

## CHAPTER 5

# CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK

### 5.1 Conclusions

From the determination of thermal and mechanical properties of the composites in the range of study on the effect of reinforcement and absorbed moisture, the following conclusions have been made:

- (i) The existence of moisture in the composites system gives plasticising effect thus reduced the  $T_g$ .
- (ii) More fibre degradation occurred during processing as the fibre volume fraction is increased.
- (iii) Glass fibre addition in PA 6,6 resulted in loss of ductility and increase in stiffness. Despite the reduction in fracture strain by 96-97%, 91-97% and 80-94% of dry, 50% RH and wet condition, tensile strengths are increased compared to unreinforced PA 6,6 counterparts by 67-200%, 20-110% and 23-140% respectively. Tensile moduli were also increased by 130-437%, 0-356% and 92-508% at dry, 50% RH and wet condition respectively as the fibre volume fraction is increased.
- (iv) Tensile strength, tensile modulus, flexural strength and flexural modulus of glass fibre composites are decreased as the moisture content increases. Water can cause matrix swelling, interphase debonding and physical damage of the interphase which are the main reason for the deterioration of tensile strength and modulus. However, fracture strain and flexural displacement show an improvement as the moisture enhances the matrix ductility.
- (v) For carbon fibre composites, fracture strain is increased by 11-24% as the moisture increases, tensile strengths are decreased compared to dry carbon fibre composites counterparts by 17-93%. Tensile modulus is also decreased by 28-37% as the moisture content increases.

- (vi) Besides fracture strain and flexural displacement, fracture properties such as  $G_c$  and  $K_c$  of these composites also improve as the samples are exposed to high humidity environment, believed to be due to the plasticisation effect.
- (vii) The properties of glass/carbon hybrid fibre composites are not as expected as predicted/calculated using modified simple ROM. It shows a negative hybrid effect on the hybrid composites.

## 5.2 Suggestions for further work

- (i) In studying the effect of absorbed moisture on the mechanical properties of the composites, the study on the effect of re-dried composites could be made. The time and temperature to re-dry the composites can be varied.
- (ii) The effect of testing temperature and speed on the mechanical properties could also be made. The span to depth ratio in the study on the effect of impact properties could be further investigated.
- (iii) In studying the effect of hybridisation to the composite properties, variety of hybrid fibre arrangements and different hybrid types such as sandwich hybrids, laminated hybrids, intraply hybrids etc. could be further studied.