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Composites of HDPE and MMT modified by species of different chemical nature. Synthesis and evaluation of transport properties to hydrocarbons.

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Abstract – Three monomers with different chemical nature were used to modify sodium montmorillonite by different paths. The main scope is to convert clay into an organophilic material compatible with polyolefins. In particular these modified clays were mixed with HDPE by melting process. These polymeric materials were characterized and used for film preparation. Those films served to perform pervaporation experiences with cyclohexane as hydrocarbon. It was noticed that barrier properties were affected by the presence of the different monomers into clay lamellas.

Transport properties of membranes prepared from HDPE and modified montmorillonite clay (MMT) were studied. MMT was modified by the following chemical species: ε-caprolactam (ε-CLa), ε-caprolactone (ε-CLo) y octamethylcyclotetrasiloxane (TOMS). They were introduced into silicate interlamellar spaces by different paths. Those compounds were employed to study their effects on barrier properties on HDPE/MMT films.

ε-CLa was introduced into MMT by water solution in the presence of HCl [1]. ε-CLo was intercalated using MMT modified with Cr^{3+} ions [2]. Whereas, TOMS was put into MMT after cationic interchange with hexadecyltrimethylammonium to turn it into organophilic clay (orgMMT); TOMS was intercalated by sonication [3].

The presence of the modifiers was determined by FTIR and clay structural changes were analyzed by X-ray diffraction.

MMT/ε-CLa and MMT(Cr^{3+})/ε-CLo clays exhibited a significant interlamellar increase according the size of the introduced monomer. Since molecular size of TOMS is smaller than HDTA ion, structural analysis of orgMMT/TOMS nanoclay from XRD patterns do not show any shift, taking the orgMMT pick as reference. Probably HDTA alkylic chains generate a non polar medium where those oligomers could diffuse.

FTIR spectra clearly show the presence of the organic groups of the modifiers.

These materials were incorporated to melted polymer into a Haake torque rheometer Rheocord 9000 equipped with a mix chamber and roller rotors. Changes in the HDPE mixes were evaluated by XRD, SEM and thermogravimetric analyses. Barrier properties were determined by pervaporation; these experiences were carried out at three temperatures in standard device using cyclohexane as hydrocarbon. Activation energies show a correlation with the chemical nature of employed species. An increase in membrane with non-polar modifiers is observed, indicating an increase in the barrier properties.

Results show the feasibility of obtaining MMT modified with different organic molecules, making possible the synthesis of nanocomposites with specific properties to modified HDPE transport properties.

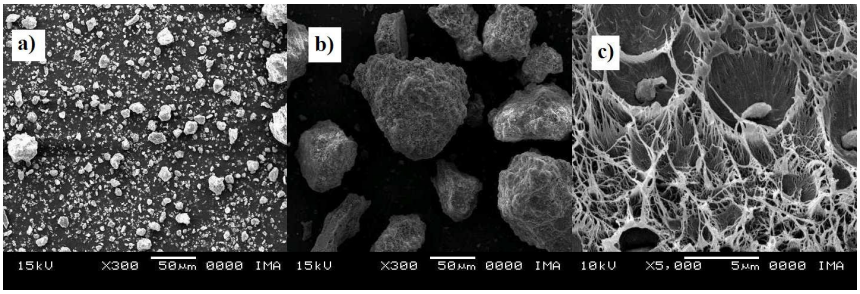

Figure 1: SEM photographs of **a)** MMT, **b)** orgMMT and **c)** HDPE modified with MMT/ε-CLa

References

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