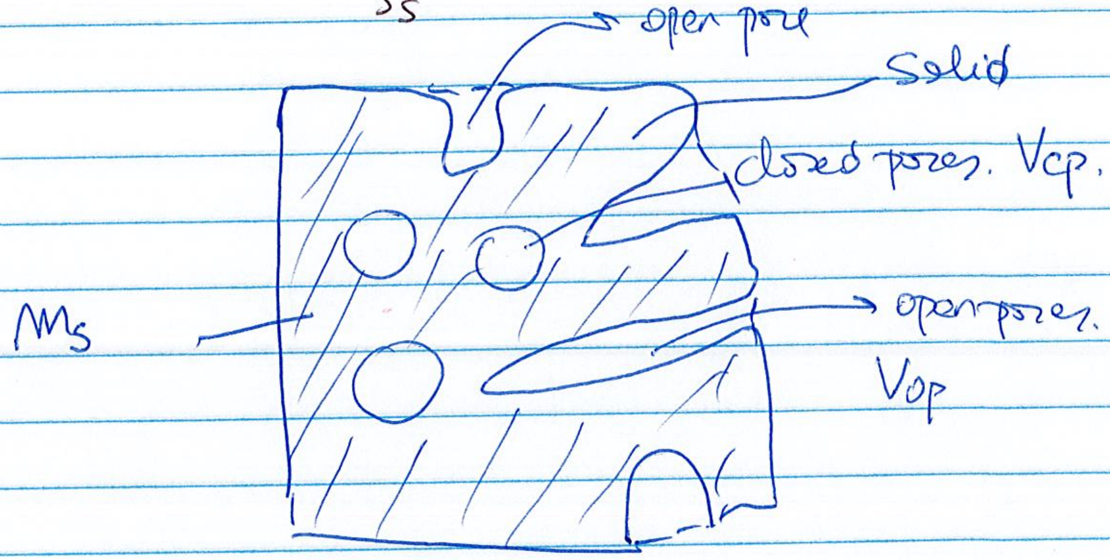
NOTES LECTURES 8-29-17

$$\varepsilon_{app} = 1 - \frac{\rho_{app}}{\rho_s}$$



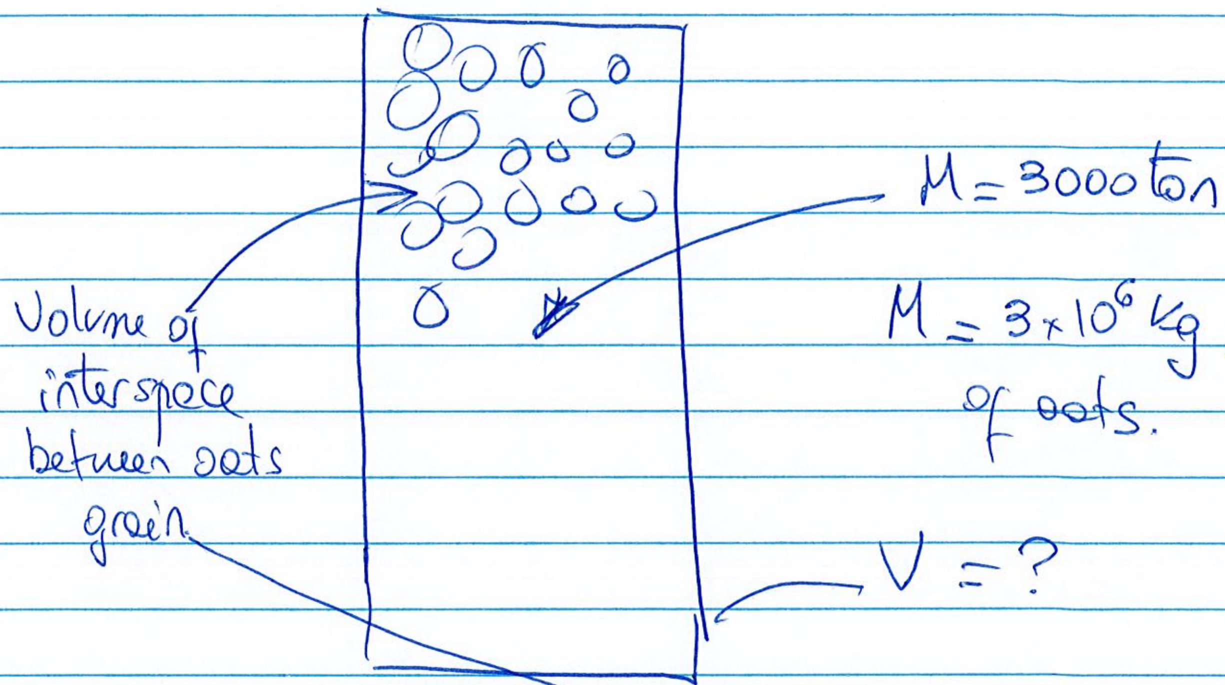
$$\rho_{app} = \frac{M_s}{V_s + V_{cp} + V_{op}} \qquad \rho_s = \frac{M_s}{V_s}$$

Apparent density

$$\varepsilon_{app} = 1 - \frac{\dfrac{\cancel{M_s}}{V_s + V_{cp} + V_{op}}}{\dfrac{\cancel{M_s}}{V_s}} = 1 - \frac{V_s}{V_s + V_{cp} + V_{op}}$$

$$\varepsilon_{app} = \frac{\cancel{V_s} + V_{cp} + V_{op} - \cancel{V_s}}{V_s + V_{cp} + V_{op}} = \frac{\overbrace{V_{cp} + V_{op}}^{\text{closed pores + open pores.}}}{\underbrace{V_s + V_{cp} + V_{op}}_{\text{TOTAL volume}}}$$

EXAMPLE 1



$$\varepsilon_B = 0.4 = \frac{\text{Volume of interspace}}{V_{silo.}}$$

$$\rho_B = \frac{M}{V} = \frac{3\times10^6\ kg}{V_{silo.}}$$

$$V_{silo} = \frac{3\times10^6\ \cancel{kg}}{\rho_B\ [\cancel{kg}/m^3]} = 3234.2\ m^3$$

ρ_B ? but you know $\varepsilon_B = 0.4$

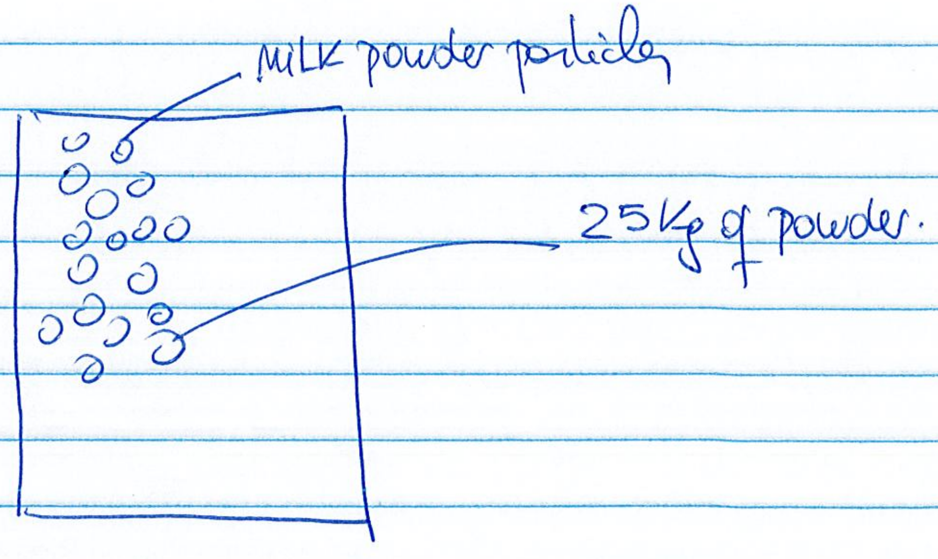
$$\varepsilon_B = 1 - \frac{\rho_B}{\rho_{PART}}$$

$$\rho_B = (1-\varepsilon_B)\,\rho_{PART} = (1-0.4) \times 1546\ \frac{kg}{m^3} =$$

$$\rho_B = 927.6\ \frac{kg}{m^3}$$

$$V_{silo} = \frac{3 \times 10^6\ kg}{927.6\ kg/m^3} = \underline{\underline{3234.2\ m^3}}$$

EXAMPLE 3



(a) Volume of the bag

(b) Amount of N_2

DATA $\rho_S = 1100\ kg/m^3$

$\varepsilon_{gp} = 0.15$ $\varepsilon_{TT} = 0.43$

(a) $\rho_B = \dfrac{M}{V_{bag.}}$ ← 25 kg. (4)

$$\varepsilon_{TP} = 1 - \frac{\rho_B}{\rho_S} \longrightarrow \rho_B = \rho_S \left[1 - \varepsilon_{TP}\right]$$

$$\rho_B = 1100\left[1 - 0.43\right] = 627 \ kg/m^3$$

$$V_{bag} = \frac{25 \ kg}{627 \ kg/m^3} \simeq 0.04 \ m^3 = 40 \ l \cong 10 \ gal.$$

$1 \ m^3 = 1000$

$1 \ gal \simeq 3.7 \ l \approx 4 \ l.$

(b) Volume of N_2 ≡ Volume of open pores + Volume of interparticle space

$$\varepsilon_B = \frac{\text{Volume of open pores + interspace volume}}{V_{bag.}}$$

Volume of N_2 = ε_B x ~~xxx~~ $V_{bag.}$

$$\varepsilon_{cp} = 0.15 = 1 - \frac{\rho_{per}}{\rho_S}$$

1100 kg/m³

$$\rho_{part} = (1 - 0.15) \times 1100 \, \frac{kg}{m^3} = 935 \, kg/m^3$$

$$\varepsilon_B = 1 - \frac{\rho_B}{\rho_{part}} = 1 - \frac{627 \, \cancel{kg/m^3}}{935 \, \cancel{kg/m^3}} = 0.33$$

$$\boxed{\text{Volume}\, N_2 = 0.33 \times 0.04 \, m^3 \cong 3.6 \text{ gallons of } N_2}$$

1 kg of water

WANT TO HEAT UP THAT WATER FROM 20°C TO 80°C

ENTHALPY CHANGE $= Q = M \times \Delta T \times C = 1\,kg \times (80° - 20°C) \times 4.2\,\frac{KJ}{kg\,K}$

$Q = 4.2\,\frac{KJ}{\cancel{K}} \times 60°\cancel{C} = \underline{2520\,KJ}$

Assumptions $C_{WATER} \approx$ Constant

FROZEN FOOD

HEAT CALCULATION ~~TO~~ FROM $-20°C$ to 80°C

CAN WE USE $\cancel{Q =} \Delta H = M \times C \times \Delta T$

BECAUSE PHASE CHANGES AND BECAUSE A BIOMATERIAL/FOOD IS NOT WATER