CHAPTER III

EXPERIMENTAL PROCEDURE AND ANALYSIS TECHNIQUES

3.1 Experimental Procedure

The experiments are conducted using manufacturing system which currently operates at NIPPON PAINT (THAILAND) Co.,LTD. The system is a production process of basic color consisting of two major steps: mixing and grinding.

Raw materials, such as pigment, resin, and solvent are weighted by the balance and put into mixing tank. In this experiment the pigment is Titanium dioxide (TiO_2). The resin is Acrylic resin. Solvents are Butyl cellosolve (Butyl glycol ether), N-buthanol, Cellosolve acetate (Ethyl glycol acetate), and Solvesso 150. Typical properties of materials are shown in Appendix A. The raw materials are stirred and mixed together. Diagram of the mixing tank is shown in Figure 3.1 and dimensions of the mixing tank are shown in Table 3.1.

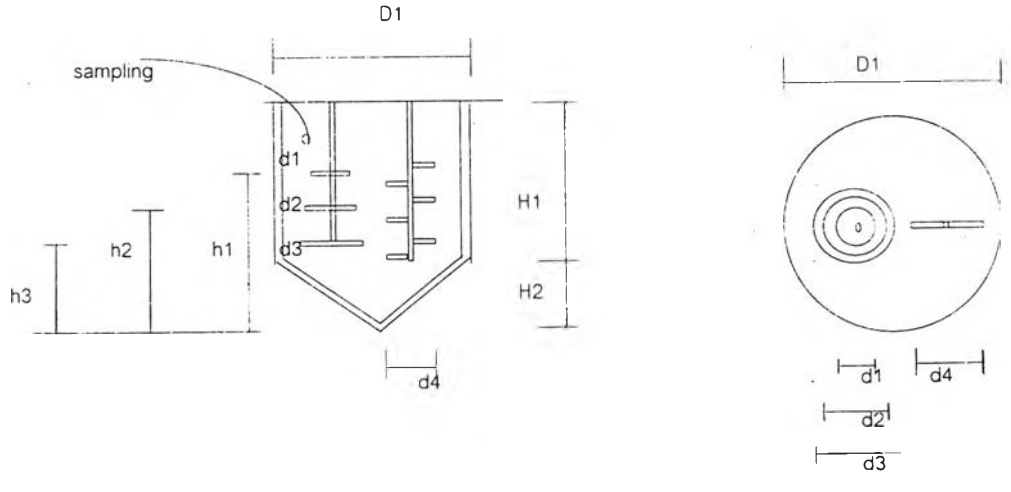

Figure 3.1 Diagram of the mixing tank, disperser and diameter of tank

Table 3.1 Dimensions of the mixing tank

Item	mm.
Diameter of tank, D1	1550
Height of cylindrical section, H1	2300
Height of cone section, H2	441
For the first floating axle	
-Propeller diameter, d1,d2,d3	300, 325, 350
-Propeller height, (from bottom of cone) h1,h2,h3	1146, 771, 391
For the second floating axle	
-Impeller diameter, d4	400
-Impeller height, (from bottom of cone), h4	441

The mixing tank is a cylindrical tank with bottom cone. It is made of steel without baffle and is equipped with two dispersers. The dispersers consists of speed motor model MSG-10 (rt-3011) with a control unit. One of the disperser has three units of tooth propeller and the other has six units of pitch multi blade turbine. The speed of two dispersers is 800 rpm. This step is batch process.

The mixing times used in this study are 60, 90 and 120 minutes. The viscosity are 70, 72, 74, 76 and 85 KU. During the mixing process, 250 ml. of sample is taken at the top level of the agitated vessel for measurement of viscosity by stormer viscometer. Ten ml. of sample is taken again at the same position for measurement of fineness by grind gauge meter. The measurement of viscosity is described in analysis technique of vicosity and fineness is described in the standard method (Appendix B). Location of sampling point is shown in Figure 3.2.

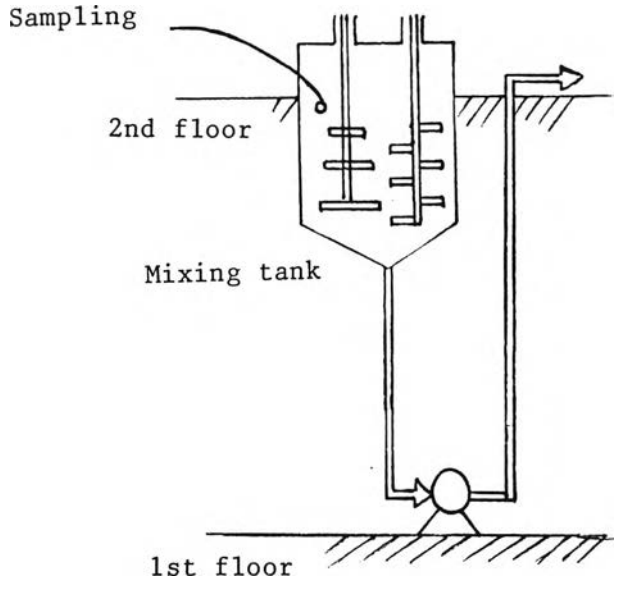

Figure 3.2 Location of sampling point at the mixing tank

After the raw materials are mixed at specified mixing time, the mixture is transferred to the receiving tank by transfer pump in grinding process. Diagram of the receiving tank is shown in Figure 3.3 and dimensions of the receiving tank are shown in Table 3.2.

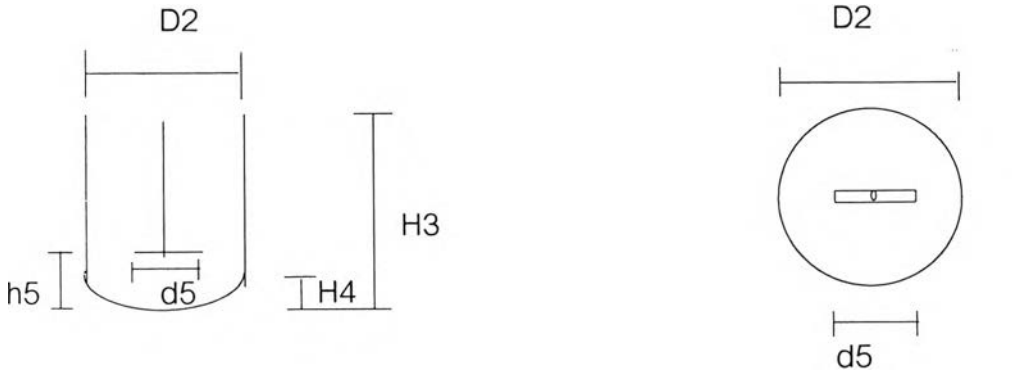

Figure 3.3 Diagram of the receiving tank, disperser and diameter of tank

Table 3.2 Dimensions of the receiving tank

Item	mm.
Diameter of tank, D2	1600
Height of cylindrical section, H3	1670
Height of cone section, H4	330
Turbine diameter, d5	800
Impeller height (from bottom of cone), h5	330

The receiving tank is a cylindrical tank, made of steel without baffle. It is also equipped which a pitch two blade turbine type. The speed of the disperser is 90 rpm. From the receiving tank, the mixture is transferred to grinding machine by transfer pump. The feed inlet to the grinding machine is at the bottom part as show in Figure 3.4.

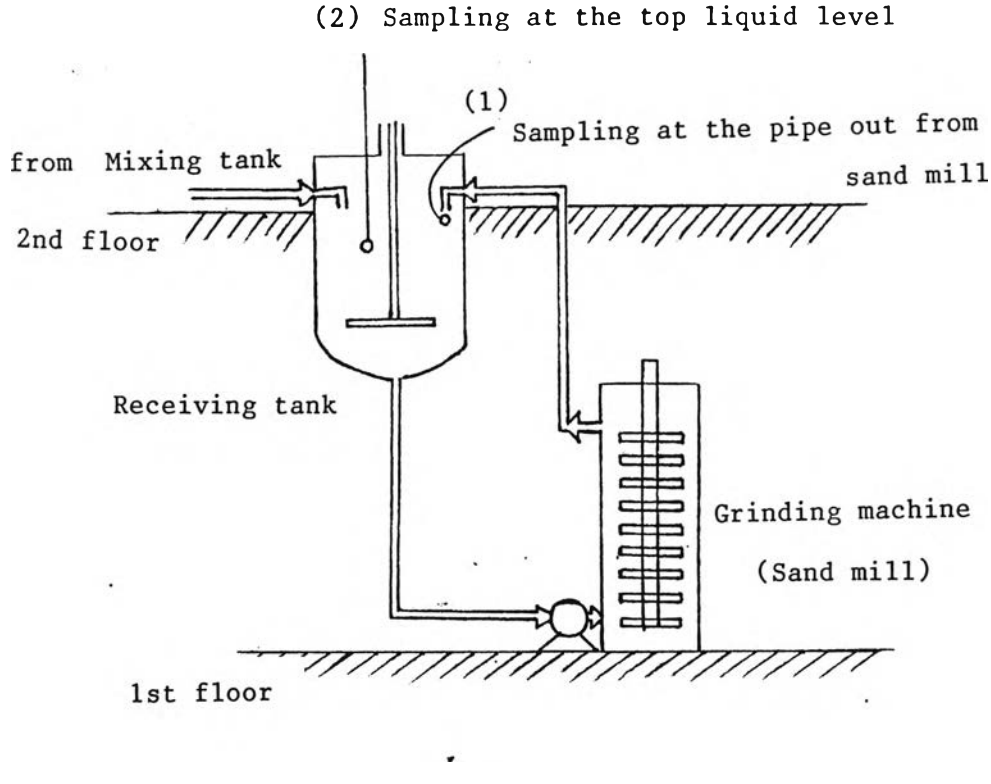

Figure 3.4 Flow diagram of grinding process and sampling points

This step is continuous process because raw materials are circulated from receiving tank to the bottom of grinding machine and flow out at the top of grinding machine to the fop of receiving tank by piping until fineness of dispersed pigment is under specification.

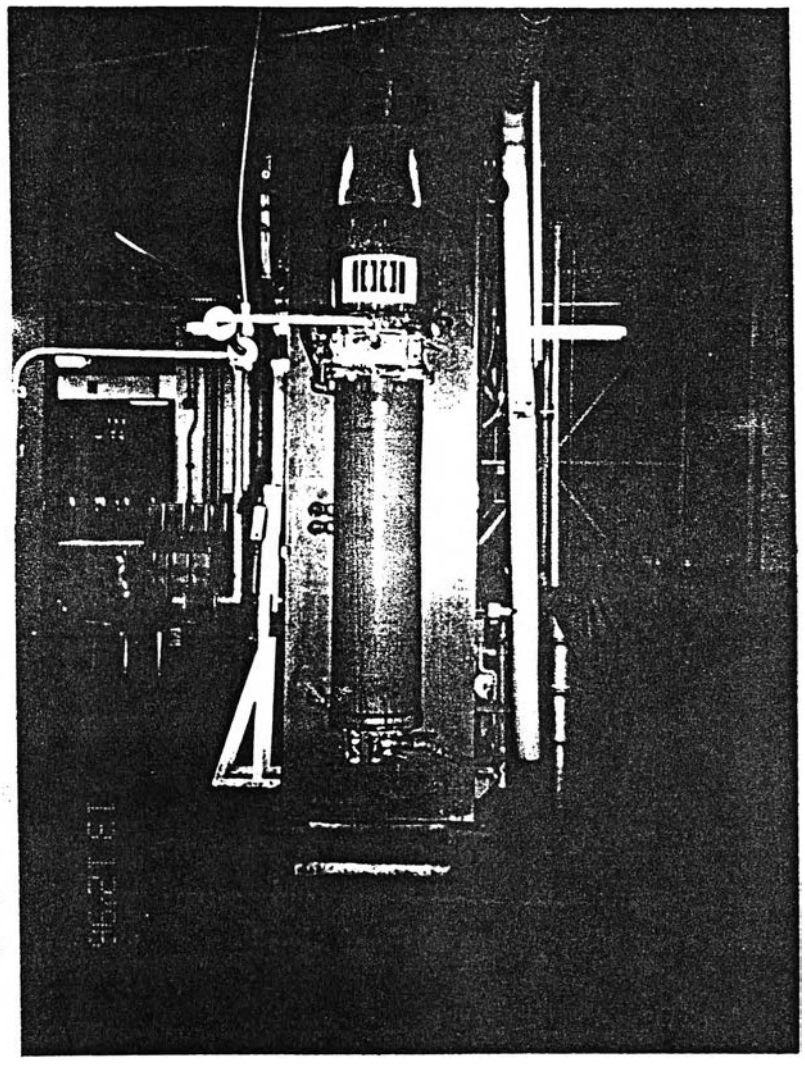

Figure 3.5 Grinding machine

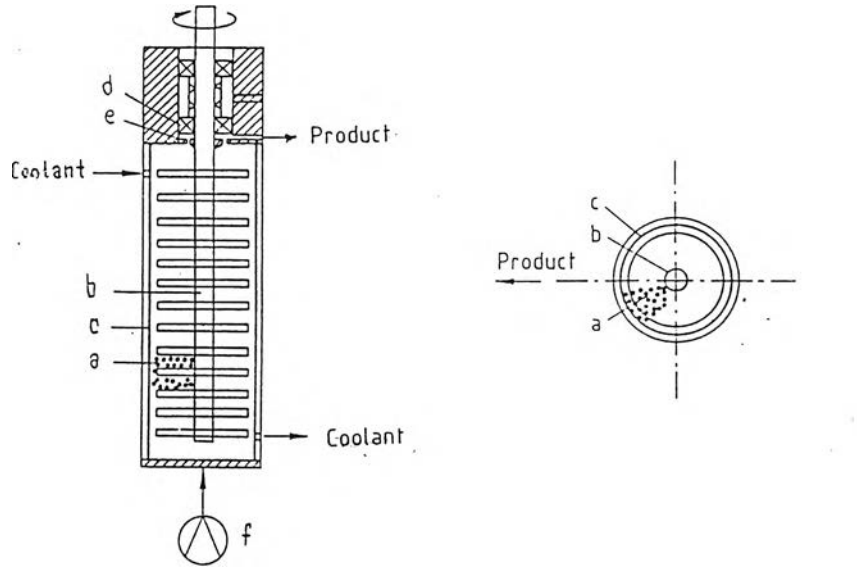

Figure 3.6 Diagram of Cylindrical chamber:
a) Grinding media b) Rotor c) Grinding chamber
d) sealing system e) Separator f) Pump

Figures 3.5 and 3.6 shows grinding machine and diagram of cylindrical chamber respectively. The grinding machine can be divided into two parts: machine and cylindrical chamber. Cylindrical chamber has multi disks with tooth propeller. The chamber is filled with glass beads, diameter 1-2 mm., about 80% of chamber volume. The glass bead is medium dispersers to support grinding of pigment particle in order to take well dispersing in paint.

The flow rate of circulating raw materials in grinding machine is varied as 16, 18 and 20 kg./min. Every 1 hour after grinding time passed 2 hours, 10 cc. of sample is taken at the pipe out from grinding machine in receiving tank and at the top level of the vessel for measurement of fineness by grind gauge meter. The measurement of fineness is the same as that in mixing step which described in the standard method (Appendix B).

3.2 Analysis Techniques

Analysis methods supported in this experiment can be divided into two parts: viscosity analysis method and fineness analysis method.

3.2.1 Analysis of Viscosity

In each run of the experiments, property of paint measured is viscosity after mixing raw material according to formulation ratio by using the impellers. Two hundred and fifty ml. of paint sample is taken from mixing tank to measure viscosity. Digital stormer viscometer is the apparatus for this experiment which is shown in Figure 3.7.

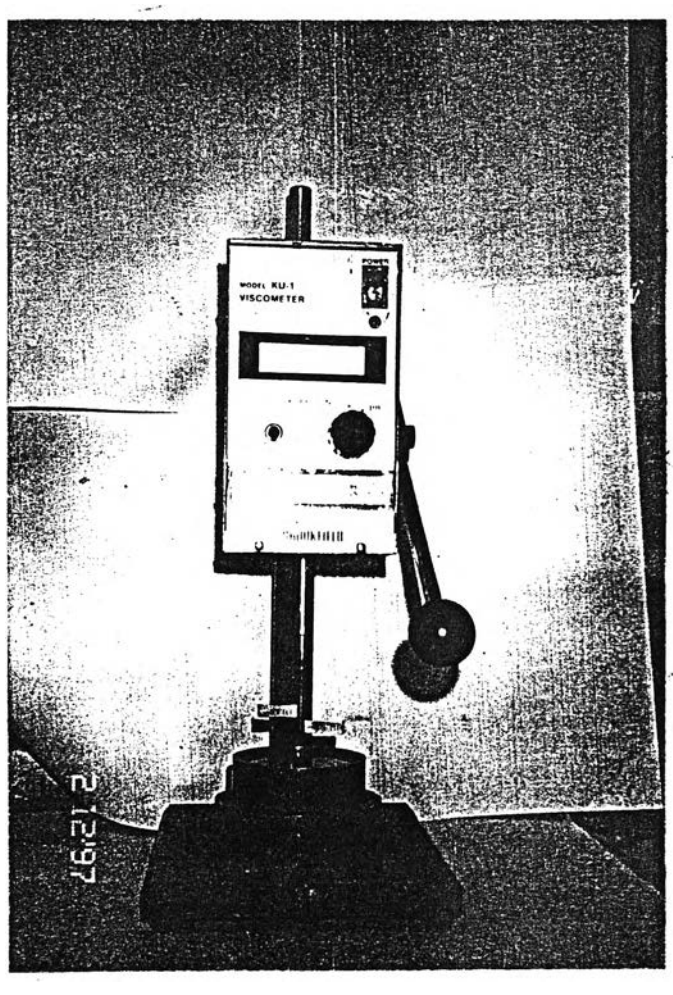

Figure 3.7 Stormer viscometer

Principle of viscosity analysis is to determine the resistance of liquid rheology against stirring. When raw materials are mixed together, properties of liquid can be changed including viscosity. The sample is treated at 25°C by cool water. After that this sample is stirred by the impeller of stormer viscometer. Shear force is taken in during stirring , and liquid resists the impeller. The shear forces affects properties of liquid on viscosity. At the beginning, the shear force does not have consistency which results in different digital value. When shear force has been consistented, digital value shows actual viscosity value of liquid. The unit of this analysis method by stormer viscometer is Kreb Unit (KU).

3.2.2 Analysis of Fineness

After mixing and grinding step, the fineness of paint is analyzed. Mixing and grinding step mix raw materials together and disperse pigment into resin and solvent. Particle of pigment is deagglomerated and deaggregated in this step. So analysis of fineness is to determine fineness of pigment in paint. Fineness gauge and scraper, so-called "grind gauge meter", are used in this experiment which is shown in Figure 3.8.

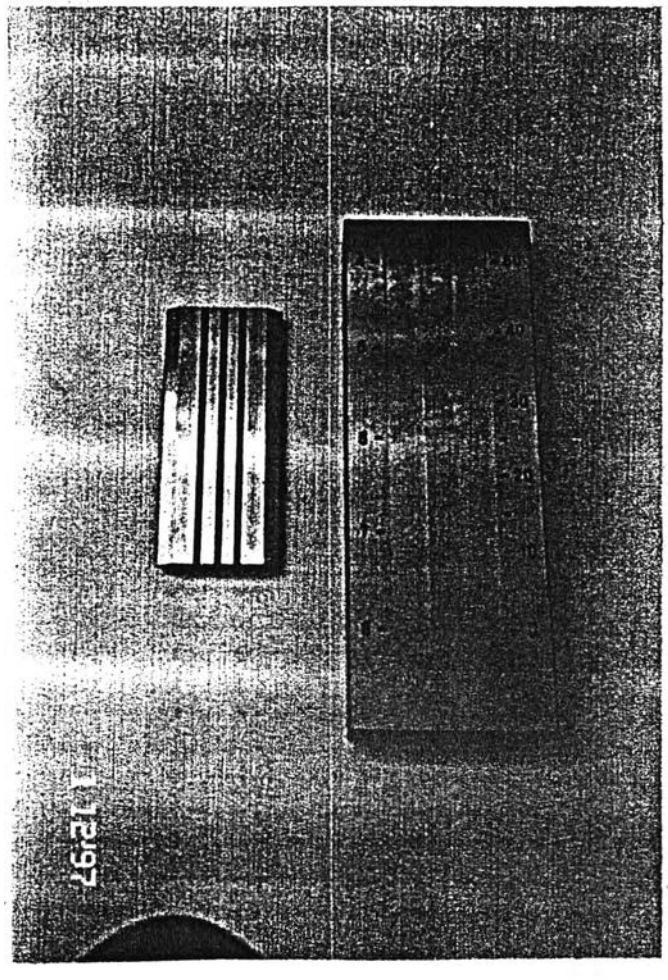

Figure 3.8 Grind gauge meter

The fineness gauge is groove metal bar. The groove has shallow zone and deep zone. 20 cc. of sample taken after mixing and grinding step is dropped onto the groove of fineness gauge. The scraper is swept on sample from deep to shallow zone. The particle of pigment should show on the groove. When region or spots of pigment particle show at any location of the groove, fineness value is defined at that point.

The unit of fineness value is micron (micrometer). This analysis method follows standard method of Japan (JIS-K-5400-4.7.1) which is shown in Appendix B.