Example of Estimation of Average Horizontal Hydraulic Conductivity

(Mays, 2012)

EXAMPLE 3.4.1

An unconfined aquifer consists of three horizontal layers, each individually isotropic. The top layer has a thickness of 10 m and a hydraulic conductivity of 11.6 m/day. The middle layer has a thickness of 4.4 m and a hydraulic conductivity of 4.5 m/day. The bottom layer has a thickness of 6.2 m and a hydraulic conductivity of 2.2 m/day. Compute the equivalent horizontal and vertical hydraulic conductivities.

SOLUTION

Equation (3.4.5) is used to compute the equivalent horizontal hydraulic conductivity:

$$K_x = \frac{K_1 z_1 + K_2 z_2 + K_3 z_3}{z_1 + z_2 + z_3}$$

$$= \frac{(11.6\ \text{m/day})(10\ \text{m}) + (4.5\ \text{m/day})(4.4\ \text{m}) + (2.2\ \text{m/day})(6.2\ \text{m})}{(10\ \text{m} + 4.4\ \text{m} + 6.2\ \text{m})} = 7.25\ \text{m/day}$$

The equivalent vertical hydraulic conductivity is computed using Equation (3.4.12):

$$K_z = \frac{z_1 + z_2 + z_3}{\frac{z_1}{K_1} + \frac{z_2}{K_2} + \frac{z_3}{K_3}}$$

$$= \frac{10\ \text{m} + 4.4\ \text{m} + 6.2\ \text{m}}{\frac{10\ \text{m}}{11.6\ \text{m/day}} + \frac{4.4\ \text{m}}{4.5\ \text{m/day}} + \frac{6.2\ \text{m}}{2.2\ \text{m/day}}} = 4.42\ \text{m/day}$$

Note that the equivalent hydraulic conductivities above are computed based on the assumption that each layer is individually isotropic, that is, $K_x = K_z$ in each layer. ■