Chapter 1

Conventional & Isochronal Tests
Deliverability tests on gas wells have been used for many years to determine flow capacity. In early times gas wells were rated by opening the well fully to the atmosphere and determining its open flow capacity. In order to prevent wastage of gas and possible formation damage, open flow potential (capacity) tests of gas wells were soon determined by flowing the wells against a particular pipeline backpressure. Since a backpressure is maintained at the surface during these tests, they are commonly called backpressure tests.

1.1 Derivation of Fundamental Flow Equation

In order to understand the relationships that exist when gas flows through a formation into a wellbore, certain mathematical developments are necessary. We start with the derivation of Darcy’s law for the radial flow of gases. Consider radial flow toward a vertical wellbore of radius $r_w$ in a horizontal reservoir of uniform thickness and permeability as shown in figure 1.1. The radius at the external boundary is $r_e$ and the pressure is $p_e$.

If the flow rate of the gas at any radius, $r$, is $q_r$ it can be shown that

$$q_{rw} \left( \frac{r_e^2 - r^2}{r_e^2} \right) = q_{rw} \left( 1 - \frac{r^2}{r_e^2} \right) \quad (1.1)$$

where $q_{rw} = \frac{2\pi rhk}{\mu_g Z}$ at $r = r_w$, i.e., the flow rate at the well

By Darcy’s Law: