How to Calculate the Storage Coefficient of an Aquifer? | Geography

Article shared by : **Madhulika**

Storage coefficient of an aquifer is the volume of water discharged from a unit aquifers 0.05 to 0.30.

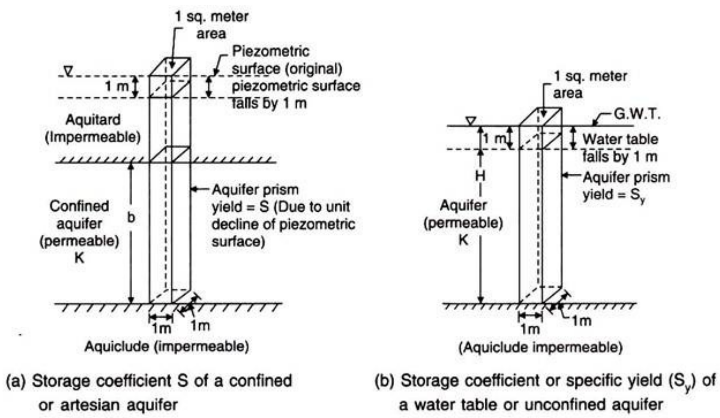

Fig. 4.4 Diagrammatic representation of coefficient of storage

Under artesian conditions, when the piezometric surface is lowered by pumping, water is released from storage by the compression of the water bearing material (aquifer) and by expansion of the water itself. Thus, the coefficient of storage is a function of the elasticity of water and the aquifer skeleton and is given by as-

$S = \gamma_w b(\alpha + n\beta)$ …(4.4)

Where, S = coefficient of storage, fraction; n = porosity of aquifer, fraction; b = saturated thickness of aquifer (m); γ_w = units weight of water (9810 N/m^3); $\beta = 1/K_w$, reciprocal of the bulk modulus of elasticity of water $K_w = 2.1\ GN/m^2 = 2.1 \times 10^9\ N/m^2$; and $\alpha = 1/E_s$, reciprocal of the bulk modulus of elasticity of aquifer skeleton.

The fraction of storage attributable to expansibility water-

$S_w = 4.7 \times 10^{-6}\ nb$ …(4.5)

The bulk modulus of compression of some formation material are given in Table 4.3.

Table 4.3 Bulk modulus of compression of formation materials:

Material	*Bulk modulus of compression* E_s, $N/m^2 \times 10^5$
Plastic clay	5-40
Stiff clay	40-80
Medium-hard clay	80-150
Loose sand	100-200
Dense sand	500-800
Dense sandy gravel	1,000-2,000
Rock—fissured, jointed	1,500-30,000
Rock—sound	> 30,000

Example 1:

An artesian aquifer 20 m thick has a porosity of 20% and bulk modulus of compression 10^8 N/m^2. Estimate the storage coefficient of the aquifer. What fraction of this is attributable to the expansibility of water?

The fraction of storage attributable to the expansibility of water (taking only the second term within the backets)-

$$S_w = 0.0187 \times 10^{-3}$$
$$= \frac{1.87 \times 10^{-5}}{1.98 \times 10^{-3}} \text{ of } S \approx \frac{1}{100} \text{ of } S, \text{ or } \mathbf{1\% \text{ of } S}$$

Example 2:

In a certain place in Andhra Pradesh, the average thickness of the confined aquifer is 30 m and extends over an area of 800 km^2. The piezometric surface fluctuates annually from 19 m to 9 m above the top of the aquifer. Assuming a storage coefficient of 0.0008, what ground water storage can be expected annually?

Assuming an average well yield of 30 m^3/hr and about 200 days of pumping in a year, how many wells can be drilled in the area?

Solution:

$\Delta GWS = A_{aq} \times \Delta$ piezo. Surface $\times S = (800 \times 10^6)(19 - 9)\ 0.0008$ or

$6.4 \times 10^6\ m^3$, or $6.4\ M\ m^3$

Annual draft $= (30 \times 24)\ 200 = 0.144 \times 10^6\ m^3$ or $0.114\ Mm^3$

Number of wells that can be drilled in the area = 6.4/0.144 = 44.5, say 44 wells 0.144

Of course, the well sites have to be investigated and there should be sufficient spacing for the wells.

Example 3:

piezometric head is lowered by 50 m, which drains half the thickness of the aquifer.

Assume a storage coefficient of 2×10^{-4} and a specific yield of 16%.

Solution:

(a) $\Delta GWS = A_{aq} . \Delta GWT . S_y = 100 \text{ ha} \times 15 \text{ m } (0.16)$

$= \mathbf{240 \text{ ha-m}}$

(b) $\Delta GWS = A_{aq} [\Delta \text{ piezo. head} \times S + \Delta GWT \times S_y]$

(as confined) (as unconfined)

$= 100 \text{ ha } [20 (2 \times 10^{-4}) + 30(0.16)]$

$= \mathbf{480.4 \text{ ha-m}}$

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