CHAPTER 6

Conclusions and Recommendations

6.1 Conclusions

This present work investigated low molar mass liquid crystals (LC) as the additive to improve processability for several types of polymers and LCs (including engineering polymers and commodity plastics). Four types of liquid crystals have been applied to the base polymers at only small concentration to create the binary blend of base polymer and LC. Melt mixing was the standard method to blend the polymers and low molar mass liquid crystals. The rheological behaviors of polymer and their blends were observed by parallel plate rheometric measurements and the effects on mechanical properties of the binary blends were observed by tensile strength. The preliminary studies of the effects of low molar mass liquid crystal by the ternary blends are also performed. The conclusions from this research can be summarized as follows:

1. The addition of low molar mass liquid crystals to base polymers affects the reduction of the melt viscosity of their polymers, as measured by the parallel plate rheometric measurements. Only concentration of 0.4% by weight of low molar mass liquid crystal can reduce the viscosity of the base polymer from at lease 20 percent to more than 80%, depending on types and characteristics of base polymers.

2. The mechanisms of viscosity reduction by liquid crystals mainly come from LC anisotropic properties over the range of processing temperature of each polymer. At the anisotropic state, they might align their molecules into flow direction and conduce the flow behavior of matrix phase into the same direction, depending on the degree of dispersive and distributive mixing. However, this phenomenon has to be further investigated.

3. The reduction of viscosity of the base polymer implies that the processing temperature of polymer can be reduced.

4. The glass transition temperature of the blends does not significantly change from the base polymers. This phenomenon proves that LCs do not have direct plasticizing effects on the thermal properties of base polymers.

5. The tensile strengths of the blends do not significantly change, comparing with the base polymers. These results show that low molar mass liquid crystal do not affect the mechanical properties of base polymers.

6. The viscosity of polymer alloys SAN/PMMA under the phase separation condition might be lower than that of the miscible region conditions. This may be because of the incompatible interface effects and the lack of adhesion between two phases

7. The addition of low molar mass liquid crystal into the miscible blends of SAN/PMMA alloys also has the same effect as pure polymer but the degree of viscosity reduction is less significant. Special interfacial between phase separation and the effects of reduced viscosity need further investigations.

8. The glass transition of polymer alloys SAN/PMMA and their ternary blends follow the rule of additive blends, that Tg of each blend compositions is between that of the pure component and the differences between the binary's and ternary's Tgs are negligible.

6.2 Recommendations for further studies.

1. Usually, engineering polymers can be used at high temperature and Tg, Tm are very high. Some engineering polymers will degrade before melt, so solution cast is the preferred process. This research will lead to enchance the processability of engineering polymers which are difficult to process by melt-mixing method.

2. If we use the same viscosity in the melt, this research will lead to the lower energy consumption rate, because at the same viscosity. LC blend will need lower energy.

3. It should be interesting to study the phase diagram of low molar mass liquid crystal and the base polymer, especially polymer alloys that present the interesting behavior. The morphologies of their blends are also interesting to investigate.

4. This research will lead to the most important question; "Why can LC reduce the viscosity of the blend?" and the synthesis method of LC is needed to be further explored to tailor-made the viscosity.