

Clay polymer nanocomposites: Investigation of their mechanical properties for industrial and technological applications

Q Y Soundararajah¹, B S B Karunaratne^{1*} and R M G Rajapakse²

¹ Department of Physics, University of Peradeniya, Peradeniya

² Department of Chemistry, University of Peradeniya, Peradeniya

This study aims at investigating the Mechanical property enhancement of clay polymer nanocomposites. The bentonite clay was used to be intercalated with polyaniline to prepare the intercalated montmorillonite polyaniline nanocomposites (MMT-PANI). The MMT clay was ion exchanged with H⁺ and dried at 120 °C. The H⁺ present in the clay was then exchanged with anilinium ions. The anilinium ions present within the intergalleries were polymerised by a chemical oxidation route using S₂O₈²⁻. The resultant slurry was dried under room temperature for 3 to 4 days. The green coloured polyaniline form known as the emeraldine salt containing MMT composite (EMS – MMT) was resulted. Various compositions with different clay contents were prepared with a constant polymer concentration. X-ray diffraction spectra were obtained for raw MMT clay, H⁺ treated MMT and for the EMS-MMT series. Rectangular bars were pressed uniaxially at 4 M Pa for making the test samples and were vacuum dried at 120^o C and 150^o C for two hours prior to the testing. The mechanical properties were investigated using a mechanical testing machine in the ceramic laboratory. Four-point bending was used to investigate the modulus of rupture (MOR) and Young's modulus (Y). The fracture toughness (K_{1C}) was found using single edge notch beam.

The EMS-MMT series showed a drastic increase in the MOR and Young's modulus at rather low filler content. This result clearly indicates that the ability of dispersed silicate layers that increase the MOR and Young's modulus of EMS-MMT nanocomposites can be directly related to the average length of the layers, hence to the aspect ratio of the dispersed nanoparticles. The MOR may strongly depend on the nature of the interactions between the matrix and the filler. The increase is due to the presence of polar and ionic interactions between the polymer and silicate layers. The increase in the fracture toughness was achieved due to increased interfacial areas and improved bond characteristics of the EMS-MMT nanocomposites. The results indicate that the mechanical properties enhanced even at low clay loadings more than the neat materials. Further work is necessary to investigate the other property enhancement.

Financial assistance by the National Science Foundation, research grant RG/2005/FR/04 is greatly acknowledged.

* bsbk@pdn.ac.lk

Tel: 081-2394598