

CHAPTER V

CONCLUSIONS AND RECOMMENDATION

In this research, an attempt was made to prepare graft copolymers of MMA and ST on EPDM by solution polymerization using benzoyl peroxide as an initiator. The conversion, grafting efficiency, percentage of free rubber, percentage of copolymer and percentage of graft copolymer was recorded as functions of reaction temperature, rubber concentration and reaction time. The graft EPDM (GEPDM) was also used as an impact modifier and stabilizer for acrylic sheets. The mechanical and physical properties including morphology of the modified acrylic sheets containing graft EPDM (GPDM) with various contents and grafting levels were investigated. The retention of mechanical and physical properties of the modified acrylic sheets containing GEPDM after thermal and UV aging was reported. The kinetics of thermal degradation and activation energy of the modified acrylic sheets were also evaluated.

5.1 Conclusions

5.1.1 Preparation and grafting properties of GEPDM

The graft copolymerization of MMA and ST onto EPDM was carried out by solution polymerization initiated by benzoyl peroxide. The appropriate condition of graft copolymerization was 1 wt% of initiator dosage 8% of rubber concentration, 50/50 %w/w of EPDM/MMA-ST ratio and 75/25 %v/v of MMA/ST ratio at 90°C for 16 h to achieve the GEPDM product consisting of 88.1% of grafting efficiency.

5.1.2 Mechanical properties of the modified acrylic sheets containing GEPDM before and after thermal and UV aging

The mechanical properties of the modified acrylic sheet containing GEPDM and %GE before and after thermal UV aging were reported. It was found

that the impact and flexural strength of the modified acrylic sheet reached to 52.08 KJ/m² and 96.75 MPa, respectively when GEPDM was applied as 2.0 wt%. For the addition of GEPDM content in the range of 1.0-2.0 wt% with 60-88.1% of %GE could retain and/or increase the mechanical properties of the modified acrylic sheet after thermal and UV aging.

5.1.3 Morphology of the modified acrylic sheet

From SEM micrographs, the addition of GEPDM into the modified acrylic sheets increased homogeneity between thermoplastic and rubber phases with increasing GEPDM content. Thus, the GEPDM could act as the interfacial agent or compatibilizer to improve the mechanical properties of the modified acrylic sheets.

5.1.4 Transparency stability of the modified acrylic sheets after aging.

The thermal and UV stability of the modified acrylic sheets was also examined by monitoring the yellowness of the test specimens, which was reported in the term of ΔE . The ΔE of the modified acrylic sheets increased with increasing the GEPDM content. The increase in the %GE of GEPDM reduced the ΔE value of the modified acrylic sheets.

5.15 Thermal properties of modified acrylic sheet

The DSC thermogram indicated that T_g of EPDM was shifted from -52.9°C to -40.3°C due to higher rigidity of EPDM after graft copolymerization of ST and MMA which are the monomers for producing the brittle materials. For the addition of 1.0-2.0 wt% of GEPDM reduced T_g from 110°C to 108°C for PMMA and 73°C to 72°C for PS resulting from the soft segment of EPDM in GEPDM. However, the increased in the GEPDM content above this point increased T_g value of PMMA and it was close to that of unmodified one. This result was opposite to that of PS phase. This was possible that GEPDM was more compatible to PS phase than PMMA phase in the modified acrylic sheet.

5.16 Kinetics of thermal degradation

The initial decomposition temperature of EPDM (415.9°C) was higher than that of GEPDM (287.2°C) due to the effect of brittle PMMA and PS phases inside GEPDM. The thermal decomposition of the unmodified acrylic sheet (MMA/ST = 80/20% w/w) showed the two-stage thermal decomposition. Conversely, the modified acrylic sheet with containing GEPDM exhibited the one-stage decomposition pattern due to the higher compatibility. The increase in the GEPDM content promoted the higher T_p value resulting from the effect of EPDM segment in the GEPDM. The overdose of GEPDM caused the reduction of T_{id} possibly due to the higher incompatibility and GEPDM might be partially decomposed at the initial decomposition process.

The E_a of GEPDM (274.5 kJ/mol) was significantly higher than that of EPDM (222.5 kJ/mol). The E_a of thermal decomposition of the modified acrylic sheets increased to 210.7 kJ/mol of 1.0 wt% of GEPDM which was higher than that of the unmodified one. However, it was observed that the E_a values of the modified acrylic sheets decreased with increasing the GEPDM content due to the higher incompatibilization effect.

5.2 Recommendation for the future work

1. From the result of this study, the GEPDM should be applied for the commercial production scale of the casted acrylic sheets that are used in outdoor applications.
2. The new techniques such as microwave or plasma graft copolymerization should be further studied to enhance the rate of reaction.