Viscometer vs. Rheometer:

Which is the Better Choice?

This is the type of query that comes in from customers to instrument manufacturers on a frequent basis. It may go somewhat like the following set of statements and questions.

We produce certain thickeners and thinning agents used by the pharmaceutical industry in their formulation of creams and ointments. We want to purchase a new viscometer (although our local dealer suggests a rheometer). In our understanding, the rheometer can perform the function of the viscometer (and more). A possible downside may be the inability to match the standard industry protocol for a specific QC test method. Is this a correct statement in general terms? If the rheometer is the better instrument, why can't it match the standard industry test? Is there any other difference or disadvantage to consider? Finally, please advise which model of rheometer with accessories is most suitable for our application.

Pharmaceutical manufacturers generally find that rheometers offer several major benefits, in particular a broader range of test capabilities compared to the standard bench top viscometer. (See Figure 1) If that test capability can be combined with rugged construction of instrument for use in QC, which lengthens the time interval between service appointments, then the choice of a rheometer over a viscometer may be more practical to consider. If cost is affordable, then the same instrument may prove effective in both applications.

Rheometers, which operate in both controlled stress as well as controlled rate modes of operation, provide a more general capability for rheological evaluation of flow behavior. Controlled stress tests are specifically applicable to the direct measurement of yield stress and creep. Yield stress characterizes the force needed to initiate flow of an ointment; squeezing product out of a tube is a specific example. Creep testing measures the flow behavior under a constant force like gravity; a lotions ability to hold position after application and not drip or run is the type of situation that you evaluate with this test.

Both viscometer and rheometer can measure viscosity vs. shear rate and viscosity vs. temperature. These are standard tests common to R&D and QC. Once the characterization of additives used to thicken or thin has been accomplished, R&D may specify a single shear rate for use in QC to perform a pass/fail test.

R&D must always consider whether to have QC perform additional tests like yield stress and creep for more complete characterization of final product performance. Expanded test standards will eventually come out from pharma industry organizations which identify these additional methods and require the use of a rheometer to complete the measurement. So considering a rheometer purchase in QC does have some merit.

Figure 1: Brookfield RST-CPS Rheometer with Cone Spindle
Can Characterize Ointment Rheology

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The spindle types traditionally found in QC may be the disc-type shown in Figure 2. The rheometer user may recommend the cone spindle shown on the instrument in Figure 1. This difference in spindle types may account for the variance in viscosity values that result when running identical tests for viscosity vs. rotational speed with rheometer and viscometer. The shearing action imparted by each spindle running at the same speed will be different. Therefore the viscosity values will also be different. Therefore the viscosity
values will also be different.

Your decision on choice of rheometer vs. viscometer may ultimately be determined by answers to questions like the following:

"Is it important to have controlled windows for acceptable readings on yield stress, viscosity, and creep? Are there environmental issues in the multiple locations where the product is manufactured that could be affecting these values?"

"Will this more comprehensive rheological analysis produce a more consistent product?"

"Can I peroform this set of tests as easily and quickly as the standard viscosity test?"

"Is there a measurable payback that justifies the investment?"

While instrument manufacturers can give you lots of recommendations, ask them to go a step further and provide them with a test sample for evaluation. Study rheological data for a product that has performed acceptably and data for a product that has failed. See if the rheology data shows up the difference in measurement values to clearly single out the failed product.

One final approach is to consult with associates or colleagues in other companies to compare their experience with expanded test protocols. If the additional work costs more than the gain in product quality, then the decision is ovbious. However, if the improvement in product performance can win new customers, then the added effort is certainly worth the cost.

Figure 2: Brookfield Disc-Type Spindle Traditionally Used in QC Test

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