

GUIDE

Using Wet Scrubbers for Combustible Dust Control

Wet Scrubbers Offer a Viable Alternative to Dry Collectors for Combustible Dust Control

When it comes to dust collection for manufacturing plants, manufacturers generally understand the employee and environmental safety aspects. But many manufacturers may not be aware of the combustibility of the dust their processes may be creating. For example, in food production, processes such as grinding, transferring or mixing ingredients can produce massive quantities of suspended particles. Dust from foods, plant matter, metals, fuels, plastics, dyes and many other materials can be explosive when combined with other environmental conditions. Electrical devices or processes that can produce sparks or heat can trigger an explosion, especially in areas where poor housekeeping practices have allowed dust to accumulate.

These explosions can be catastrophic in terms of destruction, injuries and deaths. One example is the Imperial Sugar Refinery explosion in Port Wentworth, Georgia, that killed 14 employees and hospitalized 40 others. Hundreds of other examples have been documented by the Chemical Safety Board (CSB).

The [Occupational Safety and Health Administration](#) (OSHA) and the [National Fire Protection Association](#) (NFPA) have implemented standards and programs designed to reduce the number of combustible dust explosions. In many cases, choosing the right dust collection system and the right provider can help reduce the likelihood of catastrophes like the one at Imperial Sugar.

This paper examines how the use of a wet scrubber rather than a dry dust collection system can lower the risk of a dust explosion, the types of wet scrubbers available, as well as precautions and guidelines to follow if your facility must use a dry dust collection system instead of a wet scrubber.

What Is Combustible Dust?



According to the NFPA definition, a combustible dust is a solid material composed of distinct particles or pieces less than 500 microns in size that presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations. The following represent some [types of combustible dusts](#):

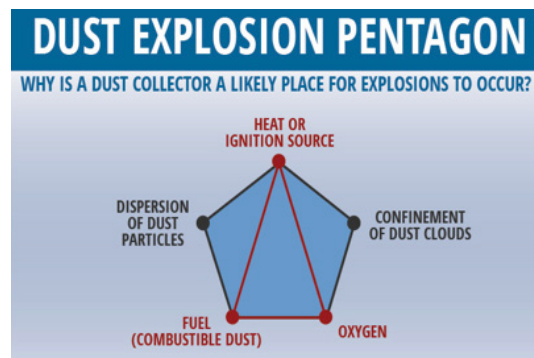
- **Agricultural products:** egg whites, powdered milk, soy flour, cornstarch, sugar, tapioca, whey and wood flour, among others.
- **Agricultural dusts:** alfalfa, apple, cocoa powder, coffee dust, malt and rice flour, among many others.
- **Carbonaceous dusts:** charcoal, coal, coke, cellulose, among others.
- **Chemical dusts:** adipic acid, ascorbic acid, calcium acetate, lactose, methyl-cellulose, sodium ascorbate, and sulfur, among others.
- **Metal dusts:** Aluminum, titanium, iron, magnesium, and zinc.
- **Plastic dusts:** (poly) acrylamide, (poly) ethylene, epoxy resin, molded melamine, phenolic resin, polyvinyl chloride among many others.

For the "Combustible Dust" list from OSHA, download the free poster available at: <https://www.osha.gov/Publications/combustibledustposter.pdf>.

Assessing the Likelihood of Dust Combustion

Many of the materials on OSHA's list are only combustible when they occur in the right particle size, right concentration and under the right conditions. A dry dust collector can produce an environment that combines the five conditions required to trigger a dust explosion:

1. Combustible fuel, such as the dust
2. Adequate dispersion of dust particles
3. Heat or an ignition spark, such as that caused by friction or static electricity
4. The presence of adequate oxygen
5. The presence of confined dust clouds



Dust explosions can occur in any industrial manufacturing context where the five risk factors are present. Although a solid piece of wood, metal, or plastic does not suggest the potential for an explosion and neither does a sack of sugar or grain, these materials can be extremely explosive when they are dispersed as fine particulates in the presence of an ignition source. Solid, noncombustible items can be turned into combustible dusts during

manufacturing processes like machining (sawing, grinding, drilling) or finishing (buffing, polishing and abrasive blasting, etc).

Calculate Air Volume

Calculating the air volume is critical to proper dust collection system design. Air flow or air volume is measured in cubic feet per minute (CFM). Insufficient air volume will result in inadequate dust collection and a disappointing installation. The basic formula for calculating air volume is $Q = V \times A$. Q is the volume of air (cubic feet per minute), V is the desired velocity at the hood (feet per minute), and A is the open area of the hood (square feet) into which the air will be drawn. For example, if we have a hood opening that is 18" x 18" and have determined the correct velocity is 250 fpm, then we would calculate the air volume to be 2.25 square feet x 250 feet per minute, which equals 562.5 cubic feet per minute. Conversely, if we know the volume of air and the desired conveying velocity, we can calculate the optimal duct sizes using the same formula, which is expressed as $A = Q / V$.

Secondary Explosions

One of the biggest dangers with combustible dust is that a primary explosion can ignite an even larger secondary explosion. The shockwave from the initial explosion can dislodge additional accumulated dust that can create more destructive explosions due to the higher quantity of dispensed dust. Dust layers thicker than 1/32" increase the potential for secondary explosions, so facilities must be vigilant about housekeeping.

How to Reduce the Risk for Dust Explosions

OSHA Guidelines

OSHA recommends the following dust control steps:

- **Capture:** Install a properly designed, approved and maintained dust collection system to capture dust before it escapes into a work area.
- **Contain:** Make sure dust is contained within the equipment or system that is built to handle it safely.
- **Clean:** Regularly and thoroughly clean work areas, all surfaces and spaces to remove combustible dusts not captured or contained.

Wet Scrubber Systems

Wet scrubbers—devices that use water to remove dust from air—are an often-overlooked alternative to baghouses or other dust collection approaches for some types of combustible dust. By the nature of the mechanisms applied within a wet scrubber, these devices can effectively mitigate the risk factors for explosion:

- The use of water reduces the heat source and dust cloud.
- Wet scrubbers also eliminate the dust dispersion that is essential for combustion by aggregating dust particles within water droplets.

Some dusts are “water reactive,” which means they may become more hazardous, or remain hazardous, when mixed with water. In addition, some types of wet scrubbers only remove gaseous components, so they aren't suitable for dust collection. Here are several types of wet scrubbers that are suitable for particulate removal:

- **Impinjet® Wet Scrubbers**

Impinjet® wet scrubbers collect particulates and clean, cool and absorb vapors and gases. They offer high collection efficiencies (99% for particles 5 microns or larger) with low water consumption and minimum pressure drop. Impinjet scrubbers are highly resistant to fouling and available with capacities as high as 200,000+ CFM.

- **Venturi Scrubber**

A Venturi scrubber collects fine particulates and mists. It uses the differential between high velocity gases and free-flowing water to create fine droplets that can entrap contaminants and hold them in suspension. Venturi scrubbers are capable of removing very small particles. They can be coupled with Impinjet scrubbers for even higher efficiency.

- **Eductor Wet Scrubbers**

Eductor scrubbers are designed to remove both soluble gases and particulates by inducing a gas flow using high pressure liquid focused into a Venturi throat. This eliminates the need for a separate exhaust fan or blower to transport the contaminant-laden airstream to the filtration device. Eductor scrubbers can also be used for direct-contact condensation.

For more details on wet scrubber system options, visit <https://www.slyinc.com/products/wet-scrubbers/>

What If You Have a Dry Dust Collector?

Even if you already have a dry dust collector installed or your application limits you to a dry dust collector, there are still ways to reduce the chances of a dust explosion. Baghouses and cartridge filters can be equipped with explosion vents and suppression systems. The process and plant need to be protected by isolating the system ductwork with fast-action dampers or suppression to stop flames from moving down the inlet ductwork and back into the plant and process.

Optional equipment and measures for reducing the chances of an explosion (meeting NFPA standards) include:

- Flameless venting or quench tubes
- Grounded and/or conductive filter bags
- External grounding of housings
- Sprinklers or other types of fire suppression systems
- Electrical enclosures and wiring

OSHA also recommends the following precautions (which are equally applicable when using wet scrubbers):

- Implement a hazardous dust inspection, testing, housekeeping and control program.
- Use surfaces that minimize dust accumulation and facilitate cleaning.
- Inspect for dust residues in open and hidden areas (suspended ceilings, ductwork, etc.) regularly.
- If ignition sources are present, use cleaning methods that do not generate dust clouds.
Do not use compressed air to blow away dust.
- Use only explosion-proof vacuum cleaners approved for handling combustible dust.
- Locate relief valves away from dust deposits.
- Control open flames, smoking and sparks.
- Keep materials capable of igniting dust away from process materials.
- Separate heated surfaces and systems from dusts.

Conclusion

Combustible dust is a major consideration when designing an appropriate dust collection system. A wet scrubber solution is the preferred method because it eliminates some of the five risk factors for combustible dust explosions. Various types of wet scrubbers can remove specific types of dust, any of which may be suitable for the application needed.

About Sly, Inc.

Sly, Inc. has the expertise to design dust collection systems that help its customers meet NFPA standards and the intent of the OSHA Combustible Dust National Emphasis Program initiated in 2008. Sly has excellent working relationships with all major suppliers of combustible dust protection equipment and works closely with its customers to integrate explosion protection solutions.

Solutions include:

- Determination of the presence of combustible dust
- Hazard analysis by an explosion protection expert to evaluate system design and identify housekeeping requirements and required documentation
- Documented design calculations
- Pred (reduced explosion pressure in a vented enclosure) values calculated and documented
- Determination of fireball length and clearances required for worker safety
- Requirements for vent ducts on indoor applications
- Gas-tight construction for inert gas closed-loop systems

Common Sly-provided combustible dust equipment may include:

- Explosion vents designed in accordance with NFPA-68-2018
- Suppression systems designed in accordance with NFPA-69-2014
- Isolation solutions for dusty air inlets, clean air outlets, and dust discharge in accordance with NFPA-69-2014 and NFPA-654-2017
- Flameless venting or quench tubes in accordance with NFPA-68-2018
- Grounded and/or conductive filter bags in accordance with NFPA-77-2019
- External grounding of housings in accordance with NFPA-77-2019
- Sprinkler systems in accordance with NFPA-13-2019
- Electrical enclosures and wiring to meet NFPA-70-2017 (NEC®)

For more information on the basic principles of, and requirements for, identifying and managing fire and explosion hazards of combustible dusts and particulate solids, consult NFPA 652 (Standard on the Fundamentals of Combustible Dust). In addition, NFPA 654 (Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids) provides requirements for all phases of the manufacturing, processing, blending, conveying, repackaging, and handling of combustible particulate solids or hybrid mixtures, regardless of concentration or particle size, where the materials present a fire, a flash fire, or an explosion hazard.

With nearly 150 years of expertise, Sly is a trusted advisor in designing industrial dust collector and wet scrubber systems. Sly manufactures their own dust collectors and wet scrubbers and provides custom solutions for a wide range of applications. Valuing its relationships is a hallmark of their business, Sly works closely with its customers to develop the right solutions and deliver detailed quotes on time. Learn more by visiting www.slyinc.com.