Kinematic Viscosity

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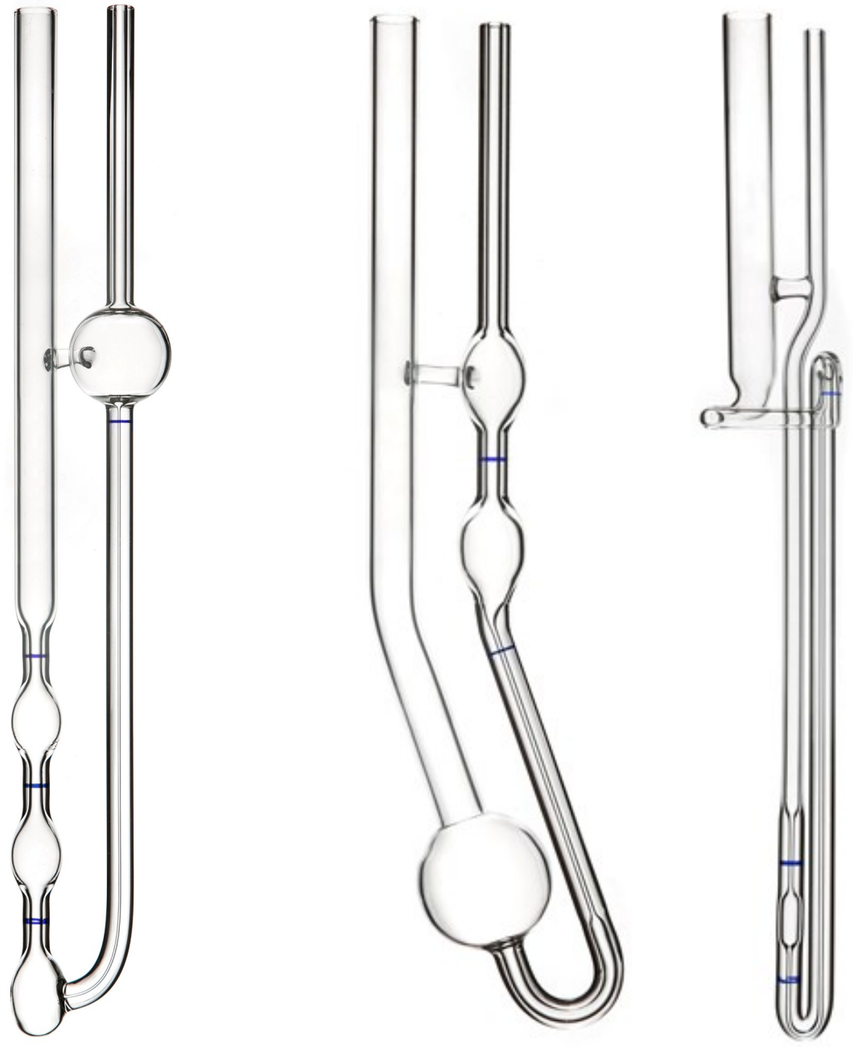
What is Kinematic Viscosity

Kinematic viscosity is a measure of a fluid's resistance to flow under the force of gravity. It’s determined by measuring the time in seconds, required for a fixed volume of fluid to flow a known distance by gravity through a capillary within a calibrated viscometer at a known and closely controlled temperature. It’s an important property and specification for petroleum products.



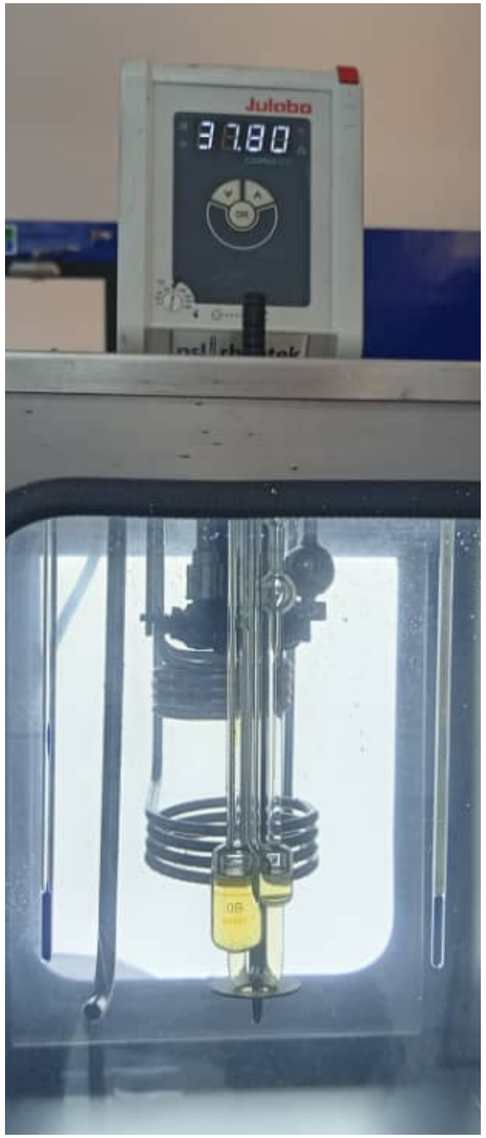
Why do we test Viscosity

In diesel fuel, viscosity is what determines how efficiently the fuel can move through different engine parts such as injectors, fuel lines, and pumps. The viscosity of diesel fuel is influenced by factors like temperature, chemical composition, and the presence of additives.

Diesel fuel that's too viscous can result in damage to the fuel pump, such as wear on the cam and follower, due to the increased pressure. On the other hand, diesel fuel with excessively low viscosity may lead to insufficient lubrication. It also plays a role in determining the fuel delivery rate and the quality of fuel atomisation during the injection process.

In fuel oil, viscosity is used to determine preheat in order to have proper burner tip atomisation in steam boilers.

The viscosity of a fuel also determines how well it can be pumped through pipelines, and to and from vessels.



How does it work?

Kinematic Viscosity is determined by measuring the length of time in seconds taken for a fixed volume of liquid to flow under gravity through the capillary of a calibrated viscometer at a closely controlled and known temperature. Throughout the test the viscometer must be fully submerged in an oil bath maintained at a constant temperature and the prescribed test temperature. The standard method used in the petroleum industry is ASTM D445.

The kinematic viscosity (determined value) is the product of the measured flow time and the calibration constant of the viscometer. Two such determinations are needed from which to calculate a kinematic viscosity result that is the average of two acceptable determined values.

Potential Issues and Solutions

➡ Temperature

Temperature control is the most important parameter for obtaining accurate and precise kinematic viscosity measurement.

A slight deviation in temperature can have a large effect on the viscosity of a fluid. The viscosity bath temperature for the most common measurements, 40°C and 100°C, must be regulated to within +/- 0.02°C.

That is an extremely narrow window and attention must be taken to achieve this regulation.

Potential Issues and Solutions

➡ Thermometer

In order to obtain accurate temperature measurements, a specified thermometer or other temperature-sensing device having the specified accuracy and meeting the requirements of ASTM D445 must be used.

The thermometer must be immersed in the bath at the correct depth. The thermometers should be calibrated at least yearly to +/- 0.02°C. The thermometer ice point should be determined every six months and the correction factor applied.

Potential Issues and Solutions

➡ Bath Temperature Uniformity and Stability

The entire length of the viscometer must be maintained at the required test temperature to ensure all viscometers are tested at the correct test temperature. The type of circulator used, the age of the bath fluid and the bath fluid viscosity impact temperature uniformity.

The bath must be located away from a draft which might cause disproportionate temperature variations in the bath (such as in a fume hood or under an A/C vent). Temperature stability will be negatively impacted if a second viscometer is added to the test bath during the same time that another adjacent viscometer is being used for a measurement.

Potential Issues and Solutions

➡ Lighting

There needs to be sufficient lighting of the sample in the tube while in the bath to ensure consistent visual detection of the meniscus crossing the timing lines.

Attention needs to be taken that the lighting device does not affect the bath temperature control and stability.

Potential Issues and Solutions

➡ Viscometers

All viscometers must be calibrated to calculate viscosity. SISA purchase calibrated viscometers with constants at the test temperatures needed for analysis. Viscometer constants are verified at least yearly. The size of the viscometer must be chosen such that the flow time is greater than 200 seconds to eliminate possible operator error.

The tube must be free from dust or other particles and the fluid should clearly wet the surface of the glass. To clean the viscometers several rinses with a sample solvent such as naphtha, followed by a drying solvent such as acetone, and then purging with a dry, dust-free gas such as air or nitrogen, are appropriate for ensuring the viscometers are clean and dust free. Certified reference materials are analysed regularly to verify the viscometers are accurate.

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