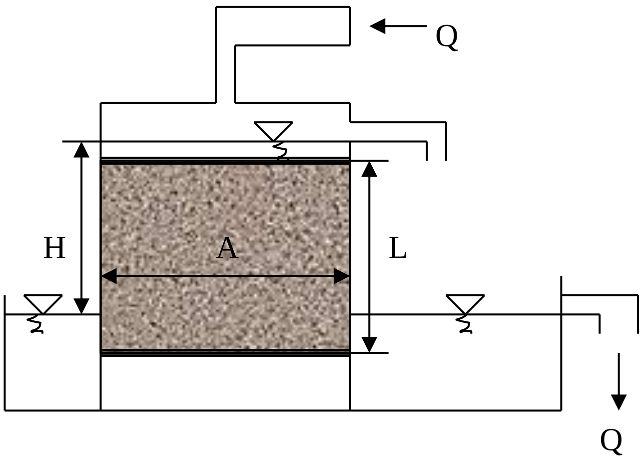
ITU

CIVIL ENGINEERING FACULTY HYDRAULICS DIVISION

HYDROLOGY

Examples-5 Groundwater

1. A soil sample with a length of 25 cm and a cross sectional area of 80 cm^2 is placed in a H = 10 mm constant headed permeameter. The Q discharge passing through this sample is measured to be 0.16 cm^3/s. Calculate the hydraulic conductivity of the soil.



2. The distance between two observation wells in an unconfined aquifer is 70 m. Static water surface elevations are 75.0 m in well A, and 74.4 m in well B. The tracer injected from well A reaches well B in 3 hour and 40 minutes. Soil porosity is 13%, aquifer thickness is 30 m.

Note: Water temperature is assumed to be 10^0C and dynamic viscosity of water at this temperature is $134*10^{-6}$ Ns/m^2.

a) Find water table slope between the wells
b) Compute the real velocity of groundwater flow and the filter velocity of groundwater flow
c) Determine the hydraulic conductivity of the aquifer
d) Compute transmissivity of the soil
e) Compute specific permeability of the aquifer

3. Water with a discharge of 0.03m /s is drawn trough a pumping well with 40cm diameter from an unconfined aquifer having 40m thickness.After the steady state situation water level decreases equal to 3,2 and 1,9 m are observed in two pumping wells situated at 20 m and 50 m distance, respectively.

a) Compute the hydraulic conductivity and the transmissibility of the soil
b) Compute the water level decreases in the pumping well

4. Water is coming with a discharge of 0.07m^3/s from a well which was drilled through a horizontal bottomed pressurized aquifer (artesian well) with an 8 m thickness. The water level readings at the two observations wells which are 55 m and 115 m far from this well are 12.6 and 14 m, respectively. Calculate the hydraulic conductivity of this aquifer.

HINTS:

- *Darcy's law*. The velocity $V_f=Q/A$ and the piezometric gradient I, where Q is the discharge of groundwater flow and A is the cross-section area of a soil sample, are proportional for a certain type of soil: $V_f = KI$

It is a fictive velocity (*filter velocity*), because Q is divided by the cross-section area A. In reality, the flow takes place only in the pores, therefore real velocity V_a is higher than V_f:

$$V_a = Q / A_a = Q/(p\,A) = V_f / p$$

where p is the porosity of soil. However, the knowledge of V_f is sufficient to determine the discharge Q of the groundwater flow.

- $$Q = \pi K \frac{h_2^2 - h_1^2}{\ln \frac{r_2}{r_1}}$$
- $T = mK$ where m is the thickness of the aquifer. Therefore T and K are related.