CHAPTER I

Introduction

1.1 General Introduction

Polymers are the materials which were discovered and produced for many purposes. At present, wood, steel and ceramic are replaced by polymers because of theirs useful in many ways such as light weight, low cost of fabrication and easy processability. However, in using polymer, it is involved in mechanical properties especially for stress tolerance which is worse than wood, steel and ceramic. But for now the newly developed polymer blend and polymer with traditional fillers (e.g. glass fiber and carbon fiber etc.) or polymer composite exhibit a higher various properties of polymer such as mechanical, thermal, optical, barrier and electrical properties [1].

Generally, the addition of traditional fillers or microfillers with high content into polymer matrix can be very effective in injection moulded products, such as automotive parts and electrical parts, and lead to stiffness of materials. However, for film application these fillers are not very useful because the large size and high contents of filler have been negatively affected on the toughness, transparency and surface appearance [2].

To overcome the disadvantages of polymer composites with traditional fillers, polymer nanocomposites are developed and become the most versatile industrial advanced materials. Because nanofillers in polymer nanocomposites exhibit several advantages when compare to polymer composites with traditional fillers, for example lower contents of fillers, lower density, improved transparency and increased barrier properties [2-11].

Polymer/clay nanocomposites, which are a typical of polymer nanocomposites, have attracted great interest due to the potential for exceptional improvement in mechanical [2-4, 6, 9-12], barrier [5-6, 8, 12-14], thermal [2, 6-10, 14] and other physicochemical properties [2, 8, 11] at very low clay loading. For example, adding only 3 to 4 wt% montmorillonite clay to nylon 6, mechanical [3-4, 6] and barrier properties were improved several times [8]. Therefore, many research have focused on developing polymer/clay nanocomposites using various kinds of polymers [2-6, 7-14]. Generally, inorganic clays have poor interaction with organic polymers. In order to achieve good interaction with polymers, hydrophilic clay has to be modified with surfactant (e.g. alkylammonium ions) to convert its surface to be organophilic clay, which are generally achieved by ion exchange reactions between organic molecules with a cation group and sodium ions of clay [13, 15].

Polymer/clay nanocomposites are formed mainly by three techniques which are solution method, in situ polymerization [13-14] and melt processing [2-12]. Among these techniques, melt processing technique is particularly the most attractive method because of its low cost, versatility, high productivity and compatibility with current polymer processing techniques for commercial applications [4].

The degree of clay dispersion (intercalation and exfoliation) strongly affects the properties of polymer/clay nanocomposites [3-6, 11]. The exfoliated polymer/clay nanocomposites are especially desirable for improved properties because of the high aspect ratio, homogeneous dispersion of clay and large interfacial area between polymer and clay. Moreover, the presence of silicate platelets in polymer/clay nanocomposites influenced crystallization behavior of polymer matrix, such as the addition of silicates induced crystal transformation from α-form to γ-form of nylon 6 [8, 10].

The purpose of this research is to study the effect of surfactant on the degree of clay dispersion in nylon 6 nanocomposite films. The effect of organoclay loading on mechanical, thermal and gas barrier properties of nylon 6 nanocomposite films is also determined. The relationship between degree of clay dispersion and nylon 6 nanocomposite films properties such as mechanical, thermal and barrier properties is also investigated.

1.2 Objectives

1. To study the effect of surfactant on the degree of clay dispersion in nylon 6 /clay nanocomposite films.
2. To investigate the effect of organoclay loading on mechanical, thermal and gas barrier properties of nylon 6/clay nanocomposite films.
3. To study the relationship between the degree of clay dispersion and nylon 6/clay nanocomposite films 's properties such as mechanical, thermal and gas barrier properties.

1.3 Scopes of the research

1. Compare the number of long alkyl chains of surfactants, trimethyl tallow quaternary ammonium chloride and dimethyl bis (hydrogenated-tallow) ammonium chloride, in nylon 6/clay nanocomposite films.
2. Vary the organoclay loading of nylon 6/clay nanocomposite films.
3. Characterize nylon 6/clay nanocomposites in which the degree of clay dispersion, crystalline phase of nylon 6, thermal, mechanical and gas barrier properties of these materials will be studied.