MANSCO PRODUCTS

tov viscometer system

focus

Value Considerations

The TOV Viscometer System, because of its operating shear rate, is the only viscometer with a sensitivity that allows all portions of a polymer molecule to enter the damping equation. The end result is a more meaningful viscosity measurement. For plant managers and process engineers, this translates into value:

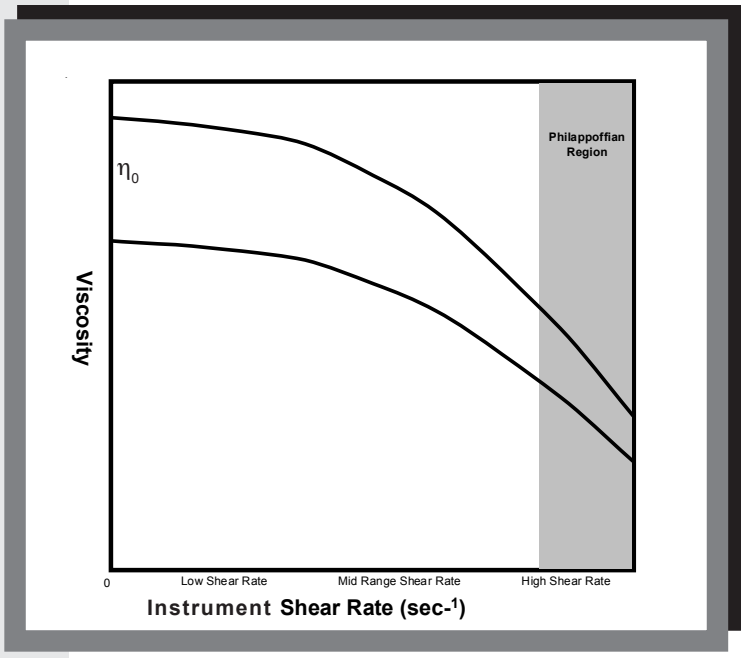
CONTROL LOOP
The TOV can and should become part of the vacuum control loop for the final polymerization vessel. In a CP (continurous polymerization) system with a TOV at each end of the transfer line, either cascade or double cascade control systems can be used. In single cascade, the TOV at the finisher is used with proportional control. In double cascade the unit near spinning would be the "master" or integral-only control and the other TOV near the finisher would be the "slave." (In a polymerization process, viscosity derviative action is never used.)

LOW MAINTENANCE
The TOV is a very low maintenance device. Many plants have been running with them continuously for over 10 years.

NARROW RANGE
With every TOV purchase, the customer selects the viscosity units and range of operation. Calibration is then set in the range specified by the customer.

Intrinsic Viscosity, Shear Rate, & the TOV Viscometer System

In a condensation polymerization process the material exit the "finisher" moves slowly to spinning with a shear rate of probably less than 10 sec^{-1}. To obtain the most reliable viscosity measurement of this material the apparent viscosity vs. shear rate curve must be observed.



The Viscosity vs. Shear Rate Curve

At very low shear rates the viscosity remains near η_0, the viscosity at zero shear rate, sometimes referred to as the Newtonian viscosity. But as the shear rate of measurement increases, the apparent viscosity drops, rather precipitously, until reaching another plateau asymptotically, called the Philappoffian region. The reason for the decrease of apparent viscosity with shear rate is that not all segments of a molecule can respond to the more and more rapid motion of the measuring device. This is demonstrated in the accompanying curve of viscosity vs. shear rate.

The TOV Viscometer System (TOV) measures viscosity well before the Philappoffian region, at much lower shear rates where the measurement of viscosity is much more significant. With its unsurpassed sensitivity at its operating shear rate, the TOV provides much more effective and meaningful results on a repeatable basis.

TOV Viscometer System™ by MANSCO PRODUCTS

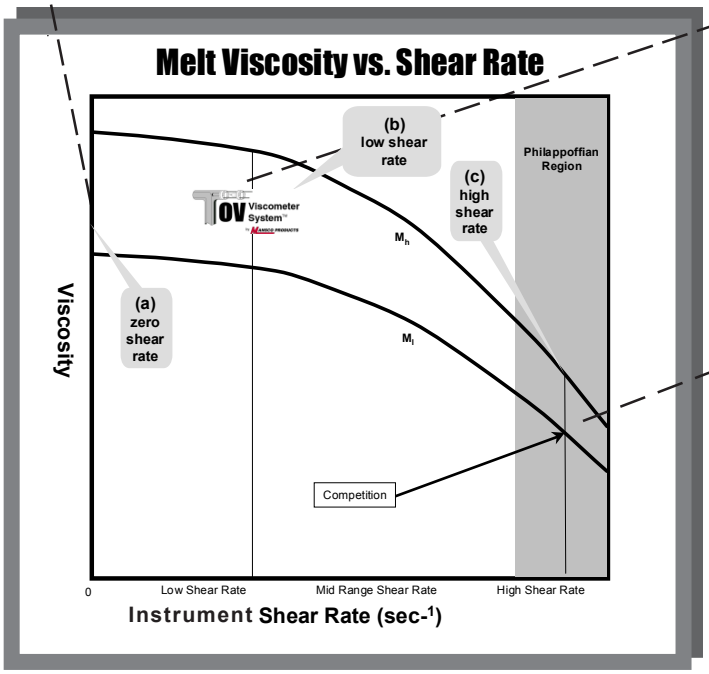
Viscosity and Shear Rate . . . a closer look

(a) Zero Shear Rate:

Also called the Newtonian Viscosity. The highest viscosity possible for a given polymer at a given temperature.

(b) Low Shear Rate:

In a non-Newtonian fluid, as shear rate increases, the viscosity decreases. On the graph below, two curves are shown: one for a fluid at high molecular weight (M_h) and one for a lower molecular weight (M_l). At lower shear rates, there is a significant difference in viscosity, depending on the molecular weight. The TOV Viscometer System (TOV) measures viscosity at this lower shear rate where viscosity measurement is most significant. The TOV operates with the most sensitivity within this narrow range thereby producing a much more effective and reliable result.



(c) High Shear Rate:

As the shear rate continues to increase, it reaches a plateau, called the Philapoffian region. As the fluid approaches, the differences in the viscosity of the fluid with higher molecular weight (M_h) and lower molecular weight (M_l) become more and more negligible. At this point, in the Philapoffian region, although viscosity can be measured or derived, the results are much less effective and the reliability factors decrease by significant proportions.

For more information, please contact:

TOV Viscometer System™

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