CHAPTER 7
CONCLUSIONS

The blend system discussed in this thesis is that of the most widely used commodity plastics HDPE and PP. This work explores the preparation of the blend, its modification with dicumyl peroxide – a low molecular weight modifier known to produce chain scission in PP and cross-linking in HDPE. The mechanical properties – tensile properties, flexural properties and impact strength, the thermal properties – thermal stability, storage modulus and tan δ and rheological properties – melt viscosity and die swell ratio were examined for the unmodified and modified HDPE/PP blends.

The study shows that DCP can be used to modify the mechanical, thermal and rheological properties HDPE, PP and their blends. The mechanical properties of the blend vary with the blend composition as well as concentration of the modifier used. All unmodified blends examined show mechanical properties in between those of the pure components. DCP modification shows significant improvement in mechanical properties of the blends.

The mechanical properties of the blend vary with the processing method used. Extruded samples of unmodified and modified HDPE/PP blends exhibit higher mechanical properties than the injection moulded samples. 20% HDPE/80% PP blend shows highest mechanical properties for the unmodified and modified versions.

Measurement of melt viscosity of unmodified and modified blends indicate pseudoplastic nature in the molten state. The shear viscosity of
PP rich blends – 20% HDPE/80% PP and 40% HDPE/60% PP, decrease with increase in DCP concentration. The shear viscosity of HDPE rich blend 60% HDPE/40% PP blend increases with concentration of DCP to a maximum value at 0.3phr DCP and then decreases. The shear viscosity of 80% HDPE/20% PP blend exhibits a steady increase with increase in DCP concentration. This variation in shear viscosity is shown by the blends at all three temperatures. This shows that the blend which exhibits the best mechanical properties has also low melt viscosity and is easy to process. Thus DCP is a potential modifier to optimize the properties of HDPE/PP blends.

The extrudate swell ratios of all the four blends referred to above and their DCP modified versions increase with increase in shear rate. The extrudate swell ratios of PP rich blends decrease with increase in DCP concentration. This further shows that DCP is useful in controlling the elastic behaviour of HDPE/PP blends.

The thermal degradation studies indicate that the modified blends to have higher thermal stability than the unmodified blends. The stability increases with DCP content and the highest stability is observed for 0.3phr DCP modification. All DCP modified versions of the 80% HDPE/20% PP blend show higher storage modulus than the unmodified blend. The tan δ values increase with increase in temperature for both the blends and their modified versions. All DCP modified versions of 80% HDPE/20% PP blend show lower tan δ values than the unmodified blend. The tan δ values of 20% HDPE/80% PP blend increase with increase in DCP concentration, reach a maximum at 0.3phr and then decrease.

Differential scanning calorimetry indicates two melting peaks for the blends corresponding to the two polymers used and a single
crystallization peak. This shows that the blends on cooling after melt mixing can develop a favourable morphology to obtain good mechanical and thermal properties. Melting point of HDPE increases to a maximum at 0.3phr DCP and then decreases. Melting point of PP decreases with increase in DCP concentration.

Composites prepared with 80% HDPE/20% PP and 20% HDPE/80% PP blends using nylon mats as reinforcements generate a useful class of recyclable composites. The composites with nylon mats of fibre diameter 0.2mm and 0.4mm have greater tensile strength, tensile modulus, flexural strength, flexural modulus and impact strength than the respective matrix. The DCP modification improves the properties of 80% HDPE/20% PP matrix composites. The highest value is observed in the case of composites employing a maleic anhydride modified matrix. Recycled blends and composites show superior properties compared to the unmodified blends indicates that they are short nylon fibre reinforced composites.

The storage moduli and loss moduli of all composites of maleic anhydride modified 80% HDPE/20% PP blend are higher than those of their respective matrix. The storage moduli of all composites of unmodified and maleic anhydride modified 20% HDPE/80% PP blend are lower than their respective matrix. The onset temperature of decomposition and temperature for 50% decomposition of all composites of the unmodified 80% HDPE / 20% PP and 20% HDPE / 80% PP blend are higher than those of their respective the matrix.