Cleaning Glass Capillary Viscometers

Capillary Viscometers: How are they Cleaned?

Clean viscometers are essential for precise and accurate measurements. Because CANNON receives a significant number of requests for advice concerning proper cleaning methods, we offer the following instructions as a guide to cleaning most glass capillary viscometers.

Removing the Test Sample from the Viscometer

The first step in viscometer cleaning is to remove the bulk of the test sample. For low viscosity liquids, the viscometer may be turned upside down and allowed to hang while the test sample drains via gravity into a vessel. For high viscosity liquids, the sample may have to be drawn out under vacuum. The material remaining in the viscometer must then be removed by flushing with a suitable solvent. Distilled water is an obvious choice for aqueous solutions. Petroleum-based lubricants and asphalts can usually be dissolved with light naptha, heptane, octane, highly aromatic solvents and many other petroleum-derived solvents. Varsol® is a commercial solvent that works very well for this purpose. It may be difficult to find a suitable solvent for some types of samples.

Highly viscous samples do not easily pour from the instrument, nor do they generally respond well using vacuum. The best approach is to lower the viscosity by heating the instrument in an open oven or with a stream of hot air. Inverting the instrument and suspending it in an open oven over a receptacle to catch the sample can suffice. Another method is to draw the bulk of the sample out while the instrument is at an elevated temperature in a constant temperature bath. This method works particularly well for viscometers such as the Zeitfuch® Cross-Arm viscometer since the entire cleaning is performed while the viscometer remains fixed in the constant temperature bath. CANNON often places viscometers in an open aluminum oven (2” wide × 7” long × 5” deep), maintained at an elevated temperature during the cleaning procedure. Even after the bulk of a viscous sample is removed from the instrument, dissolving the rest of it may pose a considerable problem. Our findings show a mixture of octane isomer is effective in removing the last traces of high viscosity standards from viscometers.

Drying the Viscometer after Cleaning

The viscometer must be completely dry before another sample is loaded. Cleaning with highly volatile solvents is recommended, since any remaining solvent quickly evaporates after the solvent is flushed from the viscometer. Often, however, the best choice of solvent for the material in the viscometer is not necessarily volatile. In this case, a second highly volatile solvent, which will dissolve the first solvent, can be used for the final step in the cleaning. Acetone is commonly used as the second solvent due to its high volatility and its ability to dissolve traces of petroleum solvents and water.

A low velocity stream of clean air is sufficient to evaporate the remaining traces of volatile solvent, but be aware that rapid evaporation of these solvents can cool the surface of the glass to such an extent that humid air may be brought below the dew point, causing a film of water to form on the inner surfaces of the viscometer. Heating the air being drawn in to the instrument, or heating the glass itself, usually overcomes this problem.

Cleaning Insoluble Deposits from Viscometers

Capillary viscometers are often used to measure materials which leave stains or significant deposits of material insoluble in normal cleaning solvents. The most common approach for removing this material involves filling the instrument with a chromic acid cleaning solution and allowing the instrument to soak in the acid for up to 24 hours. Chromic acid solutions are strongly oxidizing and will convert many materials to a soluble form. Chromic acid does not attack the borosilicate glass of the viscometer and thus will not alter the calibration constant. Proper procedures must be followed when using and discarding chromic acid since it is a hazardous material. A commercially manufactured oxidizing reagent (ALNOCHROMIX™) is chromium-free and may be substituted for chromic acid solutions. ALNOCHROMIX™ is available from Alconox Inc., or their preferred dealers.

Beware of glass cleaners with a high pH as changes in viscometer calibration as great as 20% have been observed due to the prolonged use of alkaline cleaning solutions. If alkaline cleaning solutions with a pH greater than 10 have been used, the viscometer calibration should be verified to ensure that there has not been a significant change.

Insoluble particles stuck in the capillary of a viscometer can sometimes be dislodged by using an ultrasonic cleaner.

If you are encountering a special cleaning problem, we urge you to contact CANNON for assistance.