ACKNOWLEDGMENT

First and foremost, gratitude and praises goes to Allah, in whom I have put my faith and trust in. During the entire course of this study, my faith has been tested countless times and with help of the Almighty, I have been able to go pass the obstacle that stood in my way.

I also would like to take this opportunity to express profound gratitude to my research supervisors Assoc. Prof. Dr. Aziz Hassan and Prof. Dr. Rosiyah Yahya for the noble guidance and valuable advance throughout the period of study. Their patience, time, and understanding are highly appreciated. A word of thanks also goes to the staffs of Chemistry Department, Mr. Zulkifli Abu Hasan, Ms. Ho Wai Ling & Ms. Nisrin , Mr. Chan from Mecomb, Mr. Keong & Mr. Lau from Melchers as well as Mr. William & Mr. Chua from Research Instrument for providing assistance in many ways.

My fellow friends especially Nor Mas Mira, Noordini, Rafiq, Ruth, Rozana Othman and Chin Sek Peng should also be recognized for their support in their invaluable views.

Last but not least I would like to thank my family members whom I owe a debt of attitude for their prayers, encouragement and moral support throughout the whole duration of studies.

ABSTRACT

Polyamide 6 (PA6) with various loading of short glass fibres, SGF (2%, 5%, 8%, 10% & 16% V_f) were prepared by injection moulding. The mechanical properties of composites were studied through tensile and impact tests. Composites were subjected to a series of mechanical tests at various testing conditions. The aim of the investigations was to show in which way the SGF content and testing conditions influence the materials behaviour. For different conditions, SGF/PA6 composites were subjected to dry as moulded (DAM), 50% RH and wet conditions. Results showed that composites strength decreases as moisture is introduced and temperature is raised. The melting temperatures as well as thermal stability of composites were also studied by DSC and TGA techniques respectively. The composites were also subjected to DMA analysis to examine the viscoelastic behaviour of materials under periodic stress. TGA analyses revealed that the thermal stability increase with an increase in the SGF content. DSC results showed that as the glass fibre content increases, the degree of crystallinity also decrease. Mechanical test showed that the tensile modulus and tensile strength increase steadily while the elongation at break decrease with an increase in the SGF content and/or strain rate. The toughness of moulded materials was characterised using linear elastic fracture mechanics approach. The critical strain energy release rate, (G_c) increases as the glass fibre loading increases. The reduction in ductility and toughness are attributed to the constrained mobility of polymer chains in the presence of SGF.

ABSTRAK

Poliamida 6 dengan pelbagai komposisi gentian kaca pendek (2%, 5%, 10% & 16% V_f) disediakan dengan menggunakan mesin acuan suntikan. Ciri-ciri mekanikal komposit dikaji dengan menggunakan ujian regangan dan impak. Komposit didedahkan kepada siri-siri ujian mekanikal pada pelbagai keadaan pengujian. Tujuan kajian ini adalah untuk menunjukkan bagaimana komposisi gentian kaca dan keaadaan persekitaran mempengaruhi bahan komposit. Bagi persekitaran yang berbeza, gentian kaca pendek dan poliamida telah didedahkan kepada keadaan kering, 50% kelembapan relatif dan basah. Keputusan ujian menunjukkan yang kekuatan komposit menurun apabila terdedah kepada kelembapan dan kenaikkan suhu. Suhu cair penghabluran serta kestabilan terma diuji dengan menggunakan teknik DSC dan TGA. Komposit turut diuji dengan menggunakan kepada analisis DMA untuk menguji tahap kekenyalan pada tekanan berkala. TGA analisis menunjukkan bahawa kestabilan terma bertambah dengan peningkatan kandungan gentian kaca. Keputusan DSC pula menunjukkan, dengan peningkatan komposisi gentian kaca pendek, darjah penghabluran turut menurun. Ujian mekanikal menunjukan bahawa modulus dan kekuatan regangan turut meningkat, dengan peningkatan komposisi gentian kaca pendek . Ketahanan bahan pula telah dicirikan menggunakan pendekatan mekanik kegagalan kenyal berterusan. Kadar lepas tenaga pemanjangan kritikal, (G_c) meningkat dengan pertambahan gentian kaca pendek. Penurunan dalam kemuluran dan ketahanan adalah disebabkan oleh pergerakan terhad rantai polimer dengan kehadiran gentian kaca pendek.

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND SYMBOLS

a	crack length
a/D	notch to depth ratio
B	specimen thickness
C	compliance
D	depth of specimen
DAM	Dry as moulded
E	Young's modulus
E'	Storage modulus
FRPC	Fibre reinforced polymer composites
G_c	critical strain energy release rate
h_{tup}	specimen height from tup until touch the specimen
K_c	critical stress intensity factor or fracture toughness
l	fibre length
l_c	critical fibre length
L_n	number average fibre length
L_w	weight average fibre length
M_f	weight of fibre
M_m	weight of matrix
P	peak load
S48	support span at 48 mm
S60	support span at 60 mm
S/D	support span to depth ratio
T_c	crystallisation temperature
T_g	glass transition temperature
T_m	melting temperature

tan δ	Damping factor
V_f	volume fraction of fibre
V_m	volume fraction of matrix
χ_c	degree of crystallinity
W	fracture energy
w	specimen width
Y	geometry factor
ΔH_m	heat of fusion
$- \Delta H_c$	crystalline enthalpy

CHAPTER 3: EXPERIMENTAL

CHAPTER 4: RESULTS AND DISCUSSION

CHAPTER 5: CONCLUSIONS AND SUGGESTION FOR FUTURE WORK