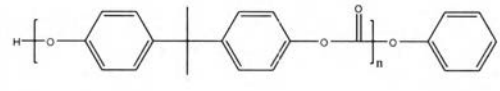
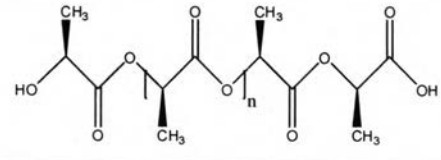
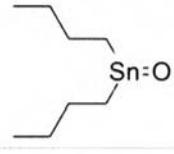
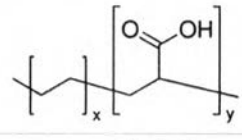
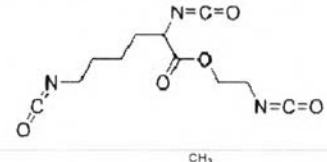
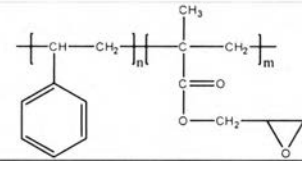
CHAPTER III

EXPERIMENTAL

3.1 Materials

- Polycarbonate (PC) grade PC 110 Chi Mei
- Poly(lactic acid) (PLA) grade PLA 3052D
- Dibutyltin oxide (DBTO from Sigma Aldrich)
- Ethylene acrylic acid copolymers (EAA from Sigma Aldrich)
- Lysine triisocyanate (LTI from Yick-Vic Chemicals & Pharmaceuticals)
- Poly[styrene-co-(glycidyl methacrylate)] (PS-g-GMA) (PS-g-GMA from O-BASF The chemical company)

Table 3.1 The information of the material

Material	Appearance		Structure
	form	color	
PC	Beads	Clear	
PLA	Beads	Clear yellow	
DBTO	powder	White	
EAA	Beads	Clear	
LTI	liquid	Dark brown	
PS-g-GMA	Flask	Clear	

3.2 Experimental Procedures

3.2.1 Neat PC, PLA

PC and PLA pellets are required to be dried at a temperature of 80°C for 24 hours before using the process to prevent hydrolysis of polymers. This is followed by injection molding to prepare a specimen used for characterization and testing.

3.2.2 PC/PLA (no reactive compatibilizer)

PC and PLA have to be dried before processing and then be mixed them in twin screw extruder with temperature zone 240 - 260°C. Screw speed 70 rpm. PC/PLA ratio is 90/10, 80/20, 70/30, 60/40, and 50/50 % by weight.

3.2.3 PC/PLA/Dibutyltin oxide (DBTO)

PC and PLA are dried in an oven with the same condition above, and then PC/PLA at ratio 70/30 %by weight are mixed with 0.01, 0.05, and 0.1 phr DBTO at the same mixing temperature and mixing time as the PC/PLA system in twin screw extrud-er. Finally, they are extruded and cut into pellet form.

3.2.4 PC/PLA/EAA

PC and PLA are dried in an oven with the same condition above, and then PC/PLA at ratio 70/30 %by weight are mixed with 1, 3, and 5 phr EAA at the same mixing temperature and mixing time as the PC/PLA system in twin screw extruder. Finally, they are extruded and cut into pellet form.

3.2.5 PC/PLA/EAA/DBTO

PC and PLA are dried in an oven with the same condition above, and then PC/PLA at ratio 70/30 %by weight are mixed with the optimum ratio of EAA in the presence of 0.01, 0.05, and 0.1 phr DBTO at the same mixing temperature and mixing time as the PC/PLA system in twin screw extruder. Finally, they are extruded and cut into pellet form.

3.2.6 PC/PLA/LTI

PC and PLA are dried in an oven with the same condition above, and then PC/PLA at ratio 70/30 %by weight are mixed with 0.1, 0.5, 1, and 3 phr LTI at the

same mixing temperature and mixing time as the PC/PLA system in twin screw extruder. Finally, they are extruded and cut into pellet form.

3.2.7 PC/PLA/PS-g-GMA

PC and PLA are dried in an oven with the same condition above, and then PC/PLA at ratio 70/30 %by weight are mixed with 0.25, 0.5, 0.75, and 1 phr PS-g-GMA at the same mixing temperature and mixing time as the PC/PLA system in twin screw extruder. Finally, they are extruded and cut into pellet form.

3.3 Equipment

3.3.1 Machine

3.3.1.2 Twin Screw Extruder

PC/PLA alloys were prepared by Lab tech twin screw extruder with L/D ratio of 30 and 25-mm-diameter. The operating temperature was maintained at 180-230-250-270°C with screw speed of 50 rpm.

3.3.1.2 Injection Molding Machine

Tensile (ASTM D 638), notched Izod impact (ASTM D 256), flexural (ASTM D 790) specimens were prepared by an injection molding machine (Asia Plastic-90 Injection molding).

3.3.2 Characterization

3.3.2.2 Miscibility Observation

The miscibility and dynamic mechanical properties of the samples were observed by DMA technique. The scans were carried out in dual cantilever mode at a constant heating rate of 2°C/min and at a frequency of 1 Hz from 30°C to 200°C to obtain the glass transition temperature (T_g) of samples.

3.3.2.3 Crystallization Behavior and Thermal Properties Observation

The melting temperature (T_m), the crystallization temperature (T_c) and ΔH were observed for studying the crystallization behavior by using DSC. The samples were scanned with the rate of 10°C/min by heated-cooled-heated from 25°C to 250°C.

3.3.2.4 Thermal Stability Analysis

Thermogravimetric analysis (TGA) was used to investigate the degradation temperature (T_d). The samples were analyzed at temperature of 50-700°C with the heating rate of 10°C/min under the nitrogen gas atmosphere.

3.3.2.5 Rheology

The melt viscosity, the effect of shear rate and alloy composition on the melt viscosity were carried out by capillary rheometer with a capillary diameter of 1 mm (L/D= 20, 15 mm of barrel diameter) at 250°C.

3.3.2.6 Mechanical Property Testing

The impact test, following ASTM D256, was carried out at room temperature using Zwick testing equipment. The tensile strength (ASTM D638) and flexural strength (ASTM D790) were tested by Instron Universal Testing Machine and Rockwell hardness tester, respectively. The minimum of five specimens were tested for each report.

3.3.2.7 Morphology

The fracture surface of samples after the impact testing were coated by gold and then observed by SEM (Hitachi S-4800).

3.3.2.8 Structure analysis

Nuclear magnetic resonance (NMR) spectroscopy was used to investigate the occurrence of copolymer between PC and PLA. The spectra was recorded on a Varian Mercury operated at 400.00 MHz. Samples were dissolved in $CF_3COOD/CDCl_3$ (20/80 vol.-%). Tetramethylsilane (TMS) was used as an internal standard to measure the chemical shift.

3.3.2.9 Weather ability

The sample was tested weather ability by Light Accelerated Weathering Test (QUV) (Q-Panel QUV/se with Solar Eye irradiance controller) according to ASTM G154 cycle3. The test divided into 2 steps. Step 1, the sample was kept under 0.49 W/m^2 UV irradiance at 70 °C for 8 hours in QUV machine. Step 2, the sample was kept under humidity at 50 °C for 4 hours in QUV machine. Ater this

step, the test was go back to step 1 as a cycle. The test was performed for 500 hours in QUV machine.

3.3.2.10 Heat distortion temperature (HDT)

HDT of a specimen, following ASTM D648, was carried out with load of 1820 kPa and heating rate at 120 °C/hr by HDT/VICAT softening temperature tester (Yasuda model HD-PC).