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Effect of geometric dimensions and fibre orientation on 3D moisture diffusion in flax fibre reinforced thermoplastic and thermosetting composites

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Abstract

In this work, we investigate the diffusion behaviour of twill flax fabrics reinforced thermoplastic and thermosetting composites elaborated by the vacuum infusion technique. Water absorption tests were conducted by immersing composite specimens into tap and salt water at room temperature. In particular, the effects of aspect ratio, thickness and fibre orientation are considered. The principal three-dimensional (3D) diffusion parameters are identified by 3D Fick's and Langmuir's models using an optimization algorithm. It is found that the flax reinforced thermoplastic composite absorbs less water than the flax thermoset composite. In addition, the obtained absorption curves indicate that the equilibrium mass gain linearly increases with fibre orientation, decreases with thickness and strongly related to the diffusion rate. Furthermore, 3D water diffusion kinetics are shown to depend on the samples aspect ratio and governed by a privileged direction.

Keywords: *Flax fibre; water ageing; 3D diffusion models, thickness effect, fibre orientation effect, edge effect.*

1. Introduction

The problem of moisture ingress into natural fibre reinforced polymer composites is of great importance in different sectors in particular the automotive and the marine industries [1-4]. Indeed, the presence of moisture in these materials can significantly affect their general properties and may lead to a limitation of their use. Therefore, it is crucial to investigate and understand the diffusion kinetics in this type of materials when exposed to humid conditions to ensure their expansion and development.

Several works dealing with the ageing of natural fibre reinforced thermosetting