

## **PREFACE**

Polyethylene terephthalate (PET) is a predominant polymer in the packaging industry because of its excellent properties. The need to make a light weight packaging material has driven the substitution of glass and metal packaging by polymeric materials. PET became a preferred packaging material due to its light weight, transparency, good mechanical strength, low permeability and recyclability. However, this extensively used packaging material gives a limited shelf life of the packaged goods and also has several limitations due to its other suboptimal properties. Hence, there is a constant need to further improve the mechanical strength, thermal stability and gas barrier properties of PET.

The PET is an environmentally safe material due to its high recyclability. However, there are numerous other polymeric materials which are produced as E-waste and have a vast potential to be reused for producing materials having improved properties. ABS is present in large portion of electronic equipment and contributes in a significant part of electronic waste (E-waste). This widely present ABS in E-waste gives opportunity to reuse and reutilize it.

Here in this work PET nanohybrids have been prepared using three different nanoclays namely NK75, nanotalc and Cloisite 30B. The preparation, structure and characterizations of different properties have been done in detailed manner. The nanohybrids have been prepared by solvent casting route having different clay concentrations. The dispersion and interactions of nanoclays with the PET matrix have been studied and the nanoclays have been found to be homogeneously dispersed in the PET matrix. Prepared PET nanohybrids have been tested for their thermal stability, mechanical properties, hardness, gas barrier properties as well as their structural advancement upon stretching. The different

micromechanical models have been used to precisely predict the mechanical and gas barrier properties of nanohybrids. The structural changes upon stretching and effect of presence of nanoclays in PET matrix have been studied.

Further, the utilization of E-waste have been done by extracting waste poly(acrylonitrile butadiene styrene) (ABS) and using it in making polymer blend with polyethylene having improved properties. The blends have been prepared with different concentrations of maleic anhydride (MA) by melt compounding. The chemical blends have been characterized to have improved mechanical properties and found to be suitable for possible practical purposes.

This thesis has been divided in seven chapters. The first chapter is Introduction and literature review which gives the understanding about nanohybrids, problem of E-waste and its utilization along with detailed literature survey. The second chapter presents the different experimental techniques used for the characterization. The third chapter “Structural, mechanical and gas barrier properties of poly(ethylene terephthalate) nanohybrid using nanotalc” (work published in *Journal of Applied Polymer Science*, (2020): 137(27), 48607) presents the PET nanohybrids and their characterizations having nanotalc as filler. The fourth chapter “Effect of addition of NK75 nanoclay on properties of PET/clay nanohybrid” (work published in *Journal of Polymer Research*, (2020): 27(2), 1-9) discusses the preparation and characterization of the PET nanohybrids using NK75 nanoclay. The fifth chapter, “Enhancement in properties of PET/clay nanohybrids using 30B nanoclay” (work published in *SN Applied Sciences*, (2019): 1(11), 1-11) gives the preparation and characterization of PET/30B nanohybrids. The sixth chapter, Utilization of E-waste by single-step reactive extrusion (work published in *Polymer*, (2021): 221, 123626) presents the utilization of ABS extracted from E-waste to prepare a polymer blend having improved properties. The last

chapter presents the major conclusions drawn from this work and suggestions for the future work in this field. The reference work is given at the end.