TO THE EDITOR:

In a recent article (*1*) Han refers to an earlier work by Sylvester and Rosen (*2*). Some comments are in order.

To give proper credit, the equation

$$\Delta P_{\text{ent}}/\tfrac{1}{2}\,\rho V^2 = K + K'/N_{Re} \quad (1)$$

was to the best of our knowledge first proposed by D. B. Holmes (*3*) as was clearly stated (*2*), and not by us as implied by Han. We demonstrated its applicability to Newtonian and viscoelastic fluids, and pointed out that K and K' must be functions of geometry, of n, the flow index for power-law fluids, and for viscoelastic fluids some parameter characteristic of the fluid's elasticity.

Han separates his entrance pressure drops into a viscous component and an elastic component using the results of Weissberg (*4*) to calculate the viscous component and then compares the elastic component to our predictions for elastic energy storage based on assuming that the fluid's elastic component follows Hooke's law in shear (*2*). First of all, Weissberg's analysis applies to a Newtonian fluid, and to substitute an apparent viscosity for a non-Newtonian fluid is questionable at best. Second, it has been clearly shown that ΔP_{ent} decreases with n for viscous fluids (*2*). Third, I could not find Han's Equation (9) attributed to Weissberg in the reference cited. What does appear is

ΔP_{ent} (Newtonian, $\beta = 0$)

$$< 3.47\,\frac{\mu Q}{a^3} = \frac{27.76\mu Q}{D^3} \quad (2)$$

As Weissberg's creeping flow analysis is applicable at low N_{Re}, where only the second term of Equation (1) above is significant, the result substituting $Q = (\pi/4)D^2V$ is $K' < 43.6$. This is inconsistent with the experimental value of $K' = 159 \pm 30$ recently reported by Kaye and Rosen (*5*).

Reference 5 shows that K' for Newtonian fluids is within 4% of the asymptotic ($\beta = 0$) value at $\beta = 0.25$. Han's data (Figure 5) show no asymptote at much lower values of β. While it is conceivable that polymer melts might show such vastly different behavior (although the eventual asymptote is a logical necessity) it may also be due to a lack of precision, particularly at $\beta = 0.0069$. It will be noted that two of the points for $\beta = 0.0069$ in Figure 6 are about 10% below the $f = 16/N_{Re}$ line. Since the power-law Reynolds number is *defined* to give $f = 16/N_{Re}$ when the true equilibrium pressure gradient is used to calculate f, the experimental value of dP/dx is about 10% low (the precision in N_{Re} is assumed to be considerably greater). This may not seem like much, but ΔP_{ent} is obtained by extrapolation (a fair distance, in Han's case), and can result in ΔP_{ent} being on the order of 30 to 40% too large (see Figure 1) despite the four significant figures given. This would result in a corresponding error in the value of K' calculated from that ΔP_{ent}.

NOTATION

a = test section radius (Weissberg's notation)
β = area contraction ratio = $(D/D_0{}^2)$
D = diameter of test section
D_0 = diameter of entrance section
ρ = fluid density
ΔP_{ent} = entrance pressure drop
V = average velocity in test section
x = axial distance from contraction

LITERATURE CITED

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4. Weissberg, H. L., *Phys. Fluids*, **5**, 1033 (1962).
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