CHAPTER III
EXPERIMENTAL

3.1 Materials

Neat smart card body including Polyvinyl Chloride (PVC), Polycarbonate (PC) and Polyethylene Terephtarate Glycol (PETG) was supported by Smartrac Technology LTD (Thailand).

3.2 Equipments

3.2.1 QUV Weathering Tester (QUV / SE Accelerrated Weathering Tester)

QUV accelerated weathering tester was operated with both UV-B lamps irradiance and dark light at 0.48 W/m^2 340 nm for 4 hours at 37°.

3.2.2 Colorimetric Spectrophotometer (ColorFlex)

Total color different (ΔE) of plastic cards was investigated by using a Colorimetric spectrophotometer (ColorFlex).

3.2.3 Universal Testing Machine (Instron 4206)

The mechanical properties of plastic card were performed using Universal Testing Machine (Instron 4206) for tensile properties. Tensile testing was conducted in accordance with the standard test method for tensile properties of thin plastic sheeting —ASTM D882-91. The grips moved apart at a constant speed of 50 mm/min, modulus was tested at least five samples of each condition. The specimen size was 10.00 mm x 85.60 mm. The thickness of all cards was set to 0.80 mm. All calculations were based on a minimum of five samples.

3.2.4 Haze-Gloss tester (Gardner BYK)

The surface of samples was analyzed by gloss property. Gloss property of plastic cards measured in gloss value at 60° by using a Haze-Gloss tester (Gardner BYK) in accordance with ASTM D523-89.

3.2.5 Thermogravimetric Analysis (TGA)

The samples were analyzed by TG/DTA using Perkin-Elmer TG/DTA Pyris Diamond instrument under N_2 flow of 200 ml/min. The heating process was used at 30°-700°C at heating rate of 10°C/min under nitrogen atmosphere.

3.2.6 Atomic Force Microscope (AFM)

The surface of samples was analyzed by topography using Atomic Force Microscope (Park/XE-100). Topography of plastic cards operated in the non-contact mode by scanning a sample under tip. The scan size and scan rate were 40 x 40 μm^2 and 0.3 Hz respectively.

3.2.7 Fourier Tranformation Infared Spectroscopy

The surface degradation of samples was analyzed by ATR measurement using FTIR Spectrometer (Nicolet/Nexus:670). The measurement was made in absorbance mode, model Vector 3.0, using 32 scans per resolution.

3.3 Experimental Procedures

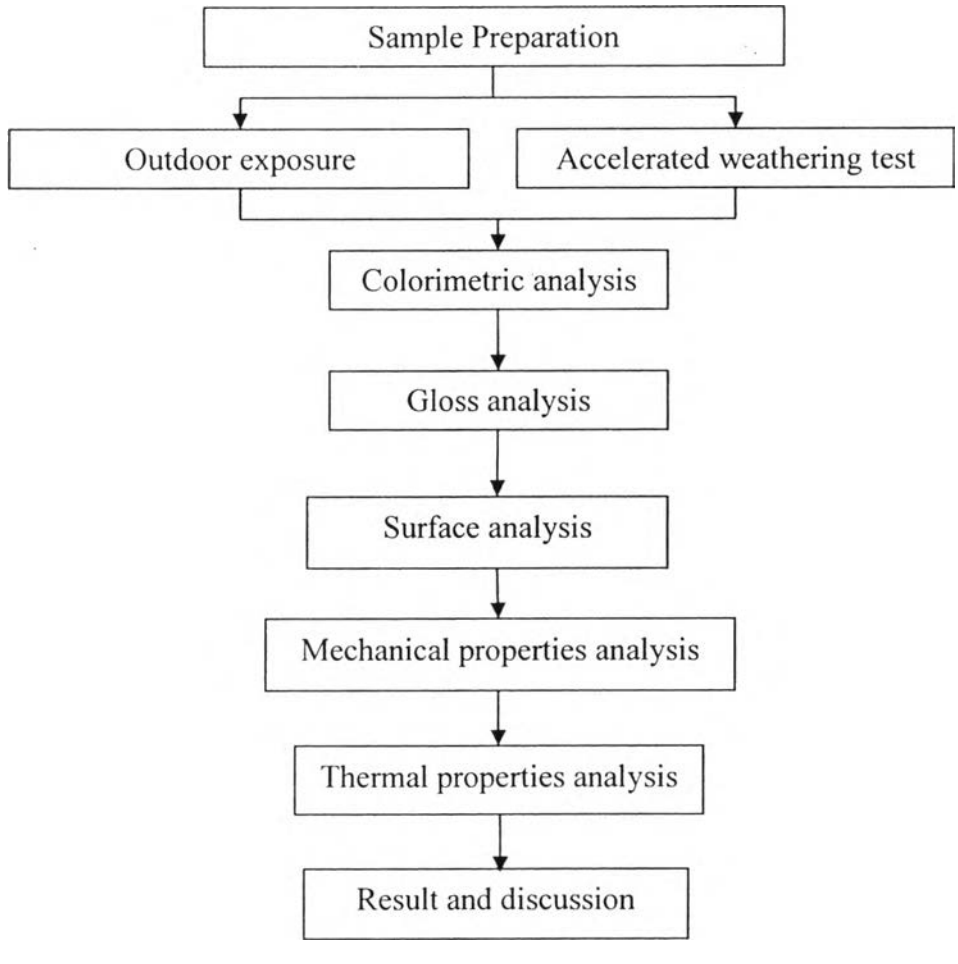

Figure 3.1 Separation procedure flow diagram.

3.3.1 Samples Preparation

Neat smart card body including Polyvinyl Chloride (PVC), Polycarbonate (PC) and Polyethylene Terephtarate Glycol (PETG) was supported by Smartrac Technology LTD Thailand in accordance with an international standard (ISO 7816). The sample cards have dimensions of 85.60 × 53.98 mm and thickness 0.76 mm.

3.3.2 Samples Exposure

3.3.2.1 Outdoor Exposure

The period of outdoor exposure test was set at 1, 2, 3, 4, 5 and 6 months, respectively.

3.3.2.2 Accelerated Weathering Test

Accelerated weathering test was performed by QUV accelerated weathering tester. QUV accelerated weathering tester was operated with both UV-B lamps irradiance and dark light at 0.48 W/m^2 340 nm for 4 hours at 37°.

3.3.3 Effect on Sample

3.3.3.1 The exposed materials depends primarily on the amount of radiation absorbed, the emissivity of the specimen, the amount of thermal and the amount of moisture.

3.3.3.2 The amount of radiation absorption reflects to involve to Total color different (ΔE) value of the surface.

3.3.4 Characterization of Exposed Samples

3.3.4.1 Total color different (ΔE)

Color's conversion of plastic cards was analyzed by Total color different (ΔE). Total color different of plastic cards was investigated by using a Colorimetric spectrophotometer (ColorFlex) equipped with Standard Illuminant D65

3.3.4.2 Gloss Property

The surface of samples was analyzed by gloss property. Gloss property of plastic cards measured in gloss value at 60° by using a Haze-Gloss tester (Gardner BYK) in accordance with ASTM D523-89.

3.3.4.3 Mechanical properties

Mechanical properties of plastic card were investigated by Universal testing machine (Instron 4206) for tensile properties in Young's modulus and tensile strength. Tensile testing was conducted in accordance with the standard test method for tensile properties of thin plastic sheeting —ASTM D882-91. The grips moved apart at a constant speed of 50 mm/min, modulus was tested at least five samples of each condition. The specimen size was 10.00 mm x 85.60 mm. The thickness of all cards was set to 0.80 mm. All calculations were based on a minimum of five samples.

3.3.4.4 Thermal Properties

Thermal properties measured by Thermo gravimetric analysis was carried out on a Perkin-Elmer TG-DTA pyris diamond instrument over 30°-700°C at heating rate of 10°C/min under nitrogen atmosphere. Thermo gravimetric analysis (TGA) was used to investigated the degradation temperature (T_d).

3.3.4.5 Topography

Topography of plastic card surfaces was measured by Atomic force microscope (AFM, Park system XE-100) in non-contact mode. The three-dimensional scan was 40 x 40 μm^2. The scan rate was 0.3 Hz (J. Maatta *et al.*, 2007).

3.3.4.6 Functional Group

Functional group of plastic card structure was measured by FTIR Spectrometer (Nicolet/Nexus:670). The measurement was made in absorbance mode, model Vector 3.0, using 32 scans per resolution.

3.3.5 Correlation of the Results

The results from each measurement were correlated by MATLAB with exponential equations between outdoor exposure's results and accelerated weathering tester's results. The exponential equations of the results are calculated by using the following equation:

$$y = ae^{bx} + c \tag{3.1}$$

Where y is the tensile strength (GPa) independent of x, both a and b are coefficients that are estimated by the fit and c is coefficient of error term.