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Building a Stronger Combustible Dust Safety Program

Effective combustible dust prevention begins with understanding facility-specific hazards. Dust testing, hazard analyses, engineering controls, housekeeping, and employee training work together to reduce fire and explosion risks while supporting safer operations.

BY MATTHEW HATZENBUHLER

In many manufacturing and processing environments, fine particles produced during routine operations can become combustible under the right conditions, creating the potential for fires or explosions. NFPA 660 defines combustible dust as a finely divided combustible particulate solid, including combustible fibers/flyings, that presents a flash fire hazard or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations. Because no two workplaces have the same dust profile, process conditions or risk factors, it is essential for safety managers and industrial hygienists to evaluate the specific combustible dust hazards present in their facilities. Understanding where dust is generated, how it accumulates and what ignition sources may be present are critical steps in developing a prevention strategy that protects employees and supports a safer, more productive operation. The following considerations can help facility operators assess their combustible dust risks.

Recognizing the Conditions That Can Lead to a Dust Explosion

A combustible dust explosion requires oxygen, an ignition source, combustible dust, airborne dispersion of the dust particles and some form of enclosure or confinement to occur at the same time. When these elements are present together, a small event can quickly escalate into a serious occupational hazard.

Often combustible dust explosions occur in two stages, triggered by a smaller combustion event. The initial event is known as a primary explosion. In some cases, it may be limited to one piece of equipment or one area of the facility. However, the greater danger often comes from a secondary explosion. This can happen when the force of the first blast dislodges dust that has accumulated on floors, beams, equipment or other surfaces, creating a larger airborne dust cloud that ignites.

This rapid burning process is called deflagration. For safety

professionals, it may be helpful to think of deflagration as a fast-moving flame front traveling through a suspended cloud of combustible dust. When that reaction occurs inside enclosed equipment, a room or another confined space, pressure can build rapidly and result in an explosion. Understanding these conditions helps employers identify where dust control, ignition prevention and housekeeping measures are needed to reduce risk to workers.

Confirming If Workplace Dust Presents a Combustion Hazard

Before facility managers can select appropriate safeguards, they are required per NFPA to first determine whether the dust generated by processes is combustible. This requires explosibility testing using ASTM test methods referenced by the National Fire Protection Association (NFPA). Testing helps establish key characteristics of the dust, including whether it is combustible, and if it is found to be combustible, what its K_{st} and P_{max} values are. These are vital to know how much pressure an explosion could produce and how quickly an explosion could propagate.

K_{st} value measures how fast pressure rises during a dust explosion. It indicates the explosion's relative severity and helps determine what type of explosion protection may be needed for dust collectors, process equipment and enclosures. A higher K_{st} value generally means a more violent explosion could occur.

P_{max} value is the maximum pressure that can be produced during a dust explosion under test conditions. It helps safety professionals and engineers understand how much pressure equipment or protective systems may need to withstand or safely relieve.

If testing shows the dust is not completely inert, meaning its K_{st} value is above zero, explosion protection must be included as part of the dust collection and hazard control strategy. These results give safety teams, engineers and industrial hygienists the data they need to make informed decisions about equipment design, explosion venting, isolation, suppression and other protective measures.

NFPA standards also require facilities that handle or generate combustible dust to complete a dust hazard analysis (DHA). This analysis evaluates the risks associated with dust-producing operations and identifies the fire and explosion protection measures needed to help protect workers, equipment and the facility. A DHA may be



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performed by qualified internal personnel or by an independent consultant.

Once completed, the analysis is typically reviewed by the authorities having jurisdiction. Depending on the facility, these reviewers may include federal, state or local inspectors, fire officials and insurance representatives. Their approval helps confirm that the facility's combustible dust prevention strategy aligns with applicable safety expectations and provides a practical framework for reducing employee exposure to fire and explosion hazards.

Pinpointing Ignition Hazards in Dust-Generating Areas

Because ignition is a key element in a combustible dust event, facility managers should carefully evaluate any area where dust is produced, processed, conveyed or allowed to accumulate. Even a small heat source can become dangerous when combustible dust is present in the right concentration.

Safety teams should look for potential ignition sources such as overheated bearings or equipment components, friction from moving machinery, open flames, welding or cutting activities, smoking,

sparks, static electricity, and damaged or malfunctioning electrical wiring or equipment. These hazards should be assessed not only near production areas, but also around dust collectors, ductwork, transfer points, storage areas and other locations where dust may settle or become airborne.

Identifying ignition sources gives employers an opportunity to strengthen controls before an incident occurs. Preventive steps may include routine equipment inspection and maintenance, electrical classification reviews, bonding and grounding, hot work controls, housekeeping improvements and employee training. Addressing these hazards is an important part of protecting workers from fires and explosions associated with combustible dust.

Using Safe Housekeeping and Dust Collection Practices

How dust is removed matters. Facility personnel should avoid cleaning combustible dust with compressed air, air wands or dry sweeping methods, because these practices can send fine particles back into the air. Once airborne, the dust may resettle on overhead surfaces, equipment, floors and

structural components, continuing to create a fire or explosion hazard.

From an occupational health and safety standpoint, improper cleanup can also increase worker exposure to hazardous airborne contaminants. Instead of dispersing dust, employers should use cleaning methods and engineering controls designed to capture particles safely at the source or remove them without creating a suspended dust cloud.

A high-efficiency dust collection system, properly designed for the specific process and dust characteristics, is an effective engineering control. When equipped with appropriate explosion protection, the system can help capture combustible dust and other hazardous contaminants, improve indoor air quality and reduce the likelihood of conditions that could lead to a fire or explosion. Safe housekeeping procedures, worker training and routine inspection of dust collection equipment are part of a broader combustible dust management program.

Inspecting the Workplace for Dust Accumulation

One of the most practical ways to spot combustible dust concerns is to conduct regular visual inspections throughout the facility. Employees should be trained to recognize dust buildup in high-visibility areas such as floors, work surfaces, machinery and processing equipment. These routine checks can help safety teams identify problems before they develop into more serious fire or explosion risks.

Inspections should also include less obvious locations where dust can collect over time. These may include ductwork interiors, elevated beams, ceiling joists, rafters, light fixtures, cable trays and other overhead or hard-to-reach surfaces. Dust that is out of sight can still become airborne during equipment vibration, maintenance activity or a primary explosion, creating conditions for a larger secondary event.

As a general warning sign, dust accumulation measuring about 1/32 of an inch, roughly the thickness of a dime, should be treated as a potential fire or explosion hazard. Particle size is another important factor. Finer dust particles can remain suspended more easily and may burn more rapidly, increasing the severity of a combustible dust event. Regular inspections, documented findings and prompt cleanup are essential parts of a strong occupational health and safety program.

Building a Combustible Dust Safety Program

A strong combustible dust management program should go beyond equipment selection. It should include worker education, clear procedures and ongoing oversight to help ensure hazards are identified, controlled and revisited as conditions change. Employees who operate equipment, perform maintenance, conduct housekeeping or work near dust-producing processes should receive training on combustible dust hazards, warning signs and the safeguards that apply to their specific jobs.

In addition to completing a dust hazard analysis, employers should develop a written program that explains how combustible dust risks will be managed across the facility. This program should define responsibilities, outline required controls and provide a framework for evaluating whether life safety goals are being met.

Key elements may include a formal process for managing changes to equipment, materials, production methods or housekeeping practices that could affect dust hazards. Facilities should also conduct process hazard analyses for dust-generating points, as

required by OSHA, and establish a plan for reducing or removing the dust hazard at each source.

Address housekeeping as a core safety function, not a secondary task. A documented cleaning strategy should specify approved methods, cleaning frequency and areas requiring routine attention, so combustible dust does not accumulate. The program should also include a preventive maintenance and inspection schedule to keep dust collection systems, process equipment, electrical components and other controls operating properly and in compliance.

Putting Combustible Dust Prevention Into Practice

Combustible dust can be difficult to manage in manufacturing and processing environments, but an effective prevention strategy starts with the basics: identify the hazard, understand how dust behaves in the workplace and apply controls that reduce risk.

Engineering controls, written procedures, employee training, housekeeping and preventive maintenance all play a role. When these measures are applied consistently, facility managers are better positioned to reduce airborne dust, prevent dangerous accumulation, protect workers and support safe, reliable production. **OKS**

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