VISCOELASTIC PROPERTIES AND STRUCTURE OF MWCNT/EPOXY RESIN NANOCOMPOSITE

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Due to the intensive production of different nanoscale filler and various resin type polymer composites the great attention is given to research of properties of nanocomposite (NC) materials. Nanofiller in composite material is capable to improve many characteristics at filler content much lower than in comparison with a micro or macro sized composite filler.

The aim of the current work is to establish the viscoelastic properties of the epoxy resin nanocomposite filled with multiwall carbon nanotubes (MWCNT) depending on their content. Bisphenol A epoxy resin LH 289 and curing agent H 289, as well as masterbatch with 5 wt. % multiwall CNT were used for sample preparation. Dogbone type samples with different CNT contents (0, 0.2, 0.5, 1.0, 1.9, and 3.8% wt.) and with dimensions 150 mm x 10 mm x 4 mm were manufactured in silicon moulds. The elastic and viscoelastic properties of the epoxy resin and NC with different concentrations of CNT were studied out by tensile quasistatic and creep tests. Quasistatic tensile tests were performed in order to determine effect of CNT on elastic properties of NC and to choose the stress levels for creep experiments. Based on the results obtained three stress levels corresponding to 1/4, 1/3 and 1/2 of tensile strength were chosen. The creep experiments lasted for 5 hours following 19 hours of creep recovery. The structure of investigated material was studied by scanning electron microscopy using fracture surfaces of NC specimens. The thermophysical properties of the NC were investigated using dilatometry method.

Creep compliance curves were approximated using Boltzmann-Volterra equation and stress- and temperature-time analogies. The correlation between mechanical and thermophysical characteristics of NC was estimated. With addition of CNT the upper yield stress of NC decreased up to 8%, but tensile strength increased up to 18% and strain at break up to 38% in comparison with unfilled epoxy. Obtained results show that coefficient of thermal expansion of CNT filled NC decreased by 40%, but glass transition temperature slightly increased at medium CNT content. As a result of creep tests the creep compliance of NC with the maximal CNT content was decreased by app. 30% at all stress levels.