VI International Materials Symposium
MATERIAIS 2011

XV Meeting of SPM – Sociedade Portuguesa de Materiais

18-20 Abril 2011
Guimarães, Portugal
SELF-SENSING HYBRID COMPOSITE ROD WITH BRAIDED REINFORCEMENT
FOR STRUCTURAL HEALTH MONITORING

K.P. Rosado¹, S. Rana¹, R. Figueiro¹, C. Peres²

¹FMRG-Fibres Materials Research Group, Textile Engineering Department, University of Minho, Guimarães, Portugal, npu@gep.uminho.pt
²C-TAC-Territory, Environment and Construction Centre, Civil Engineering Dept., University of Minho, Guimarães, Portugal

Enhancing the performance and lightness of different structures has already been achieved by the employment of composite materials. Nowadays, a new challenging perspective is being given to these materials by the inclusion of non-metallic conductive components. This emerging technology will lead to multifunctional composites with possible applications in structural health monitoring and traffic monitoring. The aim is to avoid corrosion problems from metallic components, as well as to eliminate the need of expensive equipments used for the health monitoring of large infrastructures.

In the present research, using a piezoresistive non-metallic conductive material like carbon, it was possible to add the monitoring ability to a hybrid braided composite rod reinforced with glass fibres. Braided structure was used to enhance adhesion between the composite rods and concrete structures. Carbon was introduced to the composite either in the form of continuous filaments or chopped fibres. The characterization of the sensing behaviour was feasible with a parallel set-up that registered a synchronized measurement of the electrical resistivity and the mechanical stress applied in bending. The effect of different variables affecting the piezoresistive or sensing behaviour of the composite such as the type (continuous or chopped), weight content (23%, 47% and 100%) and positioning (axially aligned or non-aligned) of the carbon element were studied in detail.

Self-sensing of strain or deformation was found in all composite configurations studied. However, good sensing with a stable electrical resistivity variation was registered only by the composite containing 23 wt. % of non-aligned continuous carbon fibre. Although increasing carbon wt. % significantly enhanced the conductivity of the composite rods, an enhanced and stable sensing behaviour was achieved using less carbon content. The minimum stress and deformation to notice the piezoresistive effect was 7 MPa and 0.02% respectively, which proves the suitability of these specially designed composite rods to be used in structures for health monitoring.

Keywords: Self-monitoring; Fibre reinforced composite; Braiding technology.