EXPERIMENT 1

PROBLEMS FROM AQUIFER PROPERTIES

PROBLEM 1:

In an unconfined aquifer extending over 4 km^2, the water table was initially at 26 m below the ground surface. Sometime after an irrigation of 20 cm (full irrigation), the water table rises to a depth of 25.5 m below the ground surface. Afterward $1.5x10^6$ m^3 of groundwater was withdrawn from this aquifer, which lowered the water table to 27.5 m below the ground surface. Determine: (i) specific yield of the aquifer, and (ii) soil moisture deficit (SMD) before irrigation.

Solution:

(i) Volume of groundwater withdrawn from the unconfined aquifer = Area of the aquifer x Drop in the water table x Specific yield

Substituting the values, we have,

$$1.5\times10^6 = 4\times10^6\times(27.5 - 25.5)\times S_y = 4\times10^6 \times 2.0\times S_y$$

$$\therefore\ S_y = \frac{1.5\times10^6}{4\times10^6\times 2.0} = 0.19,\ \textbf{Ans.}$$

(ii) Volume of water recharged due to irrigation (V_R) = Area of the aquifer influenced by irrigation x Rise in the water table x S_y

Let us consider the aquifer area influenced by irrigation to be 140 m^2, then the volume of water recharged (V_R) will be:

V_R = 140 x (26.0-25.5)0.19 = 13.3 m^3

Volume of irrigation water (V_I) = 140 × 0.20 = 28.0 m^3

Now, Soil moisture deficit (SMD) before irrigation = V_I - V_R = 28.0-13.3 = 14.7 m^3.

Or, SMD =14.7/140 = 0.105 m = 10.5 cm, Ans.

PROBLEM 2:

In an area of 200 ha, the water table declines by 3.5 m. If the porosity of the aquifer material is 30% and the specific retention is 15%, determine:

(i) specific yield of the aquifer, and

(ii) change in groundwater storage.

Solution:

(i) We know, Porosity = Specific yield (S_y) + Specific retention (S_r)
$0.30 = S_y + 0.15$
Therefore $S_y = 0.30-0.15 = 0.15$ or 15%

(ii) Change in groundwater storage = Area of the aquifer x Drop in the water table x Specific yield

$$= (200 \times 10^4) \times 3.5 \times 0.15$$

$$= 105 \times 10^4 \text{ m}^3, \text{ Ans.}$$

PROBLEM 3:

The average thickness of a confined aquifer extending over an area of 500 km^2 is 25 m. The piezometric level of this aquifer fluctuates annually from 10 m to 22 m above the top of the aquifer. Assuming a storage coefficient of the aquifer as 0.0006, estimate annual groundwater storage in the aquifer.

Solution:

Annual groundwater storage (GWS) in the confined aquifer is given as:

GWS = Area of the aquifer x Rise in the piezometric level x Storage coefficient

$$= (500 \times 10^6) \times (22-10) \times 0.0006$$

$$= 3.6 \times 10^6 \text{ m}^3, \text{ Ans.}$$