Air Quality Module: Control of Air Pollutants at the Source

I. Introduction:

- Focus on controlling air pollutants at the source.

- Emphasis on the importance of source control in air quality management.

II. Particulate Matter Control Methods:

- Two broad methods for particulate matter removal: Mechanical and Electrical.

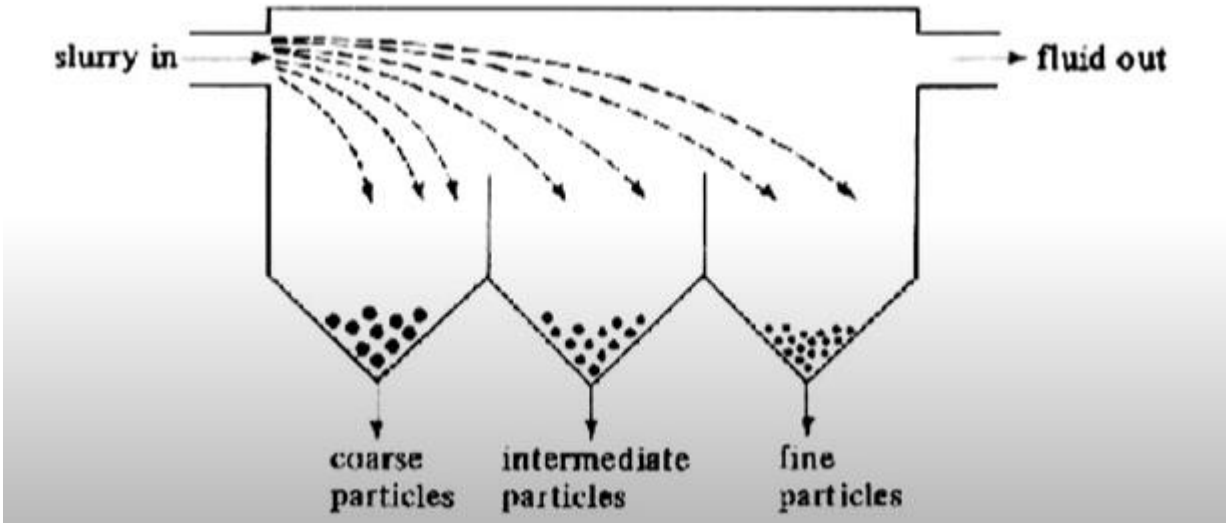
III. Mechanical Methods:

A. Gravity-Based Methods:

- Settling Chambers: Flue gas or slurry passed through a chamber; particles settle by gravity based on mass and size.

- Limitation: Effective for larger particles; smaller particles may not settle due to inadequate settling velocity.

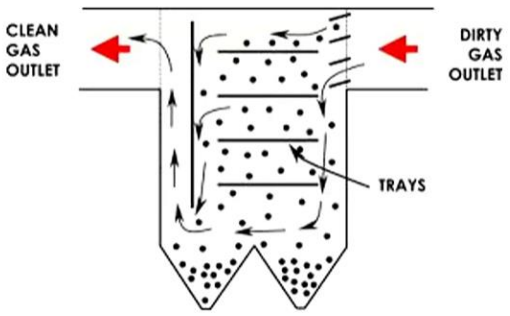
- Complementary methods: Back filters used in subsequent steps to remove smaller particles.



B. Plate-Based Method:

- Introduction of plates to expedite particle deposition.

- Gas travels a short distance, particles deposit on plates, which can be removed and cleaned.



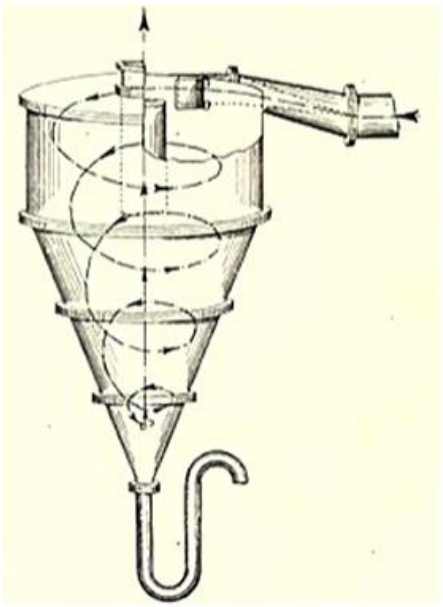
C. Inertial Method (Cyclonic):

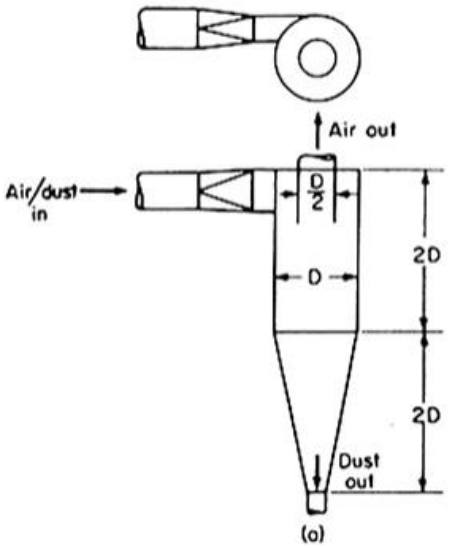
- Introduction of a cyclonic, centrifugal force.

- Gas with particles introduced tangentially; larger particles thrown out by centrifugal force as the gas follows a helical path.

- Efficiency: Effective for particles >20 micrometers; efficiency decreases for smaller particles.

- Design consideration: Cyclones used as a preliminary step before finer particle removal.





LEC 12

Detailed Lecture Notes: Control of Particulate Matter and Filtration Methods

II. Mechanical Filtration:

A. Inertia Filtration:

- Filtration as a process for small particles.
- Small particles can't be effectively removed by gravity or inertia alone.
- Filtration involves navigating through a complex network of fibers, not a clear hole.

B. Filtration Materials:

- Fibrous material in filters resembles an intricate jungle of fibers.
- Examples from everyday life: face masks during the COVID pandemic.
- Importance in industries using masks with cartridges based on the pollutant type (e.g., ammonia).

D. Industrial Applications:

- Filtration used in various industrial settings, from face masks to car engines.
- Different types of filters for engine and cabin air intake in cars.

E. Filtration Configurations:

- Filters can be in the form of bags or large containers.
- Bags can be configured for the dirty air to pass through the fabric, or vice versa.
- Detailed configurations impact efficiency, with considerations for inlet and outlet.

F. Filtration Mechanisms:

- Filtration involves three main mechanisms: Diffusion, Impaction, and Interception.
  - **Diffusion:** Particles move through the filter material due to random motion and stick to fibers.
  - **Impaction:** Particles with sufficient inertia hit and adhere to fibers.
  - **Interception:** Particles are intercepted by fibers due to proximity.

- Combination of diffusion, impaction, and interception ensures effective filtration.

G. Electrostatic Precipitators:

- Principle similar to a scanning mobility particle seizer.
- Particles in gas are charged and diverted by an electric field, collecting on plates.
- Large-scale applications in power plants and cement plants to remove ash and fly ash.

LEC 13

**Lecture Notes: Controlling Gaseous Pollutants at the Source

II. Absorption:

- Removal of gaseous pollutants by making them soluble in a liquid.
- Typically involves bringing the gas in contact with water or a solvent.
- Use of tall towers packed with materials to maximize the interface between gas and liquid for effective mass transfer.

A. Tower Packings:

- Varied packings inside absorption towers for increased surface area.
- Integral part of chemical engineering processes, often integrated into larger systems.

III. Adsorption:

- Associated with materials like silica gel or granular activated carbon.
- Granular activated carbon used for water purification and gas stream cleaning.
- Effectively removes organics from gas streams, especially hydrophobic ones.
- Versatility: Can be used as a packed bed or incorporated into face masks.

IV. Incineration:

- Burning gaseous pollutants for disposal, converting them into carbon dioxide and water.

- Proper incineration requires sufficient air or oxygen to prevent black smoke emission.

A. Flaring Incinerators:

- Multiple ports for different processing units.
- Ensures the clean burning of organics, minimizing environmental impact.
- Examples include industrial flares and oil rig incinerators.