M E 433

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Today, we will:

- Do more examples of air cleaners in series and parallel; particle histograms
- Discuss cascade impactors
- News article presentation by Hannah Seeger

Example: Histograms of particle number fraction through air cleaners in series Given: Two particle cleaners in series as sketched below, with different values of $D_{p,cut}$.

To do: Sketch the particle number fraction histograms at each of the three locations. **Solution**:



Example: Air Cleaners in Series or Parallel

Given: Two identical air cleaners are available to clean a polluted air stream. We want to know which is better – to connect them in series or in parallel. At a particular D_p ,



To do: Compare the overall removal efficiency in series and for the *best case* in parallel. What is the *best* overall removal efficiency you can get from these two cleaners? Give your answer as a percentage to 3 significant digits. Equations: Series: Parallel:

$$E(D_{p})_{overall} = 1 - \prod_{j=1}^{m} \left[1 - E(D_{p})_{j} \right] \qquad E(D_{p})_{overall} = 1 - \sum_{j=1}^{m} f_{j} \left[1 - E(D_{p})_{j} \right], \quad f_{j} = \frac{Q_{j}}{Q_{total}}$$
Solution:
$$\int \underbrace{\operatorname{Solution}}_{i} = 1 - (1 - E_{A})(1 - E_{B}) = 0.985 \qquad 985 \qquad$$



Figure 9.7 of Heinsohn & Cimbala. Cascade impactor: (a) schematic diagram, showing trajectories of particles of three different diameters (adapted from Willeke and Baron, 1993); (b) Andersen eight-stage, non-viable, 1 ACFM ambient air sampler (from Andersen Instruments Inc.).



Figure 9.8 of Heinsohn & Cimbala. Particle collection efficiency for each stage of an Andersen eight-stage, 1 ACFM ambient air sampler with preimpactor (redrawn from Andersen Instruments, Inc.).



Bottom line -> Large Dp particles set collected on upper trays, Small Dp on lower trays.