Polypropylene nanocomposites

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Polypropylene (PP) is widely used for many applications due to its low cost, low density, high thermal stability and resistance to corrosion. Blending polypropylene with clays to form nanocomposites is a way to increase its utility by improving its mechanical properties. Compared to conventional composites, polymer layered-silicate (PLS) nanocomposites have maximized polymer-clay interactions since the clay is dispersed on a nanometer scale. This results in lighter materials with higher modulus and reduced linear thermal expansion making them desirable for some applications such as exterior automobile parts.

Polypropylene nanocomposites are still challenging due to the lack of affinity of organophilic PP for hydrophilic clay. The goal of this research is to prepare PP nanocomposites by direct melt-blending of polypropylene with silicate/surfactant lamellar mesostructures.

TEM and x-ray diffraction are commonly used to characterize nanocomposites. However, these two complementary techniques present several drawbacks. Rheology in the molten state is an alternative way of monitoring the degree of exfoliation of the clay : the dispersion of the clay into the polymer matrix results in a higher elastic modulus especially at low frequency. This solid-like behavior is related to the formation of a clay fractal network inside the polymer matrix and can be related to the aspect ratio of the dispersed clay.

Different mixers have been used to prepare these nanocomposites. Dispersion quality appears to be strongly correlated to the flow field in the mixer. Mixing conditions are optimized in order to achieve good exfoliation without breaking the lamellae. This strategy should lead to high aspect ratios.