

ASKING THE RIGHT QUESTIONS ABOUT CARTRIDGE DUST COLLECTION

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Over the past decade, cartridge-style dust collectors have overtaken baghouses as the preferred technology for pharmaceutical dust collection. Combining maximum filtration efficiency with compact size and reduced pressure drop, a high efficiency cartridge dust collector will in most cases be the system of choice.

Choosing the best cartridge collection system for a given application, however, involves research and attention to detail. This article will review four key areas of investigation. By reviewing these topics with a knowledgeable equipment supplier and knowing the right questions to ask, engineers will be better equipped to make informed dust collection decisions.

1. Will the dust collector ensure compliance?

Engineers today must deal with an increasingly complex alphabet soup of regulations as the EPA, OSHA and other organizations continue to tighten air quality and safety requirements. Meeting these requirements should be first and foremost in any dust collection game plan. Failure to comply may result in fines, production shutdowns or costly litigation. In one recent case, a federal jury awarded \$20.5 million to the plaintiffs in a lawsuit involving workplace air quality.

Personal protection involves understanding the toxological properties of the material, reviewing the Occupational Exposure Limit (OEL) and performing a risk-based exposure evaluation to determine the methods for proper control. In many cases, some level of isolation and containment is required due to the fact that the pharmaceutical dust is extremely potent and must not be released into the surrounding environment while being captured.

How can engineers know if dust collectors will comply with OEL? The equipment supplier should provide a written guarantee stating the maximum emissions rate for the equipment over an 8-hour time weighted average (TWA).

Engineers should also become familiar with the National Fire Protection Association's new "*NFPA 68 Standard on Explosion Protection by Deflagration Venting*", which provides stringent and mandatory requirements for dust collection applications involving explosive dusts. The change from a guideline to a standard is enforced by OSHA, which in October 2007 launched a National Emphasis Program focusing on the safe handling of combustible dusts. Deflagration and explosion potential exists with most active pharmaceutical ingredients (APIs). Control measures such as explosion venting, chemical suppression and isolation systems may be required depending on the physical characteristics of the dust relating to K_{st} (a measure of the rate of pressure rise or deflagration index of a dust cloud), MIE (Minimum Ignition Energy) and the location of the collector. When explosion vents are required, they must be vented to the outside by either placing the collector outdoors or ducting the vent exhaust a specified

distance through the building structure. Farr APC recommends use of an independent professional engineer to specify what explosion protection is required for a given material as it relates to standards in NFPA, ATEX and the major insurance carriers.

The new directives are significant because many plants will now have to install updated dust collection/deflagration venting equipment or chemical suppression equipment that is manufactured in accordance with NFPA standards to ensure compliance.

2. Will it fix the problem?

Though compliance is a major issue, it is not the only issue. What else is the dust collector expected to do? Perhaps it must control API emissions to the established OEL, accommodate changes or expansions in the facility, or solve a performance problem experienced with an older dust collection system.

A good way to pinpoint objectives is by using a site survey form available from most equipment suppliers. This form typically calls for information on the process and the material to be collected, operating hours and conditions, electrical requirements, airflow and pressure ratings, and other specifics of the application. The survey will also call for detailed information on the physical properties of the dust (i.e., K_{st} and MIE, as required by NFPA 68).

Even if the dust is a commonly utilized excipient, something in the process may cause it to behave differently. Therefore, dust should always be tested, preferably using a sample collected from used filters. What are the median size and particle distribution of the dust? Is it in the shape of long fibers, needles, uniform spheres or jagged crystals? Is it combustible? Is it sticky or hygroscopic? These are just some of the characteristics that can and should be determined through a series of bench tests available from independent laboratories and many equipment suppliers.

A site survey coupled with lab testing is the best approach for determining the dust collector's required filtration efficiency and pressure drop across the filter media and, from this, what type of collector design and media will be most effective for the application.

3. Will it perform reliably?

Dust collection equipment can often be a maintenance headache, but this need not be the case. Reliability problems typically stem from neglecting or misunderstanding details about the unit's performance during the initial selection process or when changes are made in the facility. By following the steps above, engineers can help to ensure more reliable performance from their dust collectors.

Although the site survey and lab analysis typically provide enough data, in some cases the engineer may opt to commission full-scale dust collection testing. Full-scale testing typically requires a large dust sample that is run through dust collectors on a test rig in a simulation of real-life operating conditions. Pressure drop, dust load, filter media and other parameters can be varied to determine the optimal collector design. Full-scale testing is usually limited to analysis of difficult or hard-to-handle dusts, or applications where there is a history of chronic dust collector "upsets".

When selecting equipment, it also helps to be aware of design and technological improvements that can enhance reliability and performance. Examples include:

Horizontal vs. vertical cartridge mounting: Some pleated filter cartridges are mounted horizontally. The biggest problem with horizontal mounting is that the dust does not get cleaned off the top of the filter, causing the dust to blind at least one third of the filter, effectively reducing the functional surface area.

Also, because the incoming dust is dumped on top of the filters, there is no pre-separation of heavy or abrasive particles from the air stream, which can significantly shorten filter life.

An antidote to this problem is a system using vertically mounted cartridges. The best designs incorporate a high, side entry inlet with a series of staggered baffles that distribute the air and also separate out larger particles, dropping them straight into the hopper. This reduces the load on the filters and helps eliminate problems encountered with horizontal mounting by helping to maximizing of the effective surface area.

Advances in pleat spacing: Most dust collection cartridges use tightly packed media configurations. Though they offer high efficiency, much of the media surface area is unavailable for filtering, allowing dust to remain trapped within the filter even after pulse cleaning.

A recently introduced pleating technology makes use of hot melt separators that open up the full length of the pleat, allowing the entire depth of the pleat to be utilized. This design thereby allows significantly higher air flows per sq. foot of media than what has been achieved in the past, effectively maximizing the functional surface area.

Because virtually all the media surface is exposed to the air stream, the filter tolerates more dust between cleaning pulses. The open pleat design also results in significantly lower pressure drop as well as improved dust release characteristics during pulse cleaning, using fewer pulses, and therefore less energy.

4. Will it provide the best possible return on investment (ROI)?

Although initial capital expenditure is important, it is not only the initial cost but also the *total life cycle cost* that is important. What will it cost to operate and maintain the unit and as well as the frequency of filter replacement? How much compressed air will it use? Can it save on maintenance of electrical components such as motors and control panels that are exposed to the dust?

A final consideration revolves around the ease of manipulating and servicing the dust collector's components. Is the dust collector user-friendly? This is important since maintenance personnel time is a cost factor. If the filters last nearly twice as long as competing technologies, and slide in and out more easily, there is both an economic benefit and a safety benefit. Obviously the fewer man-hours spent on filter changeout, the more cost-effective the dust collector becomes..

User-friendly designs also create several safety benefits such as reduced exposure to dusts by reducing the frequency and time of each filter change. A user-friendly design becomes even more important for operations and maintenance personnel when utilizing contained dust collectors, because if a system is difficult to service, there is a greater chance of circumnavigating the safety features: I.e., containment is operator dependent.

A reputable equipment supplier can analyze the various cost and safety factors and help analyze the best ways to improve ROI and get the most out of dust collector performance.

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