Use d_{10} to reflect the typical pore throat size

For fresh water:

$$h_c = \frac{2\sigma}{\gamma r} \quad (\text{for } \; r \; \text{in cm})$$

$$\sigma = \frac{72.8\text{dyne}}{\text{cm}} \cdot \frac{0.00102\,\text{g}}{\text{dyne}} \cdot \frac{981\,\text{cm}}{\text{sec}^2} = \frac{72.8\text{g}}{\text{s}^2}$$

$$\gamma = \rho g = \frac{1\text{g}}{\text{cm}^3} \cdot \frac{980\text{cm}}{\text{s}^2} = \frac{980\text{g}}{\text{cm}^2 - \text{s}^2}$$

For sand

$h_{c\text{-water}}$ **= (2*72.8)/(980*0.017/2) = 17.5cm**

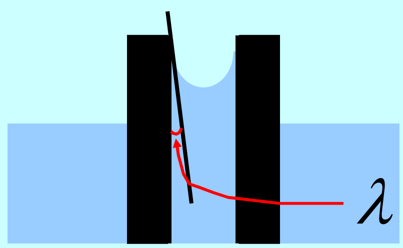
$h_{c\text{-gas}}$ **= (2*33)/(0.68*980*0.017/2) = 11.6cm**

For silty-sand

$h_{c\text{-water}}$ **= (2*72.8)/(980*0.0017/2) = 174cm**

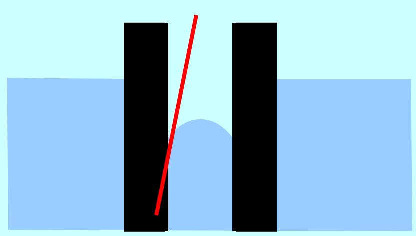
$h_{c\text{-gas}}$ **= (2*33)/(0.68*980*0.0017/2) = 116cm**

Thus far we have looked at fluids with a contact angle near zero and the cosine of zero is one, so we have not had to consider it



Some fluids have a contact angle approaching 90º and that needs to be considered in estimating capillary rise

$$h_c = \frac{2\sigma\cos\lambda}{\gamma r}$$



For a nonwetting fluid that angle will result in a depression rather than rise

MAXIMUM HEIGHT YOU CAN RAISE WATER BY SUCTION:

AS LIMITED BY PREVAILING ATMOSPHERIC PRESSURE:

(lb/in^2 sea-level ~14.7, Denver ~12.2, Mexico City ~11.1, Mt. Everest ~4.9)

THEORETICALLY

$$H_{Pa} = \frac{P_a}{\gamma_W} = \frac{14.7\ lb/in^2}{62.4\ lb/ft^3} \times \frac{144 in^2}{ft^2} = 33.92ft$$

But PRACTICALLY SPEAKING ABOUT 28ft at sea level

Denver: ~23ft
Mexico City: ~21ft
Mt. Everest: ~9ft

$$Q = KiA$$

$$K = \frac{Q}{iA}$$

$$K = \frac{\left[\dfrac{45\ ml\ \frac{1cm^3}{1ml}}{120\ sec}\right]}{\left[\dfrac{(25 - 10)in}{29.5\ in}\right]\left[\pi\left(1\ in\ \frac{2.54cm}{in}\right)^2\right]} = \frac{0.04\ cm}{sec}$$

Reasonable for sand?

Dye moves through the tube
It moves ~30 cm in 17.5 min

$$V_{Darcy} = Ki = K\frac{dh}{dl}$$

$$V_{Interstitial} = \frac{Ki}{\phi} = \frac{K}{\phi}\frac{dh}{dl}$$

$$\phi = \frac{0.036\ \mathrm{cm/sec}\ \ 0.5}{\dfrac{30\mathrm{cm}}{17.5\mathrm{min}\ \dfrac{60\mathrm{sec}}{\mathrm{min}}}} \sim 0.63$$