ASKING THE RIGHT QUESTIONS ABOUT CARTRIDGE DUST COLLECTION

By John Dauber, North American sales manager, Camfil Farr Air Pollution Control

Over the past decade, cartridge-style dust collectors have overtaken baghouses as the preferred technology for dust collection for the processing industries. Combining high efficiency filtration 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 several key areas of investigation. By reviewing these topics with a knowledgeable equipment supplier and knowing the right questions to ask, engineers and other processing professionals will be better equipped to make informed dust collection decisions.

1. Will the dust collector comply with emission requirements?

Engineering and operations departments 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 well-publicized case, a federal jury awarded $20.5 million to the plaintiffs in a lawsuit involving inhalation of welding fumes.

Cartridge collector equipped with safety monitoring filter bank.

OSHA has established permissible exposure limits (PEL) for hundreds of dusts ranging from nonspecific or "nuisance" dust to highly toxic substances. These limits are based on 8-hour time weighted average (TWA) exposure. Further information on PELs can be found at http://www.osha.gov/SLTC/pel/. One area of concern involves stricter limits on exposure to hexavalent chromium, a known carcinogen generated by processes

such as welding or cutting of stainless steel, thermal spraying, and application of anticorrosion paints for aircraft and military use. OSHA has set thresholds as low as 5 micrograms (0.005 milligram) per cubic meter TWA. This is 10 times stricter than the limits for some other toxic dusts. Dust collectors need to be equipped with very high efficiency filtration media to meet such requirements.

How do you know if your dust collector will comply with emission thresholds? The equipment supplier should provide a written guarantee stating the maximum emissions rate for the equipment over an 8-hour TWA. Filter efficiency stated as a percentage is not an acceptable substitute, even if the supplier promises 99.9 percent efficiency. OSHA only cares that the quantified amount of dust in the air is below established limits.

While OSHA guidelines must be met, it is also good practice to follow the guidelines published by the American Conference of Governmental Industrial Hygienists (ACGIH). The guidelines in this manual are sometimes a little tighter than those OSHA has adopted.

2. Do I have a combustible dust issue?

You should also become familiar with the National Fire Protection Association's "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 2008 reissued a National Emphasis Program focusing on the safe handling of combustible dusts. More recently, in an Advance Notice of Proposed Rulemaking (ANPR) published in the October 21, 2009, Federal Register, OSHA announced its intent to develop a comprehensive federal safety standard on combustible dust – further evidence that compliance in this area will continue to be a top priority.

Kst Values of Common Dusts

Common Dusts	Micron	Kst Value
Activated Carbon	18	44
Aluminum Grit	41	100
Aluminum Powder	22	400
Asphalt	29	117
Barley Grain Dust	51	240
Brown Coal	41	123
Charcoal	29	117
Cotton	44	24
Magnesium	28	508
Methyl Cellulose	37	209
Milk Powder	165	90
Paper Tissue Dust	54	52
Pectin	59	162
Polyurethane	3	156
Rice Starch	18	190
Silicon	10	126
Soap	65	111
Soy Bean Flour	20	110
Sulphur	20	151
Tobacco	49	12
Toner	23	145
Wood Dust	43	102

Figure 1. Kst values of common dusts

The explosive power of a dust is denoted as "Kst", the rate of pressure rise. Figure 1 compares the Kst values of a number of common dusts. For a much more comprehensive compendium, go to http://www.dguv.de/ifa/en/gestis/expl/index.jsp. This web site contains a European database known as "GESTIS-DUST-EX" that lists the combustion and explosion characteristics of more than 4,000 dusts. The database provides a useful reference point, although it is not a substitute

for the required dust testing. To determine whether your particular dust is combustible, it must undergo explosibility testing in accordance with ASTM test methods.

Explosive dusts can be organic or metallic in nature and are present in a long list of manufacturing industries including agricultural, chemical, food, paper, pharmaceutical, textile and woodworking. Under the new directives, any dust with a Kst value >0 is considered to be potentially explosive. This is significant because, to ensure compliance, many plants now have to install updated dust collection/explosion venting equipment that is manufactured in accordance with the latest NFPA standards.

3. Will my collector 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 reclaim valuable product, maintain a higher level of cleanliness in manufacturing areas, accommodate changes or expansions in the plant, 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.

Even if the dust is a common type, such as wood dust, 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, uniform spheres or jagged crystals? Is it combustible? Is it sticky or hygroscopic? These are just some of the characteristics that can 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.

This dust collector explosion vent is manufactured in accordance with the latest NFPA standards to protect against combustible dust hazards.

4. 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 plant. By following the steps above, you can help to ensure more reliable performance from your dust collector.

Although the site survey and lab analysis typically provide enough data, in some cases you may opt to commission full-scale dust collection testing. Full-scale testing typically requires a large (55-gallon) dust sample that is run through a full-size dust collector on a test rig in a simulation of real-life operating conditions. Dust particle size, pressure drop and other parameters can be precisely monitored and real-time emissions monitoring can be performed. Full-scale testing is usually limited to analysis of difficult or hard-to-handle dusts, or applications where emissions control requirements are particularly stringent.

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 on their sides. 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.

Horizontally mounted filters are subject to uneven dust loading, leading to shorter filter life and potential fire or explosion hazards.

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. This situation can shorten filter life or, in spark-generating applications, pose a fire hazard because any spark entering the collector will come into direct contact with filter cartridges.

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.

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.

Because virtually all the media surface is exposed to the air stream, the filter holds more dust between cleaning pulses. The open, breathable 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.

The open-pleated design of this filter results in significantly lower pressure drop as well as improved dust release characteristics during pulse cleaning.

5. Is the collector optimally equipped for safety?

While the most basic function of a dust collector is to keep workers and workplaces safer, not all collectors are created equal from a safety standpoint. As noted above, vertically mounted cartridge systems offer inherent safety advantages over horizontally mounted cartridges. Here are some additional features to consider as you work with your equipment supplier:

Cartridge dust collector equipped with an OSHA-compliant safety platform.

OSHA-compliant railed safety platforms and **caged ladders** can prevent slips and falls when workers access the collector for service. **Lock-out/tag-out doors** prevent injury caused by inadvertent opening of doors during a pulsing cycle and/or exposure to hazardous dust. Where highly toxic dust is being handled, a **bag-in/bag-out (BIBO) containment system** may be required to isolate workers from used filters during change-out.

Ease of filter change-out should be explored. Are the filter cartridges positioned for ease of access? Do they slide in and out of the housing readily? Pulling out a dirty overhead filter that weighs 100 pounds can result in neck, back and foot injuries, so make sure the collector you choose is service-friendly.

Fire and explosion prevention must also be optimized. A range of features and technologies can be employed, from vertical mounting to the use of flame-retardant filter media to spark arrestors and sprinkler systems. Where explosive dusts are present, approved explosion vents and/or other components will be needed for controlled deflagration.

You might also want to equip your collector with a **safety monitoring filter**. This is a secondary bank of high efficiency air filters that prevent collected dust from re-entering the workspace if there should be a leak in the dust collector's primary filtering system.

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

A safety monitoring filter is a required component in a recirculating dust collection system that recycles air downstream of the collector. Where feasible, the best way to maximize ROI is through use of a recirculating system. By recycling heated or cooled air back through the plant, the cost to replace that conditioned air is eliminated. Many plants report five- to six-figure annual energy savings. Also, dust collectors in shops with high ceilings can often improve the efficiency of a heating system by taking hot air off the ceiling and delivering it at ground level.

Another advantage of recirculating systems is the reduction in regulatory paperwork. By containing the air indoors, the engineer can deal with OSHA and avoid the time-consuming EPA permitting involved when contaminated air is exhausted outside. Recirculating systems have special safety and performance concerns that must be addressed, but the payback can still be substantial.

Finally, it is not initial cost but total cost of ownership that counts. What will it cost to operate and maintain the unit and replace the filters? How much compressed air will the collector use? Does the system incorporate "green" features such as variable frequency drives and premium efficiency fan motors that can reduce energy costs and sometimes be eligible for utility rebates or incentives? Can it save on maintenance of electrical components such as motors and control panels that are exposed to the dust? A reputable equipment supplier can project these costs mathematically and help analyze the best ways to improve ROI and get the most out of dust collector performance.

Special features such as this premium efficiency fan motor can reduce energy costs and save on total cost of dust collector ownership.

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