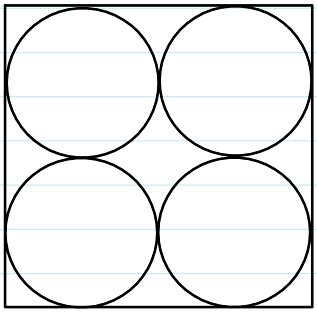
2.1.1

Tuesday, August 24, 2010
12:51 PM

A cubical pattern of grain packing is shown below; grain sizes are uniform and each sphere touches all neighboring spheres. Determin the porosity of a sample with this type of grain packing. Does the porosity depend on the grain size?

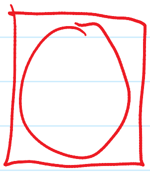
4.1/8=0.5125



$\frac{4}{3}\pi r^3 = \text{Volume}$

1 sphere $r = 1\ m^3$

2 2



R

$V_{Box} = 2^3\ m^3 = \underline{8\ m^3}$

$\frac{4}{3}\pi r^3 = \frac{4}{3}\pi$

1-4.1/8=0.4875

4/3*3.1415=4.1887

2.2.1

Cubic Packing

Let's assume a cube containing $n \times n \times n$ number of uniform spheres. Then, the porosity of this representative volume is given by

$$\alpha = \frac{v_i}{V} = \frac{(nD)^3 - (n^3)\left(\frac{4}{3}\pi\left(\frac{D}{2}\right)^3\right)}{(nD)^3} = 1 - \frac{\pi}{6} = 0.4764 = 47.64\%$$

The porosity for this type of grain packing does not depend on the grain size, D.

2.5.1

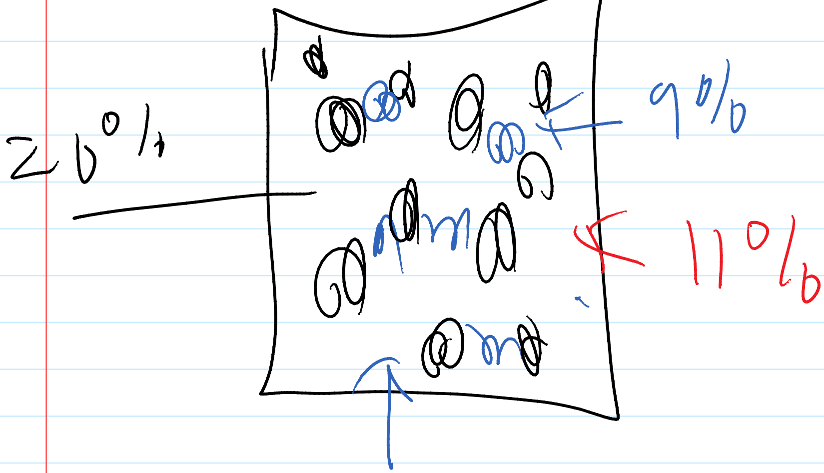
Thursday, August 26, 2010
12:53 PM

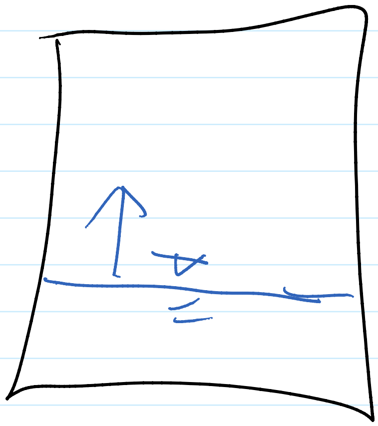
Determine the water level rise in an unconfined aquifer produced by a seasonal precipitation of four inches. The aquifer's porosity is 20% and its specific retention is 9%.

$\frac{4''}{0.11} =$

Specific yield = porosity- specific retention   0.2-0.09=0.11

4/0.11=36.3636 or about 3 feet





$\phi = 20\%$

$S_r = 9\%$

4/0.11=36.3636

The specific yield of the aquifer can be found using equation 2.10

$$S_y = \alpha - S_r = 0.20 - 0.09 = 0.11$$

and the water level rise can be found from equation 2.9

$$V = (A)(\Delta h) = \frac{w_y}{S_y} = \frac{(4\ inches)(A)}{0.11}$$

$$\Delta h = 36.4\ inches \approx 3\ ft$$

2.5.3

Thursday, August 26, 2010
12:54 PM

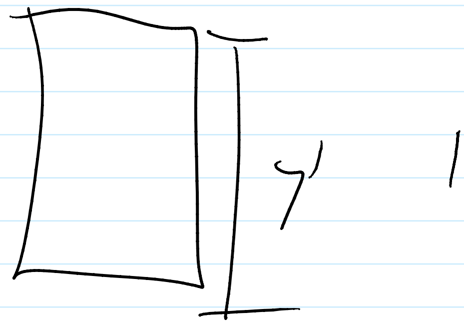
How much water can be produced by lowering the water table of an unconfined aquifer 7 ft over an area of 1 mile^2? The aquifer's porosity and specific retention are 0.38 and 0.15

$\phi = S_r + S_y$

$S_y = 0.38 - 0.15 = 0.23$

0.23*7=1.61 ft of water

$S_y = 0.38 - 0.15 = 0.23$



1.61 foot*mile*mile in acre*feet

About 532,000 results (0.35 seconds)

1.61 (foot * mile * mile) = 1 030.4 acre * feet

More about calculator.

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1.61 foot*mile*mile in feet^3

About 1,680,000 results (0.48 seconds)

1.61 foot * mile * mile = 44 884 224 feet^3

More about calculator.

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The specific yield of the aquifer is given by

$$S_y = \alpha - S_r = 0.38 - 0.15 = 0.23$$

Then, equation 2.9 can be used to estimate the volume of water released:

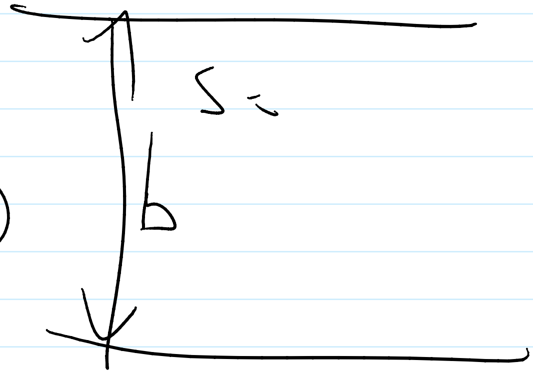
$$\begin{aligned} w_y = S_y V &= (0.23)(7\ ft \times 1\, mile^2) \\ &= (0.23)(7\ ft \times 2.788 \times 10^7\ ft^2) = 4.5 \times 10^7\ ft^3 \end{aligned}$$

2.8.2

Thursday, August 26, 2010
12:54 PM

The specific storage of a 45 m thick confined aquifer is 3x10-5 /m. How much water would the aquifer produce if the piezometric surface is lowered by 10 m over an area of a square kilometer?

S = Ss*b = 3*10^-5*45=0.0014



Water produced = 0.0014*10=0.014 meters of water

0.014*1000*1000=14000.0 cubic meters of water produced

Not very much!

The relationship between specific storage and storage coefficient is

$$S_s = \frac{S}{b} \qquad \text{where } b \text{ is the aquifer thickness.}$$

Thus, $S = S_s b = (3\times10^{-5}\ m^{-1})(45\ m) = 1.35\times10^{-3}$ and the volume of water released is given by

$$V = (A)(\Delta h)(S) = (1\times10^{6}\ m^{2})(10\ m)(1.35\times10^{-3}) = 13{,}500\ m^{3}$$