



Given:

Wet Bulk Density = 2.24 g/cm³
Particle Density = 2.65 g/cm³
Fluid Density (FD) = 1.0 g/cm³

What is:
Porosity = ?

$$BD = (1 - \phi) PD + \phi (FD)$$

$$\phi = \frac{SW - DW}{V_T} \quad \frac{DW}{V_T} = PD(1 - \phi)$$
$$\phi = 1 - \frac{DW}{PD * V_T}$$

$$BD = (1 - \phi) PD + \phi (FD)$$

$$BD = PD - \phi PD + \phi FD$$

$$BD = PD + \phi (FD - PD)$$

$$BD - PD = \phi (FD - PD)$$

$$\frac{BD - PD}{(FD - PD)} = \phi$$

We have wet bulk density so $\frac{2.24 - 2.65}{1 - 2.65} = \frac{-0.41}{-1.65} \sim 0.25 = \phi$
use fluid density for water



Knowing:

Wet Bulk Density = 2.24 g/cm³
Particle Density = 2.65 g/cm³
Fluid Density (FD) = 1.0 g/cm³
Porosity = 0.25

And If:

Total Volume = 25cm³

What is:

Saturated Weight = ?

Dry Weight = ?

$$BD = (1 - \phi) PD + \phi (FD)$$

$$\phi = \frac{SW - DW}{V_T} \quad \frac{DW}{V_T} = PD(1 - \phi)$$
$$\phi = 1 - \frac{DW}{PD * V_T}$$

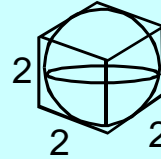
$$\text{Saturated "Weight"} = \text{Vol} * \text{WBD} = 25\text{cm}^3 * 2.24 \frac{\text{g}}{\text{cm}^3} = 56\text{g (MASS)}$$

$$\text{Dry Weight} = \text{SatWgt} - \text{WaterWgt} = \text{SatWgt} - \phi \text{ TotVol} * \text{FD}$$

$$= 56\text{g} - (0.25 * 25\text{cm}^3) * 1 \frac{\text{g}}{\text{cm}^3} = 56\text{g} - 6.25\text{g} = 49.75\text{g} \sim 50\text{g (MASS)}$$



$$\phi = \frac{V_v}{V_T} = \frac{2^3 - \left(m \frac{4}{3} \pi r^3\right)}{2^3}$$



m is # spheres r is their radius

m	r	r ³	mr ³
1	1	1	1
8	1/2	1/8	1
64	1/4	1/64	1

$$\phi = \frac{2^3 - \left(\frac{4}{3} \pi\right)(1)}{2^3} = 0.476 \quad \text{A constant!}$$

HENCE MAX ϕ FOR UNIFORM, CUBIC PACKED SPHERES IS ~ 48%

MIN ϕ WOULD RESULT FROM RHOMBEHEDRAL PACKING ~ 26%

IN GENERAL, IRREGULAR PACKING & ANGULAR PARTICLES YIELD HIGHER ϕ

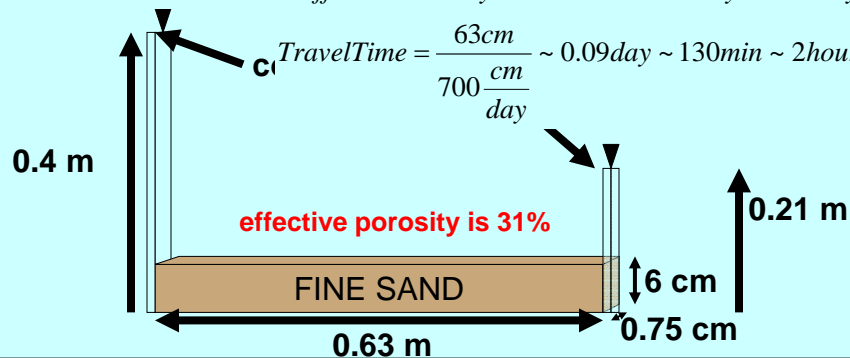


$$Q = \frac{1 \text{ liter}}{\text{day}} = \frac{1 \text{ liter}}{\text{day}} \frac{1000 \text{ cm}^3}{1 \text{ liter}} = \frac{1000 \text{ cm}^3}{\text{day}}$$

$$\text{Darcy Velocity} = \frac{Q}{\text{Area}} = \frac{1000 \text{ cm}^3}{6 \text{ cm} \cdot 0.75 \text{ cm}} = 222 \frac{\text{cm}}{\text{day}}$$

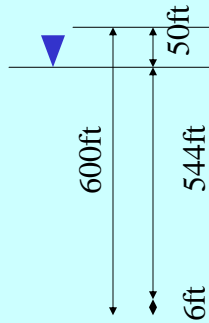
$$\text{Average Linear Velocity} = \frac{\text{Darcy Velocity}}{\text{Effective Porosity}} = \frac{222 \frac{\text{cm}}{\text{day}}}{0.31} = 716 \frac{\text{cm}}{\text{day}} \sim 700 \frac{\text{cm}}{\text{day}}$$

$$c^t \text{ Travel Time} = \frac{63 \text{ cm}}{700 \frac{\text{cm}}{\text{day}}} \sim 0.09 \text{ day} \sim 130 \text{ min} \sim 2 \text{ hours}$$





pressure on your head (6ft tall) at the bottom of a well
surface at sea level
bottom at 600 ft
water level 50 ft below the surface



Gage Pressure

$$P = \gamma h = 62.4 \frac{lb}{ft^3} 544 ft = 33945.6 \frac{lb}{ft^2}$$

$$P = 33945.6 \frac{lb}{ft^2} \frac{1}{144} \frac{ft^2}{in^2}$$

$$= 235.7 \frac{lb}{in^2} = 235.7 psi$$

Absolute Pressure ~ 235.7psi + 14.7psi
~ 250.4psi