Tensile and compressive damaged response in Flax fibre reinforced epoxy composites

Zia Mahboob, Ihab El Sawi, Radovan Zdero, Zouheir Fawaz, Habiba Bougherara

PII: S1359-835X(16)30378-5
DOI: http://dx.doi.org/10.1016/j.compositesa.2016.11.007
Reference: JCOMA 4479

To appear in: *Composites: Part A*

Received Date: 26 May 2016
Revised Date: 28 October 2016
Accepted Date: 5 November 2016

Please cite this article as: Mahboob, Z., Sawi, I.E., Zdero, R., Fawaz, Z., Bougherara, H., Tensile and compressive damaged response in Flax fibre reinforced epoxy composites, *Composites: Part A* (2016), doi: http://dx.doi.org/10.1016/j.compositesa.2016.11.007

Tensile and compressive damaged response in Flax fibre reinforced epoxy composites

Zia Mahboob[a,*], Ihab El Sawi[a], Radovan Zdero[b], Zouheir Fawaz[c], Habiba Bougherara[a,*]

[a]*Department of Mechanical & Industrial Engineering, Ryerson University, Toronto, ON, CANADA*
[b]*Department of Mechanical Engineering & Department of Surgery, Western University, London, ON, CANADA*
[c]*Department of Aerospace Engineering, Ryerson University, Toronto, ON, CANADA*

Abstract

Composite reinforcement by natural fibres like Flax do not enjoy the same popularity in engineering design as Carbon or Glass fibres on account of the relatively immature mechanical data on Flax-composites. Tensile and compressive mechanical properties are determined for Flax-fibre-reinforced-Epoxy composite. Damaged response is followed through SEM observations and by measuring evolving stiffness and permanent deformation. Specimens are repeatedly loaded-unloaded at progressively increasing maximum loads until failure, allowing a quantitative description of in-plane modulus and inelasticity evolution. Stiffness degradation rates do not necessarily correlate with inelastic straining rates, and modulus may remain unchanged while still accumulating inelastic strains – therefore both modulus and inelastic strain need evaluating to fully describe the material damaged response. Damage initiates within the fibre or at fibre-matrix interface; matrix-related damage appears not critical to damage initiation and progression. The reported data is valuable for the development of predictive models of damaged-condition response in Flax-epoxy structures.

Keywords: `A. Biocomposite, A. Natural fibres, B. Mechanical properties, Damage evolution`

1. Introduction

Composites wherein reinforcement is provided by natural (or, bio-based) fibres have been the subject of much recent research on account of their competitive mechanical properties [1, 2], and perceived environment-friendly features such as low toxicity manufacturing [3, 4], renewability of constituent materials [5, 6], and potential end-of-life recyclability [6]. The relative novelty of natural fibre composites means that research is far behind the maturity enjoyed by those of Carbon or Glass fibres. Also, large-scale industry adoption of natural fibre composites for load-bearing

*Corresponding authors
Email addresses: `zmahboob@ryerson.ca` (Zia Mahboob), `habiba.bougherara@ryerson.ca` (Habiba Bougherara)