PREFACE

Nanotechnology has received special attention in recent years as it offers a growing range of applications in many fields. Nanosilica is an attractive filler that be used for the modification of properties of polymers. This novel material has many unusual properties, such as a low thermal conductivity, refractive index, along with a high surface area and thermal stability. The addition of nanosilica particles to glassy polymers modify the permeability coefficients for several gases and vapours. Addition of very small amount of nanofillers brings about a large enhancement of the mechanical and thermal properties of the polymers. Utilization of nanosized organic-inorganic hybrid particles for advanced applications requires high quality with respect to chemical purity, homogeneity, morphology and a controlled state of agglomeration as well as low production costs. This lead to the production of surface modified silica particles and such modified nanofillers have generated great interest in scientific research and industrial development.

The present work focuses on the modification of the commonly used thermoplastics, polypropylene and polystyrene using nanosilica prepared from a cheap source of sodium silicate. Melt compounding technique has been used for nanocomposite preparation as it is simple and suited to injection moulding. Nanosilica in a polymer matrix provide significant enhancement in strength, stiffness and impact strength. Incorporation of silica particles in a polymer also improves its thermal stability. To achieve better dispersion of fillers in polymer matrices the mixing was done at different shear rates. The enhancement in material properties indicates that at higher shear rates there is greater interaction between particles and the matrix and it
depends on filler concentration and type of polymer used. Nanosilica is a useful filler in thermoplastic polymers and has been applied in automotive applications, electronic appliances and consumer goods.

This thesis is divided into six chapters. General introduction to the topic is described in chapter 1. Salient features of polymer nanocomposites, their synthesis, properties and applications are presented. A review of relevant literature and the scope and objectives are also mentioned in this chapter.

The materials used and the various experimental method and techniques employed in the study are described in chapter 2. Preparation of nanocomposites by melt blending using Thermo Haake Rheocord, preparation of samples, evaluation of mechanical and thermal properties using UTM, Impact testing and characterization using DMA, TGA and DSC and morphology by SEM are described.

The preparation of nanosilica from a laboratory scale to a pilot plant scale is described in chapter 3. Generation of surface modified silica, evaluation of kinetic parameters of the synthesis reaction, scale up of the reactor and modeling of the reactor are also dealt with in this chapter.

The modification of the commodity thermoplastic, Polypropylene using nanosilica is described in chapter 4. Preparation of PP/silica nanocomposites, evaluation of mechanical properties, thermal and crystallization characteristics, water absorption and ageing resistance studies are also presented.

The modification of Polystyrene using synthesized nanosilica is described in chapter 5. The method of preparation of PS/silica
nanocomposites, evaluation of mechanical properties (static and dynamic), thermal properties melt flow characteristics using Haake Rheocord, water absorption and ageing resistance of these nanocomposites are studied.

The summary and conclusions of the study are presented in chapter 6.