

12/21/2016 V_T revisited for 1750

For T_v

$$F_g = F_d$$

$$\overset{\text{OBJECT}}{mg} = \frac{1}{2} \rho V^2 A C_d \overset{\text{MEDIUM}}$$

$$\Rightarrow V_T = \left(\frac{2mg}{\rho A C_d} \right)^{1/2}$$



Assume Spherical precipitate

$$m_p = \rho_p V_p = \rho_p \frac{4}{3} \pi r_p^3$$

$$A_p = \pi r_p^2$$

$$\text{Substituting. } V_T = \left(\frac{2 \rho_p \frac{4}{3} \pi r_p^3 g}{\rho_m \pi r_p^2 C_d} \right)^{1/2}$$

$$= \left(\frac{8}{3} \frac{\rho_p g r_p}{\rho_m C_d} \right)^{1/2}$$

12/21/2016 V_T (1750 cont'd)

$$V_T = \left(\frac{8}{3} \frac{\rho_p g}{\rho_m} \frac{r_p}{c_d} \right)^{1/2}$$

$$\rho_p = 271 \text{ g/cm}^3 = 2710 \text{ kg/m}^3 \text{ CaCO}_3$$

$$\rho_m = 1000 \text{ kg/m}^3 \text{ H}_2\text{O} (4^\circ\text{C})$$

$$r_p = 10 \mu\text{m} = 10 \text{ mm} \times \frac{1 \text{ cm}}{10 \text{ mm}} \times \frac{1 \text{ m}}{100 \text{ cm}} \\ = 1 \times 10^{-2} \text{ m}$$

$$C_d = 0.47 \text{ (sphere)}$$

$$V_T = \left(\frac{8}{3} \right) \left(\frac{2710 \cancel{\text{ kg/m}^3}}{1000 \cancel{\text{ kg/m}^3}} \right) \left(9.81 \frac{\text{m}}{\text{s}^2} \right) \left(\frac{10^{-2} \text{ m}}{0.47} \right) \right)^{1/2}$$

$$= \left\{ \frac{\left(\frac{8}{3} \right) (271) (9.81) (10^{-2})}{0.47} \frac{\text{m}^2}{\text{s}^2} \right\}^{1/2}$$

$$\approx 0.84 \frac{\text{m}}{\text{s}}$$

$$V_T \approx \sqrt{151} \text{ m/s}$$

12/21/2016

$V_T (1350)$

$$F_g = F_d$$

$$mg = \frac{1}{2} \rho v^2 A C_d$$

DIMENSIONLESS!

$$\textcircled{M} \cancel{L} / \textcircled{T^2} = \frac{\textcircled{M}}{\cancel{L^3}} \frac{\cancel{L^2}}{\textcircled{T^2}} \cancel{L^2}$$

DIMENSIONS OK ✓
