Explosive Dust: A Risk that Can't Be Ignored

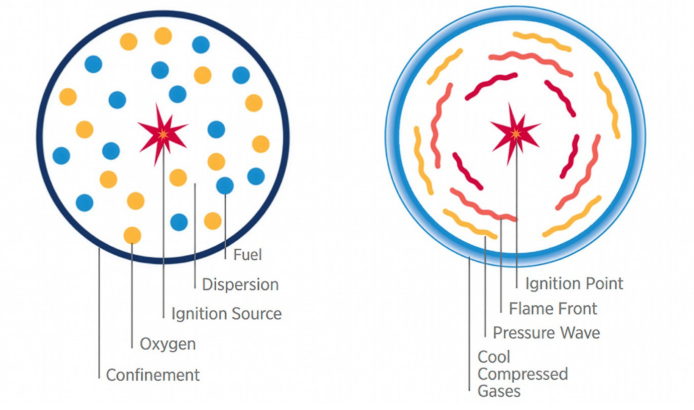
Summary

Dust explosions are a major industrial hazard. Fugitive dust can easily build up on surfaces over time, and even in materials with relatively low combustion potential, combine with facility factors to produce a devastating explosion event.

With awareness, protective measures can be put in place. For them to be effective, however, facilities need to implement both training programs and technical updates. Unfortunately, there isn't a single universal resolution to this problem. Differing dust characteristics, and facility and equipment layouts all drive the need for tailored solutions. Hi-Vac's expert team leverages over 50 years of vacuum technology expertise to determine the best fire and explosion prevention and mitigation technologies for each installation.

Understanding Explosion Mechanics

Explosions require five elements:; fuel, oxygen, dispersion, an ignition source and a confined space. Fuel can consist of a dry material dispersed as a cloud of fine particles or a flammable gas or vapors offgassed from a volatile chemical. Oxygen is a given in most plant environments. Ignition sources can be created by an open flame, a welding arc, spontaneous combustion, or through friction and electrostatic sparks. Typical production facility confinements include conveyance, processing, pulverizing or storage of combustible materials. Once all five elements are brought together in a single location, the potential for an explosion exists.



An explosion is a propagating combustion wave (deflagration) moving at less than the speed of sound. A flame front initially travels at slow speeds but increases velocity quickly, forming a leading high pressure (shock) wave. Since most confined industrial processes are not designed to withstand the pressures created by an explosion, a rupture often occurs in the confinement, releasing a high-pressure shockwave and flame. This destructive process can bring about a much larger secondary explosion and post-explosion fire, created when the initial explosion disturbs additional fugitive static dust within the facility.

Explosive Potential – A Nearly Universal Risk

Explosion Class: 1 (Weak)								Explosion Class 2: (Strong)	
Material	Kst Value	Material	Kst Value	Material	Kst Value	Material	Kst Value	Material	Kst Value
Tobacco	12	Milk powder	90	Sodium ascorbate	119	Sugar	138	Starch, corn	202
Cotton	24	Aluminium grit	100	Malt dust	122	Toner	145	Wood Flour	205
Soot	26	Wood dust	102	Brown coal	123	Sulphur	151	Methyl cellulose	209
Bronze	31	Dextrin	106	Sodium stearate	123	Lead stearate	152	Cellulose	229
Egg White	38	Melamine resin	110	Epoxy powder	125	Polyurethane	156	Barley grain dust	240
Activated carbon	44	Soybean flour	110	Silicon	126	Pectin	162		
Paper tissue dust	52	Soap	111	Epoxy resin	129	Zinc	176	Explosion Class 3: (Very Strong)	
Cellulose pulp	62	Flour, Bakers 4.3% Moist	112	Phenolic resin	129	Para formaldehyde	178	Material	Kst Value
Corn	75	Asphalt	117	Calcium stearate	132	Peat	178	Aluminium powder	400
Polyester	85	Charcoal	117	Polyethylene	134	Rice starch	190	Magnesium	508

As a rule, any potentially flammable material can and will explode under the right conditions. While almost every type of dust is potentially combustible, explosive risks can range from fairly weak to very strong. This scale is measured by a dust deflagration index known as “Kst value”. Kst values are divided into four classes, St. 0 through St. 3. Any material with a Kst value & Class greater than zero is, under the right circumstances, a potential explosion risk. Dust explosions happen regularly in industrial facilities, often involving materials such as cellulose, flour, sawdust, fungicides, plastics, resins, and fine light metal shavings, many of which are not commonly recognized as “flammable.””. Even “weak” explosion category dust can cause enormous damage to plant and injury to personnel. Silica, in fact, is the only common dust type that is completely non-combustible.

As a result, any facility that handles, stores or processes even moderately flammable solids, liquids, or gases has some degree of explosion risk.

Getting Ahead of Explosive Dust

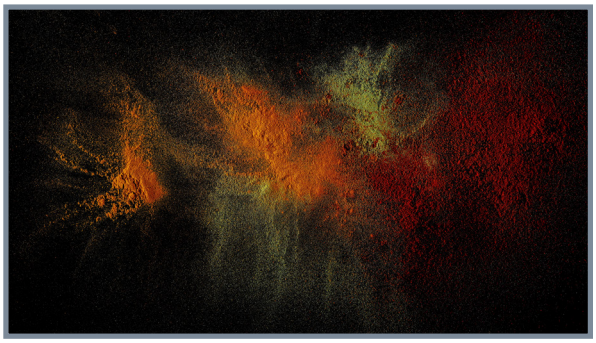
Studies show that many industrial workers and managers are unaware of potential dust explosions hazards and consequences within their facility. A 2006 Combustible Dust Hazard Study conducted by the U.S. Chemical Safety and Hazard Investigation Board (CSB) researched 140 known combustible dust materials. They found that 41% of these materials’ Material Safety Data Sheets (MSDS’s) did not warn users about potential dust explosion hazards.

Fortunately, facilities can implement a straightforward set of steps* to mitigate their dust explosion risk:

- **Implement effective dust containment systems** – designed to prevent fugitive dust from escaping their systems.
- **Regular and comprehensive housekeeping programs** – frequent cleaning of floors and other horizontal services (ducts, pipes, beams, ledges).
- **Ignition source control** – electrical cleaning devices designed for Class II locations. All systems equipped with electrostatic charge grounding and bonding hardware. Clear marking of No Smoking areas, and implementation of Hot Work permit program.
- **Training and prevention** – full employee training on combustible dust risks, SDS’s for all potential combustible dust-bearing chemicals, separator devices for foreign materials capable of acting as dust ignition sources.
- **Facility protection** – effective explosion venting away from employees, deflagration propagation isolation features within ductwork, explosion/deflagration suppression systems within dust collection systems, facility emergency action plan and clearly marked exit routes

Note: list shown is not all-inclusive.

Explosion Prevention – No One-Size-Fits-All Solution



The scope of implemented dust containment, ignition source control, and explosion venting and propagation isolation solutions may vary greatly, depending on the explosive properties of target materials. Standard Kst values may or may not apply to specific process dust outputs, depending on precise material composition, particulate sizes, and humidity level. Specific material testing may be required to determine actual explosion risk. The internal volume and structural strength of a dust collection system may also require either a larger explosion vent total surface area or more aggressive venting solution configurations. Dust collection system location can have a major impact, with internally sited systems typically requiring a flameless venting solution, unless they can be safely vented outside the building.

Tailored Solutions to Fit Your Needs

Hi-Vac's team can help you develop specific configurations to meet your dust's material characteristics. Hi-Vac offers a full range of internal and external power head locations, static management, explosion overpressure venting, flame suppression, and explosion isolation ductwork options. Nearly as importantly, Hi-Vac offers both consultative unit configuration and full turnkey manifold system design, documentation, and qualification services, guaranteeing that your installation is both sized to help you quickly and efficiently address dust accumulation on an ongoing basis, and equipped to prevent explosion propagation.

NEMA 7/9 CONTROL PANEL

CONDUIT ISOLATED WIRING

ISOLATION DUCTWORK

FLAMELESS RELIEF VENTS

CEASE FIRE® SUPPRESSION SYSTEM & FILTER GROUNDING

GROUNDING REELS

Next Steps

Find out more about Hi-Vac Industrial's range of flammable and explosion mitigation options, and begin configuring the best system for your dust profile at **www.hi-vacproducts.com**.

Citations

OSHA Combustible Dust Fact Chart - http://www.osha.gov/Publications/3371combustible-dust.pdf

OSHA Combustible Dust National Emphasis Program https://www.osha.gov/sites/default/files/enforcement/directives/CPL_03-00008.pdf

US Chemical Safety and Hazard Investigation Board - https://www.csb.gov/combustible-dust-hazard-investigation/

OSHA Hot Work Programs - https://www.osha.gov/lawsregs/regulations/standardnumber/1910/1910.252