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FRACTURE TOUGHNESS ANALYSIS BY EXPERIMENTAL AND SIMULATION OF SWCNTs – RESOLE NANOCOMPOSITES

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ABSTRACT

Fracture toughness analysis for resole reinforced with single wall carbon nanotubes (SWCNTs) has been studied, in terms of mechanical properties, which are subject to changes in SWCNTs volume fraction. Simulation program for the fracture propagation was built up to comparison the experimental results with that simulation results. The nanocomposites candidates for this study were pure matrix resole and SWCNTs - resole nanocomposites. Hot press technique was used to prepare the nanocomposites as well resole specimens using flash mold at standard conditions. The impact testing machine type pendulum hammer was used in Charpy impact mode to calculate the fracture toughness according to ISO79. Simulation program of fracture propagation of the specimens was carried out using finite difference method.

Fracture toughness results show that the toughness values were increased progressively by succession of volume fraction of SWCNTs. Fracture toughness results showed a linear dependence with the SWCNTs volume fraction. These linear relationships are strongly influenced with the reinforced condition and they are attributed to the response of the nanocomposites to the impact test conditions. Such responses were appeared as plastic deformation associated with the damage observed. The experimental observation of the failure specimens are in good agreement with fracture mechanism, which concerned with debonding mechanism, which related to SWCNTs nanocomposites failure mechanism. The failure could be explained by two processes. The first is concerned with the interlaminar effects, which increase the surface energies, and the second is related to the work required for forming plastic zone. The elastic strain energy released, which represented the physical meaning of fracture toughness, was calculated by simulation program using the experimental data. Simulation results values coming higher than experimental results values. This could be explained, as the interface affect of SWCNTs – nanocomposites, which had high strength and strong bond force. Hardness and densities values coupled with optical microscopy were evidenced to the results.

KEYWORDS: Toughness, Fracture, Resoles SWCNTs, Simulation, and Nanocomposites