

3836548 SCPO/M : MAJOR : POLYMER SCIENCE ; M.Sc. (POLYMER SCIENCE)
KEY WORD : FILLER / PROCESSING / PROPERTIES / PP&HDPE BLENDS
SUPOCH KANOKWARAPORN : THE EFFECT OF FILLER ON
PROCESSING AND PROPERTIES OF PP/HDPE BLENDS . THESIS ADVISOR :
RICHARD VENABLES, Ph.D., ARUNEE TABTIANG, Ph.D., ORAPIN RANGSIMAN,
Dr.rer.nat. 150 p. ISBN 974-589-023-5

Polypropylene (PP) with a melt flow index (MFI) of 10g/10min was blended with four high density polyethylenes (HDPE) with MFIs of 0.04, 0.9, 5.5 and 18g/10min, in the range of 10 to 30wt% of HDPE, with and without the addition of filler (40wt%). In the absence or presence of filler all blends exhibited immiscible and incompatible behaviour. The unfilled blend containing HDPE with the lowest MFI, i.e. 0.04g/10min, had the lowest unnotched Charpy impact strength and tensile elongation at break, due to the stress concentration effect of the poorly dispersed HDPE phase; for blends containing 40wt% of filler those containing the HDPE with an MFI of 0.04g/10min showed the highest unnotched Charpy impact strengths and tensile elongation at break in the filled blends. All filled compounds had lower elongation at break and unnotched Charpy impact strength than the unfilled blends. The filler modified the rheological properties of the blend system and aided in the dispersive mixing of the high viscosity HDPE phase as determined from scanning electron micrographs.

In the second part of the work, polypropylene was blended with high-density polyethylene (HDPE) with MFIs of 0.04 and 5.5g/10min, in the range of 10 to 30 wt% of HDPE. The effect of filler (40wt%) in combination with ethylene-propylene-diene monomer (EPDM) compatibiliser (20wt% based on HDPE) was investigated. It was found that EPDM alone was not an effective compatibiliser for the blend containing the highest viscosity HDPE since the HDPE phase was poorly dispersed. In combination with filler the EPDM gave a more significant effect as the filler controlled the viscosity of the PP phase, and hence aided in the dispersion of the HDPE.

In the third part of the work, the effect of EPDM (20wt% based on HDPE), a reactive coupling agent and the effects of two step-mixing were studied for the compound comprising PP, HDPE (30wt% based on PP) with an MFI of 5.5 g/10min and filler (40wt% of the total compound). The two step-mixing can improve the tensile and impact properties of compounds with coated and uncoated filler. For all compounds containing the reactive coupling agent, tensile strengths at break and at yield were higher than for the corresponding formulation without coupling agent. The compound comprising filled PP/HDPE/EPDM with the reactive coupling agent gave the highest unnotched Charpy impact energy. The effects of type of filler, i.e. talc or clay, coated with DCP on the properties of the PP blends was studied. PP blended with China clay showed a decrease in MFI and improved tensile properties but PP blends with coated talc exhibited increased MFI and slightly decreased tensile properties. It was concluded that the clay surface is involved with the free radical reactions at the filler surface, whereas talc was inactive.

An application of the system could be for the recycling of mixed plastic waste containing polymers with large variations in flow properties.