



Estimate the height of capillary rise for water in sand.

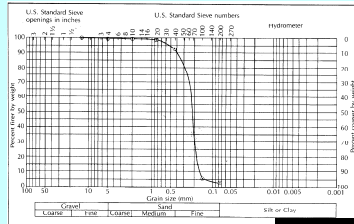
Grain size distributions in Fetter (pg74-75)

Smallest ~ 0.08 mm 10% ~ 0.17mm = 0.017cm

What if the soil is a silty sand?

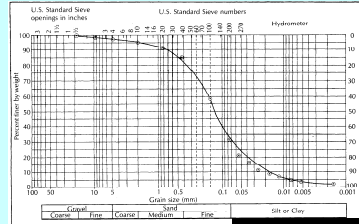
Grain size distributions in Fetter (pg74-75)

Smallest ~ 0.002 mm 10% ~ 0.017mm = 0.0017cm



▲ FIGURE 3.3 Grain-size distribution curve of a fine sand.

sand



▲ FIGURE 3.4 Grain-size distribution curve of a silty fine to medium sand.

silty sand

What if the fluid is gasoline?

Substance Surface Tension (dyne/cm)

Water 72.8 dyne/cm

Gasoline ~33 dyne/cm (note < tension for water)

specific weight? check the web (~0.68 density of water)

Which will dominate, surface tension decrease or specific weight decrease?



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

For fresh water:

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

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

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

For sand

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

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

For silty-sand

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

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



MAXIMUM HEIGHT YOU CAN RAISE WATER BY SUCTION:

AS LIMITED BY PREVAILING ATMOSPHERIC PRESSURE:

(lb/in² sea-level ~14.7, Denver ~12.2, Mexico City ~11.1, Mt. Everest ~4.9)

THEORETICALLY

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

But **PRACTICALLY** SPEAKING ABOUT 28ft at sea level

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

What are the elevation and pressure heads?

