CHAPTER VI

CONCLUSIONS

6.1 Conclusions

Factors influencing the degree of dispersion of pigments in polystyrene upon using the present continuous twin-screw kneader have the following effects :

1. Regarding the kneading temperature effect, a higher temperature (from 170 to 210 °C) led to improved dispersibility because the melt viscosity became lower.

2. As the rotational speed of the screw increased from 81 to 324 rpm, the intensity of the shear stress increased. Thus the higher the rotational speed of the screw, the higher the dispersibility. The highest rotational speed studied was 324 rpm.

3. As the feed rate of polystyrene-pigment mixture increased from 4.5 to 41.4 g/min, the dispersibility decreased. This is because the higher feed rate resulted in shorter residence time in the kneader, so dispersibility became lower.

4. Regarding the type of pigments, inorganic pigment (iron oxide) and organic pigment (carbon black), carbon black pigment dispersed more uniformly than iron oxide pigment. This may be because the physicochemical properties of carbon black is more compatible with polystyrene than those of iron oxide.

5. Comparison between the experimental results and the corresponding ideal-case values obtained from the computer simulation shows that the normalized values of the experimental fractal dimension were between the uniform random dispersion and the normal random dispersion. This means that the dispersion

efficiency of the present kneader is a few and up to 20% better than the case of the normal random dispersion but 10 to 5% worse than the case of the uniform random dispersion.

6. From the experimental results, it may be concluded that the most suitable condition kneading temperature was 210 °C. Regarding the rotational speed of the twin screw, the highest rotational speed of 324 rpm used in the study was the most suitable. The lower feed rate resulted in longer kneading time. Therefore, the most suitable feed rate in terms of dispersibility was 4.5 g/min. The low feed rate, however, will lead to reduced productivity.

6.2 Recommendation for future work

The fractal dimension was used as a quantitative index of the dispersion of pigments. From the results of computer experiments on the two ideal cases this index has been shown to depend on the sample population size, so in the interpretation of experimental results, the ratio of pigment per polymer should be investigated while taking this fact into account. If possible, the ratio should also be varied to compare experimental results with computer-simulated results.

Since dispersion is important to the compounding operation in plastics industry, it will be interesting to extend the present study. There are other factors that should be investigated, such as the type of polymers, the type of additives used, the effect of premixing and so on. In addition, the compounded sample should be tested to find the effect of dispersion on key physical properties of the polymer.