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GB/T 265-88

Replacing GB 265-83

Petroleum products - Determination of kinematic viscosity and calculation of dynamic viscosity

石油产品运动粘度测定法和动力粘度计算法

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Table of Contents

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This method is suitable for measuring the kinematic viscosity of liquid petroleum products (referring to Newtonian liquid), in the unit of m^2/s. However, during practical use, it is usually in the unit of mm^2/s. The dynamic viscosity can be obtained, through multiplying the measured kinematic viscosity BY the density of the liquid.

Note: For the liquid which is measured by this method, it is considered that the ratio of the shear stress to the shear rate is a constant, that is, the viscosity has nothing to do with the shear stress and the shear rate. This liquid is called a Newtonian liquid.

1 Summary of methods

This method is, at a constant temperature, to measure the time for a certain volume of liquid, which flows through a calibrated glass capillary viscometer, under gravity. The product of the capillary constant of the viscometer multiplied by the flow time, is the kinematic viscosity of the measured liquid, at that temperature. At temperature t, the kinematic viscosity is represented by the symbol v_t.

The product of the kinematic viscosity, at this temperature, multiplied by the density of the liquid, at the same temperature, is the dynamic viscosity of the liquid. The dynamic viscosity at temperature t is represented by the symbol η_t.

2 Instruments and materials

2.1 Apparatus

2.1.1 Viscometer:

2.1.1.1 The glass capillary viscometer shall meet the requirements of SH/T 0173 "Technical condition for glass capillary viscometer". It is also allowed to use an automatic viscometer, which has the same accuracy.

2.1.1.2 A set of capillary viscometers: The capillary inner diameter is 0.4, 0.6,

Table 1 -- Constant temperature bath liquid used at different temperatures

Note: It is better to add antioxidant additives to the mineral oil in the constant temperature bath, to delay oxidation AND prolong the use time.

4 Preparation

4.1 When the specimen contains water or mechanical impurities, it must be dehydrated, before the test; AND filtered by filter paper, to remove the mechanical impurities.

For lubricating oil of high viscosity, it may use a porcelain funnel. It may use a water flow pump or other vacuum pumps for suction filtration; OR otherwise, it can be dehydrated and filtered, after heating to a temperature of 50 ~ 100 °C.

4.2 Before measuring the viscosity of the specimen, the viscometer must be washed by solvent oil or petroleum ether. If the viscometer is stained, it shall be washed by chromic acid lotion, water, distilled water or 95% ethanol. THEN, it is put in an oven to dry, OR blow dry by hot air, which had been filtered through cotton.

4.3 When measuring the kinematic viscosity, load the specimen into a clean and dry capillary viscometer, which has an inner diameter that meets the requirements. Before loading the specimen, put the rubber tube on the branch tube 7. Use finger to block the opening of the tube body 6. At the same time, turn the viscometer upside down. Then, insert the tube body 1 into the container, which contains the specimen. At this time, use a rubber ball, a water flow pump or other vacuum pump to suck the liquid to the marking line b. Meanwhile, be careful not to cause bubbles and cracks, in the liquid in the tube body 1, as well as the expansion parts 2 and 3. When the liquid level reaches the marking line b, lift the viscometer from the container; quickly restore its normal state. At the same time, wipe off the excess specimen, from the outer wall of the tube end of the tube body 1. Remove the rubber tube from the branch tube 7. Sleeve it over the tube body 1.

Table 2 -- Constant temperature time of viscometer in constant temperature bath

5.2 Use the rubber tube, which is sleeved on the opening of the tube body 1 of the capillary viscometer, to suck the specimen into the expansion part 3. Make the specimen liquid level slightly higher than the marking line α. Be careful not to let the capillary and the liquid in the expansion part 3 produce bubbles or cracks.

5.3 At this time, observe the flow of the specimen in the tube. When the liquid level just reaches the marking line α, start the stopwatch. When the liquid level just reaches the marking line b, stop the stopwatch.

When the liquid level of the specimen flows in the expansion part 3, note that the liquid, which is stirred in the constant temperature bath, shall be kept at constant temperature; meanwhile there shall be no bubbles in the expansion part.

5.4 For the flow time which is recorded by a stopwatch, it shall make at least four repeated measurements. The difference between each flow time and its arithmetic mean, shall meet the following requirements: When measuring the viscosity at a temperature of 100 ~ 15 °C, this difference shall not exceed ± 0.5% of the arithmetic mean; when measuring the viscosity at a temperature below 15 ~ -30°C, the difference shall not exceed ± 1.5% of the arithmetic mean; when measuring the viscosity at a temperature below -30°C, the difference shall not exceed ± 2.5% of the arithmetic mean.

Then, take the arithmetic mean of not less than three flow times, as the average flow time of the specimen.

6 Calculation

6.1 At temperature t, the kinematic viscosity v_t (mm^2/s) of the specimen is calculated according to formula (2):

Where:

c - Viscometer's constant, mm^2/s^2;

τ_t - The average flow time of the specimen, s.

Example: The viscometer's constant is 0.4780 mm^2/s^2, the flow time of the specimen at 50°C is 318.0, 322.4, 322.6, 321.0 s, so the arithmetic mean of the flow time is as follows:

The allowable difference between each flow time and the average flow time is as follows:

Because the difference between 318.0 s and the average flow time has exceeded 1.6 s, it shall discard this reading. When calculating the average flow time, it only uses the observation readings at 322.4, 322.6, 321.0 s; the difference between them and the arithmetic mean does not exceed 1.6 s.

Thereby, the average flow time is:

The measurement result of the kinematic viscosity of specimen is as follows:

6.2 At temperature t, the dynamic viscosity η_t of the specimen is calculated as follows:

6.2.1 According to GB/T 1884 "Petroleum and liquid petroleum product - Determination of density - Hydrometer method" and GB/T 1885 "Petroleum measurement tables", measure the density ρ_t of the specimen (g/cm^3), at temperature t.

6.2.2 At temperature t, the dynamic viscosity η_t (mPa•s) of the specimen is calculated according to formula (3):

Where:

v_t - The kinematic viscosity of the specimen, at temperature t, mm^2/s;

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