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MECHANICAL PERFORMANCES AND MORPHOLOGY OF HDPE/HALLOYSITE NANOCOMPOSITES: EFFECTS OF MATRIX FLUIDITY AND NANOFILLER ORGANIC MODIFICATION

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It is widely established that functional properties of commercially available resins may be significantly modified by the inclusion of inorganic fillers. In particular, thanks to the advancement of knowledge gained in the last decades about the ability to produce, characterize and manipulate nanometer-scale materials, this benefit has been increasingly exploited taking advantage of the considerable surface area exposed by nanoparticles and able to allow interesting results also in presence of very low amounts of fillers.

In this context, the research has widely demonstrated that good dispersion and strong interfacial interaction play key-roles to obtain products with excellent properties.

In this work halloysite nanotubes (HNTs, $Al_2Si_2O_5(OH)_4 \cdot nH_2O$), a kind of natural hydrophilic nanoclay, were incorporated in three commercial high density polyethylene (HDPE) resins having different melt flow index. This filler, which exhibits a hollow tubular structure in the sub-micrometer range and a chemical composition similar to kaolinite, have already shown strong potential to enhance the mechanical, thermal and fire properties of some polymers [1,2].

The study was performed preparing, by melt compounding technology, HDPE/HNT formulations with content of filler up to 10 wt%, either as received or organically modified to improve its chemical affinity with the hosting matrices. The obtained samples were analyzed in terms of morphological features and mechanical and thermal properties, taking the neat hosting matrices extruded under the same conditions as the reference materials.

Morphological observations showed that all formulations have a satisfactory level of HNT dispersion, which appears more uniform in the systems containing the organomodified nanotubes. The mechanical results suggested that the reinforcement effects are influenced by the matrix fluidity and consequently by the average length of its macromolecules that below a critical length may also enter inside the hollow nanotubes as well as wrap them up.

References

1. K. Hedicke-Höchstötter, G. Teck Lim, V. Altstädt, Composites Science and Technology (2009), 69, 330–334.
2. P. Pasbakhsh, H. Ismail, M.N.A. Fauzi, A.A. Bakar, Applied Clay Science (2010), 48(3), 405-413.