

### 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  $\mu\text{m}$ .
- Its efficiency up to 99%.

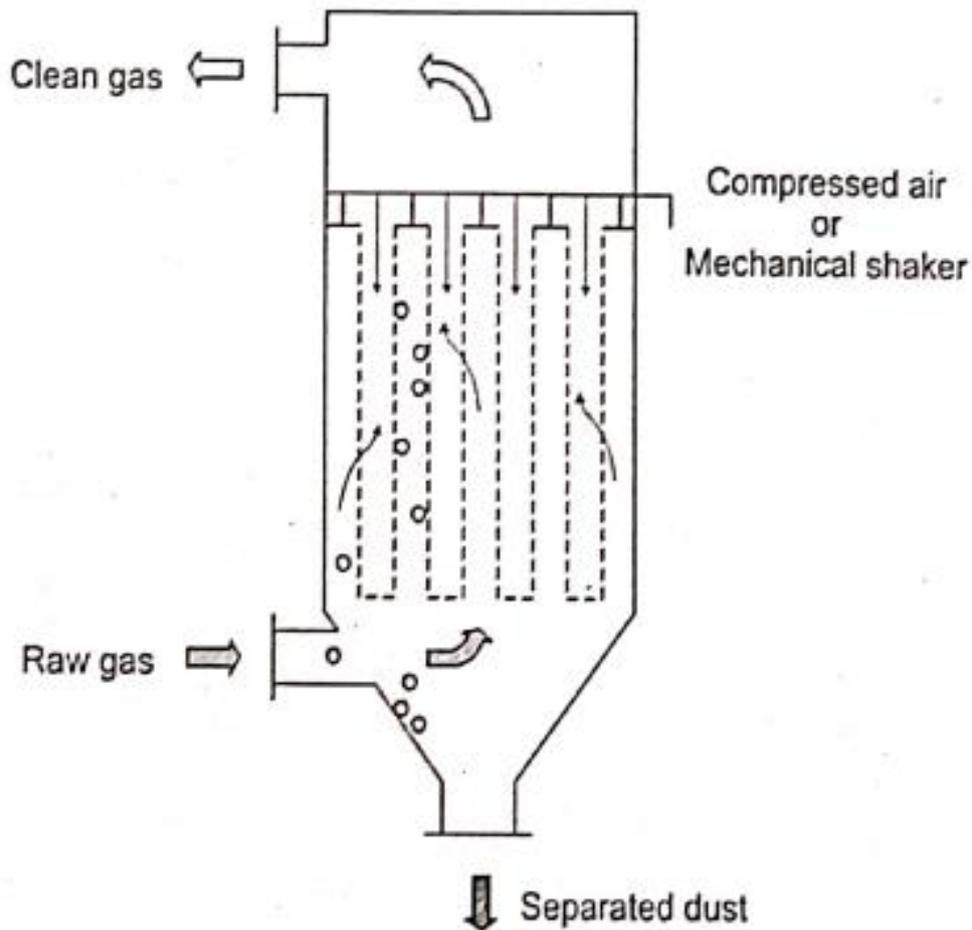
#### Working Principle/Operational Considerations:

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 ( $\Delta P$ ) 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](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

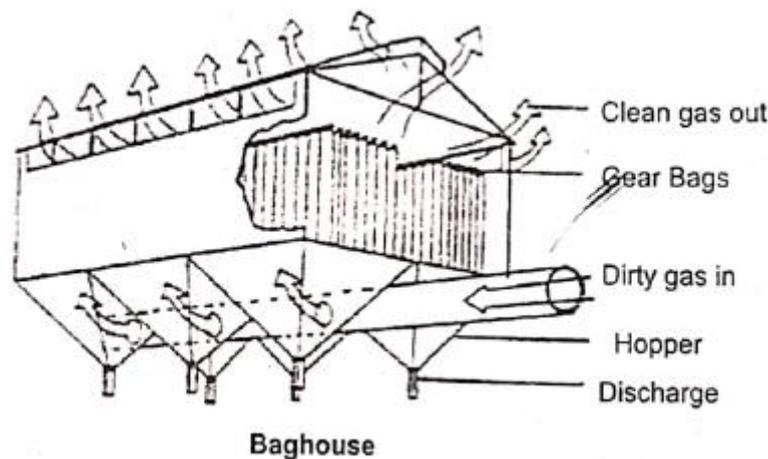
Submicrometre particles are diffused, increasing the probability of contact between the particles and collecting surfaces.

## 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 to 9m 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  $\mu\text{m}$  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