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STRESS-STRAIN BEHAVIOR OF NBR/PVC/CLAY NANOCOMPOSITES: THE EFFECT OF MORPHOLOGICAL STRUCTURE ON CONSTITUTIVE MODELS

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Hyperelasticity provides some constitutive models that relate the stress-strain behavior of polymers with strain energy density function. In this work, we report on relationship between the morphological structural and the mechanical characteristics of NBR/PVC/Clay (Acrylonitrile Butadiene Rubber/Poly Vinyl Chloride/ Cloisite30B) nanocomposites. The samples have been prepared through melt-mixing technique in Brabender internal mixer. The degree of dispersion of nanoclay layers was determined by X-ray diffraction (XRD) and tensile properties of nanocomposites were measured. Three different constitutive material models were applied, namely the Marlow, Ogden and Arruda-Boyce models, for the compounds with different clay content. The best fit of these mathematical models against experimental data were investigated due to determine the applicability of them. It is shown that loading different nanoclay contents (3, 5, 7, 10) on the NBR/PVC nanocomposites not only has a great effect on the morphology of samples but also it influences the degree of fit between the experimental data and predicted one. The results showed that the behavior of both unfilled sample conformed closely to the all this three models. But for filled samples Arruda-Boyce model showed the lowest degree of fitting with the experimental data among the other models. This model is based on the statistical mechanics of a material and represented to simulate the non-Gaussian behavior of individual chains in the network. Higher amount of nanoclay resulted in higher discrepancies between experimental data and predicted one. On the other hand, the agreement between theoretical data and experiments for Marlow model is quite acceptable which confirms that the applicability of this model does not change with the formation of nanocomposite structures. An interesting point in the fitting of the Ogden model is that the model is only fits nanocomposites with the exfoliation morphology which confirmed by TEM micrographs.