GROUNDWATER GLY 265 – 2009 – PRACTICAL 4

EXERCISE 10

A well in a 20 m thick phreatic aquifer (effective porosity 30%, recharge rate 0.3 m/yr) draws water from up to 4 km.

a) Calculate the travel time for a non-reactive solute from a factory situated 1 km from the well.

b) Calculate the travel time for a non-reactive solute from a factory situated 1 km from the well, assuming an effective porosity of 45 %. Explain the reason for the deviation from solution a).

D = 20 m	Φ_{eff} = 0.3
R = 0.3 m/yr	r = 4 km
x = 0 (well)	x_0 = 1 km (factory)

$$\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{Rt}{D\phi_{eff}}$$

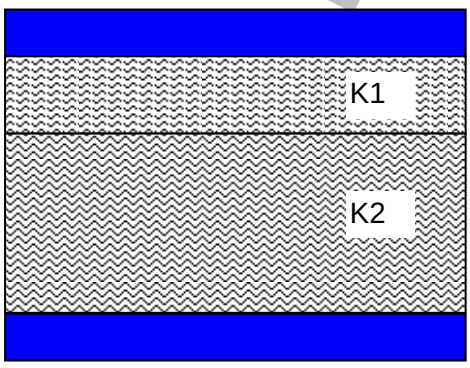
$$t=\ln\frac{0^2\,km^2-4^2\,km^2}{1^2\,km^2-4^2\,km^2}\cdot\frac{20m\cdot 0.3}{0.3m/yr}=1.291yrs$$

$$\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{Rt}{D\phi_{eff}}$$

$$t=\ln\frac{0^2\,km^2-4^2\,km^2}{1^2\,km^2-4^2\,km^2}\cdot\frac{20m\cdot 0.45}{0.3m/yr}=1.936yrs$$

EXERCISE 11

Siting of a wastewater dam on layered porous media.



Parameter	***Value***
Surface area of dam	40,000 m^2
Piezometric gradient between the dam and the aquifer	1
Thickness of layer 1	4 m
Hydraulic conductivity of layer 1	0.004 m/d
Porosity of layer 1	0.05
Thickness of layer 2	12 m
Hydraulic conductivity of layer 2	0.02 m/d
Porosity of layer 2	0.05

a) Determine the specific discharge between the dam and the aquifer. Hint: $K=\dfrac{\sum d_i}{\sum d_i/K_i}$

b) Determine the daily volume of water (in litres) leaking to the aquifer.

c) Determine the average linear velocity from the dam to the aquifer.

a) $q = \frac{Q}{A} = -K\frac{dh}{dl} = KI = 0.01m/d * 1 = 0.01m/d$

b) $Q = q * A = 0.01m/d * 40000m^2 = 400m^3/d = 400{,}000L/d$

c) $v = \frac{q}{\phi} = \frac{0.01m/d}{0.05} = 0.2m/d$

EXERCISE 12

The following water levels were measured in a 25 m thick homogeneous, isotropic porous aquifer (representative grain size distribution curve given below).

a. Draw the water table contour (1 m isopiestic lines).
b. Determine the hydraulic conductivity.
c. Calculate the specific discharge and the linear flow velocity.
d. Calculate the discharge per day for cross-section of 100 m width (perpendicular to the isopiestic lines).

Hazen Zischang Equation : $K = Cd_{10}^2 \frac{0.79 + 0.03T}{86.4}$ [m/s]

Uniformity Coefficient: $C_U = d_{60}/d_{10}$ [C_U < 4: well sorted; C_U > 6: poorly sorted]

Hazen temperature T = 1.0 at (10.00° C).

Material	C_U	*Valid for* d_{10}	*C*
Sand, sand with gravel	1 – 3	0.1 – 0.6 mm	0.0139
Sand, sand with gravel	3 – 10	0.1 – 0.6 mm	0.0116
Sandy loam	< 5	0.1 – 0.6 mm	0.0093
Sandy clay loam	< 5	0.08 – 0.6 mm	0.0070
Clay loam, sandy clay	< 5	0.06 – 0.6 mm	0.0046