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Studying the Effect of Carbon Nanotubes on the Mechanical Properties of Epoxy-Nanocomposite for the Oil Field Applications

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Abstract : Carbon nanotubes are currently considered to be one of the strongest and stiffest engineering materials available, possessing a calculated tensile strength of σTS ≈ 200GPa and Young's moduli up to E = 1.4 TPa. In the context of manufactured engineering composites, epoxy resin is the most commonly used matrix material for many aerospace and oil field, and other, industrial applications. This paper reports the initial findings of a study which considered the effects that small additions of nickel coated multi-wall carbon nanotubes (Ni-MWCNTs) would have on the mechanical properties of an epoxy resin matrix material. To successfully incorporate these particles into the matrix materials, with good dispersive properties, standard mixing techniques using an ultrasonic bath were used during the manufacture of appropriate specimens for testing. The tensile and flexural strength properties of these specimens, as well as the microstructure, were then evaluated and studied. Scanning Electronics Microscope (SEM) was used to visualise the degree of dispersion of the Ni-MWCNT's in matrix. The results obtained indicated that the mechanical properties of epoxy resin can be improved significantly by the addition of the Ni-MWCNT's. Further, the addition of Ni-MWCNT's increased the tensile strength by approximately 19% and the tensile modulus by 28%. The flexural strength increased by 20.7% and flexural modulus by 22.6% compared to unmodified epoxy resin. It is suggested that these improvements, seen with the Ni-MWCNT's particles, were due to an increase in the degree of interfacial bonding between Ni-MWCNT and epoxy, so leading to the improved mechanical properties of the nanocomposite observed. Theoretical modelling, using ANSYS finite element analysis, also showed good correlation with the experimental results obtained.

Keywords : carbon nanotubes, nanocomposite, epoxy resin, ansys
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