Tips

How to detect leaking or broken filters with a triboelectric monitor

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A triboelectric particle emission monitor detects increased dust levels caused by leaking or broken filters in dust collectors. After describing how the monitor works, this article explains how to select one for your application.

Leaking or broken filters in baghouses, cartridge collectors, and other dust collection equipment may be a fact of life in bulk solids processing plants, but they can cause big problems if they're not detected quickly. A leaking filter can produce safety risks for your workers, reduce process efficiency, create housekeeping and maintenance headaches, and damage blowers, collectors, or other equipment. A catastrophic filter failure can not only send valuable material up your plant's exhaust stack, but create problems with your neighbors, lead to an expensive cleanup job, and require that your plant pay a fine to local or state air pollution control authorities.

One way to detect increased dust levels from leaking and broken filters before they can create problems like these is to use a particle emission monitor to continuously monitor dust levels in the clean-air duct exiting the dust collector. In fact, in many applications, you'll need to install such a device to comply with the terms of your plant's EPA-issued operating permit. Various types of particle emission monitors (also called *broken bag detectors* and *dust level monitors*) are available, but one of the most cost-effective, low-maintenance, and easy-to-install options is a triboelectric monitor. This device, available from multiple suppliers, operates using the *triboelectric effect* (also known as *particle impingement* or frictional electrification), which is the electrical charge transfer that occurs between two materials when one rubs or impacts the other.

The triboelectric particle emission monitor consists of a stainless steel probe, as shown in Figure 1, which is inserted into the clean-air duct of a baghouse or cartridge dust collector and linked to sensing electronics. Depending on the application, the electronics can be housed in a sensing head that's integral to the probe and mounted outside the duct (Figure 1), or the electronics can be housed in a remote control box connected by a cable to the probe. The electronics includes a display panel with control adjustments and a relay output linked to an alarm or a controller (such as the dust collector controller or process controller).

In operation, dust particles flowing in the airstream in the duct collide with the probe, generating an electrical charge. The electronics converts this charge to a particle emission signal and continuously monitors and analyzes the signal during the dust collector's operation. When the signal exceeds a preset particle emission level, the electronics quickly initiates a time delay from a few seconds to a few minutes, depending on the application. If the signal level remains high for the time delay's duration, the relay output activates an alarm (such as a flashing light to alert the operator) or sends a signal to the dust collector controller or process controller indicating that a filter is leaking or has failed. If the signal level drops below the preset level during the time delay — indicating a false signal caused by briefly high dust levels, such as during the collector's filter-cleaning cycle — the time delay prevents the monitor from triggering an alarm or sending a signal to a controller.

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The triboelectric monitor is installed on the duct with quick-disconnect couplings, making it easy to remove the probe for cleaning and maintenance. User-friendly control adjustments on the sensing head or remote control box allow the operator to calibrate and adjust the monitor's dust level sensitivity and set the alarm point and time delay with minimal training, without the aid of a contractor or electrician.

Selecting a triboelectric monitor

You'll need to consider several factors when choosing a triboelectric particle emission monitor for your application. Working with the monitor supplier to answer the following questions will help ensure that the monitor can handle your dust and operating conditions.

- What are your dust's physical properties, including its particle size distribution, bulk density, abrasiveness, corrosiveness, cohesiveness, and conductivity? What is the dust's moisture content? This information can help the supplier determine whether the triboelectric monitor will work in your application and how frequently the probe will require cleaning.

- What kind of process is the dust collected from? What kind of dust collector will the unit monitor? If your process or collector is subject to high vibration levels or operates under high temperatures, a monitor with a remote control box is probably the best choice.

- What are your duct's shape and diameter? What material is the duct constructed of? The duct's shape and size will determine the probe length, which should be large enough to extend at least halfway across the duct without touching the other side. The duct construction material determines whether the monitor will be well grounded and provide proper signal propagation; a metal duct is conductive and works well, while a plastic duct is nonconductive and must be wrapped in metal mesh — hardware cloth, screen material, or rabbit wire — to provide proper grounding for the monitor. The mesh should cover a length of plastic duct equal to approximately three duct diameters both upstream and downstream from the monitor.

- What is the air volume through the duct in relation to the duct diameter? What are the air velocity and particle flowrate in the duct? If the air and particles don't flow quickly enough, the particles can't create the triboelectric effect when they strike the probe, making this monitor unsuitable for your application.

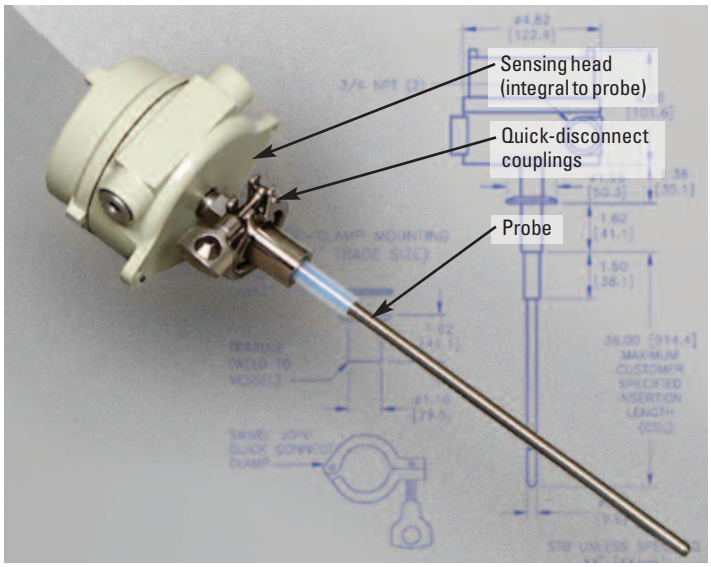
- Will the monitor be installed outdoors or in a hazardous location? Your monitor may require a remote control box or sensing head in a NEMA-rated enclosure certified to handle temperature extremes or a hazardous location.

- What are the minimum and maximum air temperatures inside the duct where the probe will be installed? High-temperature air may require a probe made of a heat-proof material, such as ceramic.

- What are the minimum and maximum ambient air temperatures in the room or area where the monitor electronics will be mounted? High-temperature ambient air may require installing the monitor with a remote control box in another location or a sensing head in a NEMA-rated enclosure certified to handle high temperatures. **PBE**

Figure 1

Triboelectric particle emission monitor



For further reading

Find more information on filter leak detection and monitoring in articles listed under "Dust collection and dust control" in *Powder and Bulk Engineering*'s comprehensive article index (in the December 2009 issue and at *PBE*'s Web site, www.powderbulk.com) and in books available on the Web site at the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

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