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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 15357-2014

**Surface active agents and detergents -- Determination of
viscosity and flow properties of liquid products using a
rotational viscometer**

表面活性剂和洗涤剂 旋转粘度计测定液体产品的粘度和流动性质
(English Translation)

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1 Scope

This standard specifies a general method for determining the viscosity and flow properties of surface-active agent and detergent liquid products using a rotational viscometer.

This standard applies to samples with a viscosity of $5 \text{ mPa} \cdot \text{s} \sim 5 \times 10^4 \text{ mPa} \cdot \text{s}$. For

Newtonian samples with a viscosity below $5 \text{ mPa} \cdot \text{s}$, a more precise method, such as a capillary viscometer, shall be used.

2 Normative references

The following documents are essential for the application of this document. For any dated reference, only the version corresponding to that date applies to this document;

for any undated reference, the latest version (including all amendments) applies to this document.

GB/T 13173-2008 Surface active agents - Detergents - Testing methods

JJG 1002 Rotational Viscometers

3 Terms and definitions

The following terms and definitions apply to this document.

3.1

dynamic viscosity

A measure of the internal frictional force when one liquid layer flows relatively to another

under a certain shear stress. It is the ratio of the shear stress (τ), and the shear rate ($\dot{D}$) applied to the flowing liquid, expressed in Pascal second ($\text{Pa} \cdot \text{s}$) or millipascal second ($\text{mPa} \cdot \text{s}$)¹. It is represented by Newton's equation.

1) The units of dynamic viscosity also include newton second per square meter ($\text{N} \cdot \text{s}/\text{m}^2$), millinewton second per square meter ($\text{mN} \cdot \text{s}/\text{m}^2$), and poise(P) and centipoise(cP). $1 \text{ N} \cdot \text{s}/\text{m}^2 = 1 \text{ Pa} \cdot \text{s} = 10 \text{ P}(\text{poise}) = 100 \text{ cP}(\text{centipoise})$, $1 \text{ mN} \cdot \text{s}/\text{m}^2 = 1 \text{ mPa} \cdot \text{s} = 1 \text{ cP}(\text{centipoise})$.

3.8

thixotropy

Under isothermal reversible conditions, shearing causes viscosity or consistency to decrease from its rest value (the instant shearing begins) to its final value (depending on the magnitude of the shear rate). When shearing is interrupted, the rest viscosity or consistency must recover within a certain time; this time is called the thixotropic recovery time.

3.9

rheopexy

The phenomenon in which the thixotropic recovery time is shortened by a lower shear rate after a relatively high shear rate interruption.

3.10

anti-thixotropy

Under isothermal reversible conditions, the viscosity or consistency increases from its rest value (the instant shearing begins) to its final value (depending on the magnitude of the shear rate) due to shearing action.

When shearing is interrupted, the rest viscosity recovers within a certain time; this time is called the thixotropic recovery time.

3.11

rheological hysteresis

Under isothermal reversible conditions, if the shear rate increases linearly from zero to a maximum value (upward line) over time and then decreases in the same way (downward line), the shear rate plot presents a hysteresis loop, which can be used to detect and characterize thixotropy or anti-thixotropy.

3.12

plasticity

When a plastic body is subjected to a stress less than the critical value τ_0 , the "yield stress", it behaves as an elastic body. Above this limit, flow occurs. When $\tau \geq \tau_0$ and the

function $D=f(\tau)$ is linear, the material can be said to follow the Bingham model.

3.13

time-dependent viscosity

Under isothermal reversible conditions and at a constant shear rate, the apparent viscosity changes with time.

4 Principle

At a specified shear rate, the dynamic viscosity of Newtonian liquids or the apparent viscosity of non-Newtonian liquids is measured using a specified rotational viscometer.

The shear rate is used as the variable for the determination, and the liquid properties are represented by plotting a relationship curve between the shear rate and the shear stress or viscosity.

5.1 Rotational viscometer. A viscometer with a co-axial cylindrical measuring unit; the

measuring range is $1 \text{ mPa} \cdot \text{s} \sim 10^6 \text{ mPa} \cdot \text{s}$, and the measuring error is $\pm 5\%$ (for Newtonian liquids); for example, the NDJ-1 and NDJ-79 rotational viscometers.

The ratio of the outer diameter to the inner diameter of the coaxial cylinder (rotor) shall not exceed 1.10.

The viscometer is verified and calibrated in accordance with the provisions of JJG 1002.

5.2 Super constant temperature water bath, accurate to $0.2 \text{ }^{\circ}\text{C}$.

5.3 Thermometer, with a scale division of $0.1 \text{ }^{\circ}\text{C}$.

5.4 Glass beakers, with an inner diameter of not less than 70 mm and a depth of not less than 110 mm.

NOTE: The size of the beaker affects the determination of the actual viscosity value. It is important to ensure consistency in the size of the container used.

6.1 Sample preparation

Prepare and preserve homogeneous laboratory samples according to Chapter 4 of GB/T 13173-2008, and let them stand at room temperature for 24 hours to remove air bubbles.

6.2 Test portion

Carefully take test portions from laboratory samples to ensure there are absolutely no air bubbles.

6.3 Apparatus conditions

When selecting a rotational viscometer and measuring unit to determine the viscosity of a specific product, the instrument and the rotor to be used, as well as the shear rate and shear time during the measurement, shall be clearly specified in the specific product standard. These selections depend on the rheological properties of the product (as shown in Figures 1 and 2).

- a) The viscosity of a product with Newtonian behavior is independent of rotor diameter, shear rate and shear time. A rotor or shear rate with a narrow measurement range shall be selected to obtain more accurate measurement values.
- b) The apparent viscosity of a non-Newtonian product is closely related to the rotor diameter or shear rate, and shear time. Shear thinning, dilatancy, plasticity, thixotropy and anti-thixotropy shall be considered. The rheological properties of the product shall be determined by testing with rotors of several diameters, shear rates and times, so as to select a suitable rotor diameter, shear rate and time, and whether to use a new test portion or wait for the liquid to recover for a certain period of time for repeated measurements.

6.4 Determination

Pour the specimen into a beaker (5.4) of about 400 mL or into a special measuring container. Adjust the specimen temperature to the selected test temperature (usually

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