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THE ROLE OF FLOW-INDUCED ORGANOCLAY ORIENTATION IN RHEOLOGICAL BEHAVIOR AND CRYSTALLIZATION KINETICS OF POLYETHYLENE/CLAY NANOCOMPOSITE FILMS

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The effect of flow-Induced organo-clay orientation on melt rheology and crystallization behavior of Polyethylene (LLDPE)/clay nanocomposite films with the same organo-clay (Cloisite 15A) content (5%) but varying in elongation rate with and without compatibilizer (Polyethylene-g-Maleated Anhydride) was considered. XRD patterns and the melt linear viscoelastic results evidenced a highly intercalated morphology for the compatibilized nanocomposite samples. A decrease in storage modulus (G') values at low frequency range for drawn samples was considered as an indication of breaking the 3-D network and flow-induced organo-clay orientation via elongational flow. The results of thermal analysis performed on the nanocomposite samples showed an increase in the crystallization onset and peak temperatures (T_P and T_C respectively) whose values were found to be increased with increasing elongational flow rate. This could be related to the nano clay nucleation effect. While the undrawn nanocomposite samples showed decreased crystallinity due to matrix chain confinement, the drawn films exhibited a greater degree of crystallinity, whose extent was increased with increasing elingational flow rate, compared to undrawn samples. This was attributed to breaking of the 3-D network and hence increasing the polymer matrix chain movement. The presence of organo-clay also increased the rate of crystallization, evaluated by half-time ($t_{0.5}$) values, as a result of its nucleating effect. This effect was greater for the drawn samples possibly due to the increased extent of intercalation taking placed during the melt elongational process. The non-isothermal crystallization data obtained for the samples were found to be nicely fitted into the Avrami equation. The Avrami exponents (n_a) values reached to 3.93 suggesting a complicated non-isothermal crystallization mechanism for the PE matrix, while it approached to 3 and hence more defined the crystallization development in nano clay containing samples because of the nucleation effect of platelets and/or tactoids with greater efficiency for the drawn samples.