

Thesis Title A Study of the Effect of Compatibilisers on
 Toughening of Polypropylene/Scrap Rubber Dust
 Compounds

Name Thawan Laosee

Degree Master of Science (Polymer Science)

Thesis Supervisory Committee

 Pranee Phinyocheep, Doctorat de l'Universite' du Maine
 Frederick Henry Axtell, Ph.D., F.I.M.
 Kalyanee Premphet, Ph.D.

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ABSTRACT

The objective of this study was to try to reuse the scrap rubber dusts from sports shoe manufacture as fillers for polypropylene (PP) and to maintain the impact properties of PP. Two types of dusts were used, midsole (M, vulcanised EVA foam) and outsole (O, vulcanised rubber blend of NR, SBR and BR). In this study, utilization of a third component called a 'compatibiliser' to improve the compatibility of the mixture was investigated. Six compatibilisers used in this study were Styrene-butadiene-styrene (SBS), Styrene-ethylene-butylene-styrene (SEBS), Maleic anhydride grafted styrene-ethylene-butylene-styrene (SEBS-g-MA), Maleic anhydride grafted polyethylene (PE-g-MA), Maleic anhydride grafted polypropylene (PP-g-MA) and Glycidyl methacrylate grafted polypropylene (PP-g-GMA).

Development of impact strength was found by using SEBS and SEBS-g-MA as the compatibiliser for both compounds filled with

midsole and outsole dusts. The improvement was significant at 6 and 10 phr of the compatibiliser. Especially at 10 phr of the compatibiliser, the impact strength were improved 90 % for PP/M/SEBS, 68 % for PP/M/SEBS-g-MA, 63 % for PP/O/SEBS and 86 % for PP/O/SEBS-g-MA. The tensile strength of each compound was slightly decreased when the compatibiliser loading increased whereas the elongation at break was significantly increased. In the PP/M/SEBS compound the elongation at break was improved 450 %. The enhancement of the impact strength and the elongation at break is believed to arise from reduction of interfacial tension between two phases of the rubber and the PP which results in reduction of the particle size of the fillers.

The scanning electron microscope (SEM) showed the reduction of rubber dust into small rubber particle size of the compound. Some fibrils were observed from the SEM micrographs. From the results of the SEM it can be concluded that SEBS and SEBS-g-MA acted as both a compatibiliser and impact modifier for the PP/scrap rubber dust compounds. The crystallisation behaviour analyzed by differential scanning calorimeter (DSC) suggested that the PP-g-MA and PP-g-GMA acted as nucleating agents giving higher PP crystallisation temperatures whereas the SBS, SEBS, SEBS-g-MA and PE-g-MA acted as retarding agents giving lower crystallisation temperatures. The optical microscopy (crossed polars) observations suggested that the addition of scrap rubber dusts resulted in a less regular spherulite texture and less sharp spherulite boundaries. The crystalline texture showed that with PP-g-MA or PP-g-GMA in the compound microspherulitic texture occurs whereas in the presence of SBS, SEBS, SEBS-g-MA and PE-g-MA the structure is still macrospherulitic.