

Particulate Matter and Filtration

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Filtration

- A filter is not (just) a screen or a sieve!
- Particulate removal by four mechanisms
 1. Sieving / Straining
 2. Impingement / Inertial impaction
 - Particles > 0.5 μm; a function of velocity, fiber size
 3. Interception
 - Particles > 0.5 μm; relatively insensitive to velocity
 4. Diffusion
 - Particles < 0.2 μm; sensitive to velocity

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Figure 1: Straining (Sieving) Figure 2: Impingement (Inertial)

Figure 3: Interception Figure 4: Diffusion

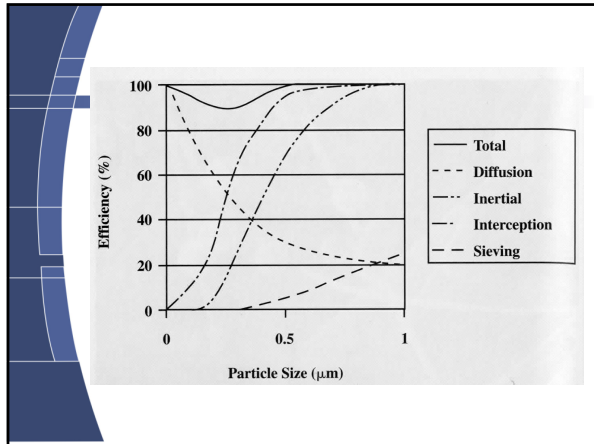
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Filtration (cont')

4. Diffusion (cont')
 - Kinetic theory of gases → Brownian motion
 - At room temperature, average speed of gas molecules is ~500 m/s (100,000 ft/min; 1120 mph)
 - But there are ~ 10¹² collisions per second
 - Net result: movement of about 1 cm per second
- Also electrostatic forces
- Viscous impingement coatings
 - Reduce particle bounce, subsequent release

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Rating air filters

- Arrestance
 - Mass of standard test dust removed
- Atmospheric dust spot efficiency
- Minimum efficiency reporting value
- HEPA
 - High-efficiency particulate air
- ULPA
 - Ultra-low-penetration air



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