



Safety

Explosion Hazards: What Are Combustible Dust Explosions and How to Stop Them

Roland Jones | Feb 11, 2021

Combustible dust explosions are a major safety hazard in the manufacturing industry. They are a particular problem in locations where flammable material and debris collect. Here's what you need to know about these blasts and how to avoid them.

Combustible dust explosions are perhaps one of the most underestimated hazards in manufacturing settings, yet they are extremely dangerous.

These explosion hazards can lead to worker injuries, deaths and even the destruction of entire buildings, according to the Occupational Safety and Health Administration (OSHA).

The U.S. Chemical Safety and Hazard Investigation Board (CSB) **identified 281 combustible dust incidents between 1980 and 2005** that killed 119 workers, injured 718 and extensively damaged industrial facilities. Since 2006, the CSB has conducted five additional investigations into dust-related incidents, and those alone killed 27 workers and injured 61 others, according to the CSB.

What are Dust Explosions Made From?

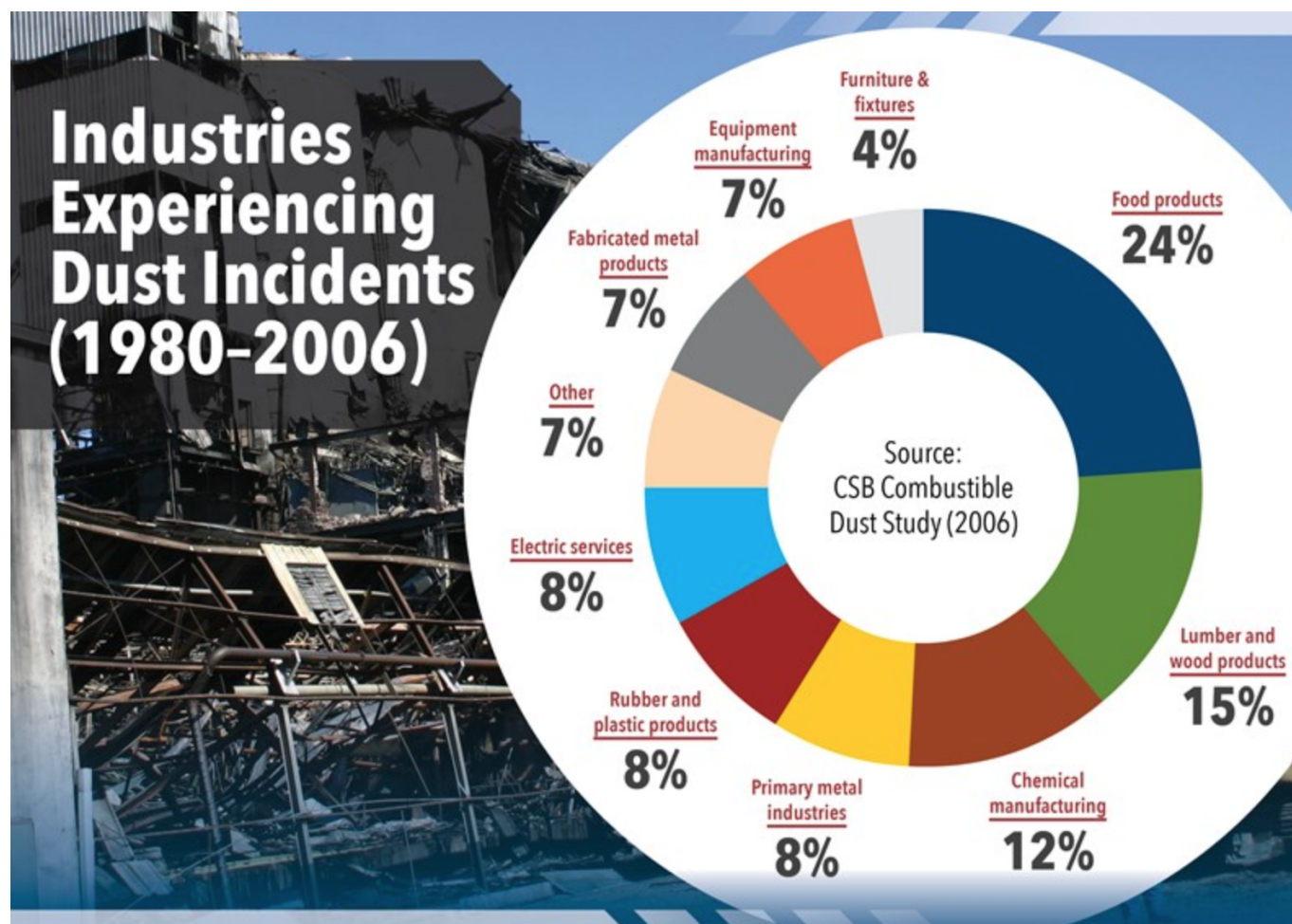
In industrial workplaces, dust is created in situations where materials are transported, processed or handled. Dust may also be created by industrial processes such as cutting, crushing, mixing or sifting, or when workers are engaged in tasks such as abrasive blasting.

"If such a dust is suspended in air in the right concentration, under certain conditions, it can become explosible."

Occupational Safety and Health Administration

A wide variety of materials found in industrial settings can be explosible in dust form, **according to OSHA**. These materials include food (e.g., candy, sugar, spices, starch, flour or feed), grain, tobacco, plastics, wood, paper, pulp, rubber, pesticides, pharmaceuticals, dyes, coal and metals (e.g., aluminum, chromium, iron, magnesium or zinc).

These materials are used in many industries and processes, among them agriculture, chemical manufacturing, pharmaceutical production, furniture, textiles, fossil fuel power generation, recycling operations, and metalworking and processing, which includes additive manufacturing and 3D printing. The CSB produced the following breakdown of combustible dust incidents by industry:



Here are three important things to know about combustible dust:

No. 1: How Do Combustible Dust Explosions Happen?



Combustible dust is composed of fine particles of material that, when mixed with air and an ignition source, are capable of exploding.

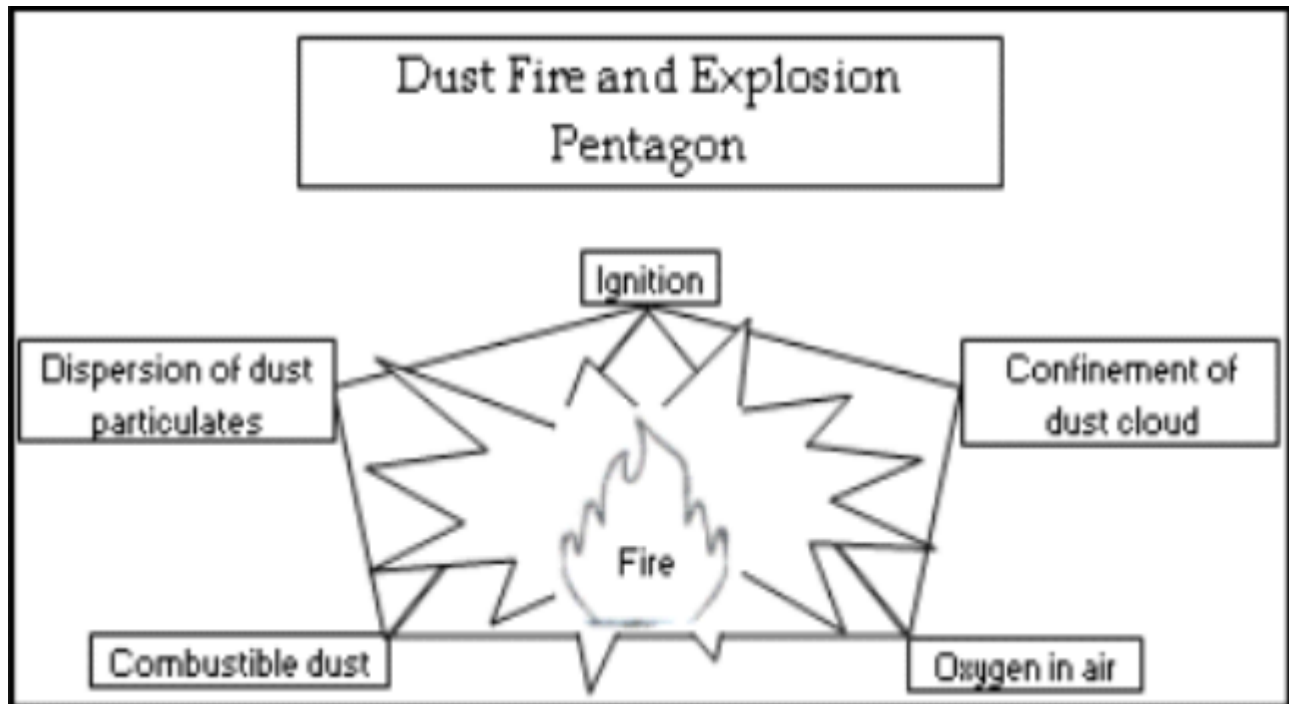
Almost any material can catch fire and explode in this state. OSHA has produced a ***combustible dust poster*** that provides examples of products and materials from which combustible dust explosions could occur if they are in powdered form.

"If such a dust is suspended in air in the right concentration, under certain conditions, it can become explosible," OSHA notes. "Even materials that do not burn in larger pieces (such as aluminum or iron), given the proper conditions, can be explosible in dust form."

When describing ***the elements needed for a dust explosion***, OSHA points to the "fire triangle," which includes:

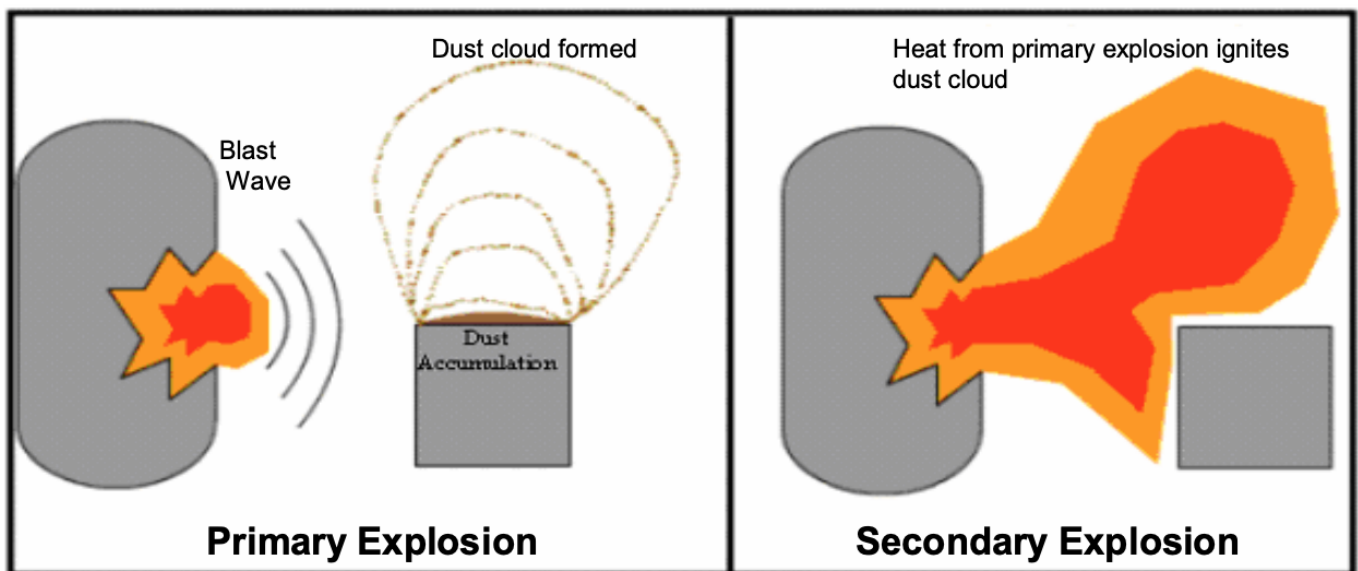
- Combustible dust (the fuel)
- Ignition source (heat)
- Oxygen in the air (the oxidizer)

Additional elements needed for a combustible dust explosion are the "dispersion of dust particles in sufficient quantity and concentration" and "confinement of the dust cloud." Taken together, these elements make up the "Dust Fire and Explosion Pentagon," which is shown below.



Essentially, if a dust cloud is ignited within a confined or semiconfined vessel, area or building, it burns rapidly and may explode.

As the diagram below shows, a combustible dust incident frequently involves more than one explosion: a primary blast in which dust in a confined space ignites, and a second explosion that takes place because the first explosion can shake loose more accumulated dust or damage a containment system (such as a duct, vessel or collector). Further explosions are also possible and may be far more destructive than the first because of the increased quantity and concentration of dispersed combustible dust, OSHA warns.



Read more: Air Filtration: What Are MERV Ratings, and How Do They Protect Your Workers?

No. 2: How to Prevent Combustible Dust Explosions



While it's difficult to eliminate the presence of air and the confinement of dust clouds within facilities (two elements of the "explosion pentagon" above), the remaining three points of the pentagon can be controlled to a significant extent, **according to OSHA**, by taking the following steps:

- **Control dust accumulation** by keeping workplaces clean and using good ventilation and dust collection systems and filters. If potential ignition sources are present, use cleaning methods that do not generate dust clouds. Only use vacuum cleaners approved for dust collection. And develop and implement a hazardous dust inspection, testing, housekeeping and control program (preferably in writing with established frequency and methods).
- **Control ignition sources** by using appropriate electrical equipment and wiring methods, and by controlling static electricity, including bonding of equipment to the ground. Control smoking, open flames and sparks, and adequately maintain all equipment that could lead to dust ignition.
- **Minimize the danger and damage from an explosion** by isolating potential hazards, using pressure relief venting for equipment, using spark/ember detection and extinguishing systems, and employing explosion protection systems and sprinkler systems. OSHA also recommends **training employees** to recognize unsafe conditions and take preventive action.

NFPA 652: Dust Explosion Standards

According to *the National Fire Protection Association's (NFPA) 652 standard*, a workplace must undergo a dust hazard analysis to assess its risk for a combustible dust explosion. This analysis is supposed to inform the safety precautions that should be taken to help reduce the likelihood of injury in the event of a dust combustion. You can read about new requirements for conducting a dust hazard analysis [**here**](#).

According to OSHA, facilities should carefully identify the following to assess their potential for dust explosions:

- Materials that can be combustible when finely divided
- Processes that use, consume or produce combustible dusts
- Open areas where combustible dusts may build up
- Hidden areas where combustible dusts may accumulate
- Means by which dust may be dispersed in the air
- Potential ignition sources

While OSHA does not have a set regulation for combustible dust hazards, facilities can still be held accountable for safety violations related to this hazard and can receive stiff penalties based on OSHA inspections, *according to Occupational Health & Safety magazine*.

The publication also notes that, as a guideline for evaluating combustible dust hazards and issuing citations, OSHA inspectors are trained to use the ***Combustible Dust National Emphasis Program***, a set of policies and procedures for OSHA to respond to situations it thinks may put the health and safety of workers at risk.

Read more: Fogged-Up Glasses: 5 Ways to Keep Eye Protection from Fogging While Wearing a Mask

No. 3: What Is the Best PPE for Explosion Hazards?



An article in *Occupational Health & Safety magazine* notes that a flame-resistant daily wear program can help protect employees from the thermal impacts of flash fire events that can result from a dust combustion.

The article outlines the benefits of implementing a daily wear program, noting that employees will arrive to work wearing flame-resistant garments, providing them with consistent and ongoing thermal protection and greatly reducing the risk of having employees unprotected should an incident occur suddenly.

The publication also notes that daily wear FR/AR garments “are most effective against thermal hazards when they are worn properly.” Therefore, ensuring sleeves are rolled down and collars are properly fastened is important, as this provides better protection against thermal hazards. The garments also “must be clean, free from debris and washed according to the manufacturer’s instructions for optimum protection.”

A good fit is important, too: A dust combustion “can impact any exposed or under-protected part of one’s body, so it is important for employees to wear FR/AR PPE that is not too loose or too tight to help mitigate the risk of injury,” the magazine notes.

Read more: [How to Exceed Flame-Resistant Clothing Requirements While Staying Comfortable](#)

What measures are you taking in your facility to avoid the dangers of combustible dust? Share your thoughts and insights in the comments below.

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