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The Effect of Nanoclays and Processing Conditions on Barrier, Mechanical and Thermal Properties of Polyethylene Films

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The technology of nano-clay polymer composites is currently generating a great deal of interest, due its potential cost effective advantages in reinforcement, barrier and fire retardant properties. Since the orientation of the high aspect ratio NCs is the decisive factor with respect to the final film properties, the current study deals with the affect of the Blow Up Ratio (BUR) on the barrier, mechanical and thermal properties of extrusion blown films. The film composition was based on Low Density Polyethylene (LDPE), Linear LDPE (LLDPE), Maleic An-Hydride Grafted LLDPE (MAH-G LLDPE) and of Nano Clays (NCs) at 5% loading. The NCs used were of a novel silane treated type. Experimental results have shown that the orientation, related to the BUR, affects significantly the resulting film properties. An increase of the BUR from 2.5 to 4.3 in the NC containing films resulted in a decrease of the oxygen barrier properties by a factor of three. Moreover, the modulus more than doubled compared to the neat film. Simultaneously, the elongation to break of the oriented NC composite film increased above the one for the neat oriented film. The dart drop impact of the NC containing film was lower than the neat films by only 5%. The crystallization and the melting points were changed by only 2 to 3 °C. However, the crystallization and melting enthalpies increased with the BUR by close to 10% in the case of the NC composite films. It was concluded that the silane treated NCs are compatible with the polyethylene blend and that the orientation of the NCs is the decisive factor with respect to the barrier, mechanical and thermal properties of NC composite films.