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Nanocomposites Based on Polyethylene and MgAl-Layered Double Hydroxide: Rheological Characterization

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Recently, Polymer/layered double hydroxide (LDH) based nanocomposites have drawn a considerable research interests because of various potential application of LDH based polymer composites. For example, the development of halogen free flame-retardant polyolefin composites showing satisfactory/improved mechanical properties, which is usually lacking in conventional magnesium hydroxide filled polyolefin composites. So far, most common method for synthesizing polymer/LDH nanocomposites reported in literature is solution intercalation and in-situ polymerisation. In the present paper we report polyethylene/MgAL-LDH nanocomposites synthesized by melt processing technique and their rheological behaviours. The composites show the sign of exfoliation of the LDH layers and significant influences of LDH loading on rheological properties. However, the morphological analysis by transmission electron microscopy (TEM) exhibits complex nature of the dispersed LDH particles. The combination of these morphological analyses with rheological behaviours gives better picture of the state of particle dispersion in the polymer matrix. The responses of the composite materials, in a dynamic frequency sweep experiment and non-linear shear deformation, have been reported in details. The results from both these type of analyses strongly indicate the network-like structure formation among the dispersed LDH particles. As a result of this, the low frequency viscoelastic responses completely deviate from the typical Newtonian mechanics that is observed in pure polymers. In the non-linear shear experiment, the network structures are destroyed on shearing and the orientation of the particles in the flow direction leads to steady viscosity of the melt. When shearing is stopped and the composite melt is subjected to rest period (called zero shear period) of sufficient duration, the regeneration of the network structure takes place, which is manifested in the stress shoot up at beginning of steady shearing after the rest period.