The Effect of Air Pollutant & Control Device Characteristics on Emission Rates

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Effects on Controlled Emissions

- Pollutant Characteristics
- Type of Control Device
- Design of Control Device
Most Pollutants are Heterogeneous

- CO is a gas and consists of one compound
- $\text{NO}_x$ is both NO & NO$_2$
- Hg may be Metallic, an Oxide, Combined with Chlorine or in an Organic Compound

- Solids may vary in many ways and also contain additional pollutants
Variations in Particulate

• Mean Particle Size
• Size Distribution
• Particle Shapes
• Density

These determine Aerodynamic Diameter
Additional Particulate Properties

- Adhesion
- Cohesion
- Surface Electrical Conductivity

These also determine Control Device Collection and Operability
Inside Cyclone Collector

- Gas turns in Cyclone
- Inertia causes dust movement away from gas flow towards the wall

- Separation increases with Particle Size
Dust Cyclone

- Used for Larger Particulate
- Some units capture PM$_{10}$

- Note opportunity to release (re-entrain) Particulate from Walls
Electrostatic Precipitator (ESP)

- Discharge Wires are Midway between Collection Plates
- Ridges in Plates Protect Dust Collected on Plates from Re-entrainment into Gas Flow Stream
Fabric Filter

- Pulsejet Type
- “online cleaning”
- Existing Dust Cake on bags filters dust in gas

- Emissions depend on type of Bag Media and condition of Filter Bags
Bag Cleaning Motion

- Filtration example shows Bag collecting Dust
- Cleaning example shows Bag inflated by Compressed Air Pulse
- Aggressive Pulsing will damage Bag
Felt Filter Media

- Filament Structure is Random, producing Media without large Holes

- Synthetic fiber produces long, round filaments
Expanded PTFE Membrane

- Notice fine structure of Surface Membrane
- Membrane acts as a Filter, both, just after Bag Cleaning and from Sieving during normal Operation
- Very effective Dust Removal
Sample Filter Bags

- Types shown presently used in Small Collectors

- Modern Cartridge Filters are not shown
Typical Control Efficiencies

- General graphs based on different Coal Fired Electric Utility Units
- Inlet Dust Loadings are similar, providing a basis to describe efficiency for Fabric Filters

FIGURE 2. Typical Fractional Efficiencies For Existing Collectors (From Electric Power Research Institute Economics of Fabric Filters vs. Precipitators, Denver, CO June 1978)
Particulate Emission Trends

- Graph is for MSW Incineration
- Initially all controls shown were ESP
- Most Fabric Filters shown follow an SDA
- Only Filterable Dust is shown