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Viscosity Determination of Crude Petroleum - Equilibrium Method by Rotational Viscometer

原油粘度测定

旋转粘度计平衡法

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Viscosity Determination of Crude Petroleum - Equilibrium Method by Rotational Viscometer

1 Scope

This Standard specifies the method of viscosity determination of crude petroleum through coaxial cylinder rotational viscometer.

This Standard is applicable to the determination of viscosity or apparent viscosity of crude petroleum whose water content does not exceed 0.5% (mass fraction).

2 Principle of Measurement

Rotational cylinder places the surrounding fluid in stable layer-by-layer rotational flow; the viscous torque of the fluid will act on the cylinder. The relations between the fluid's viscosity and torque can be expressed in accordance with Formula (1):

$$\eta = \frac{K \cdot M}{\omega} \quad \dots\dots\dots (1)$$

Where,

η ---the viscosity of fluid, expressed in (Pa•s);

M---the fluid's viscous torque acting on the cylinder, expressed in (N•m);

ω ---the cylinder's rotational speed, expressed in (rad/s);

K---flow field constant, expressed in (m⁻³).

In accordance with the relations between M and τ , ω and γ , shear stress γ on the cylindrical flow layer shall be expressed in Formula (2); viscosity or apparent viscosity shall be calculated in accordance with Formula (3) (in terms of non-Newtonian fluid, η shall be apparent viscosity η_a).

$$\tau = Z \cdot a \quad \dots\dots\dots (2)$$

$$\eta = \frac{\tau}{\gamma} \quad \dots\dots\dots (3)$$

Where,

4.2.2 Use the electronic balance to weigh sample mass (density is already known), which shall be slightly higher than the corresponding mass of the stipulated volume; place it into an outer measuring cylinder, which is previously heated.

4.2.3 In terms of sample, which maintains flow state at room temperature, directly inject the sample for determination in accordance with the determination volume.

4.3 Constant Temperature

In accordance with the viscometer's characteristics, crude petroleum's variety and test temperature, under general circumstances, maintain constant temperature for 20 min ~ 30 min. Under special circumstances, re-prolong the constant-temperature time.

4.4 Measurement

4.4.1 The selection of shear rate shall be determined in accordance with users' demands. When it is impossible to determine in advance whether it is Newtonian fluid or non-Newtonian fluid, adopt multiple shear rates for determination. In addition, determine respectively from low shear rate to high shear rate.

4.4.2 Viscosity determination: at the selected shear rate, initiate the rotational viscometer; wait till the instrument indication is basically stable, then, record the first α value. Afterwards, record once every 5 min. If in the four α values that are continuously recorded, the deviation of the arithmetic mean value of the latter three α values and the first α value does not exceed 5%, then, it shall be deemed that a balance value is reached. Thus, the determination of α value at this shear rate is completed.

4.4.3 When the sample is non-Newtonian fluid, sample shall be replaced if test temperature changes.

5 Result Calculation

5.1 In terms of rotational viscometer, whose viscosity value cannot be directly read, take the last α value. In accordance with Formula (2) and Formula (3), calculate the viscosity value or apparent viscosity value.

5.2 In terms of rotational viscometer, which adopts computer programming for determination, take the arithmetic value of the latter two determined values as the viscosity value or apparent viscosity value.

6 Precision

In accordance with the following stipulations, determine the precision of the determination result (95% confidence level).

6.1 Non-Newtonian Fluid

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