$$K_p=\left[\frac{(4.31\times10^{-6})-(6.51\times10^{-11})\,P_g+(5.03\times10^{-16})\,P_g^2}{1.00-(4.31\times10^{-6})\,P_g+(6.51\times10^{-11})P_g^2\,(5.03\times10^{-16})\,P_g^3}\right] \qquad (58)$$

Equation (57) becomes

$$V_o = V_1 P_g K_p \qquad (59)$$

and combining equations (55) and (59), we have

$$\Theta_1 = \frac{8\mu L V_1 K_p}{\pi R_o^4} \qquad (60)$$

Equation (60) defines the time constant Θ_1 derived analytically for laminar flow of a pressurized fluid of constant viscosity through a tube of radius R_o and length L. Since the subject fluids do not possess the quality of constant viscosity throughout the required range of 0 to 50,000 psi, equation (60) will not yield the desired results in its present form. From reference (g) it is seen that the coefficient of viscosity μ for the subject fluids can be closely approximated in the pressure range 0 - 35,000 psi by the linear relation

$$\mu = mP_g + \mu_o \qquad (61)$$

where the nomenclature is

μ_o . . . coefficient of viscosity under atmospheric pressure, lb-sec/in^2

m . . . slope of viscosity-pressure curve = 6.24×10^{-10} sec

The peak pressure P_g is used in equation (61), since, as explained in the section Calculated Results, the time constant Θ_1 is in general agreement with the experimental results for pressures up to 35,000 psi. For pressures that exceed 35,000 psi, a pressure equal to $\frac{3}{4}$ P_g in equation (61) yields a favorable comparison. Treating equation (61) as a correction factor in equation (60), we now have

$$\Theta_1 = \frac{8LV_1K_P}{\pi R_o^4}\left[(6.24 \times 10^{-10})\ P_g + \mu_o\right] \qquad (62)$$

While it is apparent that the density of the fluid undergoes a definite change for the pressures encountered in this investigation, a study of equations (56) and (57) indicates that this change is of the order of 10 to 15 percent. On the other hand, from reference (g) it is seen that the change in viscosity for these pressure changes is approximately 300 to 400 percent. Since the variable fluid viscosity has been accounted for, the relatively insensitive density variation can be considered negligible. Thus the assumption of constant density, i.e., incompressibility, equation (10), is justified.

A comparison of the results obtained from experiments described in the section Experimental Procedures and Results with the computed results from equation (62) is presented in the section Calculated Results.