PREPARATION AND RHEOLOGICAL CHARACTERIZATION OF NANOCOMPOSITES WITH NANODIAMONDS AS A FILLER

G.B. Vasilyev[1], V.V. Karbushev[1], M.L. Kerber[2]

1 - A.V. Topchiev Institute of Petrochemical Synthesis RAS, Polymer Rheology, Moscow, Russia
2 - D.I. Mendeleyev University of Chemical Technology of Russia, Chemical Technology of Polymers, Moscow, Russia

vgb@ips.ac.ru

Nanocomposites based on styrene-*co*-acrylonitrile copolymer and nanodiamonds of detonation synthesis method (**ND**) have been prepared by melt mixing. ND content was 0.5, 1.0, 2.5 and 5.0 weight %. Analysis of optical and transmission electron micrographs with the help of a special PC algorithm has shown that more than 95 % of ND particles have dimensions less than 100 nm.
Rheological properties of nanocomposites melt under shear and extension flow have been investigated. At steady-state shear all systems under consideration behave like pseudoplastic liquids, that is Newtonian flow takes place at low shear rates with transition to the shear thinning at high ones. Carreau model was used to fit the flow curves. An increase of ND concentration leads to the monotonous viscosity rise and for composite containing 5% ND the increase reaches three-fold viscosity growth.
The narrowing of the linear viscoelastic region with filler content was observed at oscillatory shear deformation. Elastic modulus (**G'**) value growth at ND concentration increase occurs. This effect is significant in the region of low frequencies. Seven fold G' rise takes place for composite containing 5.0% of ND in comparison with the matrix polymer. But storage moduli values for all systems under consideration are close each other in the region of high frequencies.
Tests under uniaxial extension at constant extension rate have been carried out. The transient elongation viscosity values were calculated as $\eta_E^+ = \sigma^+ / \dot{\varepsilon}$ and presented as a function of extension time. The viscosity value increases significantly with introducing 0.5% of ND and then it does not virtually change. Beginning with definite deformation the strain hardening effect appears reflecting a transition to non-linear region of extension. Essential difference in behavior of the matrix and nanocomposites consists in a scale of strain hardening effect. For composites it is more pronounced. Melt elasticity was characterized by the value of modulus corresponding to initial linear section of $\sigma(\varepsilon)$ curves. Loading of the matrix with small amount of ND (0.5 – 1.0%) leads to an essential modulus jump (on ~50%) and then it only slightly increases with filler content.
All above mentioned features were attributed to a gradual formation of structural skeleton by filler particles. Obtained data can be used for estimation of processing regimes of nanocomposites under investigation.