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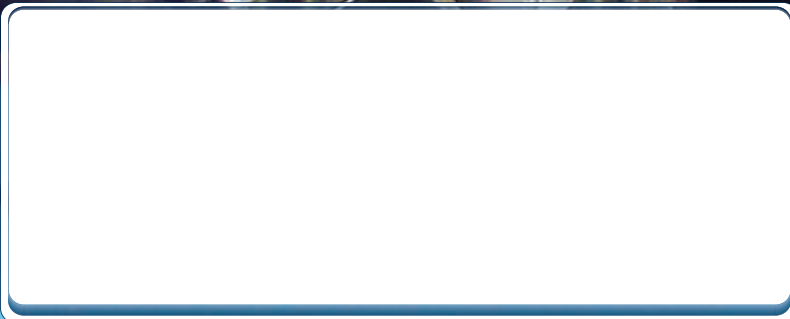
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- Trends in pleated cartridge filters
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MIXING AND BLENDING



Trends in pleated cartridge filters

Lee Morgan Farr Air Pollution Control

Choosing the right pleated cartridge filter can improve your cartridge collector's dust capture efficiency, help it operate more reliably, and reduce its energy and maintenance requirements. To help you make an informed choice, this article discusses some recent advances in pleated cartridge filter technology.

A cartridge collector is the most popular dust collector for bulk solids handling operations today. This high-efficiency unit is more compact than a baghouse collector and operates at a lower pressure drop. The cartridge collector can be designed to reduce emissions well below OSHA limits,¹ often allowing it to recirculate the air back to the plant for significant energy savings. However, many of us mistakenly think of the collector's replaceable pleated cartridge filters as generic, interchangeable items. In fact, design and performance can vary markedly from filter to filter.

Making an informed decision when selecting a cartridge filter can improve your collector's dust capture efficiency and reliability while reducing its energy and maintenance requirements. This means you need to consider several inter-related factors — including the filter's mounting position, media type, configuration, and pleat spacing — and recent technology advances for each. During your selection process, it can be helpful to work with an independent dust collection consultant. This expert can help you sift through the many new filter technologies available and find the right combination of filter features for your application.

Mounting position

How a cartridge filter is mounted or installed in the collector has a major impact on the pleated media's performance. In early cartridge collectors with vertically mounted filters and a clean-air plenum located at the collector top, dirty air would enter the collector's hopper and

flow upward into the filter housing, as shown in Figure 1a. During the cleaning cycle, dust could be cleaned off the filters only if the upward-flowing dirty air was flowing slowly enough to allow the dislodged dust to fight its way back down through the dirty airstream. This arrangement worked well for heavy dusts, but not for lighter ones.

The upward airflow through these cartridge collectors, where the media was packed much more tightly than in a baghouse collector, resulted in an upward *can velocity* (the average velocity of air approaching the filters using the collector's entire cross-sectional area) that created a limit on the amount of air that could enter a collector of a given size. For this reason, the next cartridge collector design incorporated filters mounted on their sides — that is, horizontally — so that the clean air plenum was now at one side of the collector, as shown in Figure 1b. The incoming airflow entered through the collector top, creating a down-flow effect to help dust dislodged during the cleaning cycle overcome the upward *can velocity* found in the older vertically mounted cartridge collectors. This design change improved the cartridge collector's performance over that of the older hopper-entry collector.

Yet mounting a filter on its side has some limitations. The biggest problem is that the dust doesn't get cleaned off the filter's upper side, causing the dust to blind at least one third of the entire filter, as shown in Figure 2. This dust accumulation increases the air-to-media ratio (determined by dividing the process air volume by the filter's media area; also called *air-to-cloth ratio*) and can lead to premature filter failure. One way to reduce this problem is to rotate each filter 180 degrees once a month. Another problem with horizontal mounting is that, because all the incoming dust enters at the collector's top and lands on the filter tops, there's no chance to preseparate heavy or abrasive particles from the dirty airstream. This can shorten the filter life.

Today's newest cartridge collectors have vertically mounted filters and a high, side-entry airflow inlet that directs the air into a cross-flow pattern across the collector at the same height as the filters, as shown in Figure 1c. The air first flows through a series of staggered baffles. These

baffles distribute the air throughout the housing and act as a classifier, separating the heavier particles so they drop straight into the hopper without contacting the filters. This cross-flow effect eliminates upward air velocity, thus providing a downward airflow pattern without having to turn the filters on their sides.

Media types

While many media types have been around for years, the range of available media for pleated cartridge filters is expanding as new technologies enhance media filtration and cleaning capabilities.

Available types and their applications. The most commonly used media in pleated cartridge filters is a nonwoven cellulose-synthetic blend. This media is an economical choice for dry dust collection applications at operating temperatures up to 180°F.

A polyester-silicon blend media with a melt-blown synthetic applied to its surface is a good choice for achieving emissions as low as 1 mg/m³ or less — far below the OSHA limit for nuisance dusts. This media can handle dry or moist applications with operating temperatures up to 180°F while providing a smooth surface for better dust release, thus facilitating filter cleaning.

Spunbonded polyester media is suited to applications with hot, moist airstreams in operating temperatures up to 250°F. The media can also handle hygroscopic dusts and applications requiring regular filter washdowns.

Although comparing the filters' total media area is useful, it's more meaningful to compare their usable media area.

Other specialized media have been developed for more demanding applications, including heat-resistant media for very high temperature applications, flame-retardant finishes for applications with flammable dusts, carbon-impregnated finishes for dissipating static, and ultrahigh-efficiency media for removing toxic dusts.

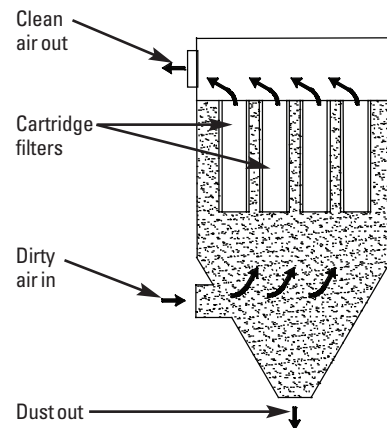
Media area and capture efficiency. Use caution when comparing the media area (stated in square feet or meters) in different cartridge filters. Although comparing the filters' *total media area* is useful, it's more meaningful to compare their *usable media area*. With horizontally mounted filters, a large proportion of their usable media area can be lost when dust collects on the filter tops, causing uneven dust loading around each filter. With vertically

mounted filters, pleat spacing and other filter design factors (discussed later in this article) can have a dramatic impact on how much media area is usable.

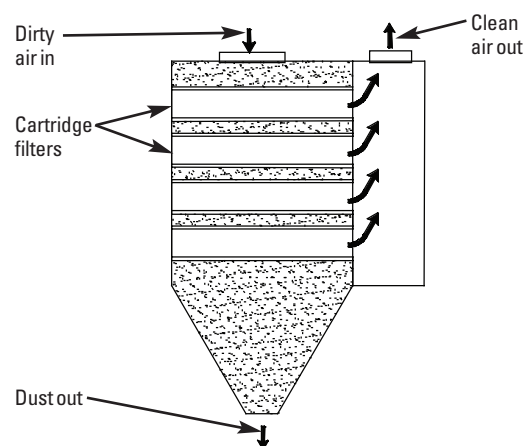
Figure 1

Cartridge collector designs

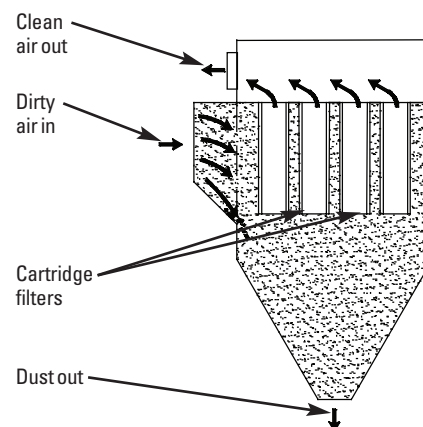
a. Airflow entry at hopper, vertically mounted filters



b. Airflow entry at top, horizontally mounted filters



c. Airflow entry at side, vertically mounted filters



Also don't rely on manufacturers' claims about a media's capture efficiency stated as a percentage, such as "99.5 percent efficiency." OSHA indoor air quality limits are measured not in percentages but in milligrams per cubic meter, so you must make sure that the amount of dust in your collector's exhaust is less than the established OSHA limits in these units of measure. A reputable collector or filter manufacturer should guarantee that emissions from your collector will be below OSHA's allowable threshold for your dust.

Filter configuration

In a standard cartridge filter, the pleated media is formed into a long cylinder and sealed at the top and bottom with end caps. Dust collects on the filter's outside surface and, during cleaning, is dislodged by a burst of compressed air blasted into the filter's interior. By knocking the dust off the filter's exterior, this reverse pulse of air cleans the filter so that it can filter more air.

One problem with a standard cartridge filter, whether mounted horizontally or vertically, is that a significant portion of the cleaning energy is wasted in pulsing the cartridge's bottom end cap, as shown in Figure 3a. Cartridge filters have recently been designed with an internal structure, such as a cone or barrel, made of pleated media (usually the same media as that in the outer layer) and with a bottom hole rather than an end cap. This allows the filters to use the pulsing energy that otherwise would have been wasted pulsing the bottom end cap and distribute the cleaning air more evenly through the filter, as shown in Figure 3b. The result is a lower pressure drop, requiring fewer cleaning pulses. The filters also prevent re-entraining the dislodged dust. As each cleaning air pulse comes out of the internal cone or barrel, it flows straight down

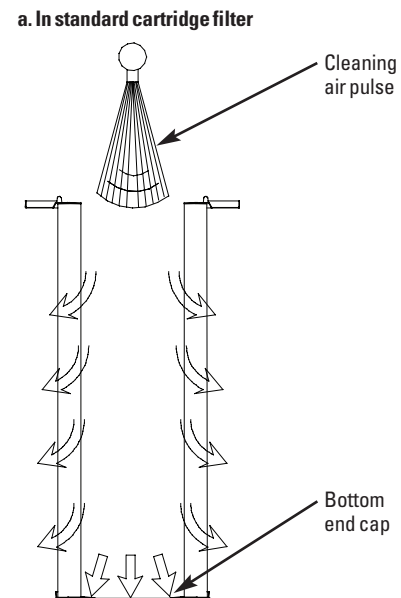
into the collector's hopper. This forces lightweight dislodged dust particles into the hopper and out of the incoming dirty airstream instead of pushing the dust toward the other filters during the pulse.

Pleat spacing

You also need to consider the spacing between the cartridge filter's pleats when selecting a filter. For years, one problem with pleated cartridge filters has been tight pleat spacing that prevents the dust building up in the pleats from being easily removed with reverse-pulse cleaning. Most filters are made with pleating machines that crease

Figure 3

Air distribution during pulse cleaning



b. In cartridge filter with internal structure

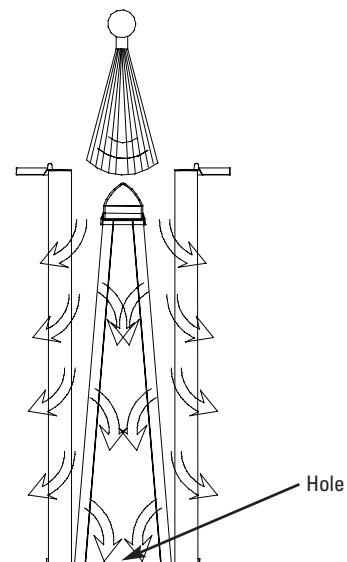


Figure 2

Dust accumulation on horizontally mounted cartridge filters



the media into an S shape, pinching off the pleat's bottom half (toward the filter's interior), as shown in Figure 4. This pleating method tightly compresses the pleats, leaving much of the media area unavailable for filtering and allowing dust to remain trapped in the filter even after cleaning.

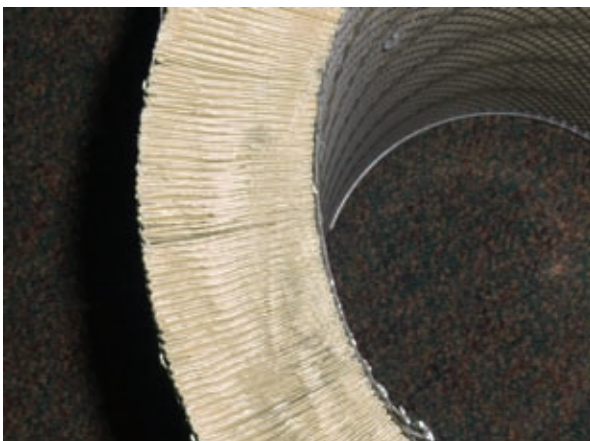
Filter manufacturers have developed cartridge filters with open-pleat designs to overcome these problems. One type is a spunbonded polyester open-pleat filter with pleats that are dimpled along their vertical length. This dimple prevents adjacent pleats from touching, making more usable media area available and facilitating dust release so that filter cleaning requires fewer pulses and, thus, less energy.

In another type of open-pleat filter, *hot-melt separator beads* — that is, intermittent beads or dots of hot-melt glue — between pleats on the interior media side form a rigid structure that maintains uniform pleat spacing, as shown in Figures 5a and b.² Based on a pleating method developed for manufacturing high-efficiency particulate air (HEPA) filter media for clean rooms, the hot-melt separator beads open up the entire pleat length, enabling the full pleat depth to be used for filtering and allowing higher air-flow per square foot of media than older pleating methods. By comparing the pleat spacing shown in Figures 4 and 5, you can see that the filter with hot-melt bead pleat spacing (Figure 5) has more usable media area than the filter with tighter pleat spacing (Figure 4). The greater amount of usable media area allows the filter to hold more dust between cleaning pulses, produces a significantly lower pressure drop, and improves dust release during cleaning.

In addition to considering pleat spacing, be cautious about selecting a cartridge filter encircled with an exterior cage. The cage is meant to help the pleats maintain their shape during reverse-pulse cleaning, but the cage covers some of

Figure 4

Tightly compressed pleats (top view)



the pleats' open area and can trap dust, preventing it from leaving the filter during cleaning and potentially shortening the filter's life. To avoid these problems, select a filter that uses cords, bands, or similar devices around the filter. These devices cover much less of the filter's open area and don't trap dust. **PBE**

References

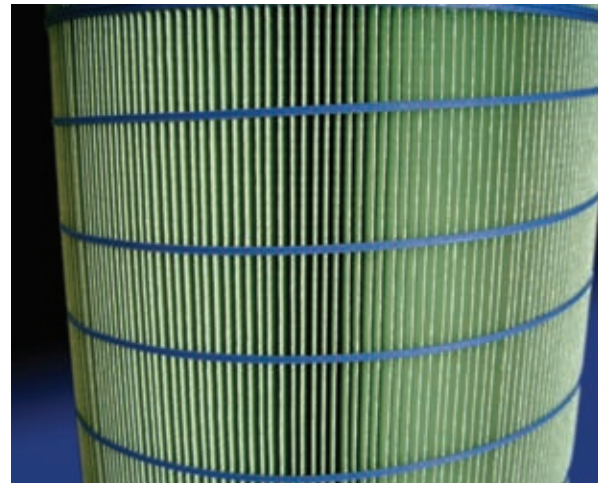
1. Find information on permissible exposure limits for your dust on OSHA's Web site at www.osha.gov (search for "permissible exposure limits"), or contact OSHA at 200 Constitution Avenue Northwest, Washington, D.C. 20210; 800-321-6742.
2. HemiPleat cartridge filter, Farr Air Pollution Control, Jonesboro, Ark.

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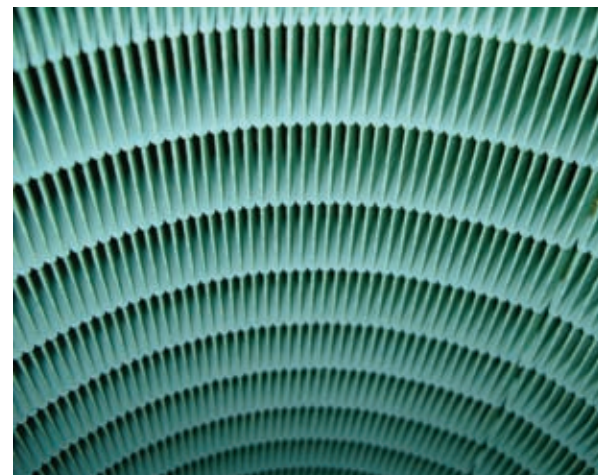
Figure 5

Open pleats made with hot-melt separator beads

a. Exterior view



b. Interior view





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