CHAPTER III

EXPERIMENTAL

3.1 Materials

3.1.1 High Density Polyethylene (HDPE)

Two different injection molding grade of High Density Polyethylene were used in this study; H 6007JU and H5818J, which supplied by SCG Polyolefin Co.,Ltd. The properties of HDPE are given in Table 3.1

Table 3.1 Physical properties of HDPE

Properties	**Melt Flow Index** (g/10 min)	**Density** (g/cm^3)	**Melting Point** °C
H 6007JU	7.4	0.963	133
H5818J	18	0.962	131
Test method	ASTM D1238	ASTM 1505	ASTM D2117

* Data reported by SCG polyolefin Co.,Ltd.

3.1.2 Polypropylene (PP)

Two different injection molding grade of polypropylene were employed in this study; P401S and P700J supplied by SCG Polyolefin Co.,Ltd. The properties of PP are given in Table 3.2

Table 3.2 Physical properties of PP*

Properties	**Melt Flow Index** (g/10 min)	**Density** (g/cm^3)	**Melting Point** °C
P401S	2.6	-	163
P700J	11	-	163
Test method	ASTM D1238	ASTM 1505	ASTM D2117

* Data supplied by SCG polyolefin Co.,Ltd.

3.1.3 Maleic Anhydride (MAH)

Maleic anhydride (MAH) was supplied by SIGMA-ALDRICH. The properties of MAH are given in Table 3.3

Table 3.3 Physical properties of maleic anhydride (Grade M188)*

Properties	**Units**	**Test result**
Molecular Weight	-	98.06
Vapor pressure	mmHg (20 °C)	0.16
Boiling point	°C	200
Melting point	°C	51-56

* Data supplied by SIGMA-ALDRI

3.1.4 Dicumyl peroxide (DCP)

Dicumyl peroxide (DCP) used in the study was supplied by SIGMA-ALDRICH. The properties of DCP are given in Table 3.4

Table 3.4 Physical properties of Dicumyl peroxide (Grade 329451)*

Properties	Units	Test result
Molecular Weight	-	270.37
Vapor pressure	mmHg (38 °C)	15.4
Melting point	°C	39-41
Density	g/ml	1.56

* Data supplied by SIGMA-ALDRICH.

3.1.5 Solvent

- Toluene AR Grade was supplied by Labscan.
- Ethanol AR Grade was supplied by Labscan, and was used as suplied.

3.1.6 Base Substance

- Potassium Hydroxide (KOH) was supplied by Carlo Erba, and was used as supplied.

3.1.7 Acid Solutions

- Hydrochoric acid (HCl) 37% wt/v (conc. solution) was supplied by J.T. Baker, and was used as supplied.

3.1.8 Indicator Reagent

- Phenopthalein was supplied by Ajex Finechem.

3.2 Equipment

3.2.1 Twin Screw Extruder

The materials were blended in a Collin D8017 T-20 twin screw extruder using a screw speed of 35 rpm .The blends were extruded through circular die as the extrudates, it were cooled further in a water bath, then dried at ambient temperature and pelletized with drawing speed of 7.5 m/min.

3.2.2 Compression Molding

Blend pellets were placed in a picture frame mold whit specific thickness and the mold preheated at 200°C for 5 minutes in the press without applied pressure by Wabash V 50 H 50 ton compression press machine. The mold was continue to compressed under pressure force of 10 tons for 3 minutes and then the mold was cooled to 35°C under same pressure as compression step.

3.2.3 Tensile Properties Testing

An Instron Universal testing machine was used to measure the tensile modulus of the blends. Testing method was followed on ASTM D638-91 test procedure. The results were obtained from the average of five sample specimen per each batch of blended material.

3.2.4 Impact Property Testing

Izod impact strength was measured using a Zwick Impact tester according to ASTM D256-92 test procedure. The result was collected from the average of five specimens per each batch of blended material.

3.2.5 Fourier Transform Infrared Spectroscopy (FT-IR)

Film samples of the blend were prepared using a compression-molding machine. Fourier Transform Infrared Spectrophotometer (FT-IR) was used to probe the specific interpolymer interaction in polymer blend. Measurements were

made in absorbance mode using a Bruker FTIR Spectrometer, model Vector 3.0 testing was operated by 32 scans at a resolution of $4cm^{-1}$.

3.2.6 Differential Scanning Calorimetry (DSC)

The measurements were carried out under nitrogen condition, using 7-10 mg of blended sample. Perkin-Elmer DSC7 instrument used for testing was previously calibrated with indium. The analysis was carried out in 3 steps as heat-cool-heat: (i) samples were heated from 30 to 200°C at heating rate of 80°C/min and held at 250°C for 5 minutes. (ii) samples were then cooled from 200°C to 30°C at cooling rate of 10°C/min. (iii) after that, samples were immediately heated from 30°C to 200°C at heating rate of 10°C/min.

3.3 Methodology

3.3.1 Preparation of Grafted Material

Grafting of maleic anhydride (MAH) onto the neat polymer (L-HDPE, H-HDPE, L-PP and H-PP) were separately prepared using different amount of dicumyl peroxide (DCP) initiator and MAH following the best condition for obtain higher grafting degree.

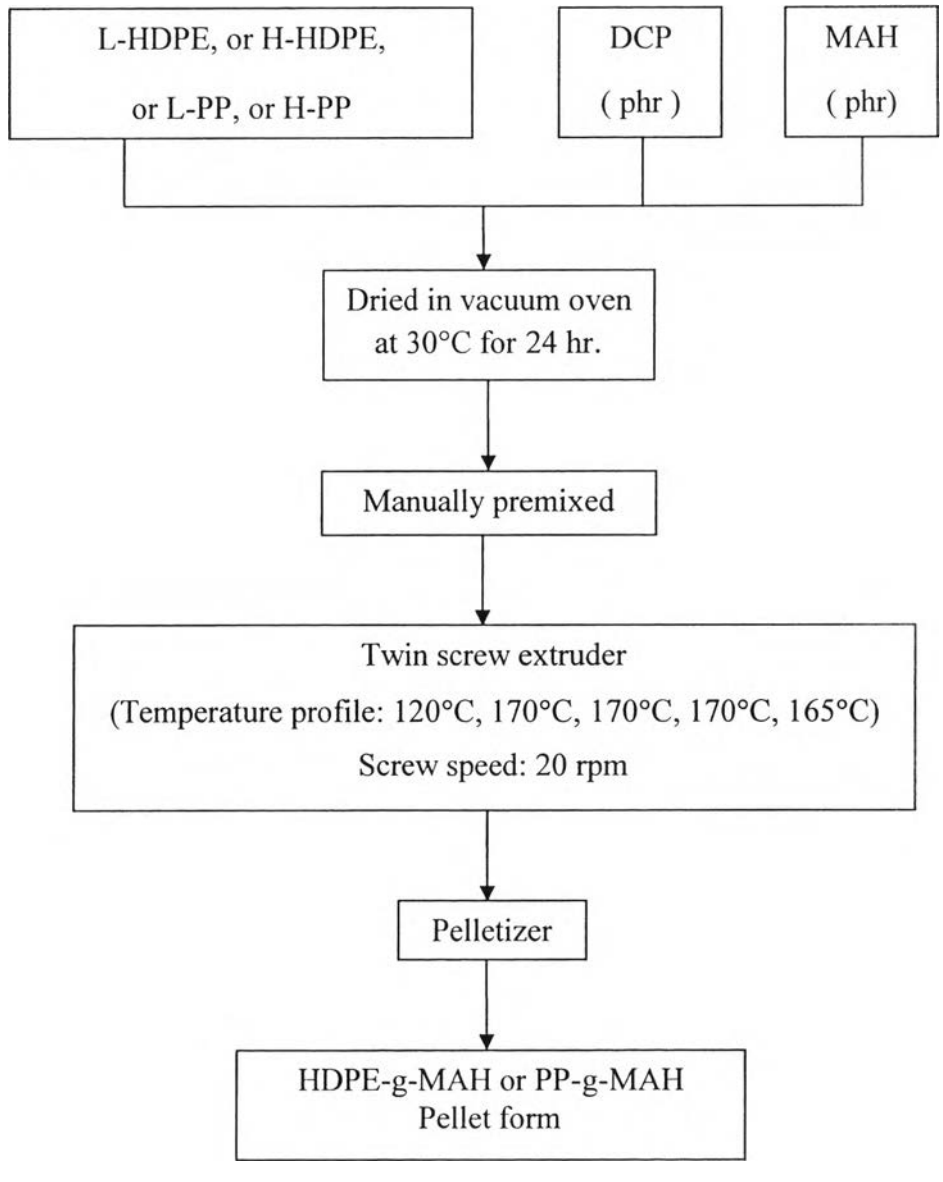

Figure 3.1 Preparation of grafting material.

3.3.2 Preparation of HDPE/PP blend with and without compatibilizer

Neat L-HDPE and L-PP were dried in an oven at fixed temperature 60°C for 24 hr. Required amount of L-HDPE and L-PP blend at certain blend ratio 75/25 L-HDPE/L-PP without and with two set of MAH grafted material compatibilizer L-HDPE g-MAH/ L PP-g-MAH in total amount of 0, 1, 3and 5 phr by putting into tumble mixer for premix then those materials are feed through twin screw extruder at processing temperature profile is 170°C, 200°C, 200°C,200°C and 190°C from feed zone to die area ,and screw speed is 35 rpm. After finishing from extruder, polymer blend extrudate is cut into pellet form by pelletizer. Other series of blend were carried out using similar processing conditions and same procedure. Detail of composition ,blend ratio and process condition used were outline in Table. 3.5 to 3.10

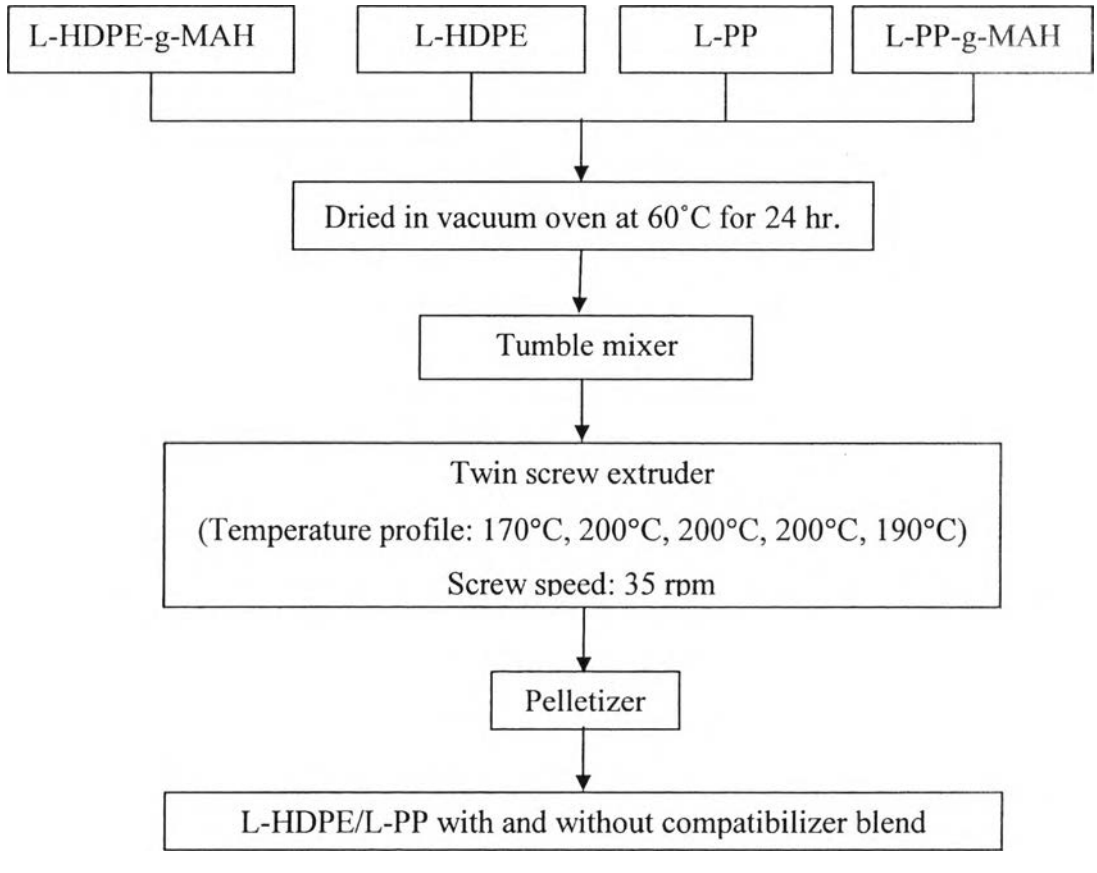

Figure 3.2 Preparation of L-HDPE/ L-PP/ L-HDPE g-MAH/ L-PP-g-MAH blend.

Table 3.5 Summary of four systems of blending

System	Type of HDPE	Type of PP	Type of HDPE-g-MAH	Type of PP-g-MAH
1	L-HDPE	L-PP	L-HDPE-g-MAH	L-PP-g-MAH
2	L-HDPE	L-PP	H-HDPE-g-MAH	H-PP-g-MAH
3	H-HDPE	H-PP	L-HDPE-g-MAH	L-PP-g-MAH
4	H-HDPE	H-PP	H-HDPE-g-MAH	H-PP-g-MAH

*** Code : L-HDPE = Low initial MFI PP(H6007JU),

H-HDPE = High initial MFI (H5818J),

L-PP = Low initial MFI PP (P401S),

H-PP = High initial MFI PP (P700J)

All four system above were varied in composition of blend shown as Table 3.6

Table 3.6 The composition of the blend

No	HDPE (%)	PP (%)	HDPE-g-MAH + PP-g-MAH (1:1) (phr)	Remark Total amount (phr)
1	75	25	0	0
2	75	25	0.5+0.5	1
3	75	25	1.5+1.5	3
4	75	25	2.5+2.5	5
5	25	75	0	0
6	25	75	0.5+0.5	1
7	25	75	1.5+1.5	3
8	25	75	2.5+2.5	5

Table 3.7 Processing condition of melt grafting extrusion

Conditions	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Temperature (°C)	120	160	170	170	165
Screw speed (rpm)	20				

Table 3.8 Processing condition of melting blending extrusion

Conditions	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Temperature (°C)	170	200	200	200	190
Screw speed (rpm)	35				

Table 3.9 Processing condition of compression molding

Step	Temperature (°C)	Compressing force (kg/cm^2)	Time (min)
Preheat	200	-	5
Compressing	200	130	4
Cooling	200 to 35	-	

Table 3.10 Processing condition for injection molding

Conditions	Zone 1	Zone 2	Zone 3	Zone 4
Temperature (°C)	160	165	175	170
Screw speed (rpm)	65			
Injection Pressure(Bar)	25			
Cooling time (Sec)	20			