STRUCTURE AND MECHANICAL PROPERTIES OF NANOCOMPOSITES BASED ON POLYPROPILENE

***M.Strat*[2]**, *Georgeta Strat*[1], *Irinel Grecu1, S. Gurlui*[2], *V. Grecu*[1], *I. Lihtetchi*[3], *S. Stratulat*[4]

[1] *"Gh.Asachi "Technical University of Iasi, Romania*
[2] *"Al.I.Cuza" University of Iasi, Romania*
[3] *Transilvania University of Brasov,Romania*
[4] *UMF GR T Popa ,Iasi, Romania*
mstrat@uaic.ro

Polymer clay nanocomposites are a new class of materials which show improved properties at very low loading levels of nanofiller comparing to conventional particulate composites of thermoplastic material[1]. Polymer nanocomposites exhibit superior mechanical properties, reduced gas permeability, improved solvent resistance and enhanced conductivity over polymers. The effect of clay treatment on physical and structural properties of polypropylene (PP J600) nanocomposite has been studied. The analysis of polypropylene nanocomposites was made by means of XRD, FT-IR, and AFM methods.

Although the terms *nanomaterial* and *nanocomposite* represent an early new and exiting field in materials science, such materials have already existed for a long time in the polymer industry and have always existed in nature. A nanocomposite is defined as a composite material with at least one of the dimensions of one of the constituents on the nanometer scale. Despite such complicated structures the smallest building blocks in these materials are generally on the nanometer scale. The manufacturing of polymer nanocomposites usually consists of two stages: the compounding of a nanocomposite and the subsequent melt-forming process such as injection-molding. A primary concern is the achievement of a polymer nanocomposite containing homogeneously distributed and well-dispersed nanoparticles. The dispersion of nanoparticles especially depends on a magnitude of processing parameters, e.g. shear rate and processing temperature, as well as on the selection of appropriate materials. The major reason is that, as it has been demonstrated, introducing clay into polymers at the nanoscale level one can obtain improved mechanical, thermal, flammability and other properties at low clay contents (1-10wt.%). Polymer layered silicates have been prepared in different ways: intercalation in solution [2], in situ polymerization and direct melt intercalation [3]. Since natural clay, as all natural products, suffers a lack of reliability, and therefore exhibits an experimental irreproducibility we choose to use in our research work with the nanoblend MB 1201 (40% nanoclay and 60% PP J600). This material was imported from PolyOne Company, USA.

Three main types of composites (phase separated, intercalated and exfoliated or delaminate structure) may be obtained when layered clay is associated, for example, with polypropylene matrix. These primarily depend on the method of preparation and the nature of components used (layered silicates, organic cations and polymer matrix).

This fact allows in the greater degree to realize their useful qualities and to carry out the directed influence on processes of structure formation and improvement of the operational characteristics of polymeric composites

The experiments carried out were focused on obtaining the polypropylene nanocomposite samples. In all the experiments the polypropylene (PP J600) with flow rate in melt of 9.21g/10min and nanoblend MB 1201 (40% nanoclay and 60% PP J600) were used. The dimensions of nanoblend MB 1201 nanoclay usually range between 1- 100 nm. It can be completely dispersed, the average size of the dispersed layers being around 25 nm, while the

L/D ratio ranges between 100 and 1000. Nanoblend MB 1201 was chosen for the experiments, with the following characteristics: interlayer distance (d-001) 3.5 nm, color-white, organic compound of smectite. The technological processes have different stages for the obtaining of the samples. We have used the segments of experiments which were repeated for different percentage mixtures of concentrate and polypropylene necessary to obtain the samples with final nanoclay contents of 4% (NPP4) and 6% (NPP6), respectively.
The concentrate was obtained on a laboratory extruder with two co-rotating helical conveyers type APV Baker, England, working at temperatures between 200- 220^{o}C on the heating zones.
Fig. 1, shows the XRD spectra of the nanoblend MB 1201, PP J600 and the various PP nanocomposites compounded in a single-screw extruder configured with different temperature arrangements. The organosilicate, nanoblend MB 1201, exhibited three distinct peaks characterising its interlayer basal spacing, at 1.63, 3.82 and 8.26 º 2θ angles. The nanocomposites spectra showed evidence of intercalation and exfoliation, indicated by the smoothening, the shifting of the second and thread, order organosilicate reflections. In addition, intercalation of the organosilicate galleries by polymer matrix can be witnessed by the shift to lower 2θ angles of the second and third order organosilicate peaks.
The organo- nanocomposites show improved mechanical properties: both tensile strength and, surprisingly, charpy impact were higher than the ones of the pure polymer.

References.

[1]. Bousmina M., Proceeding of PPS-21, (2005) 16-19 June, Leipzig, Germany

[2]. Ogata N., Jimenez G., Kawai H., Ogihara T., J. Polym. Sci. Polym. Phys.,(1997), **35**, p.389

[3]. Fornes, T. D.; Yoon, P. J.; Keskkula, H.; Paul, D. R., Nylon 6 Nanocomposites: The Effect of Matrix Molecular Weight, Polym., (2001), **42**, p. 9929

Figure.

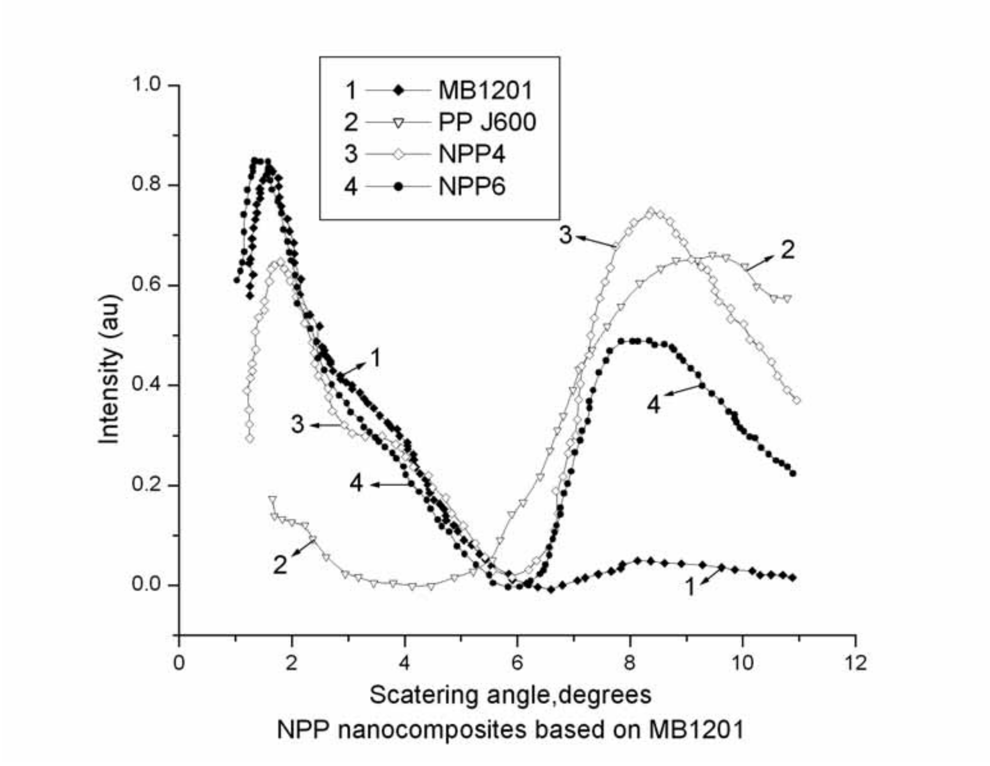

Fig.1 XRD pattern for NPP nanocomposites (1-10 degree)