Baghouse Filtration for Dust Collection and Air Pollution Control

An Online Continuing Education Course for Engineers

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Baghouse Filtration for Dust Collection and Air Pollution Control

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Introduction

Industrial dust collection systems can be broadly classified as - fabric filters, inertial separators, and electrostatic precipitators.

- **The fabric filters** capture dust particles and various other particles by impaction, direct interception, and diffusion when the contaminated gas stream passes through fabric material. Such filters are usually made from cotton, wool, synthetics or glass fiber. These include systems like baghouses and cartridge collectors.

- **Inertial separators** are dust collectors that do not rely on filters but instead rely primarily on gravity and inertia. They use inertia to separate dust from gas streams and gravity to drop it into a storage hopper. They are most effective at removing the coarser dust particles from contaminated air. Examples of prominent inertial separators include cyclone dust collectors, multi-cyclone dust collectors, settling chambers, and baffle chambers.

- **Electrostatic precipitators** work using ionization principle. They give particles a negative charge and then attract them out of the air stream utilizing a positively charged electrode. To remove disposed of dust particles, electrostatic precipitators either continuously rap against them or continuously vibrate until they fall into a bin. The combustible nature of many fine materials rules out the use of electrostatic precipitators.

Other miscellaneous dust collecting systems include wet dust collectors, small dust collectors, portable dust collectors, downdraft tables and shop vacuums.

Types of Dust Collection Systems

- **Baghouse Filters**
  - Baghouses remove dust and other particulates by passing the gas stream through filter bags made up of a long hollow cylindrical tube. The dust is collected on its exposed surface. The baghouse contains a large number of such filter bags arranged in parallel rows. Bags are intermittently or continually cleaned using shaking, reverse airflow, or pulses of air. These are extremely efficient and effective, with a collection rate of over 99% for fine particles.
- **Cartridge Dust Collectors**
  - Cartridge dust collectors are a small and compact type of dust collector. These can pack a lot of surface area into a small space and can filter very small (sub-micron) particulate very efficiently. The filter media is usually a felted material composed of cellulose, polypropylene, or other flex-resistant material. For some industries, this is essential, particularly for industries such as metalworking that generate small particulates, smoke, and fumes.
- **Cyclone Dust Collectors**
  - Cyclone dust collectors or simply cyclones work on the principle of inertia to remove particulate matter from a gas stream. In these high-velocity specks of dust carrying gas is made to pass through a conical shaped chamber in a tangential direction. This results in centrifugal action. The particles, being heavier than air molecules, are thrown against the outer wall of the chamber and fall to the bottom, where they are collected. The cleaner air leaves the cyclone through the top of the chamber, flowing upward in a spiral vortex, formed within a downward moving spiral. Cyclones are efficient in removing large particles but are not as efficient

with smaller particles. For this reason, they are used with other particulate control devices.

- **Multicyclone Dust Collectors**
  - Multi-cyclone dust collectors have a single main inlet on one side and a single outlet on the other side but incorporate many cyclone cylinders inside the chamber that run concurrently. In contrast, single-cyclone dust collectors have only one cyclone.
- **Settling Chambers**
  - Settling chambers reduce the speed of an air stream, which allows the heavier particles to settle out more quickly. They are common elements of pre-cleaning procedures. This includes the pre-cleaning of air streams before they enter dust collectors, such as baghouses that remove extra fine dust particles.
- **Baffle Chambers**
  - Baffle chambers set up a barrier that forces the air to change directions suddenly so that the inertia of the heavier particles does not allow them to remain suspended in the air stream and they fall to the bottom of the chamber.
- **Wet Scrubbers**
  - Wet scrubbers are special downdraft tables and unit dust collectors that use liquids (usually water) to intercept dust particles from the stream of gas. Wet scrubber technology is also employed in some air pollution control equipment, where it performs similar functions on molecular levels by removing soot, smog, and fine chemical pollution from the air of industrial facilities.
- **Portable Dust Collectors**

- Portable dust collectors provide localized dust collection and can easily move from place to place. They generally use either fabric filters or cyclonic motion to collect particles. Portable dust collectors are small, inexpensive, and perfect for small spaces.

- **Downdraft Tables**

  - Downdraft tables are work tables that feature built-in dust collection equipment. This equipment is designed to filter the metal and wood dust from processes performed over these tables, such as welding and wood sawing.

- **Shop Vacuums**

  - Shop vacuums are commercial vacuum cleaners that pull in wet or dry air using centrifugal fans. Inside, they collect and hold onto contaminants, dust, and fumes cyclonically or with a fabric bag filter. Shop vacs are usually canister-shaped.

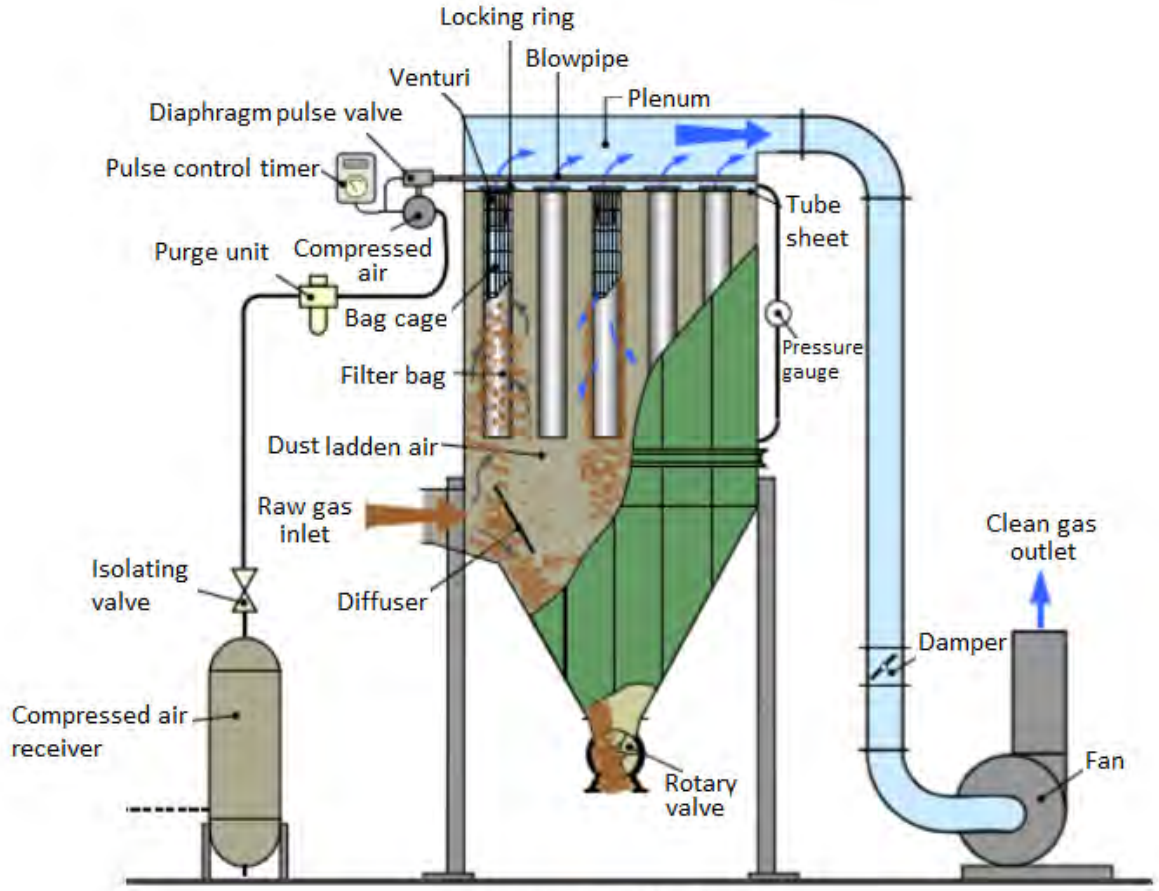
Baghouse dust collectors compared to other types of air pollution control (APC) equipment are incredibly versatile and can be engineered for almost any dust producing application by varying size and bag types. They are very efficient when properly maintained and are also rugged enough to handle rough applications. In this course, we will focus on **Fabric Type Baghouse Filter**.

Chapter - 1

Overview Of Baghouse Filters

A Baghouse removes dust and other particulates in airstream by forcing it through the rows of filter bags arranged in parallel. They work by taking the inlet dust-laden air and initially reducing the velocity to drop out larger particles, then filtering the remainder of the particles by passing the air through a fabric bag. Separation occurs by the particles colliding and attaching to the filter fabric and subsequently creating a layer of dust cake on the filter surface. This coating is responsible for efficient filtering of small particles.

The figure below shows a pulse jet bag filter, which is the most rudimentary form of the baghouse.



Components of Bag Filter

Extended operation of a baghouse requires that the dust is periodically cleaned off the filter surface in a predetermined cycle by methods such as mechanical shaking, reverse air pressure or compressed air pulse jet. The dust finally falls by gravity into the collection hopper located below the bag section and is discharged via an air lock valve, which maintains an air seal. The clean air moves upward from the center of the bags to the outlet plenum and is discharged into the environment using an inducer fan.

Baghouses differ not by the method by which dust is removed from the airstream but rather by the method by which dust is removed from the bag. According to needs and usage, dust-collector components vary in size, capacity, material, and location - but all of them function by the same basic principles and use similar basic components, such as:

- Collection hoods to catch dust at its source.
- Ductwork to transport the dust to a collection point.
- Woven or non-woven filter bags to rem m the air.
- Fans and

The entire unit is

SELECTION CON

A baghouse is size to allow the dust-laden air to pass through excessive pressure drop. The required a ed by the baghouse's optimal filtration velc is ratio — the airflow rate versus the filter m velocity through the filter media. The a on many factors, such as the dust con ase characteristics, the dust cake's poros surface finish, and the cleaning system type and cleaning interval.