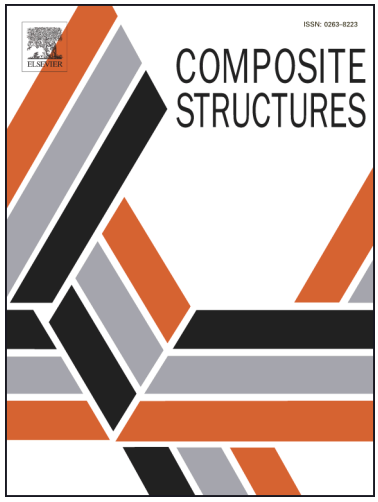

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I.B.C.M. Rocha, S. Raijmaekers, R.P.L. Nijssen, F.P. van der Meer, L.J. Sluys

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Hygrothermal ageing behaviour of a glass/epoxy composite used in wind turbine blades

I. B. C. M. Rocha[a,b,*], S. Raijmaekers[a], R. P. L. Nijssen[a], F. P. van der Meer[b], L. J. Sluys[b]

[a]Knowledge Centre WMC, Kluisgat 5, 1771MV Wieringerwerf, The Netherlands
[b]Delft University of Technology, Faculty of Civil Engineering and Geosciences, P.O. Box 5048, 2600GA Delft, The Netherlands

Abstract

In this work, a glass/epoxy material system applied in wind turbine blades was used to evaluate degradation processes induced by water ingression. Composite and neat epoxy specimens were conditioned in demineralised water at 50°C for 4800h and tested quasi-statically and in fatigue. Comparing results from mechanical tests in composite specimens, significant degradation was found, with up to 36% lower static shear strength and three orders of magnitude shorter fatigue life. For neat epoxy specimens, a lower degree of degradation was observed, with up to 17% lower tensile and bending moduli and strength. Specimens dried after having been immersed were also tested. For composite samples, recovery of shear stiffness and strength was incomplete. For neat resin, stiffness and bending strength were completely recovered but a decrease in the strain at failure was observed. It is hypothesised from differences in magnitude and reversibility of degradation between composite and neat resin that matrix degradation is accompanied by high differential swelling stresses and damage to the fibre/matrix interface in composites. The damage due to moisture ingression and the subsequent changes in failure behaviour are further investigated through thermal analysis (DSC, DMA) and optical microscopy.

Keywords: Environmental degradation, Polymer-matrix composites (PMCs), Interface/Interphase, Mechanical testing

1. INTRODUCTION

Research on material usage optimization for wind turbine blades has been on the rise in the past years, as designers seek ways to optimise the use of composite materials that comprise the main load bearing structures in blades. This can be done by reducing design uncertainty, consequently allowing for lighter blades

*Corresponding author. Tel. +31 0227 504928
Email address: i.barcelos@wmc.eu (I. B. C. M. Rocha)