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**Test methods for unsaturated polyester resins  
(English Translation)**

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### 1 Scope

This Standard specifies the test methods, scope, principles, test samples, instruments and equipment, test procedures, test results and test reports for testing the properties of liquid unsaturated polyester resins.

This Standard is applicable to the determination of absolute viscosity, hydroxyl value, solid content, reactivity at 80 °C, heat stability at 80 °C, gel time at 25 °C and refractive index of liquid unsaturated polyester resins.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, all subsequent amendments (not including errata content) or revisions do not apply to this standard. However, parties to agreements that are based on this Standard are encouraged to study whether the latest versions of these documents can be used. For undated references, the latest edition applies to this

Standard.

GB/T 2895, Determination for acid value of unsaturated polyester resins

GB/T 6682, Water for analytical laboratory use - Specification and test methods

### 3 Terms and definitions

The following terms and definitions are applicable to this Standard.

#### 3.1

hydroxyl value

The number of milligrams of potassium hydroxide consumed to neutralize the acetic acid

produced by the acetylation reaction of 1 g of unsaturated polyester resins.

### **3.2**

acid value

The number of milligrams of potassium hydroxide consumed to neutralize 1 g of test sample under the test conditions.

### **3.3**

total acid value

The number of milligrams of potassium hydroxide consumed to neutralize all carboxyl groups, free acids and free anhydrides in the polyester.

### **3.4**

solid content

The mass fraction of non-volatiles contained in unsaturated polyester resins under specific test conditions.

### **3.5**

heat stability at 80 °C

The time required for the liquid unsaturated polyester resins, at a temperature of 80 °C, from the start of the test to the appearance of gelation.

### **3.6**

gel time

The time FROM the addition of the initiator to the resin TO the resin viscosity reaches 50 Pa·s.

#### **4.1.1 Principle**

The drum or rotor rotates in the sample at a fixed speed. Due to the viscosity of the liquid, resistance is applied to the drum or rotor during rotation, generating torque, which is measured by a certain method.

The measurement process is achieved by the change of the digital pointer caused by the compression of the coil spring. The absolute viscosity is measured by the rotational viscometer by multiplying the reading by a coefficient that depends on the speed and the type of drum or rotor.

#### **4.1.2 Test samples**

##### **4.1.2.1**

Uniform, free of bubbles and impurities.

##### **4.1.2.2**

The quantity should be sufficient for viscometer measurement.

#### **4.1.3 Instruments and apparatuses**

##### **4.1.3.1**

Rotational viscometer. drum type or rotor type.

##### **4.1.3.2**

Constant temperature water bath. temperature control accuracy  $\pm 0.5$  °C.

##### **4.1.3.3**

Thermometer. measuring range 0 °C ~ 50 °C, minimum graduation value 0.2 °C.

##### **4.1.3.4**

Container. shall meet the requirements of the viscometer.

##### **4.1.3.5**

Stopwatch.

#### **4.1.4 Test procedures**

##### **4.1.4.1**

Select the drum or rotor and speed of the rotational viscometer (see Appendix

A) so that the measured reading falls between 20% and 90%, preferably between 45% and 90%, of the full scale value.

##### **4.1.4.2 Place the test sample in a container; adjust the temperature to approximately**

25 °C; then place the container in a constant temperature water bath at  $25\text{ °C} \pm 0.5\text{ °C}$  (or pour the sample into the measuring container of the viscometer), where the water bath surface shall be slightly higher than the sample surface.

4.1.4.3 Immerse the viscometer drum or rotor vertically into the center of the test sample. The immersion depth shall comply with the requirements of the viscometer.

Start timing at the same time.

4.1.4.4 During the entire measurement process, the test sample temperature shall be

controlled at  $25\text{ }^{\circ}\text{C} \pm 0.5\text{ }^{\circ}\text{C}$ . When the drum or rotor has been immersed in the test sample for 8 minutes, start the motor and read the reading after the drum or rotor rotates for 2 minutes. After reading the value, turn off the motor; wait for 1 minute, then turn on the motor; rotate for 1 minute and take the second reading.

4.1.4.5 Empty the container and repeat 4.1.4.2 ~ 4.1.4.4.

4.1.4.6 After measuring each test sample, the viscometer drum or rotor shall be cleaned using the solvent.

#### **4.1.5 Test results**

##### **4.1.5.1**

Each sample shall be measured twice. The readings shall be calculated according to the viscometer regulations and expressed as the arithmetic mean with three significant figures.

##### **4.1.5.2**

The measurement result is in Pa·s.

#### **4.2.1 Principle**

4.2.3.4 Water bath, temperature controlled at  $50\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ .

4.2.3.5 Pipettes, 5 mL and 10 mL (for acetylation solution).

**4.2.3.6 Potentiometric titrator, equipped with a calomel electrode/glass electrode system and a titration stand.**

4.2.3.7 Analytical balance, sensitivity 1 mg.

##### **4.2.4.1 Weigh approximately 5 mg of test sample containing equivalent hydroxyl**

groups (1 g of sample = 280 equal parts/hydroxyl value) into a 250 mL conical flask, accurate to 1 mg. If the approximate value of the hydroxyl value is unknown, perform preliminary tests first.

4.2.4.2 Accurately add 10 mL of acetylation solution; place a magnetic stirring bar; plug the bottle; use ethyl acetate to moisten the bottle mouth; use a magnetic stirrer to stir the test sample to dissolve it. If the test sample cannot be completely dissolved after heating, add another 5 mL or 10 mL of acetylation solution.

4.2.4.3 Place the conical flask in a water bath at  $50\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ ; immerse to a depth of about 10 mm; keep it there for 45 minutes. (This time can be shortened, for example, to 30 minutes or less, as long as the test results are the same.)

4.2.4.4 Remove the conical flask; cool it to room temperature; add 2 mL of distilled water;