Operation Of Fabric Filters

Introduction

Fabric filtration is one of the most common techniques used to collect particulate matter. Fabric filtration systems (often called baghouses) consist of the following basic components:

- Filter medium (filtering fabric) and supports (cages).
- Filter cleaning device.
- Collection hopper.
- Shell.

The filters (with their supports) are referred to as bags (hence the term "baghouse"). These cylindrical bags hang vertically in the fabric filter shell (Figure 4-1). The number of bags in each shell varies from a few hundred to a thousand or more.

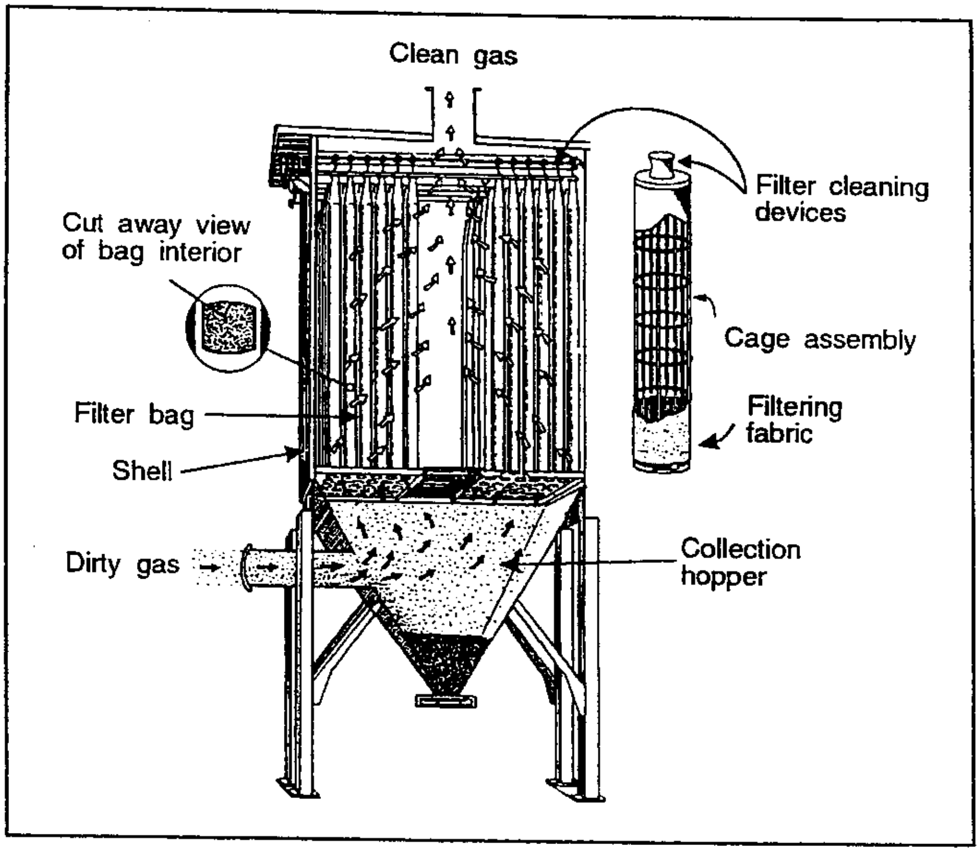

Figure 4-1. Baghouse

How Do Fabric Filters Operate?

In positive pressure baghouses, the gas is pushed through the filters.

In negative pressure baghouses, the gas is pulled through the filters.

Dirty gas is either pushed or pulled through the fabric filter by a fan. When the dust-laden gas is pushed through the fabric filter (i.e., when the fan precedes the fabric filter), the collector is called a **positive pressure baghouse** (Figure 4-2). When the fan is placed after the baghouse, the dust-laden gas is pulled through the fabric filter and the unit is referred to as a **negative pressure baghouse** (Figure 4-2). As the dirty gas passes through the filter, the dust entrained in the gas stream collects in a dust cake on the inside (Figure 4-3) or on the outside (Figure 4-4) of the bags. When the bags are cleaned, the collected particles fall into a hopper and are removed.

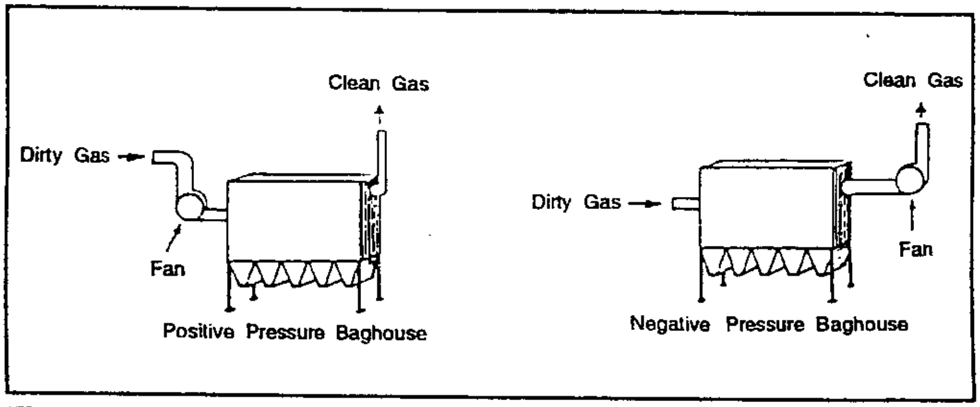

Figure 4-2. Positive Pressure And Negative Pressure Baghouses

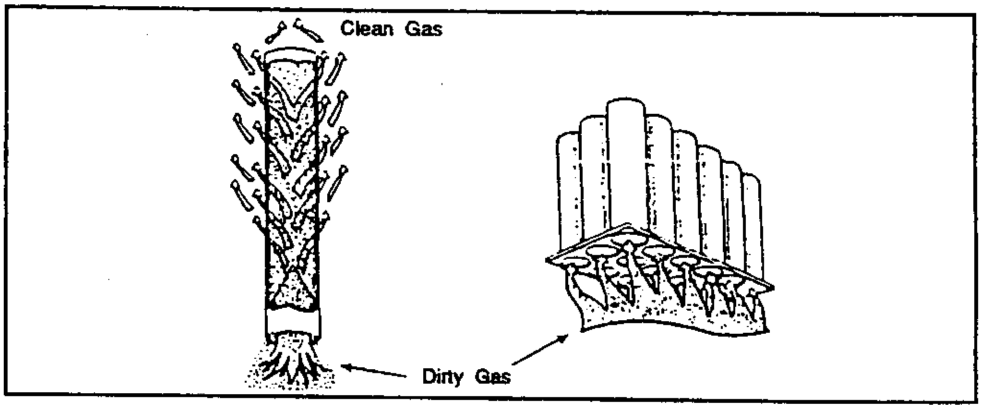

Figure 4-3. Interior Filtration

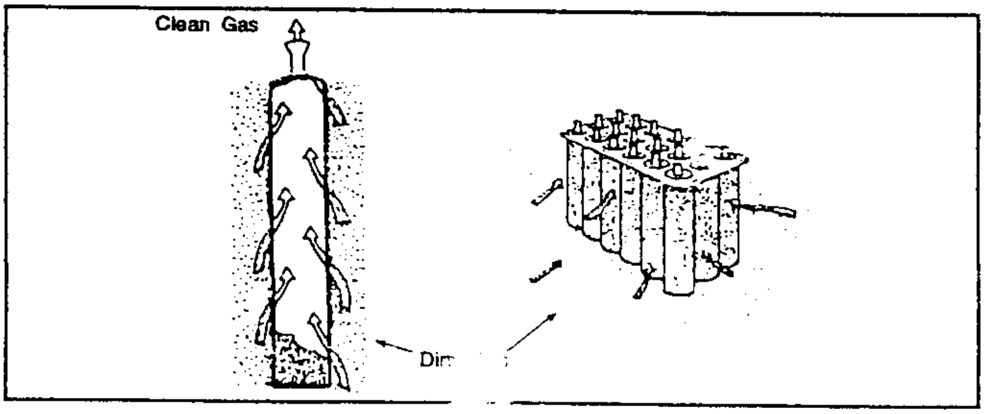

Figure 4-4. Exterior Filtration

One of the major design parameters of fabric filters is the air-to-cloth ratio. This ratio can vary depending on cloth type, particle size distribution of the material being collected, particulate matter characteristics, humidity, and bag spacing. As the air-to-cloth ratio increases, seepage through the filter medium, gas velocities at the baghouse inlet, and velocities around the bags also increase. Higher air-to-cloth ratios also tend to increase the potential for fabric holes.

How Are Fabric Filters Categorized?

Fabric filters typically are categorized by the type of mechanism used to clean the filter medium. The three most common bag-cleaning mechanisms are **pulse jet**, **reverse air**, and **shaker**.

Bag-cleaning mechanisms:
- *Pulse jet*
- *Reverse air*
- *Shaker*

Pulse Jet Fabric Filters

A pulse jet filter uses compressed air of 50 to 120 pounds per square inch gauge (psig) for routine fabric cleaning. The filter bags are supported on interior cages and are hung from a tube sheet near the top of the baghouse. Dust-laden gas is passed from the outside to the inside of the bag, depositing dust on the outside surface of the bag. Bags for pulse jet fabric filters are typically made of felted materials, which are formed from randomly placed fibers compressed into a mat and attached to a loosely woven backing material.

The gas to be filtered can enter the collector at any point beneath the tube sheet. In units with gas inlets near the tube sheet, the gas stream moves downward around the outside of the bags. The units are called **down flow** pulse jets and are claimed to have more effective cleaning action than other types of filter units, because the dust released from a bag during cleaning has a tendency to move downward with the gas flow. An equally popular design has the gas inlet located in the hopper area. The gas stream moves upward around the outside of the bags; this is called an **upward flow** design. With both configurations, a common practice is to install a deflection plate on the gas inlet to minimize bag abrasions.

In down flow units, the gas stream moves downward around the outside of the bags.

In upward flow units, the gas stream moves upward around the outside of the bags.

How Are Pulse Jet Filters Cleaned?

A pulse of compressed air periodically enters the bag, causing the bag to flex and the dust cake to crumble and fall into the hopper (Figure 4-5). The pulse jet baghouse shown below (Figure 4-6) is termed a **top access** pulse jet unit because plant personnel can enter the clean air plenum at the top to change bags. With this design, the bag and cage assemblies are mounted to permit easy removal of the bags from the top. Other pulse jet collectors, termed bottom access or **dirty-side access** units, have a hatch located below the tube sheet to permit entry to the unit. With bottom access designs, the bag and cage assemblies are attached to nipples extending downward from the bottom of the tube sheet.

Pulse jet baghouses use pulses of compressed air to flex the bags and loosen the collected dust.

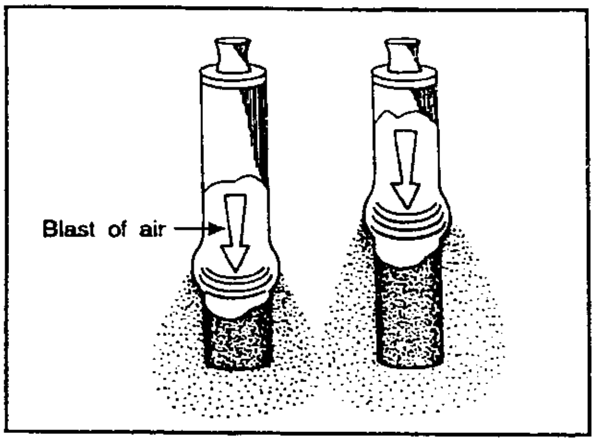

Figure 4-5. Pulse Jet Bag-Cleaning Mechanism

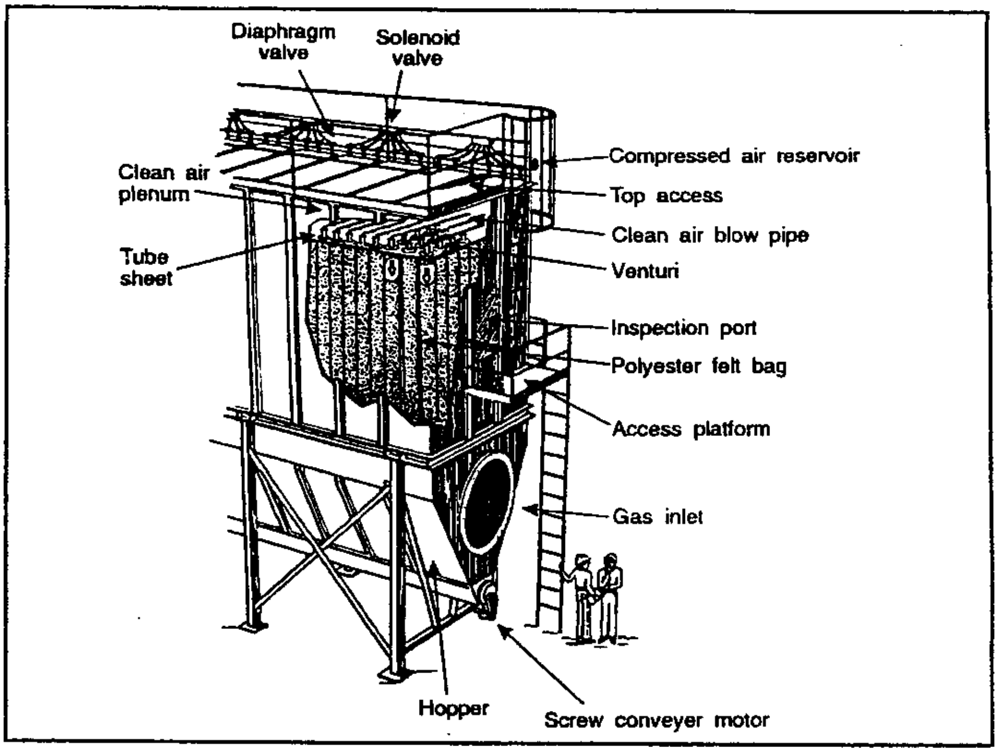

Figure 4-6. Typical Pulse Jet Baghouse

Moisture and oil traps are used in the compressed air system to reduce operating problems.

The compressed air used for cleaning is received from the plant air supply or from a compressor that serves the pulse jet collector. Because moisture can make the dust cakes difficult .. remove, it is often necessary to reduce the ambient moisture ir the compressed air to reduce operating problems in the pulse jet cleaning sy :em and in the bags. Many systems also use an oil trap to remove any condensed lubricating oil added at the compressor. The compressed air is moisture in the compressed air to reduce operating problems in the pulse jet cleaning system and in the bags. Many systems also use an oil trap to remove any condensed lubricating oil added at the compressor. The compressed air is stored at the top o: the baghouse in a reservoir, which often has a permanently mounted pressure gauge and a drain. The compressed air enters a series of diaphragm valves, each one serving a blow tube mounted above a row of bags. The diaphragm valves are operated by an electrically activated **solenoid valve**, often termed the **pilot valve**. When the solenoid valve is activated, compressed air trapped behind the diaphragm can be exhausted up the trigger line and through the solenoid valve. This allows the diaphragm valve to open suddenly and causes a pulse of compressed air to enter the top of every bag in the row served by that blow tube. In most pulse jet units, cleaning is done row-by-row without taking the compartment off-line.

In some pulse jet units, a number of small compartments are isolated from the inlet gas stream during cleaning. These units are referred to as **plenum pulse** baghouses because the entire compartment is pulsed or cleaned using a set of **poppet valves**. As a result, individual blow tubes are not necessary. The pressures used in the cleaning operation are lower than in other pulse jet units.

In plenum pulse baghouses, an entire compartment is cleaned at one time—as opposed to cleaning individual bags.

What Instruments Are Typically Found On Pulse Jet Fabric Filters?

Instruments that can be installed on pulse jet fabric filters include:

- A static pressure drop gauge (**manometer**).
- A compressed air reservoir pressure gauge.
- A gas stream inlet temperature monitor.
- A fan motor current meter (**ammeter**).

Most units have only a static pressure drop gauge, which is used to evaluate the condition of the bags and the potential for air inleakage into the unit. A compressed air reservoir pressure gauge, however, is useful to evaluate cleaning intensity, a factor that can directly relate to particulate matter emission problems. These pressure gauges can usually be retrofitted to pulse jet compressed air reservoirs. A gas inlet temperature monitor is used to help prevent condensation of corrosive materials on the bags and to help avoid exceeding the temperature rating of the bag. A fan motor current meter provides an indirect but useful indicator of the gas flow rate through the baghouse.

Reverse Air Fabric Filters

Reverse air cleaning, the simplest cleaning mechanism, is accomplished by stopping the flow of dirty gas into the compartment and backwashing the compartment with clean, low-pressure air (Figure 4-7). Dust is removed when the bags flex, and the dust cakes break and fall into the hopper.

In reverse air cleaning, the flow of dirty gas is stopped, and the compartment is backwashed with clean, low-pressure air.

Reverse air baghouses are usually compartmentalized to permit a section to be off-line for cleaning. Dust can be collected on the inside or outside of the bag. In **outside-to-inside (O/I)** flow reverse air baghouses, the dust collects on the outside of the bag. In **inside-to-outside (I/O)** flow reverse air baghouses, the dust collects on the inside of the bag.

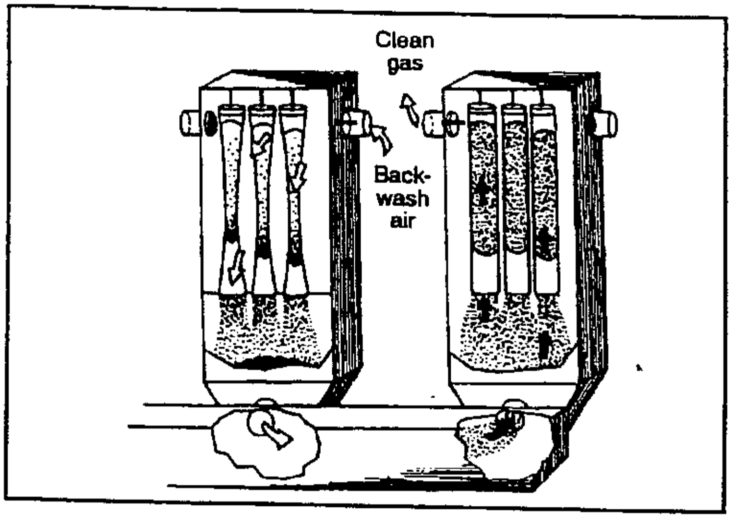

Figure 4-7. Reverse Air Bag-Cleaning Mechanism

O/I reverse air units are typically small, single-compartment units.

How Do O/I Reverse Air Baghouses Operate?

Outside-to-inside reverse air baghouses are similar to pulse jet fabric filters. The difference between them is the way in which the fabric is cleaned. Most O/I reverse air baghouses use woven fabric bags. These units are typically small, single-compartment units, similar to the illustration in Figure 4-8.

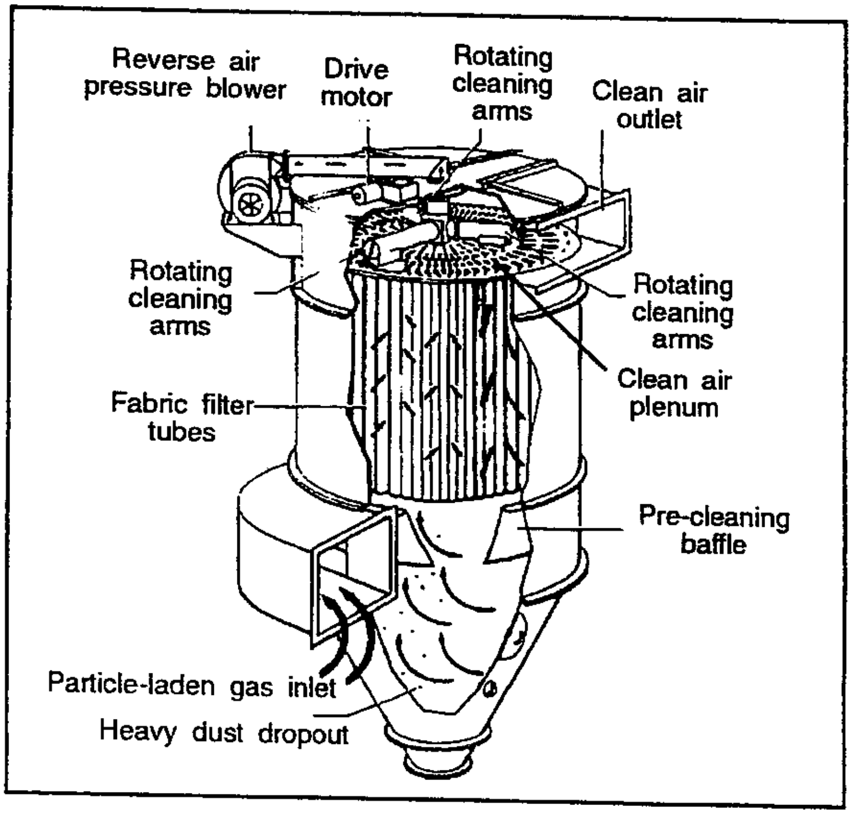

Figure 4-8. Reverse Air Baghouse Design

The bags are supported on interior cages and hang from a tube sheet near the top of the collector. The particle-laden gas enters from the bottom, and the gas stream passes up around the outside of each bag. The dust cake accumulates on the outside of the bags, and the cleaned gas passes up the center of the bags to the clean air plenum at the top. A rotating cleaning arm in the clean air plenum stops over each row of bags and forces either ambient air or filtered air in a reverse direction.

Another style of O/I reverse air fabric filter arranges the bags in a set of compartments instead of in a single compartment. Each compartment is equipped with poppet dampers to allow the filtered gas to exit the baghouse and the reverse air to enter the baghouse.

What Instruments Are Typically Found On An O/I Reverse Air Baghouse?

The instruments used on this type of fabric filter are typically limited to static pressure drop gauges. However, some units also include a fan motor current meter.

Instruments found on O/I reverse air baghouses might include:
- *Static pressure drop gauges*
- *Fan motor current meter*

How Do I/O Reverse Air Baghouses Operate?

Inside-to-outside reverse air fabric filters are typically used in moderate-to-large systems. In an I/O reverse air fabric filter (Figure 4-9), the bags are hung from a top assembly and fixed to a tube sheet that is positioned near the bottom of the baghouse. The particle-laden gas stream enters the hopper area below the tube sheet, and gas flows up the center of each bag. The dust cake forms on the inside surface of each bag. The filtered gas is collected in the clean gas plenum that surrounds the bags. Several compartments are used so that it is possible to isolate one compartment at a time for cleaning. During cleaning, the isolation dampers are activated, and the reverse air fan supplies air to the clean gas plenum. This air passes from the outside of each bag into the center of the bag and out the bottom opening. The dust cake is cracked and discharged because of the reverse air flow and the slight flexing of the cloth during cleaning.

I/O reverse air units are typically used in moderate-to-large systems.

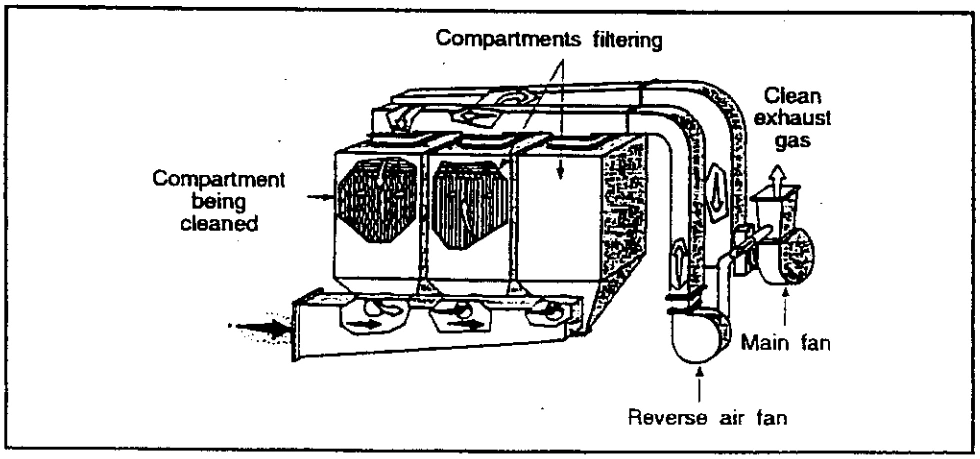

Figure 4-9. Reverse Air (I/O) Fabric Filter

Fiberglass bags can be used in I/O r· air units because the c· action is relatively gentl.

Various materials are used for the bags in I/O reverse air units. Because the cleaning action in these units is relative'v gentle, fiberglass bags, which have the highest temperature limits of any nmercially available fabric, can be used. Other common cloth material- .nclude Nomex®, Nylon®, polypropylene, and Dacron®. The bags are kept under tension to minimize fabric damage during the cleaning cycle and to reduce damage that can be caused by abrasion at the bag inlet.

Reverse air baghouses can be operated under positive or negative pressure. Negative pressure units generally have one or two fans that draw air inward and one single stack. Positive pressure units often have individual vents or stub stacks above each compartment or a single roof monitor for the entire unit. For this reason, positive pressure units are more difficult to test than are negative pressure units.

What Instruments Are Typically Found On An I/O Reverse Air Baghouse?

Instruments commonly found on I/O reverse air baghouses include:
- *Transmissometer*
- *Static pressure drop gauges*
- *Hopper-level alarms*
- *Hopper heater*
- *Inlet gas temperature monitors*

Instruments used on I/O reverse air baghouses depend on the size of the unit and on the type of effluent gas being treated. Many of the large, negative pressure systems use a transmissometer on the exhaust stack. Most systems also use static pressure drop gauges for each compartment and for the entire baghouse. Hopper-level alarms and hopper heaters are commonly used on baghouses that treat boiler or kiln processes. Some units that operate at elevated temperatures have inlet gas temperature monitors.

Shaker Fabric Filters

Shaker collectors are similar to I/O reverse air units except the bags are shaken to dislodge the collected dust.

Shaker collectors are similar to I/O reverse air fabric filters and are inspected in the same manner. The only major differences are the way the bags are hung and the way dust is dislodged from the bags (Figure 4-10). Each set of bags is mechanically connected to a shaker (either mechanical or sonic), which is usually outside the fabric filter shell. On a regular basis, one compartment is isolated from the gas stream, and the bags are shaken from side-to-side or up-and-down to dislodge the dust cake. After cleaning, the compartment is brought back on-line.

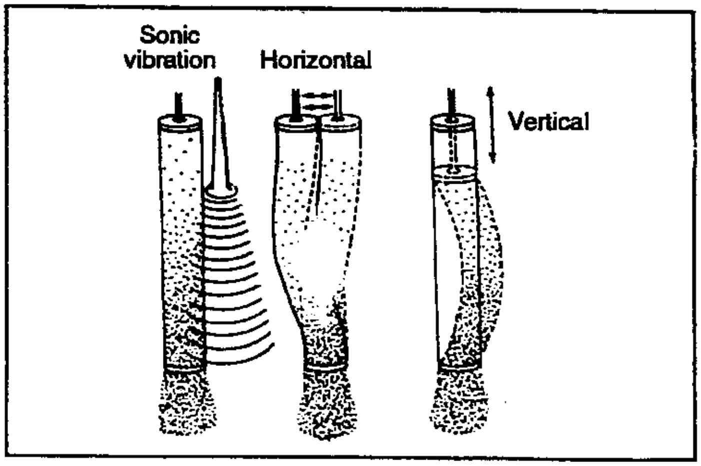

Figure 4-10. Shaker Bag-Cleaning Mechanisms

Because the cleaning action is severe, it is not advisable to use flex-sensitive (e.g., fiberglass) bag materials. Although the most common bag materials are cotton, Dacron®, polypropylene, Nomex®, and Nylon®, felted materials are used in some shaker units. Because fiberglass bags are not suitable for shaker units, shaker collectors are limited to low-temperature applications.

What Instruments Are Typically Found On A Shaker Fabric Filter?

The instruments used on a shaker collector are usually limited to static pressure drop gauges on each compartment and across the entire baghouse. Fan motor current meters are occasionally used. Inlet gas temperature monitors are used for baghouses operating at temperatures higher than 120 °F (49 °C). Shaker fabric filters can operate as positive or negative pressure units; however, most are designed for negative pressure.

Instruments installed on shaker baghouses can include:
- *Static pressure drop gauges*
- *Fan motor current meters*
- *Inlet gas temperature monitors*

Typical Emission Points

The uncollected effluent or emissions from a fabric filter are generally emitted through a stack or vent that follows the fabric filter or is part of the fabric filter system. However, fugitive emissions can occur around door seals, corrosion points, and warped access hatches.

Typical Inspection Areas

The major inspection areas for fabric filter systems are:

- Stack or vent exits.
- Stack pressure gauges.
- Physical structure/condition.
- Doors/hatches.
- Solid discharge valves.
- Hoppers.
- Clean side (when possible).
- Bags, cages, and bag attachments.
- Cleaning mechanisms (assemblies and controllers).

Summary

Fabric filtration is one of the most common mechanisms used to collect particulate pollutants. Fabric filters, also referred to as baghouses, consist of cylindrical filters hung in shells.

Baghouses are classified according to their cleaning mechanisms. Pulse jet bag-houses use pulses of compressed air to flex the bags, which causes the dust cakes collected on the bags to crumble and fall into a hopper. Reverse air baghouses use a flow of clean, low-pressure air to backwash the compartments in which the bags are hung. This causes the bags to flex and the dust cakes to crumble and fall into a hopper. In shaker baghouses, a mechanical device or a sonic device shakes the bags, causing the bags to flex and the dust cakes to crumble and fall into the hopper.

The cleaned gas stream is typically emitted through a stack or vent. Fugitive emissions can occur around door seals, corrosion points, and warped access hatches.

Review Exercises

1. Baghouse systems can be categorized according to the placement of the fan. _________ pressure baghouses have the fan located before the baghouse. _________ pressure baghouses have the fan located after the baghouse.

2. Air-to-cloth ratios are kept low to avoid:

   a. Seepage through the material.
   b. Increased gas velocities at the baghouse outlet.
   c. Increased potential for holes.
   d. All of the above.
   e. a and b only.
   f. a and c only.

3. In a pulse jet baghouse, the bags typically are:

   a. Hung from "J" hooks.
   b. Mounted to the tube sheet using snap rings.
   c. Mounted on anticollapse rings.
   d. Supported on interior cages and hung from a tube sheet.

4. In a pulse jet baghouse, does dust collect on the inside or the outside of the bags? _________

5. True or false? In most pulse jet units, cleaning is done row-by-row without taking the compartment off-line.

6. The compressed air used for cleaning in a pulse jet baghouse is air that is:

   a. Obtained from the plant air supply or provided by a compressor serving the baghouse.
   b. Purchased in tanks.
   c. Both a and b.
   d. None of the above.

7. The valve that controls operation of the diaphragm valves in a pulse jet baghouse is the _________ valve or pilot valve.

8. It is often necessary to reduce the ambient moisture in the compressed air used for cleaning pulse jet filters because:

   a. Moisture creates operating problems in the pulse jet cleaning system.
   b. Moisture reduces the volume of air that can be cleaned.
   c. Moisture can make it difficult to remove the dust cakes.
   d. a and b.
   e. a and c.
   f. b and c.

9. In O/I reverse air baghouses, the dust collects on the _________ of the bags; in I/O reverse ai baghouses, the dust collects on the _________ of the bags.

10. True or false? The cleaning action in I/O reverse air units is relatively gentle, and bag materials such as fiberglass can be used.

11. Bags in an I/O reverse air unit are cleaned in the following manner:

    a. Bag-by-bag.
    b. Row-by-row.
    c. Compartment-by-compartment.

12. The following instruments are typically found on shaker compartment collectors:

    a. Static pressure drop gauges.
    b. Fan motor current meters.
    c. Inlet gas temperature monitors.
    d. All of the above.

Answers

1. Positive; Negative.
2. f. a and c only.
3. d. Supported on interior cages and hung from a tube sheet.
4. outside
5. True
6. a. Obtained from the plant air supply or provided by a compressor serving the baghouse.
7. solenoid
8. e. a and c.
9. outside; inside
10. True
11. c. Compartment-by-compartment.
12. d. All of the above.

Quiz 1: Covering Lessons 1-4

This is the first self-graded quiz covering Lesson 1 through Lesson 4, with 10 items from each lesson. In addition to providing feedback on your mastery of the material, it gives you practice at taking a test in the final exam format. There is no answer sheet; just circle your responses on this quiz. After you have completed the quiz, use the answer key for Quiz 1 in the back of the book to check your responses.

1. The purpose of the baseline inspection is to:

   a. Collect detailed evaluation information about plant maintenance practices.
   b. Identify definitive evidence of noncompliance with regulations.
   c. Identify abnormal operating conditions that might indicate common system malfunctions.
   d. Provide a specific list of required repairs on control equipment.

2. Principles of baseline inspection include:

   a. Evaluating control device performance by comparing present conditions with existing site-specific baseline data.
   b. Evaluating, in detail, plant maintenance practices.
   c. Evaluating control device performance by comparing operation parameters at a given site with similar units at plants known to be in compliance.
   d. All of the above.
   e. a and b only.

3. During baseline inspections:

   a. As much readily obtainable information as possible is used to evaluate performance.
   b. Observations and data collection are standardized for all control devices.
   c. Detailed internal inspections of the control systems are required.
   d. All of the above.

4. True or false? Baseline inspections incorporate information gathered from measurement and observation.

5. True or false? The counterflow inspection approach (inspection from the stack to the process) is used on sources that do not have air pollution control devices for minimizing emissions.

6. The emphasis of the cocurrent inspection approach (inspection from the beginning of the process to the stack) is on:

   a. Control-device operating conditions, both measured and observed.
   b. Raw material and fuel characteristics, operating rates, operating temperatures and pressures, and other process information relevant to generating air pollutants.
   c. Determining if the problem is caused primarily by control-device-related conditions or by process-related factors.
   d. Both a and c.

7. A Level 1 inspection is:

   a. Intended to collect specific baseline data to evaluate performance of air pollution control devices and sources.
   b. Used when a more detailed and complete inspection is needed.
   c. A field surveillance tool that is intended to provide relatively frequent and specific visual observation of source performance.
   d. Used to gather baseline data to later evaluate performance of the specific sources at a given facility.

8. The baseline inspection that is limited to "walk-through" evaluations of the air pollutant source and/or the air pollution control equipment is:

   a. Level 1
   b. Level 2
   c. Level 3
   d. Level 4

9. An inspector is permitted to enter the control device:

   a. During Level 2 inspections, if the control device is not in service.
   b. During Level 3 inspections, if the control device is not in service.
   c. Both a and b.
   d. None of the above—the inspector is not permitted to enter the control device under any circumstances.

10. True or false? Portable inspection instruments are recommended because many control systems either do not have permanent on-site monitors or have monitors that are inoperative a significant portion of the time.

11. The four mechanisms commonly used to remove gaseous pollutants are:

    a. Gravity, centrifugal force, inertial impaction, diffusion.
    b. Electrostatic precipitation, combustion, absorption, condensation.
    c. Condensation, absorption, adsorption, combustion.
    d. Diffusion, combustion, absorption, adsorption.

12. Particulate matter collection mechanisms include:

   a. Condensation, gravity, inertial impaction, diffusion, electrostatic precipitation.
   b. Electrostatic precipitation, gravity, diffusion, inertial impaction, centrifugal force.
   c. Gravity, combustion, diffusion, absorption, centrifugal force.
   d. Condensation, combustion, absorption, adsorption.

13. The process by which a gas is dissolved in a liquid is:

   a. Adsorption.
   b. Diffusion.
   c. Condensation.
   d. Absorption.

14. Adsorption is:

   a. A process that involves removing gaseous contaminants by causing them to adhere to the surface of solid bodies with which they are in contact.
   b. Rapid, high-temperature gas-phase oxidation.
   c. A process in which a gas is dissolved in a liquid.
   d. A process by which volatile contaminant gases are removed from the gas stream and are changed into a liquid.

15. Combustion is governed by:

   a. Temperature and pressure.
   b. Concentration, temperature, and O_2.
   c. Temperature only.
   d. Time, temperature, and turbulence.

16. Factors to be considered when selecting a control device to reduce emissions include the contaminant's:

   a. Concentration, characteristics, and chemical and physical properties.
   b. Temperature, size, and acidity.
   c. Concentration only.
   d. Size only.

17. The collection mechanism for particulate pollutants that causes the gas stream to rotate in a spiral motion and forces larger particles to move toward the outside of the wall is called:

   a. Gravity
   b. Centrifugal force
   c. Impaction
   d. Diffusion

18. True or false? A contaminant's particle size is usually expressed by the aerodynamic diameter, which is measured in micrometers.

19. True or false? The primary factor governing adequate particle collection is particle dust resistivity.

20. True or false? ESPs are designed to operate at high pressure drops.

21. True or false? If a control device is 100 percent efficient, but a canopy hood has a capture efficiency of 75 percent, then the overall efficiency of the air pollution control system cannot be greater than 75 percent.

22. Some common hood designs are:

    a. Flanged opening, axial, canopy, and radial.
    b. Radial, airfoil, forward curved, and backward curved.
    c. Canopy, booth, slot, and flanged opening.
    d. Slot, airfoil, radial, and booth.

23. True or false? Hoods, which are part of the air movement system, are classified as either axial or centrifugal.

24. Static pressure for air movement systems that have the fan located after the control device:

    a. Becomes progressively more negative with measurements taken closer to the fan.
    b. Becomes progressively less negative with measurements taken closer to the fan.
    c. Remains level.
    d. Reflects sharp changes in pressure depending on the direction of the ductwork.

25. Air infiltration should be apparent on the gas temperature profile because gas temperatures from combustion sources or other hot processes should:

    a. Increase as the gas moves farther from the process.
    b. Remain the same regardless of the location of the gas.
    c. Decrease as the gas moves farther from the process.

26. __________ fans are more widely used than other type fans because they can handle dirtier air streams at higher static pressures.

    a. Axial
    b. Booth
    c. Centrifugal
    d. Canopy

27. Abrasion in a ductwork system most often occurs:

    a. In systems where gas flow is erratic.
    b. Just before the capture point.
    c. Just after the control device.
    d. At elbows or other points where there are sharp changes in gas flow direction.

28. A rough estimate for a belt-driven fan's rpm can be found by:

a. Multiplying 3.14 times the fan motor rpm.
b. Dividing the brake horsepower by the fan motor rpm.
c. Multiplying the fan motor rpm by the ratio of the motor and fan sheave diameters.
d. Multiplying the current by the voltage, by the power factor, and by 0.746.

29. True or false? The fan motor current must be adjusted for standard conditions before being compared with the baseline motor current.

30. True or false? Even a 5-percent shift in the corrected fan motor current from the baseline value indicates a significant change in the gas flow rate through the air pollution control system.

31. True or false? In a positive pressure baghouse, the fan is located after the baghouse, and the dust-laden gas is pulled through the fabric filter.

32. In fabric filters, the air-to-cloth ratio is kept low to avoid:

a. Increased gas velocities at the baghouse inlet.
b. Increased potential for fabric holes.
c. Seepage through the filter medium.
d. All of the above.
e. a and b only.
f. b and c only.

33. Fabric filters are categorized by the type of mechanism used to clean the filter medium. Some of the most common bag-cleaning mechanisms are:

a. Air jet, wire-mesh, and plenum
b. Pulse jet, plenum, and cartridge
c. Shaker, cartridge, and air jet
d. Reverse air, pulse jet, and shaker

34. True or false? A pulse jet filter uses compressed air of 50-120 psig gauge for routine fabric cleaning.

35. Instruments installed on pulse jet fabric filters can include:

a. A static pressure drop gauge (manometer).
b. A compressed air reservoir pressure gauge.
c. A fan motor current meter (ammeter).
d. All of the above.
e. a and c only.

36. True or false? In plenum pulse baghouses, bags are cleaned one at a time rather than all at the same time.

37. Which fabric filters often use woven fabric bags; are typically small, single-compartment units; have bags that are supported on interior cages; and have bags that hang from a tube sheet near the top of the collector?

a. O/I reverse air
b. I/O reverse air
c. Shaker
d. Pulse jet

38. Which fabric filters can use fiberglass bags because the cleaning action is relatively gentle?

a. O/I reverse air
b. I/O reverse air
c. Shaker
d. Pulse jet

39. The instruments used on shaker collectors are:

a. Transmissometers, static pressure drop gauges, and hopper-level alarms.
b. Usually limited to static pressure drop gauges on each compartment and across the entire baghouse.
c. Inlet gas temperature monitors and hopper heaters.
d. a and c.

40. Which fabric filter uses a flow of clean, low-pressure air to backwash the compartments in which the bags are hung?

a. Pulse jet
b. Cartridge
c. Reverse air
d. Shaker