CHAPTER – VII

SUMMARY AND CONCLUSIONS

The present research work has been undertaken with a view to study the effect of three different azeotropic mixtures of solvents on 100% Polyester yarns and fabrics, 80:20 PET / cotton blend yarns and fabrics and to get improved dyeing results. Although the primary objective of the work is to develop an improved dyeing method, with a view to ensure that the solvent treatments did not cause any detrimental effect on the strength of the treated polymeric materials used in the study various mechanical properties of treated materials like denier, tensile strength, tearing strength, and abrasion resistance have been studied before and after solvent treatments.

The solvents treated and control yarns and fabrics samples were subjected to SEM topography, FTIR analysis, DSC and XRD studies to understand the changes if any caused in the physico-chemical behaviour of the treated samples due to solvent treatments. Also the effect of solvent treatments on the dyeing behaviour of treated materials were studied to find the extent of improvement that can be achieved with solvent pretreatments.
In order to study the effect of solvent pretreatments on the fastness properties of the dyed materials various fastness measurements were studied and the results were analysed. The following conclusions are drawn from the study.

- The solvent pre-treatment of yarns and fabric samples of 100% PET 80:20 PET/cotton blends has resulted in the increase in the denier of the treated materials. As the pretreatment time increased, the denier of the samples also increased.

- The results of tearing and tensile strength measurements show that the strength of treated fabrics got improved up to certain time of treatments beyond which there was a small reduction in the strength of the treated materials. These observations are further strengthened by the XRD and DSC results as well.

- The abrasion resistance of the solvent pretreated materials increased for samples pretreated for shorter durations of about 6-8 minutes beyond which it was found to decrease as in the case of tensile and tearing strength measurements.

- The study made on weight loss measurements of the treated materials show a small weight loss for the solvent pretreated samples. As the time of pretreatment increased the weight loss of the solvent treated materials
increased. However this did not cause any serious damage to the strength of the materials studied.

- Scanning Electron Microscopic studies made on the surface topography of solvent treated materials show that the azotropic solvent mixtures attack the entire surface of the fibermaterials and causes erosion. As the time of solvent treatment increased, erosion propagated into interior of the fibermaterials resulting in the formation of elongated pits or cavities on the surface.

- FTIR of treated and untreated fabrics show that there is no introduction of any functional groups or alteration of the existing groups in the case of solvent treated materials used in the study. This shows that there was no change in the chemical composition of the fibermaterials studied rather only physical modification of the treated materials happened.

- Comparison of DSC of the treated and untreated fibersamples shows that there are small changes in their starting, peak and melting temperatures, however melting heat has considerably got increased for solvent treated samples due to solvent induced crystallization which is found to be inter-crystalline in nature.
XRD studies show an increase in the crystalline region and decrease in the amorphous region of the solvent pretreated samples under study. The solvent acted as a plasticizer in the non-crystalline region breaking intermolecular bonds and enhancing the segmental mobility of the polymer which induced crystallization leading to the formation of crystallites.

Pretreatment of the fabric and yarn materials used in the present study shows improved dye uptake for pretreated samples in comparison with the untreated samples. The improvement in the dye uptake results suggest that 100% Polyester can be dyed with disperse dyes even at a lower temperature of 95°C with much better dye uptake leading to savings in energy and hence savings in the dyeing cost. Also 80:20 polyester/cotton blends can be dyed with the combination of disperse and reactive dyes in one-bath / one step method by pre-treating the fiber for a duration up to 8 minutes using azeotropic solvent mixtures at a lower temperature of 95°C with better dye uptake than conventional two bath and one bath / two step methods. This also will lead to cost saving in dyeing of PET/ cotton blends.

Results of fastness studies also show that, the fastness properties of solvent pretreated samples got improved in comparison with that of untreated samples due to improvement in the strength of dye - fiber bonds.
Therefore it can be concluded that azeotropic solvents pretreatments has improved the dyeing behaviour of the polymeric materials used in the current study and can bring down the dyeing cost as it leads to better dye uptake at 95°C which is very low compared to conventional dyeing at 130°C involving high cost pressure equipments and machineries as in High Pressure High Temperature dyeing method.