In quadratic form Eq. 4–81 is

$$q_{sc} = \frac{-A + \sqrt{A^2 + 4B\psi(\overline{p}_R)}}{2B} \tag{4–82}$$

Calculation of Inertial–Turbulent (IT) Flow Factor

The value of the IT flow factor D may be estimated by relating D to the turbulence factor, β:

$$D = \frac{2.715 \times 10^{-15}\beta k M P_{sc}}{h\overline{\mu} r_w T_{sc}} \tag{4–83}$$

The velocity coefficient or turbulence factor β is found to be related to absolute permeability by Ref. 10,

$$\beta = \frac{4.11 \times 10^{10}}{k^{1.3333}} \tag{4–84}$$

However, Fetkovich et al.[29] observed that β values calculated using Eq. 4–84 were about 100 times lower than calculated from the field data. Thus, Eq. 4–84 was modified to

$$\beta = \frac{4.11 \times 10^{12}}{k^{1.3333}} \tag{4–85}$$

Using values of $P_{sc} = 14.65$ psia, $T_{sc} = 520°$R, $M = 28.966 \times \gamma_g$, and evaluating viscosity at present average reservoir pressure, D is calculated as

$$D = \frac{9.106 \times 10^{-3}\gamma_g}{hk^{0.3333}\overline{\mu} r_w} \tag{4–86}$$

For convenience, the values of B and B' may be expressed in terms of β rather than D by substituting for D from Eq. 4–83 to give

$$\begin{aligned} B' &= \frac{1.422 \times 10^6 \overline{\mu}\,\overline{z}T}{kh}\left[\frac{2.715 \times 10^{-15}\beta k M P_{sc}}{h\overline{\mu}\,\overline{r}_w T_{sc}}\right] \\ &- \frac{1.422 \times 10^6 \mu z T}{kh}\left[\frac{2.715 \times 10^{-15}\beta k(28.966\gamma_g)(14.65)}{h\overline{\mu} r_w(520)}\right] \\ &- \frac{3.1506 \times 10^{-9}\overline{z}T\beta\gamma_g}{h^2 r_w} \end{aligned} \tag{4–87}$$

or

$$B' = \frac{3.1506 \times 10^{-9}T\beta}{h^2 r_w} \tag{4–88}$$