CHAPTER 1

Introduction

Polymeric materials, which are well known under the common name "Plastics", are very important and useful at present, because of their high properties per weight ratio, comparing to existing materials such as metals and woods. They are also used in many applications, for examples, household appliances, insulation, and electronic equipment. These products required different properties of each polymer, which can be selected depending on each application.

However, their excellent properties can become a cause of limitation in manufacturing processes especially the viscosity of melt polymers. To process the plastics requires many complicated operations because their and their manufacture consumes high energy.

The processing properties of polymers can be improved by adding various additives, such as antioxidants, plasticizers and others. There are many additives to reduce melt viscosity of polymers for improving their processability, but those additives may cause many negative effects to other important properties, especially mechanical properties of the final products.

Blending polymers is the technique to obtain the new properties of polymers from existing materials without synthesizing the new polymeric materials. Mixing two or more existing polymers may create the new properties of polymers. There were many ways to mix polymers together, such as by heat (melt-mixing), by using solvent (solution casting, freeze drying) and others. The results of blending polymers have many advantages; for example, blended polymers have lower cost than synthesis the new synthesized polymers, which have the same desired properties.

The blending of low molar mass liquid crystals and liquid crystal polymers is an interested method. Liquid crystal polymers were known as reinforcing fillers to enhance the blends modulus but they also affect the melt viscosity of polymers. However, these methods were found to be valid only at high percent composition of liquid crystal polymers in the blends [Zaldua, A. et. al. 1991]

Low molar mass liquid crystals were also found to improve processability of polymers. Patwardhan, et. at. [1988] suggested that addition of low molar mass liquid crystal to amorphous polymers could improve both processability and mechanical properties of the blends.

In The United States Patent [4,434,262], Buckley, A. et. al. [1984] patented the improvement of melt processable blend comprising polymers selected from a group of polyolefins or polyesters with a low molecular weight liquid crystalline compound. Their low molecular weight liquid crystalline compounds are capable of forming an anisotropic melt phase at the melt processing temperature of the blend.

Following the above mentioned, this present work has investigated low molar mass liquid crystals as additives to improve processability for several types of polymers,

including engineering polymers and commodity plastics. Only a small concentration of low molar mass liquid crystal would be used. Melt mixing would be the standard method to blend the polymers and low molar mass liquid crystals. The rheological behaviors of polymers and their blends would be observed by parallel plate rheometric measurements and the tensile strength would be studied in order to determine the effects of low molar mass liquid crystal on mechanical properties of the binary blends.

Four types of low molar mass liquid crystal, CBC33, CBC53, HP5N, and BCH5 have been chosen in this work. Pair of blends between base polymer and low molar mass liquid crystal that has anisotropic melt temperature matched to process temperature of the base polymer, will be selected. This work is also a preliminary study of the effects of low molar mass liquid crystal on properties of ternary polymer blends.

1.1 Objectives of the Present Study

1.1.1 To investigate the various effects on the viscosity of various pairs of the base polymers and the low molar mass liquid crystals which have the anisotropic morphologies at processing temperatures of the base polymer.

1.1.2 To primarily study the effects of low molar mass liquid crystal on polymer alloy system (ternary system).

1.2 Scope of the Present Study

1.2.1 Effects of low molar mass liquid crystal on the properties of polymers.

There are eight systems of blends between low molar mass liquid crystals and several base polymers:

System 1 : Polycarbonate (PC) and CBC33.

System 2 : PC and CBC53.

System 3 : Nylon 6 and CBC53.

System 4 : Polyoxymethylene (POM) and HP5N.

System 5 : Polypropylene (PP) and HP5N.

System 6 : High Density Polyethylene (HDPE) and BCH5.

System 7 : Styrene Acrylonitrile copolymer (SAN) and BCH5.

System 8 : Poly(methyl methacrylate), (PMMA) and BCH5.

Shear viscosity of the base polymers and their blends will be determined by parallel plate rheometric measurements. The tensile strengths of the base polymers and their blends will also be investigated.

1.2.2 Effect of low molar mass liquid crystal on properties of polymer alloys.

Polymer alloys comprising SAN and PMMA at various compositions, 80/20, 60/40, 40/60 and 20/80 percent by weight of SAN/PMMA are first selected. Low molar mass liquid crystal, BCH5 would then be applied to them. The rheological behavior of binary polymer alloys and their ternary additives would be examined.