7th ECCOMAS Thematic Conference on Smart Structures and Materials
SMART 2015
A.L. Araújo, C.A. Mota Soares, et al. (Editors)

Abstract ID-069

CFRP WITH EMBEDDED MAGNETORHEOLOGICAL ELASTOMER FOR ADAPTIVE DAMPING OF THE VIBRATION

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Keywords: Magnetorheological Elastomers; Carbon Fiber Reinforced Plastics; Vibration Damping

Summary: Magnetorheological elastomers (MREs) consist of magnetically permeable particles embedded in an elastomer matrix. Their damping properties can be rapidly and reversibly varied under the magnetic field. Changes of the properties in MREs under the influence of magnetic field depend strongly on the microstructure formed during the curing of elastomer matrix. Interactions between particles in a magnetic field results in increased stiffness of the material, what makes them attractive for adaptive damping of the vibration.

The aim of this work was development of the sandwich structures composed of CFRP laminates and magnetorheological elastomers as a core. The MREs were obtained by mechanical stirring of reactive mixture of substrates with carbonyl-iron particles and next the particles were oriented into chains under the external magnetic field of 240 kA/m. As a ferromagnetic component carbonyl–iron powder, with particle size from 6-9 μm, produced by Fluka, was used. Samples with particles volume fraction equal to 11% and 33% were examined. As an elastomer commercial Biresin® U1404 system, supplied by SIKA was used. The sandwich structures were obtained by compression of MREs samples with the thickness varied from 0.5 to 3.5 mm between two CFRP laminates, composed of 2 layers of 2D carbon fabrics each, and ASSET® epoxy resin, using 30 kN pressure at temperature of 120oC for 10 min. The ASSET resin was in a powder form and curing process was carried out during pressing with MRE. For comparison the sheets of CFRP were first produced and then crosslinking of the elastomer with particles was carried out between CFRP under magnetic field. In both cases very good adhesion between MRE and CFRP was obtained. The microstructure of the sandwich structures was observed using SEM. The particles orientation in MRE before and after compression was observed with the application of μ-CT. Also rheological and damping properties of sandwich structures without and with magnetic field were studied using Ares rheology system and especially designed set-up for measuring the damping of the vibration.

This work has been supported by the EU in the framework of European Social Fund through the Warsaw University of Technology Development Programme.