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NOVEL POLY(BUTYLENE SUCCINATE) NANOCOMPOSITES WITH ORGANO MODIFIED LAYERED DOUBLE HYDROXIDE

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Abstract

Aliphatic polyesters are one of the most promising biodegradable materials because they are readily susceptible to biological attack. Poly(butylene succinate) (PBS) is one of the most significant biodegradable polyesters and is, furthermore, commercially available. It can be synthesised by polycondensation of 1,4-butanediol with succinic acid. PBS has several interesting properties including melt processability and excellent thermal and chemical resistance. However other properties of PBS, such as tensile, mechanical, flame retardant and gas-barrier properties, are frequently insufficient for various end-use applications. In order to improve these properties multi-walled carbon nanotubes, organo modified layered silicate, silica and other organo modified inorganic fillers were investigated.

In the present study several organo modified layered double hydroxide (LDH) were intercalated in the PBS matrix by the in situ polymerization method and by using a Brabender mixer starting from a commercial PBS (Natureplast003). In all cases an amount of 3 wt% of the organo-clays was employed. The organo modified LDH were prepared by the co-precipitation method using several organic renewable molecules, such as citric acid, stearic acid, sebacic acid, adipic acid, ricinoleic acid, succinic acid and sodium dodecyl sulphate.

The clays prepared were analyzed by FT-IR and X-ray diffraction while the nanocomposites were characterized by TGA, DSC and melt rheology.

The DSC results showed that the melting temperature was not affected by the addition of the clays while the crystallization temperature displayed a slightly decrease and the glass transition temperature a slightly increase. This behaviour can be explained considering that the clay can hinder the mobility of the polymer chains and indicates a good dispersion into the matrix. The TGA results exhibited a decrease in the thermal degradation temperature, probably due to accelerated chain hydrolysis arising from water released from the decomposed LDH. However the degradation temperatures are higher respect to the processing polymer temperature.

Melt rheology performed on PBS nanocomposites indicates a general mechanical reinforcement of LDH nanocontainers, except LDH citrate, for both melt intercalation and in-situ polymerisation. Significant changes are observed for in-situ polymerised nanocomposites. In this case, LDH succinate reinforces the PBS nanostructure whereas very few difference was observed via Brabender dispersion, meaning that this nanofiller seems to participate to the polymerisation.