3.5 FABRIC FILTERS

- Flue gas is allowed to pass through a woven fabric, which filters out particulate matter.
- Small particles are retained on the fabric.
- Consists of numerous vertical bags 120-400 mm dia and 2-10 m long.
- Remove particles up to 1 μm.
- Its efficiency up to 99%.

Working Principle/Operational Considerations:

Most baghouses use long, cylindrical bags (or tubes) made of woven or felted fabric as a filter medium. For applications where there is relatively low dust loading and gas temperatures are 250 °F (121 °C) or less, pleated, nonwoven cartridges are sometimes used as filtering media instead of bags.

- Dust-laden gas or air enters the baghouse through hoppers and is directed into the baghouse compartment.
- The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and a layer of dust accumulates on the filter media surface until air can no longer move through it.
- When a sufficient pressure drop (ΔP) occurs, the cleaning process begins.
  - Cleaning can take place while the baghouse is online (filtering) or is offline (in isolation).
  - When the compartment is clean, normal filtering resumes.
- Baghouses are very efficient particulate collectors because of the dust cake formed on the surface of the bags.
- The fabric provides a surface on which dust collects through the following four mechanisms:

1. Inertial collection

Dust particles strike the fibers placed perpendicular to the gas-flow direction instead of changing direction with the gas stream.

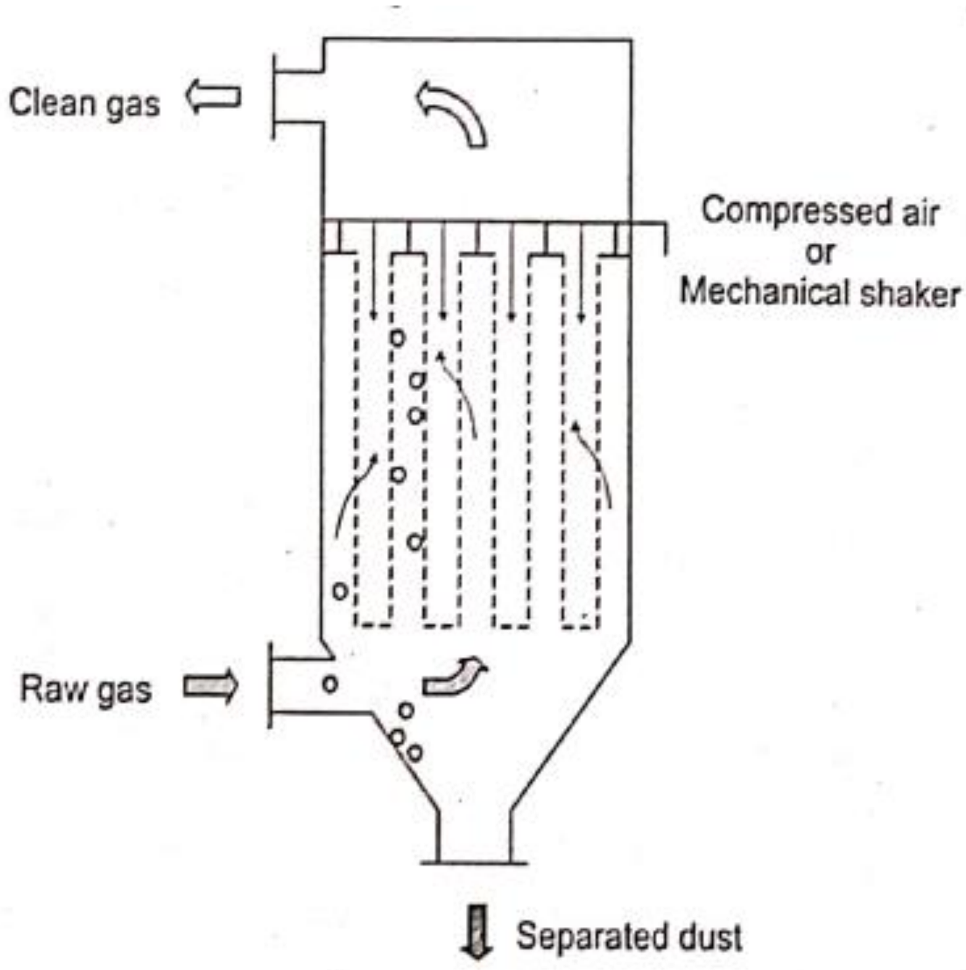

Figure 3.5.1 Fabric Filter

[Source:https://emis.vito.be/sites/emis/files/data_sheets/migrated/fabric_filter_luss_2.PNG]

2. Interception

Particles that do not cross the fluid streamline come in contact with fibers because of the fiber size.

3.Brownian movement

Submicrometre particles are diffused, increasing the probability of contact between the particles and collecting surfaces.

4.Electrostatic forces

The presence of an electrostatic charge on the particles and the filter can increase dust capture.

A combination of these mechanisms results in formation of the dust cake on the filter, which eventually increases the resistance to gas flow. The filter must be cleaned periodically.

- Filter bags usually tubular or envelope –shaped are capable of removing most particles as small as 0.5mm and will remove substantial quantities of particles as small as 0.1mm.
- Filter bags ranging from 1.8 to9m long ,can be utilized in a bag house filter arrangement shown in figure 3.5.2

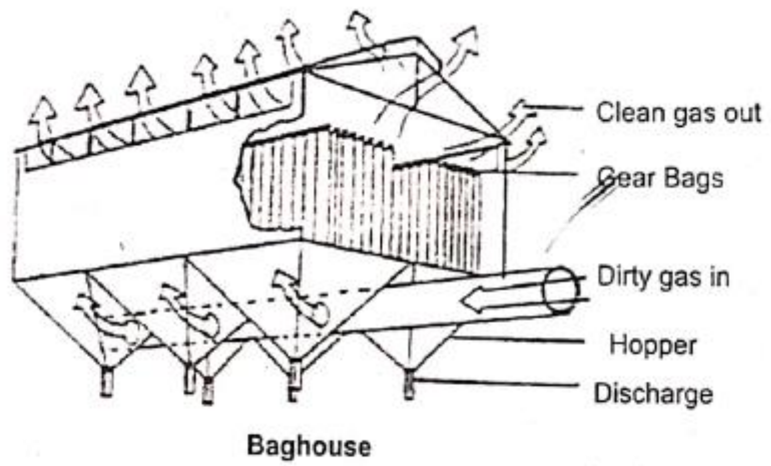

Figure 3.5.2 Baghouse

[Source:https://ars.els-cdn.com/content/image/3-s2.0-B9780750672948500208-f20-07-9780750672948.gif]

- As particulates build up on the inside surface of the bags, the pressure drop increases.
- Before the pressure drop becomes too severe, the bag must be relieved of some of particulate layer .Fabric filter can be cleaned intermittently, periodically, or continuously.

Design and performance equations:

- Pressure drop, filter drag, air-to-cloth ratio, and collection efficiency are essential factors in the design of a baghouse.
- Pressure drop is the resistance to air flow across the baghouse. A high pressure drop corresponds with a higher resistance to airflow.

- Pressure drop is calculated by determining the difference in total pressure at two points, typically the inlet and outlet.
- Filter drag is the resistance across the fabric-dust layer.
- The air-to-cloth ratio (ft/min or cm/s) is defined as the amount of gas entering the baghouse divided by the surface area of the filter cloth.
- Commonly baghouses are designed with 99.9% collection efficiency. Often cleaned air is recirculated back into the plant for heating.

Advantages

- Higher collection efficiency for smaller than 10 μm particle size
- Performance decrease becomes visible, giving pre warning.
- Normal power consumption.

Disadvantages

- High temperature gases need to be cooled.
- High maintenance and fabric replacement cost.
- Large size equipment.
- Fabric is liable to chemical attack