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## Dry media or wet scrubber?

Selecting the right equipment for combustible dust control.

By John Dauber, John Davidson,  
and Mike Walters

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**C**ombustible dust explosions are a risk in virtually any industrial manufacturing facility. Materials that are combustible as a solid will probably present a deflagration and/or explosion hazard when divided into a fine particulate through various manufacturing and reduction processes. These processes include but are not limited to machining, sawing, grinding, buffing, polishing, fettling, brushing, drilling, cutting, and abrasive blasting. Materials that can explode as a dust include most organic materials and many metals, which tend to have extreme combustible and explosive properties.

Any process producing airborne dust must also be controlled to minimize health hazards. OSHA has established minimum personal exposure limits (PELs) for respirable materials. A facility must make sure that emission levels within the plant stay below these exposure thresholds.

Thus, plant engineers are faced with a balancing act of finding the best dust-collection system to capture process dust effectively while controlling the hazards associated with these dusts—in the safest yet also most cost-efficient manner possible. Two basic types of dust collection systems are used in these situations:

### 1. Dry dust collectors

NFPA defines dry collectors as cyclones and media collectors including baghouses and cartridge collectors. This article focuses on media collectors that use high-efficiency filter cartridges to capture industrial dusts. Typically, dust-laden air enters the collector through a baffled inlet and is collected on the filter media. Periodic bursts of compressed air dislodge the dust from the filters and into a hopper, from which dust must be periodically emptied.



**“White collector”:** This cartridge collector, also used in a pharmaceutical applications, is equipped with an explosion vent with a vertical upblast-deflector plate.

**“Venturi scrubber”:** This venturi-type wet scrubber is used for combustible dust control in an automotive-parts manufacturing plant.

Cartridge dust collectors are available with a wide choice of primary filtration media that can achieve very high efficiencies on fine particulate. Specialized media deliver additional properties like fire resistance, static conductivity, and resistance to adhesive materials. In situations where materials have very low OSHA PELs, a HEPA-grade secondary filter can be added to the system to achieve cleanroom-grade efficiencies. This is important if the exhaust air is returned to the factory.



## 2. Wet collectors

“Wet” dust collectors, also called wet scrubbers, filter dust by impingement with water droplets. The smaller the droplet, the more efficient the scrubber. Various designs incorporate spray nozzles, misters, cyclonic action, venturi dispersion, and/or wet impingement configurations to capture the dust. Once captured, the water and dust drop into a settling tank where they are either separated by gravity or the dust is skimmed from the surface.

A venturi scrubber typically employs venturi-shaped construction and a spray nozzle on the inlet, which accelerates the water to break it into a fine mist. The higher the velocity, the more efficient the collector

becomes. As this occurs, the pressure drop through the system also increases sharply. Design airflow must be maintained constantly or filtration efficiency will drop.

Cyclonic or centrifugal-type scrubbers employ a variety of techniques as listed above. The image to the left shows a cutaway view of a cyclonic wet scrubber with an integrated fan/ventilator.

Wet scrubber filtration efficiencies are dependent on numerous factors—most important, the particle size of the dust being collected.

If particles are smaller than 10 microns, a venturi scrubber should be used. The higher velocities through the venturi create a finer mist that helps capture the smaller particles, but it also increases energy requirements due to the high velocities going through the venturi. If particle size is more than 10 microns, a cyclonic collector will save significantly on energy.

Maintaining a clean- or recycled-water supply is important with scrubbers. The concentration of dust particles in the scrubbing fluid must be kept at less than 5% to maintain operating efficiency. In the case of combustible metals, the amount allowed to accumulate in the

discharge vats is prescribed in NFPA 484: Standard for Combustible Metals.

### Deciding between wet and dry systems

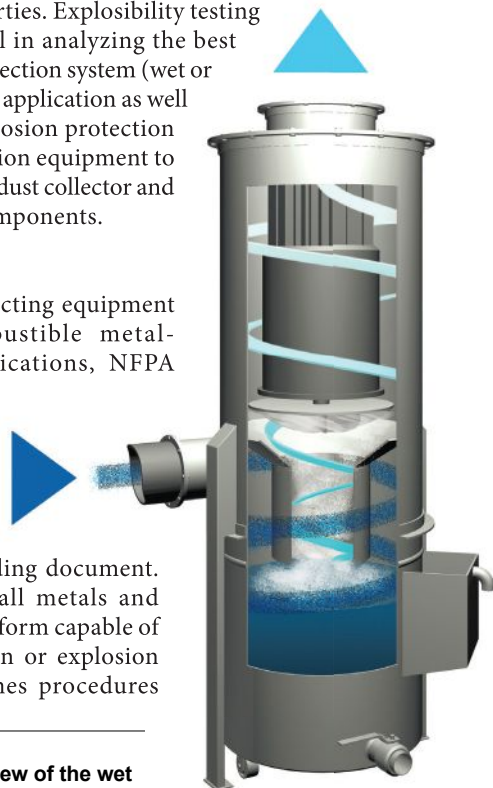
An important advantage of wet scrubbers is that when combustible dust particles are captured into the scrubbing liquid, they are removed from contact with oxygen and the combustible dust hazard is controlled. Many metal dusts, however, are reactive with water and other metals and may produce hydrogen gas. This should be considered before selecting a wet scrubber. Also, many dusts can be considered hazardous, and disposing of wet materials may be costlier than disposing of dry materials due to regulations.

Dry media collectors are inherently at higher risk of a combustible dust explosion. As a result, they require more ancillary explosion-protection equipment to meet NFPA standards and control the hazards. Dry collectors typically can scale up to very large airflows and heavy dust loads whereas wet collectors would require multiple systems to handle larger airflows. Heavy dust loading with a wet collector also means more water consumption and treatment. Table 1 provides a general comparison of wet and dry dust collectors.

Sometimes the choice between a wet or dry media system will not be clear-cut. Dust testing is the first step in the decision-making process. Two types of testing are recommended: (1) lab testing, which pinpoints physical properties of the dust that affect filter efficiency and performance; and (2) explosibility testing, which determines combustible and explosibility properties. Explosibility testing is essential in analyzing the best type of collection system (wet or dry) for an application as well as the explosion protection or prevention equipment to use on the dust collector and related components.

### NFPA 484

When selecting equipment for combustible metal-dust applications, NFPA 484—the standard that best-addresses wet collection—is the guiding document. It covers all metals and alloys in a form capable of combustion or explosion and outlines procedures



Cutaway view of the wet collector.

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to determine whether a metal is in a combustible or noncombustible form. It also applies to processing or finishing operations that produce combustible metal powder or dust.

Though NFPA 484 is specific to metals, some of its content can and should apply to nonmetal combustible

(i.e., organic) dusts. Here are some key points to consider.

### Hazard analysis

Process hazard analysis (PHA) and risk assessment are tools used to improve safety by identifying hazards such as combustible dust deflagra-

tion, fire, and explosion hazards. The analysis should start at the design phase of a project and follow the process to the end of its lifespan with periodic reviews and updates.

NFPA 652: Standard on the Fundamentals of Combustible Dust is a new standard released in October 2015. It is now the starting point for defining a combustible dust and its hazards. Its purpose is to clarify the relationship between the shared standards and the industry-specific standards such as NFPA 484 for metals, NFPA 664 for wood, NFPA 655 for sulfur, and NFPA 61 for food processing. NFPA 652 introduces a new term, “dust hazard analysis” or DHA, to differentiate this analysis from the much more complex PHAs required by OSHA for the chemical process industry.

The NFPA committee recognized the widespread lack of understanding of combustible dust hazards in industry and determined that a combustible dust standard was needed to promote awareness of the problem. Most of the information/requirements in NFPA 652 are carried over from the other standards, so users should not be surprised by the content.

However, there is one new requirement that will affect every industry with a combustible dust hazard. For existing processes handling combustible dusts, the “Owner/operator shall schedule and complete DHAs of existing processes and facility compartments within a three-year period from the effective date of the standard.” This effective date is October 2015. Currently, OSHA cites facilities that don’t have a hazard analysis, and this new standard will increase enforcement efforts.

The type of dust collector, explosion protection, and duct isolation required for each application will vary, and a DHA should be conducted to determine system requirements. Given the importance and complexity of combustible dust issues, an independent professional engineer and/or internal engineer knowledgeable of the process should perform the assessment with support from the

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dust-collector and protection-control suppliers.

**NFPA 484 Chapter 9:** In addition to implementing a hazard analysis, NFPA 484 includes several general provisions in Chapter 9 that apply whether you are using a wet or dry collection system. Table 2 summarizes these provisions in the standard. These requirements make sense to use on any combustible dust application.

**Wet scrubbers:** NFPA 484 specifies requirements for wet scrubbers handling combustible metal dusts, summarized in Table 3 in the standard. The main difference between metals and organic combustible dusts is the reactivity with water. Venting of the sump system is critical in controlling the buildup of combustible gases when collecting combustible metals.

**Dry media dust collectors:** NFPA 484 has three sections on dry collectors, summarized in Tables 4 through 6 in the standard. Each table lists the requirements for metal dusts and identifies which ones apply and are recommended by the authors for nonmetals. Table 4 summarizes common require-

ments for all dry media collectors per NFPA 484, including cyclones and media collectors. Table 5 summarizes additional requirements for dry media collectors only. Table 6 summarizes requirements to locate dry-type dust collectors inside the factory. **E**

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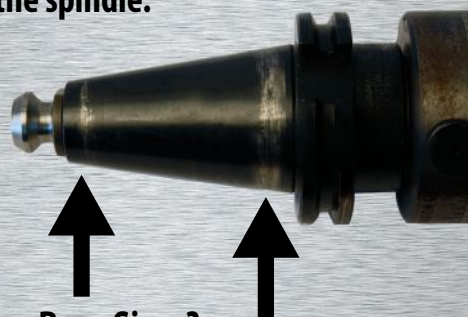
Cutaway of the dry media collector.



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