

CHAPTER V

CONCLUSIONS

The synthesis of graft copolymers from cassava starch and styrene monomer via free radical polymerization using benzoyl peroxide as initiator in aqueous medium was studied in this research. The characteristics of the obtained starch-*g*-polystyrene copolymers were affected by several parameters including the ratio of starch and styrene monomer, the amount and purity of benzoyl peroxide, the mixing method, the reaction temperature and time. The effect of the ratio of starch and styrene monomer was studied at constant benzoyl peroxide concentration. It was found that the viscosities of the system increased with increasing the amount of starch resulting from the difficulty of the free radical diffusing to starch. On the other hand, increasing the amount of styrene monomer would increase the amount of homopolystyrene formed. As a result, the equal amounts of starch and styrene monomer were used. In addition, the percent add-on and percent grafting efficiency continuously increased with increasing the concentration of benzoyl peroxide. However, both percent add-on and percent grafting efficiency significantly decreased when the amounts of benzoyl peroxide were higher than 0.5 g.

For the mixing condition, the synthesis of graft copolymer by using the starch pre-gel and adding the initiator at room temperature was the best method in term of percent add-on and percent grafting efficiency. However, mixing all raw materials at the same time seemed to be a suitable method in term of energy saving and potential for a larger scale. The reaction time of 2 hours was the best time for synthesis since at shorter reaction time, the reaction was incomplete while at longer reaction time, thermal degradation occurred. The suitable temperature for dissociation of benzoyl peroxide into free radical was at 80°C. This is because the viscosity of system at 70°C appeared to be too high whereas the termination process was accelerated at 90°C.

In this experiment, the best result was achieved when 5.0 g of starch, 5.0 g of styrene monomer, and 0.5 g of benzoyl peroxide were mixed together and graft copolymerized at 80°C for 2 hours. This provided 35.87 percent add-on, 95.64 percent conversion, 46.09 percent homopolystyrene formed, 53.91 percent grafting efficiency, 51.26 percent grafting ratio, and 88.08 percent yield.

Chemical structures determined from FT-IR spectroscopy, morphology analyzed by SEM, thermal behaviors characterized by DSC and TGA and solubility behavior determined from solubility test confirmed the existence of starch-g-polystyrene copolymer contaminated with homopolystyrene. The results obtained from GPC revealed that MW of grafted polystyrene was lower than that of homopolystyrene. Furthermore, TGA results also indicated that starch-g-polystyrene copolymer had lower thermal stability than ungrafted starch and polystyrene. This copolymer also showed higher tendency to be soluble in solvents which can solubilize starch than in solvents which can solubilize polystyrene. Its percent moisture absorption was in between those of ungrafted starch and polystyrene.



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