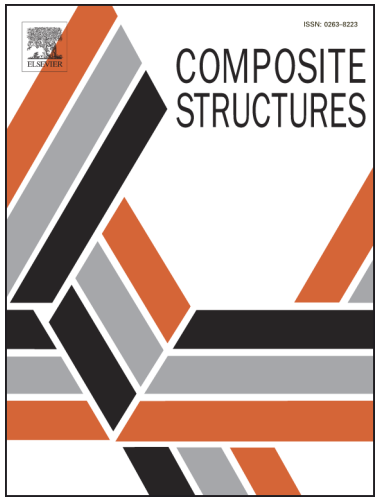

7Effects of carbon black and graphene nano-platelet fillers on the mechanical properties of syntactic foam

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7Effects of carbon black and graphene nano-platelet fillers on the mechanical properties of syntactic foam.

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Abstract

Mechanical properties of an epoxy based syntactic foams are discussed in this study. Basic syntactic foam, composed of 30% of hollow glass spheres by volume, was modified with a 1% volume fraction addition of graphene nano-platelets (GnP), treated GnPs and carbon black (CB). In treated GnPs the hollow glass spheres and the GnPs were treated with 1-Pyrenecarboxaldehyde in xylene. The flexural, tensile, compressive and Izod properties of the five different combinations of these syntactic foams, both reinforced and not reinforced, were measured and compared with the pristine epoxy. The tests show that the reinforced foams had a higher modulus in all cases. The maximum tensile load decreased with the addition of the GnPs, while it increased when CBs were used. Scanning electron micrographs were used to evaluate the dispersion of the filler in the epoxy matrix and the interaction between matrix and fillers.

1. Introduction

Syntactic foams are composite materials fabricated by dispersing hollow microspheres into a polymeric matrix. The hollow microspheres can be metal, ceramic, glass, polymer or carbon in composition [1, 2]. Epoxy and phenolic resins, silicones, polypropylene, polyamides and other polymers can be used as the matrix. Syntactic foams have gained attention in recent years because of their attractive properties. These materials are low-density, they exhibit isotropic behaviour, high specific strength, high acoustic damping capacities, thermal insulation, fire resistance and low moisture absorption [3-7]. These properties make syntactic foams interesting for lightweight structural applications, such as structural materials in the aerospace industry - they are used as the core section of sandwich structures -, underwater buoyant structures and damping panels.

Syntactic foams have been widely studied in the last few decades. Tensile, flexural and compressive tests have been evaluated with and without the presence of fillers. In general, the increase in volume fraction of microbubbles decreases the compressive, flexural and tensile strength of syntactic foam but increases the modulus of the material [3]. Published reports show that the volume fraction of hollow spheres, composition of the spheres and interaction between the matrix and the fillers influences the performance of syntactic foams [10-11].

In order to manufacture structural components, the use of syntactic foam is associated with the presence of fillers as reinforcement. Fibres, short fibres, and different nano-fillers with different concentrations have been studied for many applications. It has been found that fibres and short fibres are able to improve the tensile and flexural strength of the material while the mechanical properties under compression are lower if compared to the neat material, when the same fibres are used [12-13]. Only in one case with the