TerranearPMC Safety Share

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When writing a safety and health plan or site-specific ES&H plan or even a job hazard analysis – all documents to ensure work is conducted in a safe and healthful manner – we often are tasked to address airborne dust or particulate exposures. And typically, when we think about dust exposures, the term "nuisance" is the hazard that immediately comes to mind. Yet, when airborne dust is generated in high concentrations, regardless of the materials' specific characteristics, including being non-flammable or not having any usual or distinctive ignitable properties – the material can be explosive.

Such was the case on February 7, 2008, when the Imperial Sugar refinery, located in Port Wentworth, GA exploded. The blast killed 14 people and injured 36 others. In the five years preceding the Imperial Sugar explosion, there were three other deadly combustible dust explosions: West Pharmaceutical in Kinston, NC; CTA Acoustics in Corbin, KY; and Hayes Lemmerz in Huntington, IN. Combined, these events resulted in 14 deaths and 81 injuries.

Unfortunately, tragic events like these continue both in the US and abroad. The U.S. Chemical Safety & Hazard Investigation Board estimates that between 1980 and 2012, there were 331 combustible dust incidents, resulting in 148 deaths and 879 injuries.

Combustible dusts are finely-ground organic or metal particles found in a variety of industries and workplaces. Potentially dangerous accumulations of combustible dust can build up inside process equipment or escape from process equipment and settle on surfaces in the general work area. These accumulations can be extremely explosive when dispersed into the air in the presence of commonplace ignition sources, such as standard electrical switches or in the presence of an inadvertent spark.

Combustible dust, as defined by the Occupational Safety and Health Administration (OSHA), is "a solid material composed of distinct particles or pieces, regardless of size, shape or chemical composition, which can present a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations." A deflagration is a combustion that propagates at a speed that is less than that of sound and driven by the transfer of heat.

As stated earlier, the materials comprising airborne dust accumulations do not need to be particularly flammable or combustible in nature. Take, for instance, grain silos where elevators are installed and through poor housekeeping where grain dust accumulate, an inadvertent spark results in devasting explosions.

An OSHA Fact Sheet titled "Hazard Alert: Combustible Dust Explosions" explains how dust explosions can occur:

> "In addition to the familiar fire triangle of oxygen, heat and fuel (i.e. airborne particulate), dispersion of dust particles in sufficient quantities and concentrations can cause rapid combustion known as deflagration. If the event is confined by an enclosure such as a building, room, vessel or process equipment, the resulting pressure rise may cause an explosion. These five factors (oxygen, heat, fuel,

dispersion and confinement) are known as the Dust Explosion Pentagon. If one element of the pentagon is missing, an explosion cannot occur."

Combustible dust explosions typically occur in two waves. The first wave, also known as the primary explosion, starts with just the "right" concentration of airborne accumulated dust. This dust is held captive within a limited or enclosed space, such as inside the chamber of processing equipment. This captive dust is then subjected to a heat source which causes the dust to ignite. The ignited dust can burn very rapidly and release gases causing the pressure to rise within the enclosure and could result in an explosion. Unfortunately, the first explosion is usually only the beginning. The primary explosion disturbs and shakes up dormant dust which has collected over time on a variety of surfaces within the area. Some examples of these surfaces can be the top of or underneath machinery, ledges, rafters, duct work, inside suspended ceilings, on top of support beams, etc. The second wave, or secondary explosion, occurs as this additional dust becomes suspended in the air and also ignites. Secondary explosions are often more destructive than primary ones because of the sheer volume and concentration of additional dust available to fuel them.

Many employers (as well as employees) are unaware of the potential threat of dust explosions or fail to recognize it as a serious hazard in their facility. According to the Chemical Safety Board (CSB) video "Combustible Dust: An Insidious Hazard", the big problem with combustible dust is that we underestimate its hazards. We become complacent and we fail to take the necessary precautions.

And unfortunately, while we tend to use Safety Data Sheets (SDSs) to help obtain hazardous information for specific materials, many times they may be inadequate to help employers recognize a combustible dust hazard. After reviewing the SDSs of 140 substances known to create combustible dust, the CSB found they contained deficient information to assist the end-user in determining the hazard: 41% of the documents did not warn of the potential hazard at all, while the remaining 59% did not clearly or specifically describe the hazard in a way which was easy to identify.

The explosiveness of dust depends on the specific materials' minimum explosive concentration (MEC); a measurement of particle size and energy nature. As an example, the accepted MEC for grain dust explosions is approximately 0.05 oz. per cu. ft. In an enclosed space with a height of 2 ft., the minimum depth of dust that can lead to explosion is 0.002 to 0.004 inches. A typical sheet of paper is approximately 0.004 inches thick, so that critical MEC level can be reached in a very short time.

To put things into perspective, the MEC for grain as established at 0.05 ounces per cubic feet, equates to 50,082 milligrams per cubic meter. Occupational Exposure limits such as the OSHA PEL for nuisance particulate is 15 mg/m^3 or 5 mg/m^3 for particulate that is respirable. So, while health standards are more restrictive, dust explosions evidently do occur. Not because of a lack to control dusts when they are airborne, but rather to remove particulate on surfaces, before they have the potential to be suspended.

To reduce the risk of a dust explosion, workplaces need to control dust generation (ex. localized ventilation) and reducing the sources of ignition. Preventative measures include continuous housekeeping, sanitation, and regularly scheduled maintenance.

There is nothing noble in being superior to your fellow men. True nobility lies in being superior to your former self - Ernest Hemingway