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TECHNICAL ARTICLE DUST COLLECTION STANDARDS

# Upgrading your dust collection system to meet tougher government standards and increase profits

**Dust collection system upgrades are a hot topic in the bulk solids industry these days. Users are improving their systems not only to comply with increasingly strict government emission and safety stands, but to increase system operating efficiency and company profits. Read this article for practical advice on how to upgrade your dust collection system to meet government standards and boost your bottom line.**

Effective, safe dust collection is becoming a more challenging issue every year for bulk solids plants. The primary drivers are increasingly stringent government regulations for fine particulate emissions and explosion protection and manufacturers' increasing focus on the bottom line by using smaller, more efficient dust collection systems.

## Improving dust collection to comply with government air quality and safety regulations

Bulk solids plants are working hard to reduce stack emissions and comply with stricter air quality standards. If an OSHA audit reveals that a plant has failed to comply with emission limits, fines and penalties can cost the company hundreds of thousands of dollars. Ultimately, the plant is responsible for complying not only with EPA requirements, but all OSHA and NFPA requirements governing the collection and safe removal of dust, both inside and outside the plant. While particulate emissions from plant stacks can be controlled with effective dust collection systems and filter media, complying with government regulations is more than using the right equipment. Limiting dust generation at its source and following safe work practices throughout the process line and plant are key. The many headline-making catastrophic dust explosions in bulk solids plants in the last several years highlight the need for managing your plant's dust hazard and explosion risks with effective dust control.

## Starting with business risk management and Hazard analyses

The first step in protecting your workers from dust exposure and combustible dust explosion hazards is to identify your plant's unique operational risks. You can do this by contracting a business risk management company or independent consultants to walk through your plant and identify dust sources and hazards throughout the facility. Based on the results, you can work with this expert to develop an overall explosion protection strategy that covers your entire plant.

To go a step further, you can contract a dust hazard analysis expert (who can be a dust collector supplier's engineer or an independent consultant) to identify dust hazards specifically related to your dust collection system, including components inside and outside the plant. This third party hazard analysis will provide a qualified look at your entire dust collection system, including fans and duct work. The dust hazard expert will evaluate the system's performance and airflow, review system emissions, and recommend appropriate filter media for your dust collector. This information can help you complete a final hazard analysis report for your plant, which should

include an executive summary, registration information, an off-site consequence analysis, a 5-year accident history, a prevention program, and an emergency response program. In the event that OSHA cites your plant for failing to meet emission standards, having the hazard analysis report on file and system improvement steps underway can buy your plant probationary time to correct the problems.

Once you've completed the business risk and dust collection system hazard analyses, you can take steps to meet EPA, OSHA, and NFPA requirements by eliminating the dust hazards. These steps include redesigning equipment, improving handling methods, and using explosion protection devices to safeguard your workers, equipment, and plant.

**Redesigning equipment and improving handling methods**

For bulk solids plants, uncovering operational risks through a third-party hazard analysis report often leads to redesigning material handling and dust collection equipment and finding alternative handling and dust mitigation methods. Examples are switching from an open conveyor to a pneumatic conveying system, eliminating dust-generation points, and adding a central vacuum system.

Switching to pneumatic conveying: Unlike an open mechanical conveyor, a pneumatic conveying system encloses the material during transport, greatly reducing if not eliminating fugitive dust. Besides protecting the material from contamination, the enclosed conveying line virtually eliminates material breakage into smaller particles that can create a dust hazard. As a further safeguard against dust, not only does the system's receiver separate particles from air, it integrates dust filtration into the conveying process. The system also has fewer moving parts and offers greater flexibility than many mechanical conveyors for handling future plant expansions or changing needs.

*In this sand and gravel facility, a cartridge dust collector replaces an inefficient baghouse to meet EPA emissions standards and improve dust collection efficiency.*

Eliminating dust-generation points: By ensuring that material transfer points and handling and processing systems are dust-tight, you can prevent dust from escaping into the environment and becoming a safety hazard. At any point in the process where this isn't possible, you need to use integral or ancillary dust collectors. Examples are integrating a collector into your process (such as using a bin vent on a silo or small collector in a milling system) or adding an ancillary collector to particular equipment (such as equipping a bucket elevator with an aspirator or adding a displacement air collector to a loadout spout).

Adding a central vacuum system: Your dust collection system alone can't keep your plant clean and entirely dust free, so include regular floor-to-ceiling housekeeping in your plant maintenance program. Manually shoveling or sweeping dust or using compressed air to blow it off surfaces not only is labor-intensive but often lifts additional dust into the air. An effective way to clean dust from your plant while minimizing dust recontamination and housekeeping labor is to install a central vacuum cleaning system. This system can be customized to suit your plant's processing and handling needs. If you have a big, multistory plant, you can use a large permanently installed system designed for use by multiple operators in various locations. For a smaller plant or single process line, a portable system for use by a single operator can be the better choice; this system can be moved on a wheeled base or forklift from location to location in your plant. Either type can efficiently remove light dust during routine floor and wall cleaning or deal with large material and dust spills that would otherwise require heavy manual lifting or large equipment to remove.

Together, these material handling and dust collection improvements can limit fugitive dust emissions, minimize your safety concerns, reduce your housekeeping and maintenance costs, and help your plant conform to – or exceed – government safety standards.

**Using explosion protection to safeguard your workers, equipment, and plant**

To select effective explosion protection equipment for your dust collection system, you need to evaluate your dust's explosion potential. This requires knowing the dust's $K_{St}$ value – that is, a factor that identifies the material's exclusivity characteristic. This factor is influenced by the dust's particle size and moisture level, its rate and speed of explosion, the amount of energy required to control the explosion, and the temperature required to ignite the dust. If your material has a $K_{St}$ value over zero, it's at risk of exploding.

In addition, any combustible dust with a particle size of 420 microns or smaller can react rapidly when exposed to oxygen and an ignition source, causing a wave of multiple explosions. On a flat surface, a 1/32 – inch dust layer – only as thick as a paper clip – is a combustible hazard. Smaller particles that can float upward and land on roof rafters and other high surfaces pose an even greater combustible hazard.

You can use any of several explosion protection devices or systems to safeguard your workers, equipment, and building from a combustible dust explosion. These devices and systems can be passive or active. They vary in cost and must be chosen to suit to your enclosed equipment and its location. A passive explosion protection device, such as an explosion vent, is less costly and easier to use than an active system because it simply directs the explosion pressure and flame to a safe area. An active system, such as an explosion-suppression system, detects system changes (usually a pressure increase) likely to lead to a deflagration and then prevents or controls the event.

Passive explosion protection: You can provide passive explosion protection for your outdoor dust collector (or another enclosed piece of equipment) by installing an appropriately sized explosion vent on it. If a deflagration occurs, the vent will burst open, protecting the collector from over pressurization and directing the pressure and flame to a safe area away from the plant and workers. The collector must also be equipped with isolation devices, such as rotary airlock valves, fast-acting slide-gate valves, or chemical blocking devices, to prevent the deflagration from propagating through connecting ductwork to other equipment. If the collector is located indoors, it must be placed adjacent to an exterior wall so the deflagration can be safely ducted outdoors, away from the building.

If it's not possible to provide vent ducting through an exterior wall from your indoor collector, you can use a flame-arresting, particulate-retention device called a flameless explosion vent on the unit. However, a flameless vent is considerably more expensive than a standard explosion vent and also must be used with isolation devices to prevent the deflagration from propagating to connected equipment. If your application doesn't allow the use of a standard explosion vent, it makes sense to directly compare the cost of a flameless vent with that of an active explosion protection system before you select either method.

Active explosion protection: The most common active explosion protection system, an explosion-suppression system, typically prevents or controls a deflagration by detecting a developing deflagration and then immediately filling the dust collector with a chemical flame suppressant. The system includes controls with a power supply and monitoring capability, a device for detecting the pressure increase (or other change) prior to a deflagration, fast-acting isolation devices at connecting ductwork, and canisters filled with pressurized chemical suppressant (such as sodium bicarbonate). When the detection device signals the system controls that the pressure has increased to a predetermined level, the controls rapidly deploy the isolation devices to prevent the pressure and flame from propagating and release the chemical suppressant into the collector.

The explosion suppression system has two advantages over passive devices: First, the system suppresses the deflagration before it can escalate to a fire event, limiting damage to the collector and reducing process downtime after an event. Second, unlike an explosion vent, the system can be used on a collector located inside the plant and away from an exterior wall. Although the active explosion suppression system is often considered more costly than a passive device, a collector fitted with an explosion vent must also be equipped with isolation devices and controls, making the costs of both approaches comparable.

However, the active system's detection devices and controls make it more complex than a passive system. The active system also requires regular inspections and maintenance. While in the past active systems were subject to false positives due to equipment-generated pressure fluctuations, today's systems have advanced electronics that improve their controls' stability, eliminating most of the false positives and increasing this protection method's popularity.

**Retrofitting your dust collection system to improve operating efficiency and capacity**

The recent recession has many bulk solids practitioners examining their manufacturing processes for ways to increase production capacity and profitability. They're finding that smaller, more efficient processing systems equipped with new technologies can run longer, avoid costly shutdowns, and yield more profits. While some plants are building new facilities, many are retrofitting their existing processes to get the most out of limited space, shrink operating costs, and reduce dust emissions.

In bulk solids plants, a major focus of this retrofitting trend is creating a dust- and emissions-free operation. This requires examining and upgrading your plant's dust collection system to ensure that it can effectively filter the dust from your process. Retrofitting your existing dust collection system with more advanced components can also translate into lower energy costs.

Typical retrofits for a dust collection system include redesigning the system's ductwork, collector inlet, and capture hoods for better efficiency and retrofitting the dust collector (including selecting more effective filter media or changing the filter quantity and size, or both). In some cases, replacing the collector with a more efficient model can be a better option. Regardless of what kind of upgrades you make, work closely with a dust collector supplier or dust consultant to avoid making a costly mistake.

**Redesigning the ductwork, collector inlet, and capture hoods**

Redesigning your dust collection system's ductwork and collector inlet for even airflow into the collector minimizes wear on the filters and collector housing. Ductwork can be reconfigured with long duct transitions to decrease dust-laden air velocity into the collector housing, and duct elbows can be redesigned with internal turning vanes to minimize airflow turbulence that increases wear it bends. The collector inlet can be reconfigured to minimize filter and housing wear based on your material's bulk density and the grain loading (number of grains [1 grain equals 1/7,000 pound] per cubic foot of air) you desire through the system. By adding more capture hoods to the system or redesigning the existing hoods, you can provide more effective dust capture throughout your process.

**Retrofitting the dust collector**

You can retrofit your existing collector to make it mechanically sound and leak-free by replacing the filter-cleaning system's timers, solenoids, diaphragms, and other parts and replacing or upgrading the bag filters (and cages) or cartridge filters.

*Replacing a baghouse with a cartridge dust collector improves worker safety by eliminating the dangerous confined-space entry required for bag filter changeouts.*

Upgrading your filters is one of the most effective ways to increase your plant's overall production efficiency and meet emission and safety standards, thanks to recent filter media advances that have greatly improved bag and cartridge filter efficiency and performance. The filter type and media that are best for your dust collection system will depend on your application requirements. You also need to consider the filter's costs – initial,

operating, and maintenance – to evaluate the filter's return on investment in your application. Before you select a new filter, work with a filter media supplier or consultant to make sure you understand available filter types and media, how well they can meet your requirements, and what kind of return on investment they can provide.

Cartridge filters are becoming increasingly popular for dust collector upgrades because of the cartridge filters' advantages over bag filters. These include providing an improved air-to-cloth ratio (or air-to-media ratio; the ratio of dust-laden air in actual cubic feet per minute [acfm] to 1 square foot of filter media surface), better filtering efficiency, lower cleaning costs, and easier installation.

Improved air-to-cloth ratio and filtering efficiency: The pleated media in a cartridge filter provides from 2.5 to 3 times more filter area than that of a comparably sized bag filter, providing a better air-to-cloth ratio in the same collector housing size. Collectors are sized based on the air-to-cloth ratio, so if you're upgrading from bag filters to cartridge filters in your existing collector, the cartridge filters will increase the amount of airflow through the same collector housing, increasing system capacity. If you're replacing an existing collector, using cartridge filters allows you to install a new collector with a smaller footprint, reducing the unit's steel costs while increasing filtering efficiency.

Lower filter-cleaning and easier installation: The smooth media finish of a cartridge filter allows the dust cake to be easily dislodged with lower compressed-air pulse pressure during filter cleaning. While polyester bag filters typically require from 90- to 100-psi cleaning air pressure, cartridge filters require from 60 to 70 psi, reducing the cleaning system's compressed-air costs. Using cartridge filters also reduces and makes it easier to install and replace filters, reducing the collector's maintenance costs. While the cost of bag filters and cages can make them less expensive to replace, new manufacturing methods for cartridge filters are reducing their costs.

**Replacing your collector**

You can also replace an aging, inefficient baghouse with a cartridge dust collector that incorporates the latest dust control advances. This can meet several goals: The new collector can filter your dust more effectively and use up to 50 percent less energy than the old collector.

Cartridge filters can be replaced from outside the collector, improving worker safety by eliminating the dangers of confined-space entry during bag filter changeouts.

One caution: Avoid replacing your existing collector with a used dust collector bought through an online auction site. Although the used collector's purchase price can make it attractive, it's really a false economy, because buying another plant's old collector can leave you with a lemon that won't meet your needs. Instead, you need to properly select and size the collector and fan, engineer the ductwork and capture hoods, and select the right filter media for your application.

The result will be a balanced dust collection system that has enough constant airflow and vacuum pressure to maintain good dust control in your plant. The system can not only help your plant meet emission and safety standards, but also increase your company's profits by operating more efficiently and providing greater capacity.


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