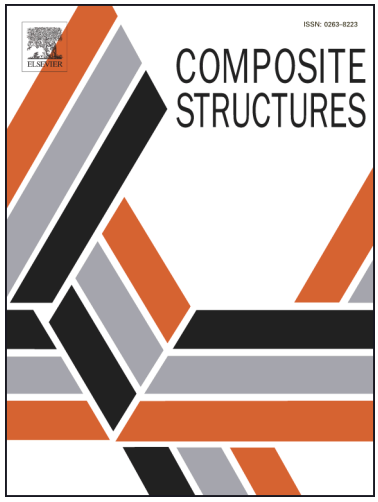

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Effect of hygrothermal aging in distilled and saline water on the mechanical behaviour of mixed short fibre / woven composites

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Abstract. In this paper, we investigate the effect of hygrothermal aging in different media on the mechanical behaviour of mixed short fibre / woven composite laminates. We study composite laminates made up of 4 plies of fiberglass fabrics (Mat 300 g/m^2, Mat 450 g/m^2, Taffetas 800 g/m^2) and unsaturated polyester resins, which are realised by contact moulding. In order to properly characterize our materials and to understand the phenomena responsible for modifying their behaviour, various physico-chemical and mechanical tests are carried out on composite laminates with and without a gel coat. The main aim of our study is to determine the mechanical properties, e.g. ultimate stress, yield strength and flexural modulus, of the laminates through three-point bending tests, under the effect of hygrothermal aging in aggressive environments, i.e. distilled water and saline water at different time intervals, and high temperature. In order to follow the physico-chemical evolutions and their influences on the mechanical properties of the composite laminates, a comparative study of the properties is carried out for both unaged and aged specimens. The analysis of all obtained results shows that aging time, medium and temperature have a significant influence on the mechanical behaviour of mixed short fibre / woven composites.

Keywords: Composite laminates, short fibre, woven, mechanical behaviour, aging, temperature, three point bending.

1. Introduction

Composite materials are often presented as materials of the future. They provide various mechanical functions that can be grouped according to their life, safety and easy in design. However, the use of these materials is subject to the knowledge of their mechanical behaviour, under both static and dynamic conditions. In the majority of cases, the industrial demand is limited to knowledge of the behaviour of a structure under a spectrum of stress and environment, which represents the best conditions in service. Depending on the efforts to be made, the designer is potentially free to steer the reinforcing fibres as he wishes. For example, the main advantages of using fibre glass-reinforced thermosetting resins (unsaturated polyester) to produce marine structures are numerous: e.g. lightweight, low cost for hull construction, and ease of use, etc. Even though, composites have interesting mechanical properties, they are also characterized by disadvantages such as their sensitivity to temperature and environment, which may influence their mechanical properties and reduce the stiffness of the structure. It is well known that during their service life, composites absorb moisture through their polymer matrix along the fibre, i.e. fibre-matrix interface, by the presence of micro voids. However, the fibres play a role of screen that can lead to degradation of the interface, and thus reducing the mechanical characteristics of the composites. A significant decrease in the mechanical properties of epoxy-based polymer matrix composites (PMCs) occurs upon exposure to moisture/water environments due to the plasticization and hydrolysis of epoxy resin [1-5]. The creep behaviour of an E-glass-polyester matrix composite presented by de Souza et al. [6] was evaluated as a function of time of immersion in water and lubricant oil. The behaviour was observed after 6 and 14 months of exposure to the aging fluids and Young's modulus of the composites