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Characterization of high density polyethylene/organoclay nanocomposites by low-field nuclear relaxation study

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Abstract –The purpose of this study was preparing high-density polyethylene/organoclay nanocomposites by melt processing using the twin screw extruder at the same temperature profile for polyethylene at different shear rates.The x-ray diffraction (XRD) was employed to characterize the formation of the nanocomposite and organoclay dispersions and high resolution NMR to study the structural characteristics of polyethylene resin. A new technique to understand changes in the molecular mobility after processing when organoclay was incorporated by low-field nuclear relaxation study using the proton spin-lattice relaxation time (T_1H) was applied. From the T_1H results, a correlation between mechanical and thermal properties was evaluated.

Polymers nowadays are produce in large scale and as commodities have low aggregate value, without any difference in their applications for specific or general purposes in spite of they are present everywhere dairy. With the objective of attending the expectative of the material market, new different kinds of resins are being produced, targeting the development of new material in special polymeric nanocomposites. The purpose of this study was preparing high-density polyethylene/organoclay nanocomposite by melt processing. The correlation between mechanical, thermal, low field NMR and XRD results were studied. Effective clay incorporation into polyethylene matrix was observed. The melt compounding was performed using extrusion process in a torque rheometer, Haake, equipped with a conical counter-rotate twin screw extruder (TWS), at two different shear rates (from 60 and 90 rpm) and a typical HDPE temperature profile. XRD was used to evaluate the dispersion degree of the organoclay incorporation into polyethylene matrixes. XRD pattern of commercial organoclay and several HDPE/OMMT compounds, obtained at different extrusion share rates (60 and 90 rpm) are shown in Fig. 1. The XRD demonstrated that the organoclay was incorporated into polyethylene matrices and some changes in the diffractograms could be observed. The purpose of characterization of HDPE/organoclay nanocomposite by low-field NMR showed that the molecular structured became very important and this technique was important to understand changes in the molecular mobility of polyethylene when organoclay was incorporated. The development of an analytical method by low field NMR was fundamental for understanding the polymeric chain dispersion in the aluminosilicate and the intercalation process between the polymer and clay lamellae. From the T_1H results, a correlation between mechanical and thermal properties was evaluated.

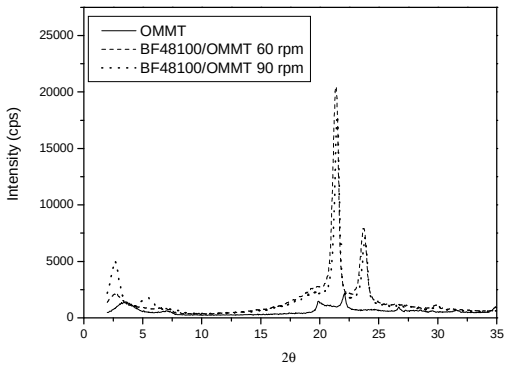

Figure 1: XRD patterns of BF-48100/OMMT nanocomposites after processing at 60 and 90rpm.

References

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