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Reactive Processing of Polymer Blends and Alloys

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Reactive processing leads to development of tailored properties in the polymeric materials. The level of properties depends on the extent of chemical reaction and on the level of compatibiliser formed at the interface due to the reaction of functional groups of the constituent polymers and the compatibilizer. Several approaches to reactive compatibilisation of various blend have been reported in literature. However, the preferred strategy is to introduce a functional polymer capable of reacting with the functional group of one of the components and is also miscible with the non-reactive component of the system. In the present study the technique has been utilized in two different systems, namely, (i) PP/PBT blends and (ii) PP/PEO blends.

I. Reactive Processing of PP/PBT Blends

A reactive compatibiliser has been developed in the form of PP-g-GMA which has a potential reactivity with carboxyl and hydroxyl end groups of PBT thereby forming a possible copolymer at the interface resulting in compatibilisation of PP and PBT. The compatibilizing efficiency of the PP-g-GMA is reflected in the morphological, mechanical and rheological behaviour of the blends on addition of grafted PP. The compatibilized blends resulted in a significant improvement in impact strength, tensile strength and % elongation at break.

Rheological studies provided a direct evidence of the compatibilisation, which was reflected in a significant increase in melt viscosity with the addition of an increasing amount of the reactive compatibiliser. The results on rheological studies have been explained on the basis of the state of dispersion and the formation of an in-situ reactive compatibiliser in the blends. The blends with a higher PBT content show a higher degree of increase in viscosity as compared to the blends with a lower PBT (20wt %) content. This has been attributed to the availability of a larger concentration of the reactive functionality as the PBT end groups to react with the epoxy functionality of the reactive compatibiliser. This observation on the basis of the availability of the reactive functionality was however, found to be insignificant for the blends with three different grades of PBT that varied in their carboxyl end group equivalents as well as the melt viscosities. The compatibilised blends prepared in twin screw extruder were found to exhibit a higher viscosity as compared to the compatibilised blends prepared in a single screw extruder. It has been anticipated that a higher level of reaction occurs in a twin screw extruder as compared to the single screw extruder due to a better mixing efficiency.

II. Reactive Processing of PBT/PEO Blends

This work was undertaken to study the effect of glycedyl methacylate grafted polyethylene octene copolymer, developed by reactive extrusion route, in compatibilising the two immiscible polymers PBT and PEO. An attempt to compare and explain the changes in terms of thermal, mechanical and morphological behavior of the binary blends of PBT/PEO blends with that of compatibilsed ternary PBT/PEO/PEO-g-GMA blends were made. The increased interactions between the two phases were characterized by SEM, DSC analysis and mechanical properties. Significant improvements were observed, especially with notched izod impact strength. Analysis of tensile properties data by using power law models is attempted to obtain better insight into the interphase adhesion and stress concentration effect's. DSC data has shown decreased heat of fusion (ΔH_f) and percent crystallanity with the increase in PEO content, but increased with the addition of compatibilser .The effect of blend composition on the state of dispersion with and without compatibilser will be discussed.