NOTES

Further Comments on the Relations between Melt Flow Index Values and Molecular Weight Distributions of Commercial Plastics

In a recent article,[1] we pointed out that a simple relation can be found for families of commercial polymers with similar polydispersities. An equation was developed to show that this simple relationship is to be expected, more or less. These additional comments are intended to emphasize the limitations of the experimental correlations. These ideas are implied in the cited article, but we did not give them the prominence they deserve.

In the article, an approximate relationship was formulated between melt flow index (MFI) and the weight average molecular weight, M_w:

$$\frac{1}{MFI} = KM_w^x, \tag{1}$$

where x = 3.4–3.7. In the development of this equation, the correlation between the zero shear viscosity, η_0, and viscosity, η, at the shear rate of the melt indexer was given as:

$$\frac{\eta}{\eta_0} = f(\tau) = K'. \tag{2}$$

Use of this relation to derive eq. (1) implies that the constant K' is the same for all polymers of a particular type, i.e., the ratio between the zero shear viscosity and the viscosity at the melt index shear stress is constant for all polymers of a given family. Therefore, there exists a family of viscosity–shear stress curves for different MFIs as shown in Figure 1.

It should be noted, however, that this is not generally true because of differences in long chain branching, polydispersity, comonomer content (where applicable), shear history, and so on. Thus, somewhat different relations were noted between ethylene–butene and ethylene–octene LLDPE copolymers that are made by different processes. LDPEs were not included in this general correlation because a common relation is not expected between MFI and M_w for polymers that vary widely in branching and polydispersity. Equation (2), then, summarizes the key requirement for MFI of a series of polymers to correlate with a single average molecular weight.

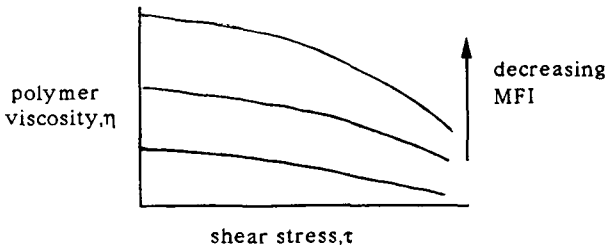

Figure 1 Viscosity–shear stress curves showing general trend of increasing viscosity with decreasing MFI at a given shear stress.

A two-point capillary flow curve should suffice in most cases to verify that a particular polymer falls into a family for which a particular relation between MFI and M_w has been established. One point should be at the MFI apparent shear stress and the other at a significantly lower stress.

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Reference

1. T. Bremner, D. G. Cook, and A. Rudin, *J. Appl. Polym. Sci.*, **41**, 1617 (1990).

Received November 27, 1990
Accepted December 20, 1990

Journal of Applied Polymer Science, Vol. 43, 1773 (1991)
 CCC 0021-8995/91/091773-01$04.00