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BAGGING AND PACKAGING

- Nanotechnology's challenges, opportunities
- When it's time to automate your bagging line
All bulk material drying systems require an air pollution control device — a dust collector, wet scrubber, or cyclone. In explaining how to combat problems from moisture-laden dryer gas, this article focuses on one type of dust collector — the pulse-jet baghouse. The principles discussed here can be applied to a pulse-jet baghouse in any high-temperature application, including systems with kilns, calciners, smelters, and boilers.

A pulse-jet baghouse in a drying application handles one of the toughest dust collection challenges: moisture-laden gas. Water vapor in the dryer’s exhaust gas affects the baghouse’s efficiency whether the unit is serving as the primary product collector (separating all the dried powder from the gas) or the secondary collector (capturing only fines and powder carryover).

The problem is that the water vapor in the dryer’s exhaust gas can condense to a liquid state when it enters your baghouse. This can result in blinded bag filters, rapid dust buildup on the baghouse’s inside walls, bridging at the hopper discharge, and metal corrosion inside the baghouse. You can stop these problems before they start and keep your baghouse operating at peak efficiency by taking this three-step approach: 1) properly designing the baghouse for your application, 2) starting up and shutting down the baghouse in the right sequence, and 3) providing effective preventive maintenance.

1 Correctly design the pulse-jet baghouse.

Several design factors come into play when you’re selecting a pulse-jet baghouse for a drying application. Here’s a quick rundown of the key design factors.

Insulation and heat tracing. To prevent water vapor from condensing out of the dryer’s exhaust gas as it enters the baghouse, the gas entering the baghouse should be at least 50°F — and preferably up to 100°F — above the gas dew point temperature. Your dryer supplier should be able to tell you the exhaust gas dew point temperature for your dryer. The dew point temperature will vary with the relative humidity and gas constituents of the exhaust gas. For instance, some constituents may be in gas form at high temperatures but condense to a liquid form at lower temperatures.

If the ambient air temperature surrounding your baghouse is much cooler than the dryer’s exhaust gas temperature, the baghouse’s operating temperature might be close to the gas dew point temperature. This can cause moisture to condense on the cool surfaces inside the baghouse, its inlet gas ductwork, and the exhaust gas ductwork leading to the main exhaust fan downstream from the baghouse. To avoid this condensation, you can insulate all baghouse and inlet and exhaust ductwork surfaces. If your baghouse is located outdoors in a cold climate, you may also need to use heat tracing (electrical wires that transfer heat) under the insulation on the housing and hopper walls to increase the baghouse’s internal temperature well above the gas dew point temperature.
Bag filter media. Choosing the right media for your bag filters is key to preventing baghouse moisture problems. Many filter medias commonly used in pulse-jet baghouses, such as polyester, can’t handle moist heat very well. They can undergo hydrolysis, an adverse chemical reaction to water molecules that weakens the bonds in the media fibers and typically makes the media brittle. Depending on the amount of moisture in the gas, polyester media (rated for a maximum dry heat temperature of 275°F) undergoes hydrolysis at temperatures as low as 200°F.

Several medias can stand up to the moist heat encountered in a drying system baghouse, and choosing one that’s right for your application depends on your drying system’s operating temperature. For a system operating below 300°F, one often-overlooked option is acrylic media. For an application operating above 300°F, aramid (known as Nomex) is a common choice. However, aramid will hydrolyze at high temperatures, making it suitable for moist heat conditions only up to about 350°F to 375°F. PPS (known as Ryton) is also rated for moist heat conditions up to 375°F. For an application operating over 400°F, you can choose either polyimide (known as P-84), which is rated to 450°F, or fiberglass, rated to 500°F.

You’ll also need to consider the chemical characteristics of your dust and dryer exhaust gas when choosing bag filter media. Custom medias are available with various chemical and mechanical surface finishes, fiber treatments, and fabric weight and density variations. Your baghouse supplier can help you select the right media for handling your application’s chemical properties.

Baghouse construction. The chemical characteristics of your dust and exhaust gas are also a factor in selecting the baghouse construction materials. These characteristics can produce an acid or alkaline attack on the baghouse, and the potential for either type of attack is magnified when the baghouse’s inlet gas temperature makes any sudden temperature excursions through the gas dew point temperature. In some applications, selecting internal wall coatings (such as specialty paints) or alloy steel walls for the baghouse housing can help the unit resist acid or alkaline attack. Constructing the baghouse with specially finished internal welds can also reduce or prevent dust buildup on the housing and hopper walls, which will also help prevent acid or alkaline attack. Your baghouse supplier can provide advice about which features are best for your application’s chemical characteristics.

Pulse-cleaning timing. With some dryers, the momentary pressure rise during the baghouse’s pulse-cleaning cycle (the result of pulsing several rows of bag filters at once) can cause gas blowback into the dryer. You can reduce this effect by using a multiposition pulse-cleaning timer board that will pulse as few rows of bag filters at one time as possible. You can also choose a bag filter configuration—that is, the number of filters per row and number of rows—that minimizes the momentary pressure rise during pulse cleaning.

Hopper discharge. Your baghouse’s discharge equipment—such as a rotary airlock, screw conveyor, or other discharge or conveying device—should be properly sized for the drying system’s capacity and rated for the system’s operating temperature. If your baghouse functions as a primary product collector, it may need an oversized discharge device at the hopper outlet to provide steady discharge and prevent powder buildup or other problems caused by powder absorbing any remaining ambient moisture.

Performance-monitoring instrumentation. Rising differential pressure across your bag filters can indicate that moisture condensation is causing dust to build up on the filters, which, if not detected early, can cause filter blinding. The most critical instrument for monitoring rising differential pressure in your baghouse is the standard differential pressure gauge. The gauge can be a simple analog instrument, like a magnehelic gauge. It can also be a photohelic switch-gauge or a pressure module that plugs into the pulse-cleaning timer board; these more sophisticated devices not only indicate differential pressure across the bag filters but have alarm settings and can control pulse cleaning on a demand basis.
Too-high temperatures in the baghouse can damage the bag filters, and too-low temperatures can cause moisture condensation. Thermal probes installed at various points in the baghouse and system ductwork can monitor baghouse temperatures and detect an upset condition. Terminals on some pulse-cleaning timer boards also allow you to install alarms that can detect thermal deviations and warn of high or low differential pressures.

2 Use the right startup and shutdown sequences.

Following correct startup and shutdown procedures for your pulse-jet baghouse will prevent or minimize problems caused by moisture in the dryer’s exhaust gas.

**Startup.** The following startup sequence covers restarting the baghouse after it’s shut down, when the bag filters already have a dust cake. [Editor’s note: The procedure for initial startup of a new baghouse or startup for seasoning a new set of bag filters has additional steps and is beyond this article’s scope.]

Restart the baghouse before starting the dryer using this sequence:

1. Start the auxiliary heat sources (space heaters used to heat the baghouse when the dryer isn’t operating) if your system has them.
2. Start the discharge equipment at the baghouse hopper outlet.
3. Start the compressed-air supply to the pulse-cleaning system manifolds.
4. Power up the pulse-cleaning timer board to initiate the pulse-cleaning cycle.

Then start the dryer and related equipment in this sequence:

5. Start the dryer’s gas heat source.
6. Start the system’s main exhaust fan. This will draw the heated dryer gas through the baghouse and ductwork to preheat all cold metal surfaces to the operating temperature. If the dryer gas is heated by a natural-gas-fired burner, starting the fan first will also purge any pockets of accumulated gas (that is, combustion products) from the system.
7. Start the feed to the dryer.

**Shutdown.** Whether you’re shutting down the drying system for routine maintenance or because of an emergency, follow this sequence:

1. Keep the baghouse hopper’s discharge equipment running.
2. Stop the feed to the dryer, and keep the main exhaust fan and dryer’s gas heat source running for a short time after this to rid the system of moisture-laden gas.
3. Shut the heat source off and run the main exhaust fan until the baghouse’s internal temperature has cooled to near-ambient conditions.
4. Set the pulse-cleaning timer board to continue pulsing the bag filters for 10 to 20 minutes after the main exhaust fan is turned off; this will fully clean the filters and remove any excess dust cake that may absorb remaining ambient moisture. (Most pulse-cleaning timer boards have a programmable cycle-down function that allows you to program this.)
5. After the pulse-cleaning cycle has stopped, stop the hopper’s discharge equipment.

3 Practice effective preventive maintenance.

Good preventive maintenance requires regular inspections and replacement of critical baghouse components. Inspect your bag filters on a regular schedule to ensure that they’re in top condition for maintaining high collection efficiency in this moist, high-temperature environment. Replace the pulse-cleaning system’s diaphragms each year, especially if you have a continuous operation with many pulse-cleaning cycles.

When operating problems lead to an extended baghouse failure, having spare parts on hand so you can replace your baghouse’s critical components can minimize the damage to other system components. This kind of preventive maintenance includes maintaining a stock of bag filters, wire support cages for the filters, and timer boards, solenoid valves, and replacement diaphragms for the pulse-cleaning system.

For further reading

Find more information on pulse-jet dust collectors and drying in articles listed under “Dust collection and dust control” and “Drying” in *Powder and Bulk Engineering*’s comprehensive article index at www.powderbulk.com and in the December 2005 issue.

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