres

1. Introduction

Composite materials can have an adverse environmental impact. This is due both to the materials required to manufacture them and difficulties at end of life. An alternative not based on petroleum products, which are in short supply, is a new challenge of the 21st century. To mitigate these problems natural fibre composites are being investigated growing from an initial interest at the research scale to some early industrial implementations, in both primary and secondary structures.

Natural fibre composites present numerous ecological and economic advantages over standard composites including reported improvements in biodegradability, requiring less energy to be manufactured, reducing dependence on petrol and lowering pollutant emissions. The specific density advantage of natural fibres over glass allows for significant weight savings. When used in transport this can reduce operating costs and emissions as well as leading to energy and carbon credits from end-of-life incineration, as shown by

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