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POLYMER/ORGANOCLAY NANOCOMPOSITES: PROCESSING, THERMO MECHANICAL CHARACTERIZATION AND MODELING OF THE MECHANICAL PROPERTIES.

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The introduction of organoclay into polymeric matrix has resulted in polymer nanostructured materials, with improved physical and mechanical properties. The aim of this work is to prepare polymer based organoclay nanocomposites, to characterize their morphology, and to address their thermo mechanical properties from experimental and modelling points of view. Two types of studies were made on two polymer matrices: poly(methyl methacrylate) and polypropylene. First, Poly (methyl methacrylate) based nanocomposites were synthesised by melt intercalation technique using organoclays (Cloisite 30B and Cloisite 20A) as fillers. X-ray diffraction and transmission electron microscopy were used to determine the dispersion and the morphology of the nanocomposites obtained. Thermo mechanical tests including tensile test and dynamic mechanical analysis (DMA) are used to evaluate the effect of the addition of organoclay on Young's modulus, storage modulus and glass transition temperature. Thermogravimetric analysis was conducted on the poly(methyl methacrylate) based nanocomposites to determine their thermal stability. The mechanical properties obtained from the tensile tests show an increase in Young's modulus and a decrease of the strain to failure as function of the organoclay concentration. Relative to the pure poly (methyl methacrylate), the dynamic mechanical analyses show an increase in the storage modulus and the glass transition temperature for both nanocomposites. The thermogravimetric analyses show an increase of the thermal stability for both nanocomposites.

The second study was about the compressive dynamic behavior of polypropylene/organoclay nanocomposites. The nanocomposite was also obtained by mixing the polypropylene matrix with a master bach of polypropylene modified anhydrid maleic (MA) and montmorillonite organoclay (pp-nanocor). The high strain rate behaviour was investigated by using split Hopkinson pressure bar, at different strain rates and various temperatures. The obtained nanocomposite exhibits a good dispersion and a partially exfoliated morphology. To study the effect of nanocomposite dispersion and morphology on the high strain rate properties, another nanocomposite was prepared by melt mixing of polypropylene and a modified montmorillonite (dellite) (pp dellite). The dynamic properties results for pp-nanocor show an increase of both Young's modulus and yield stress with the increasing organoclay concentration. However pp-dellite nanocomposites present poor mechanical properties compared to those of pp-nanocor.

For the two systems, micromechanical models including the cooperative model for the yield stress, and Richeton model for the stiffness were used to predict both yield behavior and elastic moduli as function of strain rate (or frequency), temperature and organoclay concentration. The results obtained are in good agreement with the experimental data.