CHAPTER III
EXPERIMENTAL

3.1 Materials and Chemicals

3.1.1 High Density Polyethylene

Plastic samples were cut from drinking water bottles which made of high density polyethylene (HDPE) and printed with blue color solvent-based ink by screen printing process. The bottles were prepared their surfaces before printing process by flamed-treatment method. This method created good adhering between ink and plastic surfaces.

3.1.2 Cationic Surfactant

n-hexadecyltrimethylammonium bromide (CTAB: $C_{16}H_{33}{}^{+}N(CH_3)Br^{-}$) with 98% purity in the powder form was supplied by the Fluka Company, Switzerland.

3.1.3 pH Adjustment Chemicals

Sodium hydroxide (NaOH) with 98% purity was supplied from EKA Nobel Company.

3.1.4 Water

Deionized water was used in this experiment.

3.2 Experimental Procedure

3.2.1 Deinking Part

3.2.1.1 Sample Preparation

2 areas of the HDPE bottle were cut into size of ca 7.3x7.3 cm^2. The first one was printed area and the second one was virgin area at the same position. Then each plastic sheet was cut into smaller pieces (ca 0.5x0.5 cm^2) The reason of this step was to shape for the processing step. Moreover, the small pieces of plastic also enhanced ink removal by acting as abrasives.

3.2.1.2 Analysis of % Ink Removed

Optical scanning method was used to determine % ink removed before and after deinkinging process. A HP LaserJet 4c Scanner was used to scan the samples. After that, image files were sent to Adobe PhotoShop program and analyzed by histogram method. This method used to qualify the amount of ink and % ink removed from surfaces was able to calculated by this equation. Histogram of blue ink which was determined by the machine was used for calculating in this equation.

$$\% \text{ ink removed} = \frac{\text{histogram}_{\text{before deinked}} - \text{histogram}_{\text{after deinked}}}{\text{histogram}_{\text{before deinked}}} \times 100\ \%$$

3.2.1.3 Experiment

Surfactant solution was prepared with deionized water. The concentration of surfactant solution was 5mM (5 times of CMC of CTAB). A magnetic stirrer was used to make homogeneous solution. And temperature was slightly increased above room temperature when CTAB

solution was prepared in order to dissolved surfactant in water. Next, pH level of surfactant solution was adjustment by adding of NaOH to get the value of 12. A pH meter (Benchtop pH/ISE Meter, Model 420A with Triode pH electrode Model 91-578N) was used to determine the pH level. Then the small pieces of plastic from 3 sheets of 7.3x7.3 cm^2 sized were placed in 20mL surfactant solution in a conical flask. The next step was pre-soaking step, these testing flasks were placed in the GFL 1086 Model shaking water bath at 30 ^oC for 2hrs. After that was the shaking step, these testing flasks were shaken at a speed of 200 oscillations per minute. This step took 6 hrs and 1hr 25 mines for 100% and 50% ink removed from surfaces, respectively. Then these plastic samples were washed with fresh water several times and dried in a Gallenkamp vacuum oven at 45 ^oC over night. For both 50% and 100% removed from surfaces conditions, there was virgin plastic as the control sample.

3.2.2 Processing Part

The dried plastic pieces were passed into a COLLIN co-rotating twin screw kneader ZK-25 (25mm x3D). All conditions of this step were showed below.

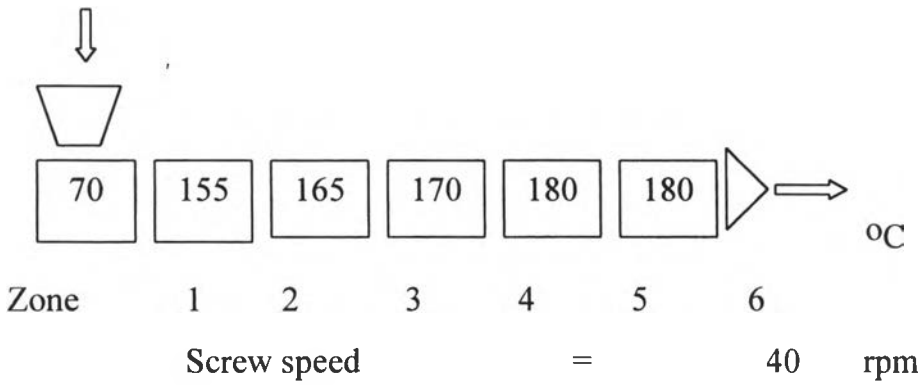

Figure 3.1 Processing condition at the twin screw extruder.

The re-extruded plastic was cooled in water at room temperature and cut into pellet shape by a Plantrol 075D2 pelletizer. And these pellets were died at 45^{o}C for 6 hrs for next step.

3.2.3 Sample Preparation for Mechanical Testing

Specimens for mechanical testing were prepared in the sheet shape by Wabash compression. The plastic pellets were heated up to 230 ^{o}C for 3 minutes and pressed at 10 tons at isothermal condition for 3minutes. After that, the sample was cooled down to room temperature in 10 minutes.

3.3 Testing Procedure and Analysis

3.3.1 Tensile Strength

Dog bone shaped samples were cut by a plastic cutting machine Yasada Seiki. And specimens were drawn in the Instron Universal Testing Machine at constant cross-head speed of 50 mm/minute. The test followed the ASTM D386.

3.3.2 Impact Resistant

The specimens were cut by the plastic cutting machine Yasada Seiki into the size of 12.75 x 63.5 mm and notch depth of 2.5mm by plastic cutting machine Yasada Seiki. This test followed ASTM D256 An Izod Impact type with V notch. A Zmick Pendulum Impact Tester was used to determine the impact resistant value.

3.3.3 Hardness

The hardness was tested by a Shore D Durometer Zwich followed ASTM D2240.

3.3.4 Differential Scanning Calorimeter (DSC)

Differential Scanning Calorimeter (DSC) was carried out on a DSC7 Perkin Elmer. Samples of 3-7 mg were prepared in aluminium sample pans. The temperature program was a heating rate of 10^{o}C/min from 30 ^{o}C to 160 ^{o}C then stayed at an isothermal temperature for 5 minutes and cool down to 30^{o}C at the same rate. This procedure was repeated 5 cycles to determine changing of melting temperature and %crystallinity.

3.3.5 Thermogravimetric Analyzer (TGA)

A Dupon TGA was used to determine the changing mass of the samples with the empty crusible as a blank correction. A temperature profile was starting from room temperature to 600 ^{o}C at a rate of 10^{o}C/min and contained an isothermal for 1 minute.

3.3.6 Spectrophotometer

All compressed plastic sheets were determined their color's difference by a Color-eye 7000 Spectrophotometer. The condition of factor for this measurement was CRIOLL and the intensity of light used was D65 which was the same intensity of the sun light.