## M E 433

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Lecture 25

## Today, we will:

- Continue to discuss applications of gravitational settling (in rooms and in ducts)
- Discuss difference between laminar settling and well-mixed settling

### **Review of equations for terminal settling velocity:**

$$V_{t} = \sqrt{\frac{4}{3} \frac{\rho_{p} - \rho}{\rho} g D_{p} \frac{C}{C_{D}}}, \quad C_{D} = \frac{24}{\text{Re}} \text{ for } \text{Re} < 0.1, \quad C_{D} = \frac{24}{\text{Re}} (1 + 0.0916 \text{Re}) \text{ for } 0.1 < \text{Re} < 5,$$
$$Re = \frac{\rho V_{t} D_{p}}{\mu}. \text{ If Stokes flow (Re < 0.1), } \quad V_{t} = \frac{\rho_{p} - \rho}{18} D_{p}^{-2} g \frac{C}{\mu}.$$

#### Example: Removal Efficiency due to Laminar Gravimetric Settling in a Duct

**Given**: Dusty air enters a horizontal duct of length L = 14.4 m and height H = 6.0 cm at average speed U = 0.20 m/s. Aerosol particles of a certain diameter  $D_p$  under consideration have a terminal settling speed of  $V_t = 0.00025$  m/s.

**To do**: Calculate the removal efficiency E for these particles. Assume laminar settling, and assume that all particles that hit the floor of the duct remain there (they stick to the floor). Give your answer as a percentage to two significant digits.

#### **Solution**:

#### **Practical Application – Horizontal Elutriator**

# A **horizontal elutriator** is a simple device that is sometimes used at the inlet to an APCS to remove some of

the larger diameter particles from the air. It is often used in coal mines, for example. It



consists of parallel horizontal plates, as sketched. Dirty air enters from the left at low air speed. As the air moves along, particles fall and settle on the plates. We assume that when the particles hit the plate, they stick there and remain on the plate – they are removed from the air. After some time, the device may get clogged, so it needs to be washed out. However, there are no moving parts, it does not require electricity, and it is simple and effective at removing particles from the air. Heavier and/or larger particles settle quickly, while lighter and/or smaller particles take longer to settle. Therefore we expect the removal efficiency of the device to depend on particle diameter and particle density.