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Morphological Dependence of the Mechanical Properties of HDPE-EVA-Clay Blend Nanocomposites

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A statistical evaluation into the influence of processing, as a function of shear and diffusion, and influence of polymer crystallinity, as a function of the blend morphology, on the clay gallery spacing and the corresponding nanocomposite mechanical (tensile) properties was carried out. The aim was to quantitatively understand the effect of combined intercalation and exfoliation on the nanocomposites mechanical behavior and correlate the basal spacing (in clay galleries) with the tensile properties. Using HDPE as the base matrix and EVA (9% VA) as the carrier of C15A – an organo-modified montmorillonite clay – an experimental design was carried out with 20% EVA9 and 5% clay. Shear was represented by a combination of screw speed and temperature and diffusion was represented by the mixing time in the design. It was found that there was a direct and quantifiable relationship between the basal spacing and the tensile properties of the clay-polymer blend nanocomposites; interestingly, there seemed to be a threshold basal spacing for clay concentration of 5% (~ 4nm) for a significant increase in the mechanical properties of the composites. Further, EVA9 is found to be a good carrier of C15A as indicated by the simultaneous increase in the tensile modulus and strength (~ 25%); showing that a skeleton-like support structure of clay platelets could be developed in the HDPE matrix. This type of statistical analysis has significant use in the packaging industry for process optimization.