

Rheometers versus melt index for polymer analysis

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Melt Index machines have been used successfully for many years for determining the flow rate of polymers in a molten state per ASTM D-1 238. It consists primarily of a heat chamber into which pellets are placed and a piston with a dead weight is placed on top. After a preset melt time the polymer flow rate, out of a fixed orifice at the bottom, is measured.

It is determined by two methods, Method A, and Method B. Method A is a timed quantity of collection, where a sample is collected for a given length of time, weighed and the answer (FR) is given as grams/10 minutes. Method B is based upon a volumetric computation, which is determined by measuring the time for the piston to drop a given distance. This gives, by computation, the cc/10 min. which can be converted to FR in gm/10 min.

This method is more accurate and opens other technical opportunities. With the new computer based models which can compute shear stress, shear rate, and viscosity, new models can also make several tests in one run and do flow rate ratio in one run. They also provide greater accuracy and statistical data. There are no operator cutting and weighing errors.

Capillary Melt Rheometers are the up and coming method for polymer characterization. They are fully automated, cover shear rate ranges from 10⁻² to 18,000 reciprocal seconds and they do the complete computation and plotting function.

The advantages over Melt Index are:

- A. Establish the characteristic curve since viscosity varies with shear rate and shear stress.
- B. Polynomial coefficients can be related to average molecular weight distribution.
- C. As compared to Melt Index, the short L/D of a Melt Index gives confusing entrance and exit effects because they vary with shear rate.
- D. Study the effects of lubricants, fillers, regrind, etc., on flow properties.
- E. Can do thermal stability studies.
- F. Ninety nine percent automated means less error.
- G. Can easily make Bagley & Rabinovitch corrections.
- H. Melt elasticity - constant shear rate - use three capillaries, 20:1, 15:1, and 10:1 L/D at constant diameter and entrance angle. Measure die swell with a laser beam and by equations determine melt elasticity.

Melt Indexers have been here a long time, and with the new technology they will continue to be here longer still. My recommendation to all of you is learn about the latest in Melt Index and Melt Rheometers.

- Paul Limbach

See also:

- Effects of molecular structure, rheology, morphology & orientation on blown film properties
- Extrusion of Nylon 66 simplified from melt rheology data
- Extrusion evaluation through pressure and melt temperature analysis
- How to get power law viscosity from two melt index values

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