

Investigation of Factors, influencing Compatibility of Organoclays and Thermoplastic Polymers

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Introduction: SAXS and WAXD techniques were applied for the investigation of organoclay-polymer composites, prepared by melt-blending of clays and thermoplastic polymers. Blends of polymers with surfactants, used in the preparation of organoclays were tested for the comparison purposes. The major purpose of this investigation is to define factors, influencing polymer-clay compatibility, to refine structural techniques for the determination of the statute of clays in clay-polymer systems and to find the relationship between morphology, mechanical and rheological properties of clay-polymer composites.

Methods and Materials: SAXS, WAXD, TEM, DSC, DMA and oscillatory shear techniques were applied. Polymers tested included Polystyrene (PS), $M_w \sim 200K$, Polymethylmethacrylate (PMMA), $M_w \sim 130K$ purchased from Aldrich and series of ethylene-vinylacetate co-polymers (PEVA), with varying content of vinylacetate co-monomer manufactured by DuPont (Elvax). Organically modified montmorillonite clays (Cloisite) were supplied by Southern Clay. Clays and polymers tested were used as received. Composites were prepared using by melt-mixing at $170^\circ C$ using Brabender mixer.

Results It was shown that the increase in polarity of the polymer matrix generally facilitates dispersion of organoclays. However both in the melt and in the solid state the presence of clays did not have significant effect on the viscoelastic properties of composites. The weak dependence of rheological properties on clay concentration was observed in polar (PMMA-clay) as well as in non-polar (PS-clay) systems for clay concentrations varying from 0 to 10% [w/w]. Interlayer (gallery) spacings in clays, dispersed in polymer matrix were measured by SAXS. The effect of matrix polarity on the gallery spacing was shown to be rather weak. The addition of organoclays did not facilitate compatibilization of immiscible polymers. These observations are indicative of relatively weak interaction between organoclays and tested polymers. The results, obtained during investigation of polymer-surfactant blends indicate that compatibility between polymer matrix and surfactant, used in the preparation of organoclays favors exfoliation of layered clay structures.

Conclusions: It can be proposed that for tested systems the degree of exfoliation is predominantly determined by compatibility between matrix polymer and surfactant layers formed on the inorganic surface of organoclay rather than by the strengths of interaction between inorganic surface and polymer matrix.