CHAPTER I

INTRODUCTION

1.1 Purpose of investigation

Polymer blending is a convenient route for the development of new polymeric materials, which combines the excellent properties of more than one existing polymer. This strategy is usually cheaper and less time-consuming than the development of new monomers and/or new polymerization route. Polymer blending usually takes place in processing machines, such as twin-screw extruders, which are considered standard industrial equipment (Cor, Martin, Christophe and Robert, 1998). The growth in the use of polymer blends is mainly due to their ability to combine the properties of their phases in a unique product. The final properties of polymer blends are directly related to the quality of their morphology which in turn depends on rheological properties of the phases of the blend, on compatibility between the polymers forming the blend (Olabisi, Roberson and Shaw, 1979).

The polymer blends are either miscible or immiscible. In miscible polymer blends, both blend components lose part of their identity and the final properties usually are the arithmetical average of both blend components. In immiscible polymer blends, the properties of all blend components are present. However, most of polymer blends are immiscible or incompatible at the molecular level, because the combinatorial entropy of mixing of two polymers is drastically smaller than that of low molecular weight mixtures, whereas the enthalpy of mixing is often positive or near zero. The incompatibility of polymeric blends is responsible for poor mechanical properties because of a lack of physical and chemical interactions across the phase boundaries and poor interfacial adhesion. Therefore, compatibilization is demanded to obtain a blend with desired properties. A common way to improve the compatibility and interfacial adhesion of polymer blends is to add compatibilizers or interfacial agents (Paul and Newman, 1978). The compatibilizers may be a homopolymer of suitable block or graft copolymer. It well known that a graft copolymer is an efficient compatibilizer for immiscible polymer blend.

Compatibilization of acrylonitrile-butadiene-styrene (ABS) and high-density polyethylene (HDPE) blends has been the considerable research and development in recent decades. Both of ABS and HDPE are two of the most widely used plastics in the world as structural materials for engineering applications. The ABS is a copolymer exhibiting a relatively effective degree of toughness and dimensional stability. ABS is comprised of styrene, acrylonitrile and butadiene monomer units. The polybutadiene elastomeric component of ABS exists as a discrete phase dispersed in the thermoplastic components. The nitrile groups from neighboring chains attract each other, due to their polarity, which binds the chains together. The presence of styrene gives the material a shiny, imperious surface. Butadiene, owing to its elastic properties, provides ABS with resilience. ABS copolymers may exhibit less than desirable environmental stability, due to relatively inadequate solvent resistance, an overcoat is often applied to articles constructed of ABS. This disadvantage might also be addressed via blending ABS with a material exhibiting a better weatherbility and/or solvent resistance than ABS. HDPE is a well-known versatile thermoplastic material and high commercial interest due to their wide range of physical and chemical properties. Their use in polymer blends of technological interest has been limited due to their typical non-polar character leading to poor adhesion (Singh, Tambe, Sumui, Raja and Dhirendra, 2006). High-density polyethylene with improved binding capabilities can be obtained by inserting polar functional groups to create reactive spots in the inert backbone (Ana, Joao and Figeiro, 2008). Maleic anhydride (MAH) is one of the widely used vinyl monomers for graft modification of polyethylenes. MAH modified polyethylene is an essential part of many plastic formulations. They are used as compatibilizers for ABS/HDPE blends and could improve the properties of neat ABS.

In this study, the compatibilization of ABS/HDPE blends by maleic anhydride grafted HDPE, as a function of the blend ratio and compatibilizers concentration, was investigated to optimize the physical and mechanical property of ABS/HDPE blend.

1.2 Research objectives

The main purpose of this study is to focus on the compatibilizing of ABS/HDPE blends using HDPE-*g*-MAH as a compatibilizer. Rheological and morphological behavior, impact strength, thermal, and weathering properties of the resulting ABS/HDPE blends are investigated for the compatibilization of ABS/HDPE blends.

1.3 Scope of the research

The scope of this research work includes:

1. Literature survey and in-depth study of this research work.

2. Preparation of HDPE-g-MAH at various MAH grafting ratios (1, 2, 3, 4 and 5 phr) using a twin-screw extruder.

3. Preparation of ABS/HDPE blends with HDPE-g-MAH comapatibilizer at ABS/HDPE blend ratios of 100/0, 80/20, 60/40, 50/50, 40/60, 20/80 and 0/100 with the optimum compatibilizer content using a twin-screw extruder.

4. Investigation of FT-IR spectra to validity the grafting of MA on to HDPE

5. Measurement of rheological behavior of the blends using a capillary rheometer to study the compatibility of the blends based on a log additivity rule model.

6. Observation of the morphological structures of the ABS/HDPE blends using scanning electron microscopic (SEM) technique.

7. Evaluation of thermal properties of the blends using differential scanning calorimetry (DSC).

8. Measurement of tensile properties, flexural strength, and Izod impact strength of the blends to evaluate the blend compatibility.

9. Measurement of weathering test of blend samples using weather-o-meter with ASTM G155

10. Summarizing the results, publishing the research outcomes in proceeding of polymer conferences, writing the thesis.