## Combustible Dust:

# An Explosive Issue

**Prone to explosions, combustible dusts are a safety hazard. However, this can be prevented by taking the necessary preventive measures. By Jamison Scott, executive VP, Air Handling Systems**

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Combustible dust has become a top safety issue in not only the US and Canada, but worldwide as well. The first reported combustible dust fire occurred in 1785 at a flour mill in Italy. Fast forward over two centuries to 2008, which saw a major sugar refinery in Georgia, US, explode due to combustible dust. In 2011, two combustible dust explosions occurred at a factory in China which manufactured Apple iPads.

The year 2012 saw a major sawmill in British Columbia, Canada, launch a fire ball reportedly 60 m high due to a suspected combustible dust explosion, and many other combustible dust explosions have been reported worldwide in many major industries. This article will focus primarily on the woodworking industry and covers what combustible dust is, whether it can happen in your facility, as well as guidelines for prevention.

## What Is Combustible Dust?

Combustible dusts are fine particles that present an explosion hazard when suspended in air under certain conditions according to OSHA (Occupational Safety and Health Administration) in the US. However, OSHA states, 'No single, universally accepted definition of combustible dust is available. Even among standard promulgated by the same standards-developing organization, the definitions vary significantly.' So while we know what combustible dust is — there is no formal definition.

Combustible dusts cover a wide range of industries including agricultural products and dusts such as sugar and wood flour; carbonaceous dusts such as charcoal and coal; chemical dusts such as calcium acetate and sulfur; metal dusts such as aluminum (rocket fuel is made from aluminum) and magnesium; and plastic dusts such as melamine and (poly) vinyl chloride.

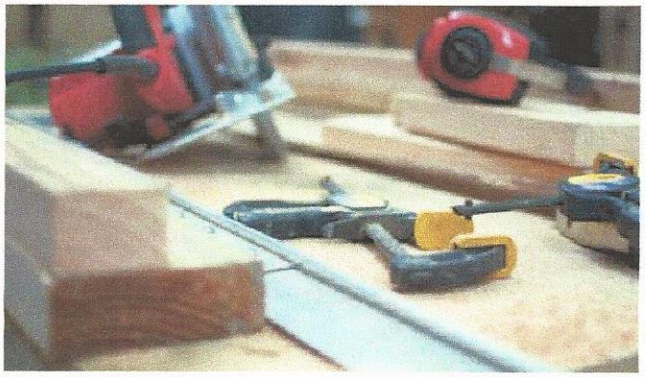
Under certain conditions, these various dusts are potentially combustible and present an explosive dust hazard. Other dusts such as stone dusts and granite, an igneous rock or common table salt which is sodium chloride, are not explosive dust hazards as they cannot combust.

## Dust Explosibility

However, it is not simply defining a dust than it is determining the explosibility of the dust. Important factors include size, shape, moisture as well as environment. If there is any doubt of combustibility, the dust must be sent to a certified facility to be tested.

Additionally, Kst value can be used as a determining factor in the deflagration of your dust. The higher the Kst value, the greater the explosion characteristic of the dust. For example, wood flour (wood dust) has a Kst Value of > 200 and < 300 meaning it has a strong explosion characteristic.

There is also a dust explosion class rating system from St 0 – St 3. The dust explosion class of wood flour is St 2. National Fire Protection Agency (NFPA) defines the size of 'Deflagrable Wood Dust' as 500 microns (0.5 mm, 0.0196") or less and has a moisture content of less than 25 percent. Another way to measure is to see if the material will pass through US No. 35 Standard Sieve according to NFPA 664 (3.3.27.1) which is approximately the 'size of fairly coarse sand'.



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NFPA defines wood derived materials as sawdust, sanderdust, planer shavings, hoggings, wood flour and moulder waste.

## What Is Wood Flour?

NFPA details wood as 'cellulosic material derived from trees, and other cellulosic materials including, but not limited to, wheat straw, flax, bagasse, coconut shells, corn stalks, hemp, rice hulls, and paper or other cellulosic fibres used as a substitute or additive to wood.' Additionally, 'Wood-Derived Materials' are defined by NFPA as 'sawdust, sanderdust, planer shavings, hoggings, wood flour, and moulder waste.'

To clarify earlier references, NFPA is an International Codes and Standards Organization that creates voluntary consensus standards used by various organisations including Authority Having Jurisdiction (AHJ), which can be anyone from a building inspector to a fire marshall. There are several useful standards covering combustible dust published by NPFA — some of the most relevant are:

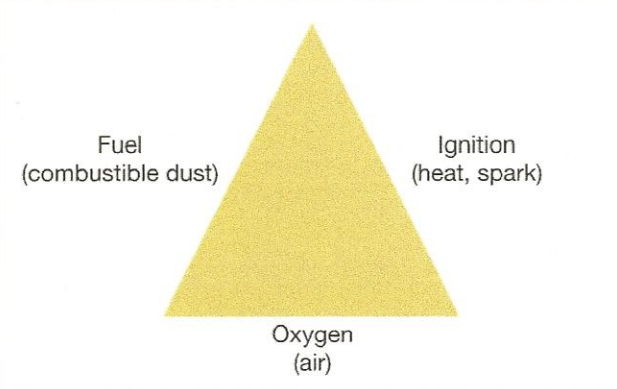
- NFPA 61: Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities. Current Edition: 2008
- NFPA 484: Standard for Combustible Metals, Current Edition: 2012
- NFPA 654: Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, Current Edition: 2013
- NFPA 655: Standard for Prevention of Sulfur Fires and Explosions, Current Edition: 2012
- NFPA 664: Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities, Current Edition: 2012

## Contributing Variables

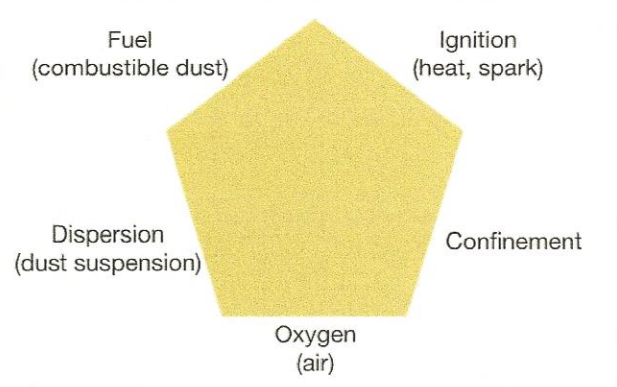
In order to have a fire you must have 'fuel', 'ignition' and 'oxygen', the three main elements of the 'Classic Fire Triangle'. However, for a combustible dust explosion you must add 'dispersion' and 'confinement', which together creates the 'Dust Explosion Pentagon'. Without these five elements, an explosion is impossible but not a fire.

With many larger combustible dust explosions, there are two issues. First is the primary issue, which is the initial combustible dust explosion. The second issue is the secondary explosion which typically comes from stagnant undisturbed fugitive dust that has settled in hidden places, which becomes dispersed and suspended due to the disturbance caused by the initial explosion.

This is what happened at the Imperial Sugar explosion in Port Wentworth, Georgia, US, in 2008. The initial explosion occurred at one location within the facility and the explosion was so forceful that it literally shook other sections of the building, releasing and suspending the previously settled fugitive dust, thus creating dust clouds in enclosed rooms that exploded as fire spread throughout the building. There is suspicion that this is also what happened at the sawmill explosion in British Columbia, Canada, earlier in 2012.




**Classic Fire Triangle**




**Dust Explosion Pentagon**

## Can It Happen In Your Facility?

According to the US Chemical Safety Board (CSB), 'three of the four deadliest accidents they investigated were determined to be combustible dust explosions,' with one recently involving a powdered metal explosion in Gallatin, Tennessee, US, in May 2011. As CSB reported at a news conference following the Gallatin explosion, "Accidents can be prevented if we find out what happened, and share the findings with industry and the public."

Additionally, with combustible dust on OSHA's radar screen, inspections have increased substantially as have the actual penalties. OSHA is taking this matter seriously using the general duty clause in classifying combustible dust violations.

One combustible dust violation alone had a US$5,000 penalty if, according to OSHA, "The employer did not furnish employment and a place of employment which were free from recognized hazards that were causing or likely to cause death or serious physical harm to employees in that employees were exposed to fire and explosion hazards caused by the presence of combustible dust."

## Standards & References

Another OSHA Citation for a woodworking facility stated "layers of combustible wood dust were allowed to accumulate to depths over surface areas in quantities that exposed workers to fire and or explosion hazards." This citation references 29 CFR 1910.22(a)(1).

CFR is the US 'Code of Federal Regulations'. Title 29 are regulations related to 'Labor'. Part 1910 refers to the 'Occupational Safety and Health Standards' while Section 22 is 'General Requirements', (a) being 'Housekeeping' and (1) as 'All places of employment, passageways, storerooms, and service room shall be kept clean and orderly and in a sanitary condition.'

So the layers of wood dust in this citation are in direct violation of the current 'housekeeping' regulation, as are combustible wood dust accumulated on I-beams, inside trough of ceiling joists as well as on the floor.

The citation continues to state "when combustible wood dust was cleared from surfaces, the employer used cleaning methods that increased the potential for a combustible dust deflagration and or explosion" because "the employer used 30 psi compressed air to blow down and clear combustible wood dust."

The current NFPA Standard as referenced in this citation states 15 psi as being the proper low pressure. This citation specifically refers to the NFPA 664 (2012) 11.2.1.1 which states "surfaces shall be cleaned in a manner that minimises the generation of dust clouds... only a low gauge pressure 15 psi... shall be used."

## Guidelines For Prevention

Studying past combustible dust explosions as well as OSHA inspections provide guidelines and a few main areas that should be highlighted, which include: hazard recognition/assessment; building design and engineering controls; administrative controls; housekeeping; and worker training.

Hazard recognition/assessment includes area such as determining if dust is combustible via dust explosion testing, which may include particle size and moisture analysis, explosion severity test which tests the Kst value and minimum explosible concentration (MEC) as mentioned earlier. It also covers issues related to NFPA as well as potential applications of state and local codes, including the role of the AHJ as mentioned earlier.

Building design and engineering controls should cover "fixed structures that are built into a facility or processing equipment designed to remove or minimize a hazard." Building design includes the building or facility which focuses on prevention of fugitive dust accumulation on surfaces, beams, etc.

Flat surfaces are not good, as well as other surfaces including rectangular shaped ductwork, overhead beams, flat surfaced lighting fixtures, and all invisible areas such as hung or suspended ceilings.

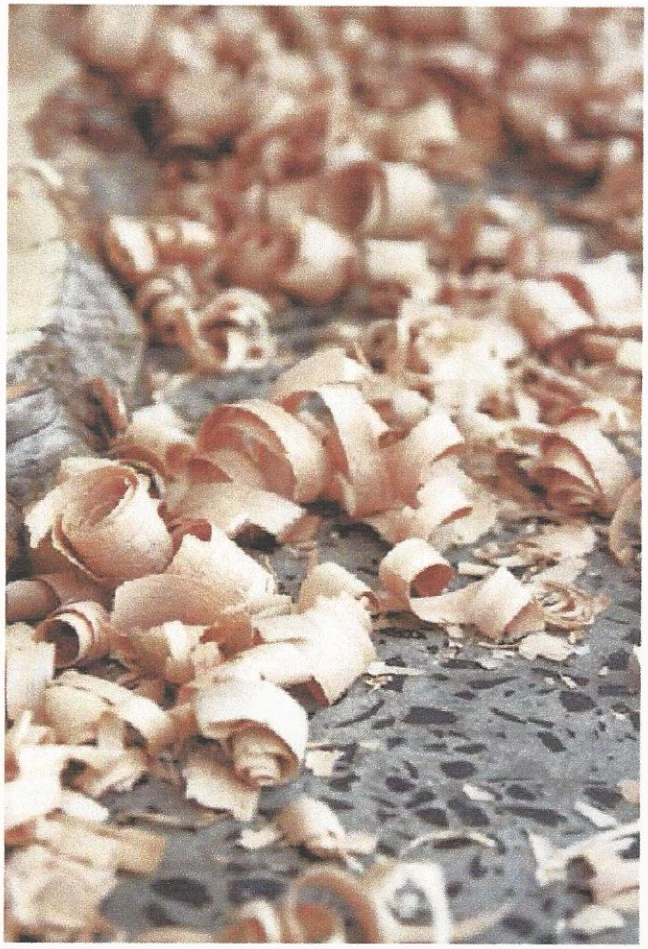
This is where good housekeeping is imperative. Engineering controls focus on the equipment such as dust collection systems or prevention devices such as spark detection in dust collectors and ductwork and explosion venting and suppression.

In the US, OSHA requires a great detail on documentation, which is one of the most important roles in administrative controls. Just like with any other safety and health regulation, OSHA requires written rules and procedures, and wants to and ensures policies are fully understood and practiced by employees. For example, is there a method to prevent escape of fugitive dust? If there is escape of dust, is there a policy to remove fugitive dust from surfaces?

## Prevention

The single most important thing any facility can do is fully engage in housekeeping and fugitive dust control. If underlying surface colours are not readily discernible, there could be a dust deflagration hazard as mentioned in another NFPA document.

If you have a green machine and you cannot see the green colour due to a layer of dust — you probably have too much dust in the area. If you can see the dust, do not ignore it. Clean it up, but do not blow off with an air gun as that simply releases and stratifies the dust. Instead, use a vacuum to collect dust. Then investigate to determine the source of the dust.



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For example, if the ductwork is not airtight, seal joints to prevent the release of dust. When inspecting the workplace for dust accumulations again, consider all flat surfaces including rectangular shaped ductwork, overhead beams, flat surfaced lighting fixtures, and all invisible areas such as hung or suspended ceilings.

Additional area of focus in prevention includes worker training. It is of utmost importance to ensure workers know what to do. Have they read operating procedures? Do they understand the operating procedures? Have they been tested to ensure they understand the procedures? Has worker training been documented?

This article attempts to simply raise awareness on the issues related to combustible dust, as there is much more to review prior to effective implementation of controlling fugitive dust and initiating a comprehensive program to control combustible dust. This is especially so as the topic of combustible dust is ever growing on a regular basis, as regulatory agencies continue to investigate ongoing issues while trying to mitigate future issues. FDM