

Remediation of soil and groundwater
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Problem set #0: dry/wet density

Problem 1

1. Volume of void

$$V_{void} = V_T - V_S$$

$$V_T = \frac{\pi d^2 h}{4}$$

$$V_S = \frac{M_S}{\rho_S}$$

$$M_S = M_{S,wet} - M_L = M_{S,wet} - \omega M_S$$

$$\Rightarrow M_S = \frac{M_{S,wet}}{1 + \omega}$$

$$V_S = \frac{M_{S,wet}}{\rho_S(1 + \omega)}$$

$$V_{void} = \frac{\pi d^2 h}{4} - \frac{M_{S,wet}}{\rho_S(1 + \omega)}$$

So the porosity volume is:

$$V_{void} = \frac{\pi * 9^2 * 9 \text{ cm}^3}{4} - \frac{850 \text{ g}}{2.67 \frac{\text{g}}{\text{cm}^3} (1 + 0.02)} = 572.5 \text{ cm}^3 - 312.1 \text{ cm}^3 = 260.4 \text{ cm}^3$$

2. Volume of water initially present in the soil

$$V_L = \frac{M_L}{\rho_w} \text{ and } M_L = M_S * \omega = \frac{M_{S,wet} * \omega}{1 + \omega}$$

$$V_L = \frac{M_{S,wet} * \omega}{\rho_w(1 + \omega)} = 16.7 \text{ cm}^3$$

3. Water to add to reach 90% saturation

$$\frac{V_L}{V_{void}} = 90\%$$

$$\Rightarrow V_L = 234.4 \text{ cm}^3$$

So the water volume to add to the soil is: $234.4 - 16.7 = 217.7 \text{ cm}^3$