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BROOKFIELD AMETEK
Instrumentation & Specialty Controls Division

analítica Salvadoreña

11 Commerce Boulevard | Middleboro, MA 02346 USA
Tel: 800.628.8139 or 508.946.6200 | Fax: 508.946.6262
www.brookfieldengineering.com

3 Easy Steps to Successful Viscosity Measurement

Figure 1: Brookfield DV3T Rheometer with Cylindrical Spindle

Pharmaceutical R&D labs test new formulations for viscosity to quantify flow behavior properties. Viscosity affects processing decisions for mixing in manufacturing and filling containers with consumer product, as well as formulation stability during transport, storage, and consumer use. Instruments called "rheometers" and "viscometers" are used to measure viscosity of pharmaceutical liquids and semi-solid materials like creams/ointments. Viscosity flow curves shown in the instrument display - see Figure 1 – characterize typical behavior of pharmaceutical products. As rotational speed of spindle increases, viscosity decreases. R&D will pick a data point on this curve and direct QC to test for that value when qualifying production batches for shipment.

There are three decisions that R&D makes in setting up the QC test method. The first is to define the viscosity range of the manufactured material. Scientific units of centipoise (cP) are typically used in North America, while other parts of the world use milli-Pascal seconds (mPa*s) as well. Fortunately, 1cP = 1mPa*s. Water is the reference material with viscosity of 1cP at 20°Celsius. Cough syrups and other medicinal liquids that are swallowed are typically below 100cP. Rubbing ointments may be around 1,000cP or higher. Thick creams can start around 10,000cP. Choice of viscometer with appropriate torque measurement range depends on knowing the material(s) that will be tested.

Two basic torque ranges are used for most pharmaceutical products. "LV" applies to low viscosity materials, while "RV" is selected for "regular" or medium viscosity products. There are choices for higher viscosity, like HA and HB, but these are not often used to test pharmaceutical liquids and creams/ointments.

Figure 2: Disc-type Spindle for Viscosity Measurement

Once the torque range has been decided, choice of instrument model is based on operating features needed for the measurement. R&D defines the type of spindle to use and rotational speed when measuring viscosity. Spindles in general are either cylindrical in shape, like the image in Figure 1, or may have a disc at the bottom as shown in Figure 2. Disc spindles are the most common type found in QC labs. There are other types as well, such as cone and T-bar, but will not be discussed in this article.

Other features in choice of viscometer include built in clock to time how long the spindle rotates before the viscosity data point is captured. If there is a temperature requirement for conditioning the sample, then viscometer should come with built-in temperature probe for verification of sample temperature. Each feature will increase the cost of

purchasing the viscometer, so it is important that R&D clearly define all details necessary to making the proper viscosity measurement.

The third and final need for QC is knowing the acceptable limits for the viscosity measurement to approve product for shipment. R&D will do testing on multiple samples during the validation process to establish cP values for the QC test. When measured viscosity is between these two and shipment takes place. If the measured viscosity falls outside, there may instrument is not reading correctly. The procedure to prove that the instrument a quick test with viscosity standard fluid (see Figure 3). The fluid is certified to value. Measurement with the QC instrument must come sufficiently close to the prove the instrument is in good working condition. Then QC must report back viscosity test.

Figure 3: Calibration Test Kit with Viscosity Standard Fluid

Follow these three easy steps in selecting the proper viscometer, along with viscosity standard fluid, and your QC Lab will be in good shape. When there is any question, go back to R&D for verification of test method and proper technique for making a valid viscosity test.

Authors: Robert G. McGregor Director, Global Marketing & High End Lab Instrument Sales
Email: bob.mcgregor@ametek.com
AMETEK Brookfield, Instrumentation & Specialty Controls Division
11 Commerce Boulevard | Middleboro, MA 02346 USA | Tel: 800.628.8139 or 508.946.6200 | Fax: 508.946.6200
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