

Today, we will:

- Do some examples with the standard **Lapple reverse flow cyclone**
- Discuss how performance of a cyclone varies with size, flow rate, etc.

Example: Lapple Cyclone

Given: A standard reverse flow Lapple cyclone is used to clean up a dusty air flow exhausted by a sanding machine in a wood shop. The main body diameter of the cyclone is $D_2 = 45.0 \text{ cm}$ (0.450 m).

- particle density $\rho_p = 730 \text{ kg/m}^3$
- bulk volume flow rate of air $Q = 0.55 \text{ m}^3/\text{s}$
- Air is at STP: $\rho = 1.184 \text{ kg/m}^3$, $\mu = 1.849 \times 10^{-5} \text{ kg/(m s)}$.

To do: Calculate the grade efficiency $E(D_p)$ for 10- μm particles. Give your answer as a percentage to 3 significant digits.

Solution: Some equations:

$$D_{p,\text{cut}} = \sqrt{\frac{3\mu D_2^3}{128\pi Q(\rho_p - \rho)}}, \quad E(D_p) = \frac{1}{1 + \left(\frac{D_p}{D_{p,\text{cut}}}\right)^{-2}}.$$

Example: Design of a Lapple Cyclone

Given: Dusty air from a manufacturing plant needs to be cleaned before being exhausted to the environment. Here is what we know about the dusty air:

- the air is polydisperse, with a wide variety of particle sizes
- particle density $\rho_p = 1500 \text{ kg/m}^3$
- bulk volume flow rate of air $Q = 0.111 \text{ m}^3/\text{s}$
- the air is at STP: $\rho = 1.184 \text{ kg/m}^3$, $\mu = 1.849 \times 10^{-5} \text{ kg/(m s)}$

To do: Design a standard reverse flow Lapple cyclone to clean the air such that the removal efficiency of 2.5- μm particles is 80%. In particular, calculate dimension D_2 , the diameter of the Lapple cyclone canister. Give your answer in meters to 3 significant digits.

Solution: Some equations:

$$D_{p,\text{cut}} = \sqrt{\frac{3\mu D_2^3}{128\pi Q(\rho_p - \rho)}}, \quad E(D_p) = \frac{1}{1 + \left(\frac{D_p}{D_{p,\text{cut}}}\right)^{-2}}.$$

