Combustible Dust

Combustible dusts are finely ground organic or metal particles that present an explosion hazard when suspended in air under certain conditions. Potentially dangerous accumulations of combustible dust can build up on surfaces in the general work area or inside process equipment. In the presence of an ignition source, these accumulations are extremely explosive. Dust explosions can be catastrophic and cause death, injury and destruction of property. Many employers are not aware that a hazard exists until an accident occurs.

WHERE COMBUSTIBLE DUSTS ARE FOUND

Combustible dusts can be found in a variety of operations and industries, including:

- agricultural (grain elevators, bins and silos),
- flour and feed mills
- food (candy, sugar, spice, starch, flour, feed),
- chemical production
- pharmaceuticals
- textiles
- wood and paper products
- coal handling and processing
- wastewater treatment
- metal processing (aluminum, chromium, iron, magnesium, and zinc)
- recycling operations (metal, paper and plastic)

They may be in the open atmosphere or out of view in dust collection bins or bags, shelves, nooks and crannies, inside of equipment and above false ceilings.

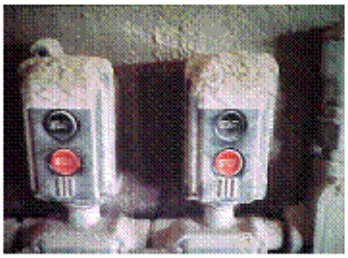

Photo: Washington State Dept. of Labor and Industries

DUST COMBUSTIBILITY

The primary factor in an assessment of these hazards is whether the dust is in fact combustible. Any material that will burn in air in a solid form can be explosive when in a finely divided form. The National Fire Protection Agency (NFPA) defines combustible dust as: "Any finely divided solid material that is 420 microns or smaller in diameter and presents a fire or explosion hazard when dispersed and ignited in air." The Material Safety Data Sheet (MSDS) for the material is one possible source for information on combustibility.

The vast majority of natural and synthetic organic materials, as well as some metals, can form combustible dust. NFPA's Industrial Fire Hazards Handbook states that "any industrial process that reduces a combustible material and some normally noncombustible materials to a finely divided state presents a potential for a serious fire or explosion."

HOW DUST EXPLOSIONS OCCUR

Primary Explosion

For any fire to occur, the three familiar elements of the Fire Triangle must be present:

(1) fuel (combustible material)
(2) heat (ignition source)
(3) oxygen

For a combustible dust to burn, two additional elements are needed:

(4) dispersion of dust particles
(5) confinement

Dispersion of dust particles in sufficient quantity and concentration can cause rapid combustion known as deflagration. If confined, such as in a room, building, or vessel, the resulting rise in pressure can cause an explosion. These five factors are known as the Dust Explosion Pentagon. The absence of any one of these five elements eliminates the potential for catastrophic explosion. Two of the elements in the explosion pentagon are difficult to eliminate: oxygen is a component of air, and the dust cloud is frequently confined within processes or buildings. However, the other three elements of the pentagon can be controlled to a significant extent.

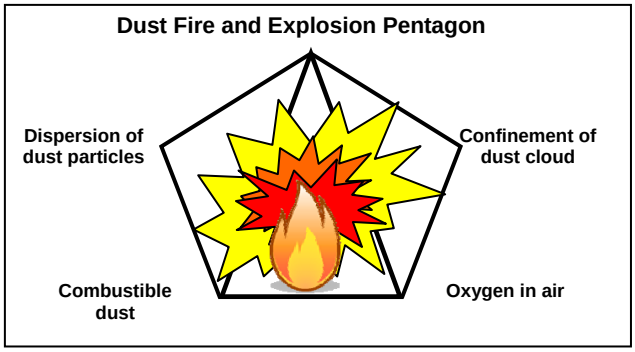

Image: Occupational Safety and Health Administration

Catastrophic Secondary Explosions

An initial (primary) explosion in processing equipment or in an area where dust has accumulated may dislodge more accumulated dust into the air, or damage a containment system (such as a duct, vessel, or collector). As a result, if ignited, the additional dust dispersed into the air may cause one or more secondary explosions. These can be far more destructive than a primary explosion due to the increased quantity and concentration of dispersed combustible dust.

Image: Occupational Safety and Health Administration

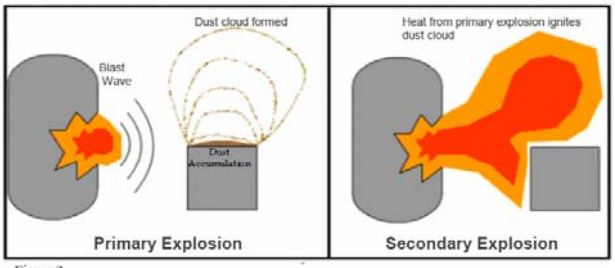

Figure 2

FACILITY DUST HAZARD ASSESSMENT

A thorough hazard assessment is essential in identifying and eliminating factors contributing to an explosion. Dusts are generated in various parts of any production process. Explosions can occur within any process where combustible dust becomes airborne, and can be triggered by a variety of energy sources.

The amount of dust accumulation necessary to cause an explosive concentration can vary greatly. As a result, simple rules of thumb regarding accumulation (such as writing in the dust or visibility in a dust cloud) can be subjective and misleading. The hazard analysis should be tailored to the specific circumstances in each facility and the full range of variables affecting the hazard.

Facilities should carefully identify the following in order to assess their potential for dust explosions.

Materials and Processes

Consider the type of materials used and how they are used in the process. Materials that can be combustible when finely divided should be handled carefully. Some processes, such as chemical blending and dust collection, use or consume combustible dusts. Others, such as milling, metal processing produce combustible dusts.

Location

Many locations need to be considered in an assessment. Consider all possible scenarios in which dust can be dispersed, both in the normal process and potential failure modes.

In equipment such as dust collectors, a combustible mixture could be present whenever the equipment is operating. Other locations to consider are those where dust can settle, both in occupied areas and in hidden concealed spaces. (e.g. floors, around equipment, walls, ledges, overhead pipes, top of equipment, false ceilings, shelves, etc). Consider whether the areas surrounding these locations may confine the dust when dispersed into air.

Dispersion

Dusts can be dispersed when disturbed, either unintentionally or as part of the process. Factors to consider when evaluating the impact of dust dispersion include air currents, ventilation systems, physical barriers as well as the volume of the area in which the dust cloud exists. Additionally, work practices such as dry sweeping or blowing will disperse dust. Consider whether areas are routinely cleaned or dust is allowed to accumulate.

Potential Ignition Sources

Consider any possible ignition sources in the area, such as open flames (welding, cutting, matches, etc.), hot surfaces (dryers, bearings, heaters, etc.), heat from mechanical impacts, electrical discharges (switch and outlet activation), electrostatic discharges, smoldering or burning dust, or cigars, pipes and cigarettes. The severity of the resulting explosions is related to the heat released in the combustion of these materials. Most dust types require an external source of ignition, as only a few spontaneously ignite in air.

Controls

After hazards have been assessed and hazardous locations are identified, one or more of the following prevention, protection and/or mitigation methods may be applied.

- Remove accumulations of combustible dust routinely from elevated surfaces including the overhead structure of buildings, false ceiling, shelves, etc.
- Avoid processes that disperse dust into air.
- Clean surfaces by vacuuming whenever possible rather than blowing or sweeping. Use vacuum cleaners approved for dust collection. Dispose of accumulated dust frequently to avoid collection of dangerous concentrations.
- Eliminate heat and other sources of ignition.
- Ensure electrical installations in hazardous dust or vapor areas meet the National Electrical Code (NEC) criteria for use in hazardous locations specific to combustible dusts (Class II hazardous locations).

- Ensure metallic or conductive dust is prevented from entering or accumulating on or around electrical enclosures or equipment

Additional information on combustible dusts can be obtained from NFPA's Uniform Fire Code®, International Code Council's International Fire Code®, Occupational Safety and Health Administration, and state and local agencies.

Please contact your Zenith Safety and Health Consultant for further assistance.