SELECTING FILTER MEDIA FOR YOUR CARTRIDGE-STYLE DUST COLLECTOR

Designing a dust collection system is a complex task, and the filter media is an especially important component to get right. Specifying the correct filter media for a cartridge-style dust collector requires comprehensive analysis of the dust itself and the specific operating conditions. This article provides information on how testing your dust and considering various process factors will help you select the appropriate filter media to improve dust collector performance and protect people and property by mitigating dust hazards.

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High-efficiency cartridge-style dust collectors provide excellent dust removal efficiencies with a low ownership cost, making them the system of choice for powder and bulk solids operations. After factoring in the initial equipment cost, overall electrical usage, compressed-air consumption, and the fact that the system requires few replacement parts or consumable costs and minimal or no maintenance costs and associated downtime, cartridge-style dust collectors tend to typically have lower costs than baghouses and cyclones.

To get the best results from your industrial cartridge-style dust collector, it's important to select the right filter media for your application. The wrong filter media selection can lead to increased energy usage, and, more importantly, it can put workers at risk from dust exposure and explosions and put you out of regulatory compliance. To help decide which cartridge filter media is right for your application, you should perform dust testing and then consider the available cartridge filter media options.

Dust testing

Before you can select a filter type for safe, optimal dust collector performance, you need to consider your material and the dust it generates. Two types of testing are necessary to determine which type of filter media your application requires, bench testing and explosibility testing. A test lab will perform dust analysis to identify particle characteristics.

Test lab workers perform dust analysis to identify particle characteristics relevant to selecting the correct filter media.

Bench testing pinpoints many of the dust's physical properties, including particle size, shape, and moisture level. This testing requires a scanning electron microscope (SEM) and other specialized equipment. Dust sample bench testing is an excellent tool to better understand the physical properties of your dust, which form the basis for selecting equipment-related components such as filter media for a dust collection system.

Explosibility testing determines whether a dust is combustible. This testing is required as part of conforming to OSHA's Combustible Dust National Emphasis Program, which in many cases relies upon NFPA guidelines on how to determine your dust's flammability and explosivity. This testing will analyze whether the dust is combustible or not. If it's found to be combustible, the dust will be tested further to determine the rate of pressure rise that it would generate if a deflagration or explosion were to happen.

To create a complete picture of your operation, the testing laboratory should ask for detailed application data. This information should include the process generating the dust, operating requirements, airflow and pressure-drop conditions, temperature and humidity, and the dust collector's location.

Once you've completed the required dust testing you should familiarize yourself with the available filter media options for a cartridge-style dust collector.

Cartridge filter media options

The choice of filter selected for your dust collector is usually driven by dust type, operating temperatures, and the level of moisture in the process. Cost is another part of the selection process, but not necessarily the most important factor. There are two basic filter media types commonly used in pleated cartridge filters. The first type is nonwoven cellulosic blend, which is

Synthetic polyester filter media.

the most economical filter media choice for dry dust collection applications at operating temperatures up to 160°F (71°C). The second type is synthetic polyester filter media or polyester-silicone blend, which is a lightweight, washable media for dry applications with maximum operating temperatures ranging from 180°F (82°C) up to 265°F (129°C).

To narrow down which type of filter media to select along with the various coatings available, consider each of the following factors about your material (dust) and process.

Material factors

Particle characteristics. Dust characteristics help determine the right type of filtration media and the *air-to-cloth ratio* needed for optimal energy savings and operational efficiency. A filter's air-to-cloth ratio is the airflow in cfm per each square foot of filter media. This is an important factor in media selection for dry dust collectors. By selecting the appropriate filter, you can help minimize maintenance problems, meet emissions requirements, and extend filter life for your cartridge-style dust collector. The air-to-cloth ratio varies depending on the characteristics of the dust being captured and the hours of operation. The air-to-cloth ratio can also vary from collector to collector and requires comparative analysis against either a similar or the same dust within a database collection. If for some reason the air-to-cloth ratio is overly high, the velocity within the collector is moving at a speed that could abrade the media (if handling abrasive dust), prevent the dust from falling out of the collector (for light and fluffy dust), or cause high pressure drop across the filters. If these conditions arise, maintenance will be required, at a minimum, or the filters may see the end of their service life.

Testing performed with an SEM for visual analysis of the dust shape and characteristics will reveal if your dust has a crystalline structure with jagged edges. For example, fumed silica or spherical metal particulate can abrade media prematurely if the air-to-cloth ratio is too high or mechanical prefiltration isn't properly used in the application. The SEM can also see if the dust contains oil, which can cause serious filtration problems, such as premature filter plugging due to the oil penetrating the media and causing high pressure drop or weakening the filter media and causing bursting when pulse-cleaned. If oil is present in the tested dust, the filter media may require an oil-resistant coating.

Particle size. Particle analysis reveals the dust's particle size distribution down to the submicron range. A dual-laser particle analyzer can pinpoint both the count (the number of particles of a given size) and the volume or mass spread of the dust. Sieve analysis is a related test that measures particle sizes greater than 100 microns. All of these tests are important because a dust can include submicron particles mixed with much larger particles. Scientific testing is the only way to identify these tiny dust particles to help you choose the appropriate media. It's a wise decision to select a filter media that promotes surface loading, such as nanofiber or PTFE, to ensure a long service life of the filter elements. Surface loading prevents dust passing through the filter media and prevents depth loading into the fibers of the media, which can make pulse cleaning more difficult. Nanofiber promotes greater surface loading compared to standard media types, preventing both depth loading and keeping the pressure drop low for a longer period of time.

Combustibility. Explosibility testing assesses whether a dust is combustible and helps determine if conductive filters are needed. In fact, per NFPA standards, which serve as guidance for OSHA's National Emphasis Program, you're required to test your dust for flammability and explosivity. If the testing lab finds that your dust is inert, there's no need for further testing. If it's combustible, the lab will conduct further analysis on dust cloud explosibility parameters to pinpoint the K_{St} (the deflagration index of a dust cloud, or rate of pressure rise) and P_{max} (the maximum pressure in an unvented, contained explosion). If your dust is found to be even slightly combustible, you'll be required to use explosion venting equipment on your dust collector, along with the appropriate filter media.

Regarding filters for combustible dusts, standard and nanofiber filter media can be treated with compounds that deliver special performance properties. Flame-retardant media are treated with a chemical that provides fire-retardant properties for use where there is a risk of fire or explosion. Fire-retardant media will extinguish itself if no other combustible material is present. Carbon impregnated media will dissipate static to aid dust release. This media is used in combustible dust applications to reduce the possibility of a static charge, which can serve as an ignition source for a fire or explosion in the dust collector. For spunbonded filter media, aluminized coatings dissipate static.

Hygroscopicity. Moisture-absorbent (hygroscopic) dusts are sticky, which can cause filters to clog. If the air is moist or humid, hygroscopic dusts can take on the characteristics of mud and become packed in the filter pleats, reducing filter life.

Ambient humidity can impact how a dust behaves, so if you're handling a hygroscopic material in a climate-controlled indoor space, then this type of material shouldn't pose a problem for the filter media in your dust collector.

However, if your process is subject to fluctuations in temperature and exposure to moisture, hygroscopic dusts require wide-pleat cartridge filters because sticky dusts cause tightly pleated filters to plug up. In these types of applications 100 percent spunbonded media is generally preferred. Moisture doesn't saturate spunbonded media, allowing it to work better in these environments. Additionally, this media is typically washable, so it can be removed, washed down, dried, and put back into operation.

Process factors

Operating temperature. Both high and low operating temperatures affect the performance of a dust collector. That's why choosing filter media that best suits your working temperature is important. Prolonged exposure of hot and cold to the plastisol, urethane, or other glue required in cartridge filter construction will cause melting or brittleness. Over time, the filter may begin to break apart; for example, the cartridge filter's end pans might fall off. Moreover, the same effects can happen to the filter media itself. Once media becomes brittle or approaches melting points, the reverse pulse-cleaning air blast can rupture the media, causing dust bypass.

Nonwoven cellulosic blend filter media is suitable for dry dust collection applications at operating temperatures up to 160°F (71°C). If your application requires filter media that can withstand a higher temperature, synthetic polyester media or polyester-silicon blend can handle dry applications with maximum operating temperatures ranging from 180°F (82°C) up to 265°F (129°C). For applications above these temperatures, specialty media like Nomex can sometimes withstand the heat generated. However, applications that experience temperatures of more than 265°F would be better served by adding cool bleed-in air to reduce the temperature or moving to a nonpleated filtration device, like a baghouse.

Static Electricity. Antistatic filter media (also called *conductive filter media*) is recommended when conveyed dusts generate static charges that require dissipation. Cartridge filters with antistatic media should be used in applications handling explosive dusts, reducing the risk of ignition sources due to static electricity charges and conforming to NFPA requirements. Applications for antistatic filters include fumed silica dust; plastic, PVC, and composite dusts; and carbon black and toner dusts.

Typically, static-dissipative filter properties are achieved by impregnating a cellulose filter with a carbon material or a synthetic filter with an aluminized coating or carbon grid impregnation. Media with antistatic properties and a wide-pleat design enable better airflow through the cartridge, improved cleaning characteristics, energy-efficient performance, and long filter life versus filters with tight pleats or no pleat separators.

Close-up of wide-pleat cartridge filter media.

Ambient humidity. If humidity is well-controlled in an indoor manufacturing space, it doesn't pose a challenge. However, if the collector is located outdoors, the filter media you select should be able to handle a wide range of environmental conditions.

For example, using nanofiber media aids surface loading and release. Spunbonded filter media handles heat and moisture better than cellulose-based products, and oleophobic and PTFE coatings promote dust release.

In addition, a wide-pleat filter allows the collected dust to release from the filter, keeping the pressure drop resistance lower through the filter for a longer time. When the pleats of the filter media cartridges are tightly packed, the dust collector's reverse-pulse-cleaning system won't eject the dust that has settled in between the pleats. Tightly packed pleats increase the resistance to the air through the filters and diminish airflow. Some wide-pleat filters use synthetic glue beads to hold the pleats open to ensure that the dust built up on the media releases during the filter cleaning process. These separators prevent the media from folding over on itself, which causes the filter to plug.

Antistatic filter media.

Summary

Effectively controlling the dusts generated in facilities that process and handle dry bulk solids is essential for the safety of employees, quality of products, and regulatory compliance. A high-efficiency dust collector designed specifically for your operation is an accepted and proven engineering control that will filter hazardous contaminants and combustible dusts to make indoor environments safer. With the help of engineering consultants and experienced equipment suppliers, processing facilities can minimize dust-related problems and maximize safety. **PBE**

For further reading

Find more information on this topic in articles listed under "Dust collection and dust control" in Powder and Bulk Engineering's article index in the December 2017 issue or the Article Archive on PBE's website, www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)

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