

Combustible dust

By John Biedka and Tom Kelly

Before you begin

To determine areas and operations where dust accumulations are likely, perform a facility dust hazard assessment. When conducting the assessment, identify:

- Materials that can become combustible when they are finely milled;
- Processes that use or produce combustible dusts;
- Open areas where combustible dusts may accumulate;
- Hidden areas where combustible dusts may accumulate;
- Means by which dust can be dispersed in the air;
- Potential ignition sources.



Introduction

The National Fire Protection Association (NFPA) defines combustible dust as “a combustible particulate solid that presents a fire or deflagration hazard when suspended in air.”

Most natural and synthetic organic materials, as well as some metals, are combustible when they are in a dust form. The NFPA's *Industrial Fire Hazards Handbook* states: “Any industrial process that reduces a combustible material and some normally noncombustible materials to a finely divided state presents a potential for serious fire or explosion.”

How does dust explode?

All fires need three basic elements to occur (the fire triangle). They are:

- Fuel;
- Ignition source (heat);
- Oxygen.

Two additional elements combine to create a combustible dust hazard. These include:

- Dispersion of dust particles in sufficient quantity and concentration;
- Confinement of the dust cloud.

When all of these elements are in place, rapid combustion known as deflagration (a rapid burning slower than the speed of sound) can occur. If an enclosure such as a building, room, vessel or process equipment confines this event, the resulting pressure rise can cause an explosion (a rapid burning faster than the speed of sound).

Most combustible dust explosions have two or more distinct phases. The first explosion may happen inside processing equipment or in areas where fugitive dust accumulates. The initial blast may dislodge additional dust or damage a collection system (such as a duct, vessel or collector). If ignited, this dust causes additional explosions.

This in turn can result in damage that is more severe than the original explosion due to increased concentrations and the quantities of dispersed combustible dust.

Dust combustibility

In assessing the potential for dust-explosion hazards, the primary factor to consider is the dust combustibility. One source of information on the material combustibility is the Material Safety Data Sheet (MSDS). Depending on the particle size, shape and the moisture content, different dusts of the same chemical material will have different ignitability and explosion characteristics. In addition, these characteristics can change when the material passes through process equipment.

Another concern is electrical classification. Some areas require special electrical equipment due to the presence, or potential presence of combustible dust. These classifications depend on:

- o The properties of flammable vapors, liquids or gases, or combustible dusts or fibers that may be present;
- o The likelihood that a flammable or combustible concentration or quantity is present.

Areas where the hazard of combustible dust is present are classified Class II locations.

Because a variety of conditions can affect the amount of combustible dust needed to reach an explosive concentration, there are other hazard analysis considerations.

Variables to consider include the:

- o Size of the dust particles;
- o Method of dispersing dust in the air;
- o Ventilation systems;
- o Air currents;
- o Humidity;
- o Physical barriers;
- o Volume of the area in which the dust cloud exists or could potentially exist.

Control measures

Hazard mitigation and dust control recommendations (See: Reference 2) to prevent explosions include:

- o Minimizing the escape of dust from process equipment or ventilation systems;
- o Using dust collection systems and filters;
- o Using surfaces that reduce dust accumulation and help with cleaning;
- o Providing access to all hidden areas to permit inspection;
- o Conducting regular inspections for dust in open and hidden areas.

In addition, other recommendations include:

- o Clean dust residues at regular intervals;
- o Use cleaning methods that do not generate dust clouds if ignition sources are present. For example, do not use compressed air;
- o Use vacuum cleaners only if approved (e.g., UL, FM) for combustible dust collection;
- o Locate relief valves away from dust hazard areas;
- o Develop and implement a written program for hazardous dust inspection, housekeeping and control.

It is also important to control potential ignition sources. Depending on the specific operation, effective controls may include:

- o Using appropriate electrical equipment and wiring methods;
- o Controlling static electricity, including bonding of the equipment to the ground;
- o Controlling smoking, open flames and sparks;
- o Controlling friction and mechanical sparks;
- o Using separator devices to remove foreign materials capable of igniting combustibles from process materials.

In addition, other controls:

- o Separate heated surfaces and systems from dusts;
- o Use industrial trucks of the proper type;
- o Use cartridge-activated tools properly;
- o Maintain adequately all of the above equipment.

Furthermore, be sure to follow established hot-work permit systems that explain how you perform hot work (welding, cutting, grinding, etc.) on and around ventilation ductwork and in areas where combustible dust may accumulate.

Conclusion

Attentive workers are one of the best ways to prevent a combustible dust situation. Workers are the first line of defense in preventing and mitigating fires and explosions. If you train the people closest to the hazard source to recognize and prevent combustible-dust hazards in the facility, they can recognize unsafe conditions; take preventative action and alert management.

References

National Safety Council. Fundamentals of Industrial Hygiene, 3rd Edition. National Safety Council. Chicago, Ill. 1988.

National Fire Protection Association (NFPA). *NFPA 654. Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*. 2006 Edition NFPA Inc. Quincy, Mass. 2006. <http://www.nfpa.org>

National Fire Protection Association (NFPA) *Industrial Fire Hazards Handbook*, 3rd Edition. NFPA Inc. Quincy, Mass. 1990.

OSHA Combustible Dust National Emphasis Program (CPL 03-00-008)

Video

Chemical Safety Board Video on Combustible Dust <http://www.csb.gov/videoroom/detail.aspx?VID=30>

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