CHAPTER 4

4.1 CONCLUSION SUMMARY

Recycling of PET waste through glycolysis with glycerol was successfully performed with the hydroxyl value of 527-815 mg KOH/g with low activation energy of 32.4 kJ/mol. The highest yields of 98% of glycolysed PET was obtained at glycolysis temperature of 200˚C, glycolysis time of 2 hours and glycolysis ratio of 1:6 with the glycolysis conversion of almost 100%.

Glycolysed PET is found to be miscible with commercial polyether polyol FA-703 thus the polyol mixtures containing various percentage of glycolysed PET are prepared. After addition of surfactant, catalyst and blowing agent, this mixture reacts further with isocyante to become polyurethane. As a result, a various range of polyurethanes are formed from different combinations of diisocyanates and glycolysed PET as the compounds with OH groups.

Various percentages of glycolysed PET in polyol mixture have produced semi-rigid foams with the density of 60-80 kg/m^3 and compression strength of 90-140 kPa. The density and compression strength of foams increases with the increasing of glycolysed PET percentage in the polyol mixture. This probably effect of the used of glycerol in glycolysis process has introduced branching structure and more 'active' hydrogen atoms to the glycolysed PET.

Similar trend obtained when the isocyanate index is varied from 90 to 120. Semi-rigid foams produced have density in the range of 60-85 kg/m^3 while compression strength in the range of 100-190 kPa. Generally the increase in isocyanate index will increase the amount of isocyanate used in the blending system and subsequently increase the crosslinking in the foam. Therefore the density and compression strength increase with the increasing of isocyanate index.

Study on compression strength shows that the semi-rigid foams tend to be anisotropic where, when the foam cells were oriented in the direction of foam rise, the compression stress parallel to rise was much higher than the one perpendicular to rise. This correlation is comparable with previous study [3].

PU foams with many potential commercial applications can be produced from the glycolysed PET which synthesis from waste PET bottles. This can help to overcome the pollution problems created by empty PET bottles and thus contribute to protecting our environment.

4.2 SUGGESTION FOR FUTURE WORKS

The recycling of pet waste materials and polyurethane foams have many interesting areas for further investigations. The following areas are worthy for further research:

1- Flexible and rigid foams series can be developed from the variation of hydroxyl value of glycolysed PET.

2- Study the effect of using various amount of water in the foam formulation

3- Study on foam aging and on haze value of foam. If the haze value is low than it can be suitably used for interior materials of automobils.

4.3 REFERENCES

1. Dirckx, V.M.R., E.J. Gerard, and H.F. Vermeire, *Use of polyol mixtures in rigid and semi-rigid polyurethane foams*. 1999, Google Patents.
2. Coppola, P.J., *Semi-rigid polyurethane foam used in packaging*. 1978, Google Patents.
3. Randall, D. and S. Lee, *The polyurethanes book. Everberg, Belgium, Huntsman polyurethanes*. 2002, New York, Wiley.
4. Peng, S., et al., *Process monitoring and kinetics of rigid poly (urethane–isocyanurate) foams.* Journal of applied polymer science, 2000. **77**(2): p. 374-380.
5. Szycher, M., *Handbook of polyurethanes*. 1999, CardioTech International Inc., Woburn, MA (US).
6. Klempner, D., V. Sendijarevic, and R.M. Aseeva, *Polymeric foams and foam technology*. 2004: Hanser Gardner Publications.
7. Kim, S.H., B.K. Kim, and H. Lim, *Effect of isocyanate index on the properties of rigid polyurethane foams blown by HFC 365mfc.* Macromolecular Research, 2008. **16**(5): p. 467-472.
8. Sakai, M., A. Ishikawa, and M. Morii, *Semi-rigid polyurethane foam*. 2001, Google Patents.
9. Eisen, N., G. Avar, and P. Haas, *Method for producing soft to medium-hard structural polyurethane foams*. 2001, Google Patents.