WHITE PAPER

How to reduce operating costs by selecting the right dust collector filter.

Today's concerns about cost control – coupled with stricter air quality and combustible dust regulations – make it more important than ever to choose and use the right dust collector filter for your application. This white paper reviews the general types of filtration media and offers tips on selecting the best filters to achieve cost savings, operating efficiency and compliance.

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AIR POLLUTION CONTROL

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Cartridge dust collection systems are the preferred technology for most dry industrial processing applications today, and there are many different pleated filter cartridges available for these collectors. As you face stricter air quality and combustible dust regulations, coupled with tighter internal cost controls, choosing and using the best dust collector filter for your process is more important than ever. Making an informed choice can improve your collector's dust capture efficiency and reliability while reducing energy and maintenance requirements.

High efficiency cartridge dust collector filters

Types of Filter Media

There are two basic categories of media commonly used in pleated cartridge filters. The choice is usually driven by dust type, operating temperatures and the level of moisture in the process.

1) Nonwoven cellulosic blend: This media is the most economical choice for dry dust collection applications at operating temperatures up to 160°F (71°C). Sometimes the fibers will incorporate a coating that enhances moisture resistance; however, cellulose media as a category are not as resistant to moisture as synthetic polyester.

2) Synthetic polyester media or polyester-silicon blend: This lightweight, washable media can handle dry applications with maximum operating temperatures ranging from 180°F (82°C) up to 265°F (129°C). These filters are washable and can recover from a moisture excursion but are not intended for wet applications.

Either type of media can be treated with a layer of nano fibers that boosts the efficiency and yields other benefits as well. Nano filter technology has advanced in recent years, and the newest generation of nano fibers can perform well even in the most extreme conditions. When a layer of nano fibers is applied on top of the base media, whether cellulosic or polyester, the nano coating promotes surface loading of fine dust, preventing the dust from penetrating deeply into the filter's base media. This translates into better dust release during cleaning cycles and lower pressure drop readings through the life of the filter – which, in turn, promote longer filter life as well as energy savings.

Standard and nano filter media can also 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. Companies involved in metalworking processes such as plasma and laser-cutting, grinding or welding commonly use filters with flame-retardant media.

Conductive or *anti-static* filters may be used where conveyed dusts generate static charges that require dissipation. Typically, static dissipation is achieved by impregnating a cellulose filter with a carbon coating or a synthetic filter with an aluminized coating. Applications for these filters include fumed silica dust; plastic, PVC or composite dusts; and carbon black/toner dusts.

Cartridge filters with anti-static media can also be used in explosive dust applications, making it possible to conform to NFPA requirements and lessen the risk of ignition sources due to static electricity charges. In combustible dust applications where the minimum ignition energy of the dust is below 3 millijoules (mJ), the NFPA requires the filters to be conductive, bonded and grounded to the filter housing.

Selection Tips

Following are five tips that can further help you determine the best filter for your application:

1. Understand the different measures of filter efficiency and how to apply them. There are two methods that dust collector filter manufacturers typically use to express filter efficiency. *Gravimetric analysis* is based on particle capture by weight: For example, filter efficiency might be stated as 99.995 percent on particles of 0.5 µm or larger by weight. Filter efficiency may also be expressed as a Minimum Efficiency Reporting Value or *MERV*, based on a scale from 1 to 16, with MERV 16 being the highest efficiency.

Bench testing identifies physical properties of the dust, aiding filter selection.

The MERV scale was developed for the HVAC filter market and does not take into account the way a dust collector operates (i.e., it pulse-cleans filters periodically when a dust cake builds up). Though MERV and gravimetric efficiency ratings are useful tools for comparing filters, you should not rely on these measures alone to determine efficiency. It is more relevant to make sure you are satisfying OSHA or EPA requirements for filter performance – OSHA if you are discharging the air and recirculating it indoors downstream of the collector, the EPA if you are discharging the air outside or into the environment.

Mass density efficiency, defined as the weight per unit volume of air, is the best predictor of a filter's OSHA compliance. For example, OSHA might require that emissions will not exceed 5 milligrams per cubic meter at the discharge of the dust collector. Similarly, the EPA doesn't care about percentage efficiency claims: They want to know that emissions will be at or below required thresholds, typically stated as grains per cubic foot or milligrams per cubic meter.

Concerned about which efficiency measure(s) to use? If so, you are not alone. But there is a way to cut through the confusion and make sure your bases are covered: Require your filter supplier to provide a written guarantee of performance stating that the filters you select will satisfy applicable OSHA or EPA requirements.

It is worth noting here that ASHRAE is developing a new standard specifically for measuring performance of dust collector filters. Finalization of that standard, however, is at least a couple of years away.

2. Test your dust.

The collection and testing of dust samples is a long-established practice used by manufacturing professionals to make informed dust collection decisions. While dust testing has always been good practice, it is rapidly becoming a necessity in today's regulatory climate.

An engineered test is performed at an official testing facility to confirm that this dust collector can withstand an explosive event. Scan QR code to view brief explosion test video.

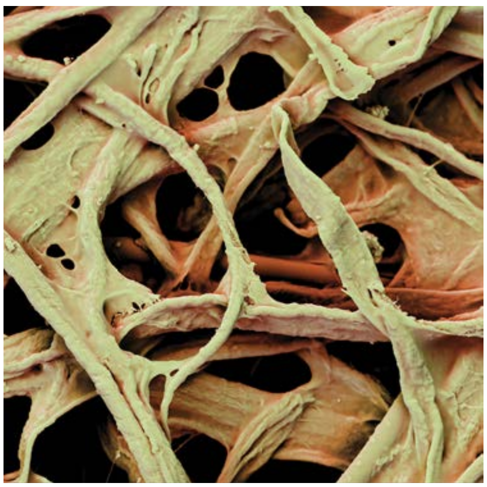
There are two types of dust testing: (1) bench testing, which pinpoints physical properties of the dust, and (2) explosibility testing, which determines whether a dust is combustible.

Bench testing involves a series of tests that provide valuable data for filter selection. *Particle size analysis* reveals the dust's particle size distribution down to the submicron range to determine the filtration efficiency needed to meet emissions standards. This test pinpoints both the count (the number of particles of a given size) and the volume or mass spread of the dust. Knowing both is important because many dusts are mixed.

A *video microscope* provides visual analysis of the dust shape and characteristics. Together with particle-size analysis, this tool is vital for proper filter selection. For example, a microscope may be needed to detect oil in the dust.

Moisture analysis equipment measures a dust's moisture percentage by weight, providing information that can prevent moisture problems. A *humidity chamber* is used to see how quickly a dust will absorb moisture. This helps to identify hygroscopic (moisture-absorbent) dust which requires widely pleated filter cartridges, as these sticky dusts cause filters to plug. Additional bench tests can help to determine the optimal design of other dust collection system components. It is not necessary to bench-test dust 100 percent of the time, but if there is anything at all unusual about the process and/or the dust, it's a good idea.

Base media with nano fiber coating



Base media with no coating

To determine whether a dust is combustible, it should undergo separate explosibility testing as stated in NFPA Standard 68. If a dust sample is not available, it is permissible to use an equivalent dust (i.e., same particle size, etc.) in an equivalent application to determine combustibility. But once the dust becomes available, it is still recommended that you go back and test the dust using either the 20-liter test method described in ASTM E1226-12a or the similar method described in ISO 6184/1.

Using your dust sample, the lab will start with a screening test to determine whether the dust is combustible. If the dust is not combustible, testing will stop there. If it is combustible, the lab will conduct further testing on dust cloud parameters to pinpoint the Kst (defined as the deflagration index of a dust cloud, or rate of pressure rise) and Pmax (the maximum pressure in a contained explosion).

Explosibility testing is performed primarily to help determine what explosion protection or prevention equipment is needed on your dust collector and related components. But it can also play a role in filter selection. For example, testing for the minimum ignition energy can help determine if conductive filters are needed.

3. Evaluate total cost of ownership.

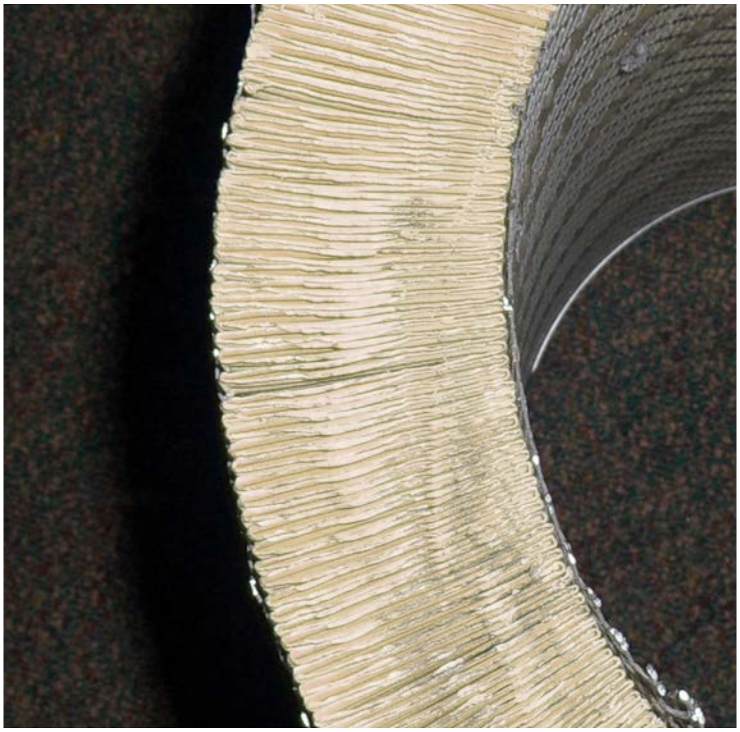
When choosing between two cartridge filters with the same rated efficiency, some purchasers will regard these items as a commodity and simply choose the lowest-priced filter. But as with most purchasing decisions, initial cost is only one factor, and it requires a "Total Cost of Ownership" (TCO) evaluation to make the best filter selection.

TCO helps you determine what it really costs to own your dust collector filters by calculating *all* the components of true filter cost: energy, consumables, and maintenance and disposal. A reputable filter supplier should have software to help you perform the calculations. The TCO evaluation will ultimately save you money, time and energy by ensuring the most cost-effective filter choice.

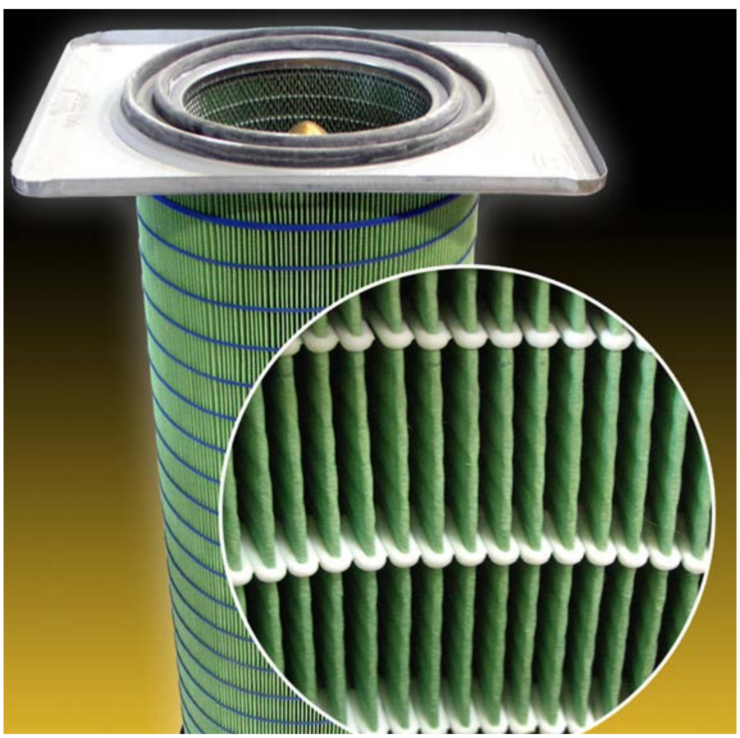
4. Consider a nano fiber media even if you do not have a "difficult" dust challenge.

When they were first introduced to the market, nano fiber media were regarded as a high-end choice limited to exotic or demanding dust capture challenges. Though these filters carry a cost premium, their use is becoming more widespread for all types of applications as plant managers and engineers come to understand their benefits. Compared to standard media, nano fiber filters offer higher filtration efficiencies as well as better energy performance, superior cleanability, and greater resistance to wear and tear from pulse-cleaning. Because of these benefits, some filter experts believe nano fiber media will become standard in the future.

As a rule of thumb, if you are looking for high initial filtration efficiency and better release of dust through surface loading, then nano fiber media should be the default choice. Beyond this, even for



Tightly pleated filter tends to trap dust within the pleats.



Open-pleated media allows the collected dust to release from the filter, keeping the resistance lower through the filter and extending filter life. Exploded view shows internal pleat separation technique.

a "non-high-performance" application, a TCO analysis (above) might be worthwhile to find out if the added cost of nano fiber media will be more than offset by resulting savings in energy and filter change-out and disposal costs. In a system operating at very high airflow, for example, a half-inch reduction in pressure drop achieved with a nano fiber filter can make a huge difference in energy consumption.

5. Look for a uniform wide pleat media design.

Many filter manufacturers add filter media to the point where the pleats are so tightly packed that when dust gets between the pleats, the reverse pulse cleaning system of the dust collector will not eject the dust from the pleats. This increases the resistance of the air through the filters and diminishes airflow. The key is to use a wide pleat where 100 percent of the media is usable.

A wide pleat filter allows the collected dust to release from the filter, keeping the resistance lower through the filter for a longer time. Some wide pleat filters use state-of-the-art technology of synthetic bead pleat separators to ensure pleats are kept wide and open for the best dust release possible. These separators prevent the media from folding over on itself, which could cause the filter to plug.

A wide pleat filter will often contain *less* total media area than a tightly pleated model. But the total square footage of the media is not what you want to look for: It's the total *usable* media area that's really important.

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About the author:
Rick Kreczmer has held numerous positions with Camfil APC, and currently serves as aftermarket sales manager.

Camfil APC (**www.camfilapc.com**) is a global manufacturer of dust, fume and mist collection equipment and is part of Camfil, the largest air filter manufacturer in the world. For further information, contact (800) 479-6801 or (870) 933-8048, e-mail **filterman@camfil.com**, or visit **www.camfilapc.com**.