CHAPTER I
INTRODUCTION

Blending of polymers is an excellent way for developing new materials with improved properties, although most blends are immiscible. Immiscible blend morphology generally can either be co-continuous if the two blend components have roughly equal volume fractions, or the minor component can form discrete domains inside the major component continuous phase. The size and shape of the domains greatly depend upon several factors, such as the ratio of the melt viscosity of components, interfacial tension and adhesion, and processing parameters. The properties of such mixtures depend on the properties of two polymers and the interfacial characteristics. If two incompatible polymers are blended, for example polar polyamide and non-polar polyethylene, the interfacial adhesion is poor and the blend will has poor mechanical properties. Unfavorable interactions lead to large phase sizes and poor interfacial adhesion, which are the primary causes for the inferior mechanical properties. Effective compatibilization is the key to successful commercialization of immiscible polymer blends. One approach is to use macromolecules such as graft or block copolymers that act as interfacial agents. Another approach is reactive compatibilization; in recent years, reactive compatibilization of polymer blends has been the subject of much interest.

Knowledge of how the blend components interact is necessary in order to have an idea of the expected properties. Much work has been reported on blends of nylon with rubbers and polyolefin. The reported work has been dedicated to the study of nylon 6 with polyolefin, such as high-density polyethylene (HDPE), low-density polyethylene (LDPE), ethylene propylene rubber, and ethylene-based propylene diene monomer. Compatibilization of these ethylene based polymers has been achieved through use of copolymer or adducts of maleic anhydride [1], different acrylates such as polyethylene-graft-butylacrylate [2] and polyethylene-methacrylic acid isobutyl acrylate terpolymer [3]. The observed change has been explained on the basis of possible interfacial reaction between amine groups in nylon 6 and the carboxylic groups in the copolymers.

The functionalization of polyethylene with a small amount of ionic group is a particular attractive way of compatibilizing polyamide with polyethylene because the amide group may interact with the ionomer via hydrogen bonding, ion-dipole interactions, or/and metal ion coordination during melt blending. The introduction of such specific interaction can improve compatibility and may promote miscibility of polyamide and polyethylene blends.

Nylon 6 is an important engineering thermoplastic having good melt flow, high heat resistance, high strength, high rigidity and good barrier properties. However, nylon 6 has poor dimensional stability, high water absorption and poor impact strength. Therefore, nylon can be blended with a polymer having a high impact strength; an example is the Surlyn® Reflection series where nylon is blended with a ethylene-methacrylic acid copolymer partially neutralized with zinc. The purpose of this work is to investigate blends of nylon with another polymer, specifically high-density polyethylene (HDPE). HDPE is a polyolefin widely employed in the packaging and the injection-molding industries. HDPE forms good moisture barriers and possesses very good tensile and impact strength. Polyethylene and nylon 6 are not compatible and hence blending of these materials result in poor properties. We believe this compatibility can be improved by the addition of a compatibilizer.

In this study, blends of nylon 6 and high-density polyethylene (HDPE) using maleic anhydride grafting on high-density polyethylene (HDPE-g-MAH) as a compatibilizer were investigated. DuPont markets this compatibilizer under the trademark Fusabond®. Moreover HDPE-g-MAH can be partially neutralized with zinc, and the effects of this neutralization was studied. Attentions were focused on the thermal behavior, rheological properties, mechanical properties and phase morphology of these blends as a function of the compatibilizer content.