What is the Big Deal about Combustible Dust Vacuum Cleaners?

Why industrial combustible dust vacuum cleaners require expert design and the options available to remove and prevent concentrations of fugitive combustible dust that cause catastrophic secondary dust explosions.

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Standard industrial vacuum cleaners are vulnerable to ignition making them unsuitable for combustible dusts. Any time there is powder flowing in one direction through a plastic vacuum cleaning hose it can create significant static electric charge. If a charged, ungrounded hose used to vacuum combustible dust powder were to come into contact with a grounded object, the static electricity could arc and trigger a violent explosion.

There is also the possibility that there may be static electricity build-up on individual dust particles sucked into the vacuum which is another reason why combustible dust vacuum cleaners need redundant grounding in five different ways, eliminating the possibility of any kind of explosion from the vacuum cleaner.

Combustible dust vacuum cleaners, designed to remove fugitive combustible dust safely and efficiently, include portable drum style vacuums, stationary continuous duty central vacuum systems, and portable breakaway vacuum cleaners that are an economical alternative to central vacuum cleaning systems.

Fugitive dust, or particulate matter (PM), is basically any solid or liquid suspended in the air through wind or human interaction. While half of all fugitive dusts are greater than 10 microns (human hair is 70 microns) and settle on surfaces rather quickly, the other half are smaller than 10 microns (not visible to the naked eye) and can remain suspended in the air for days or weeks settling on the top of equipment, rafters and ducting.

NFPA 652 defines combustible dust as “a finely divided combustible particulate that presents a flash-fire hazard or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations.”

Dust explosions require 5 elements, fuel (combustible dust), oxidant (oxygen), ignition source, dispersion (dust cloud), and confinement - which leads to pressure rise and vessel rupture.

Combustible dust flash fires occur when a fourth element, the suspension of fuel (dust) into an environment, is introduced to the three elements of the fire triangle, fuel (combustible dust), ignition source (heat) and an oxidizer (usually air).

Dust explosions occur when a fifth element, an enclosed space, is present, forming the dust explosion pentagon comprised of fuel (combustible dust), ignition source (heat), an oxidizer (usually air), dispersion of dust particles (in sufficient quantity and concentration) and a confined area (vessel, area or building).

Catastrophic secondary explosions occur when the force from a primary blast wave from an explosion dislodges fugitive dust from surfaces and disperses them into the air, producing dust clouds that ignite, creating a domino-type effect throughout a facility. If you mitigate the accumulation of fugitive combustible dust to limits below a sufficient quantity and concentration, secondary dust explosions are unlikely.

While each combustible dust has different thresholds that constitute sufficient quantities and concentrations that lead to explosions, OSHA guidelines state, " in general, a thickness greater than 1/32 of an inch is cause for concern when the surface area covered by settled dust exceeds five percent of the floor area in a given room."

Many facilities appear to be free of concentrations of dust at eye level, but the culprit behind many secondary dust explosions is the accumulation of dust in out of sight places such as overhead beams, joists, duct work, and the tops of equipment. According to OSHA's National Emphasis Directive on Combustible Dusts CPL 03-00-008 section IX.E.3.c all surfaces need to be included in the hazard evaluation noting that the available surface area of bar joists, steel beams, tops of machinery and rough wall surfaces serve as significant dust accumulation points.

As of September 2020, NFPA 652 requires organizations that deal with combustible dusts to have a Dust Hazards Analysis (DHA) on hand, that identifies and evaluates fire, flash fire and explosion hazards throughout a facility as well as safeguards in place that adhere to the general requirements for mitigation, including "housekeeping thresholds for dust accumulation levels."

Broadly speaking, vacuum cleaning is the preferred method to remove combustible dust accumulations. Sweeping creates airborne dust, moving that dust somewhere else, but industrial vacuums suck up and contain all the dust.

Prior to OSHA's National Emphasis Program (NEP) on Combustible Dust some facilities would attempt to use shop-type vacuums similar to what people have in their garages to remove combustible dust from surfaces. Those types of vacuums not only create sparking hazards but are ineffective at sucking up fine dust particles or heavy materials, and often create their own dust clouds when operating.

With combustible dust present in a facility, the use of an intrinsically safe vacuum that adheres to Class II Division 2 design may be necessary even in non-Class II Division 2 areas. Early in the NEP OSHA issued numerous citations for using standard vacuum cleaners where Class II Division 2 equipment is required.

VAC-U-MAX compressed-air operated, ATEX tested and certified combustible dust vacuum cleaners are available in 15, 30 and 55 gallon collection capacities, and include drum dolly and took kit.

Every plant has unique processes and thresholds when it comes to combustible dust. There is no one size fits all vacuum cleaning applications and no single standard, or one industrial vacuum cleaner that can meet the requirements for all combustible dusts. Companies really need someone who has intimate knowledge of how chemicals react in certain environments and has experience in NFPA standards to help them choose the right combustible dust vacuum cleaner.

In some applications small portable air or electric powered drum-style units will suffice, while others require large electric and diesel-powered units for multiple users and filtration systems capable of capturing particles that are invisible to the naked eye. Somewhere in between are portable breakaway systems that combine the portability of drum style units and benefits of central vacuum cleaning units without the cost.

While there are intrinsically safe electric industrial vacuum cleaners available, the most economical solution for cleaning combustible fugitive dust are air-operated vacuums.

Beyond the fact that air operated vacuum cleaners use no electricity and have no moving parts to create spark hazards, well-built

air operated vacuum cleaners are grounded in five ways beginning with the air line that supplies compressed air to the units. Because most plants have compressed air lines made from iron that conduct electricity, air operated vacuums use static conductive high pressure compressed air lines.

In addition to the static conductive air lines, static conductive hoses, filters and casters are employed to further reduce risk. Finally, a grounding lug and strap that travels from the vacuum head down to the 55-gallon drum, eliminates the potential for arcing.

Air operated vacuums for combustible dust are safer in terms of grounding, they also work more efficiently in the industrial environment than commercial or industry specific vacuum cleaners, such as agricultural vacuums which are great for farm use, but not necessarily suited to rugged industrial applications where environmental safety, ergonomics and productivity matter.

Vacuum cleaners designed specifically to withstand rigorous 24/7 operation can deliver consistent performance that adds to a company's bottom line in heavy use industrial facilities.

These units are easy to maneuver and support one operator up to 50' feet away from the vacuum and also provides excellent suction for overhead cleaning in hard-to-reach areas with the use of wand extensions, reducing the time and mess involved in more manual cleaning methods that disperse

If portable intrinsically safe vacuum cleaners are the "muscle cars" of the combustible dust world, then central vacuum cleaning systems are top-of-the-line luxury vehicles.

Stationary central vacuum systems are ideal for environments requiring continuous 24/7 operation and the simultaneous use of up to 20 pickup points. These systems employ powerful stationary industrial vacuum cleaners that have strategically placed piping throughout a facility connecting hoses to a common li

Central vacuum cleaning system with source capture and reclaim into bulk bag for potential reuse, recycle, or disposal.

When designing a central vacuum cleaning system factors that must be taken into account are characteristics of the material cleaned (such as abrasiveness, corrosiveness, flammability, or explosion hazard); volume collected; bulk density; particle size; filtration goals; maximum temperature; total number of pick-up points; the number of simultaneous operators; hose size, longest vertical and horizontal tubing runs from vac; available floor space; and collection container considerations.

Some manufacturers use regenerative blowers as a vacuum source in central vacuum systems which have airflow but not the simultaneous vacuum. Regen blowers look appealing because they show a lot of airflow for a given horsepower, but they do not generate enough vacuum to move material over distances in tubing when vacuum pressure goes up, i.e., when the job gets harder, performance is lost.

Traditionally central vacuum systems require a bag house with either a chemical suppression system or an explosion venting system to meet NFPA and OSHA standards which often leads to outdoor installation, bringing other challenges such as air permits as well as construction permits.

There are also smaller central vacuum systems that can service up to three operators at once with piping runs up to 200 feet while conforming to NFPA standards for indoor installation because the "dirty volume" is less than eight cubic feet, allowing installed units without the need for an explosion vent or chemical suppression system. These smaller indoor installations can avoid air permitting requirements with many local municipalities, while returning HEPA-filtered air into the plant environment.

In larger less centralized facilities where sizing a central vacuum system would be cost prohibitive due to power necessary to suck dusts from one end of the facility to the other, breakaway central vacuum systems are a cost-effective solution.

Breakaway vacuum systems operate much like central vacuums with fixed tubing networks, but units are portable (much like the portable air-operated vacuums) and utilize several smaller tubing networks. For instance, if a user is working in a 100 x 200 sq foot area and there are two more areas in another building, individual tubing networks are created and the vacuum cleaning unit is able to break away from one tubing network and rolled to the next network, and so on and so forth.

Breakaway vacuum systems avoid costs and delays that may occur with central vacuum cleaner applications, providing the convenience of a multi-inlet central vac, with the energy efficiency and flexibility of a portable vacuum.

Like the smaller central vacuums and the portable air operated vacuums that allow for indoor operation, because breakaway vacuum systems have a filter separator and collector

Model 1050 with 55-gallon material intercept features blow-back filter cleaning, allows easy access to confined areas, and is designed with forklift pockets for easy portability.

less than eight cubic feet, it does not need an explosion vent for use in Class II, Division 1 & 2 areas, per NFPA standards and OSHA regulations.

With the largest models of breakaway systems able to move 5 Tons of powder in an hour from 30ft away these units are capable of generating high vacuum and excellent airflow, so they have the ability to pull massive amounts of material over distances.

Central vacuum cleaning systems with strategic tubing networks and portable vacuum cleaners allow manufacturers the ability to use the vacuums to clean up spills and perform regular cleaning to mitigate buildup of combustible dusts in hard-to-reach areas, maximizing ROI.

Founded in 1954, VAC-U-MAX has been at the forefront of leading-edge vacuum conveying and cleaning technology across a wide range of industries including food, pharmaceutical, chemical, plastics, and others. To learn more, visit www.vac-u-max.com and fill out RFQ or call (800) VAC-U-MAX, (800) 822-8629, or (973) 759-4600; e-mail info@vac-u-max.com.

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