Combustible Dust

A two-part guide for education and prevention.

Created for your safety by:

PERFORMANCE INDUSTRIAL

The frontrunner behind the scenes.

Introduction

2002 – Vicksburg, Mississippi: **Six severe injuries and five deaths**
2003 – Kinston, North Carolina: **Dozens of severe injuries and six deaths**
2003 – Corbin, Kentucky: **Seven deaths**
2003 – Huntington, Indiana: **Two burned employees and one death**
2008 – Port Wentworth, Georgia: **14 deaths and more than 40 hospitalized for severe burns**
2011 – Gallatin, Tennessee: **Five deaths and three severe injuries**
2011 – Louisville, Kentucky: **Two deaths and two severe injuries**
2014 – Kunshan, China: **75 deaths and 185 injuries**

The incidents listed above are the stories that made the news. Not included are the 50 other combustible dust accidents between 2008 and 2012 documented by the Chemical Safety Board that led to an additional 29 fatalities and 161 injuries. Each one involved facilities that ignored the risks. Each life lost was preventable.

It's going to take proactive responsibility to reduce combustible dust hazards. Whether it's better cleaning practices, safety procedures, or emergency preparedness – together we can take the initiative to learn more.

Please take a moment to read through this document and share it with your colleagues and team members. We hope that by sharing this information, we can do our part in making sure every worker can go home safe at the end of the day.

Yours to count on,

Mark W. Miller
Visionary & President
Performance Industrial

PART 1:
Why Dust Combusts

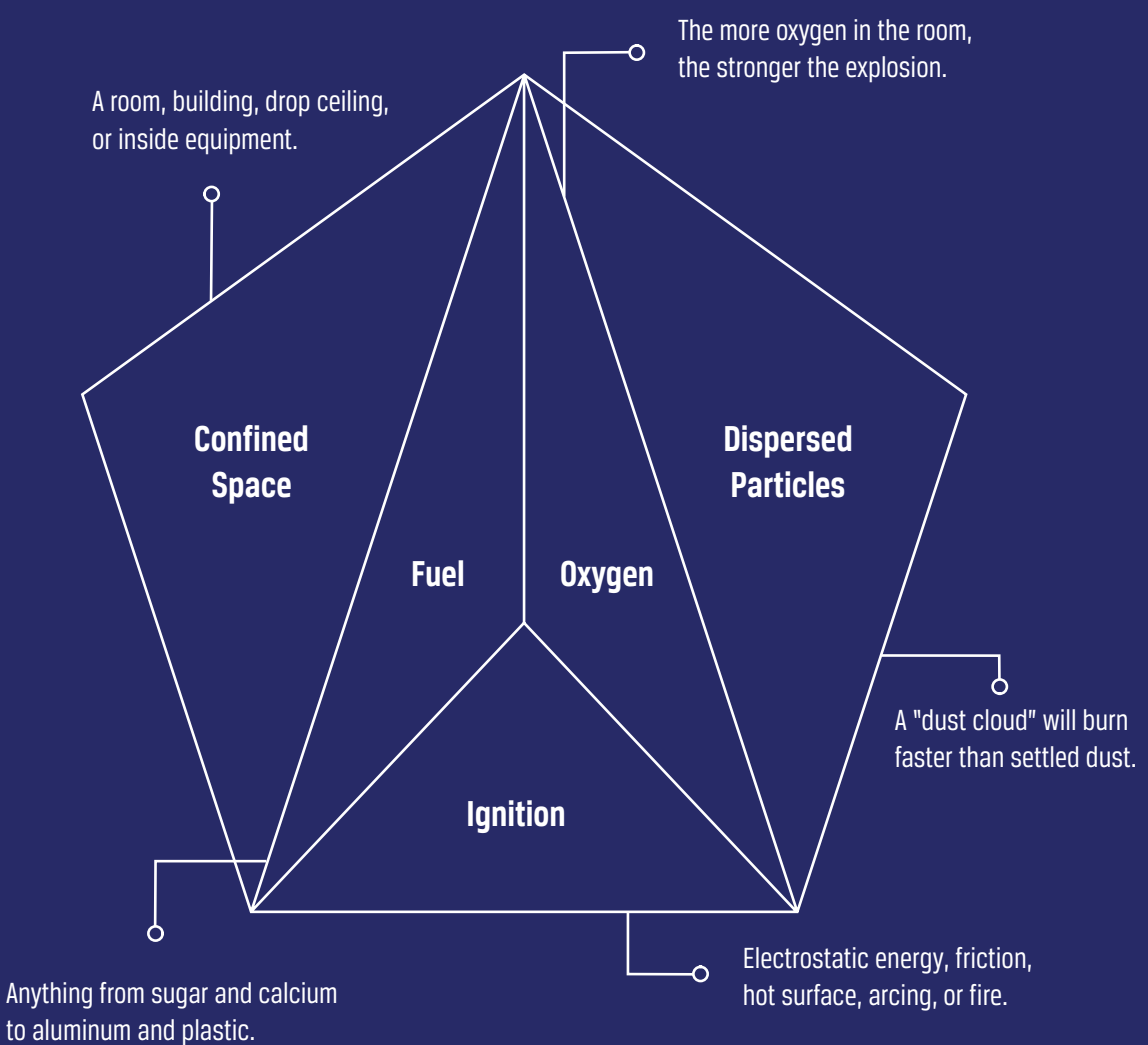
The science behind
the deadly hazard.

The Dust Combustion Formula

The first step in understanding this deadly hazard is to learn why dust can combust. Like any fire, a combustion explosion begins with three elements – fuel, oxygen, and an ignition source. However, what pushes it over the edge are two additional components: 1) the dispersion of particles; and, 2) a confined space. Confined spaces create pressure and dispersed dust particles have more vulnerable surfaces. **The more pressure and exposed surfaces, the bigger the explosion.**

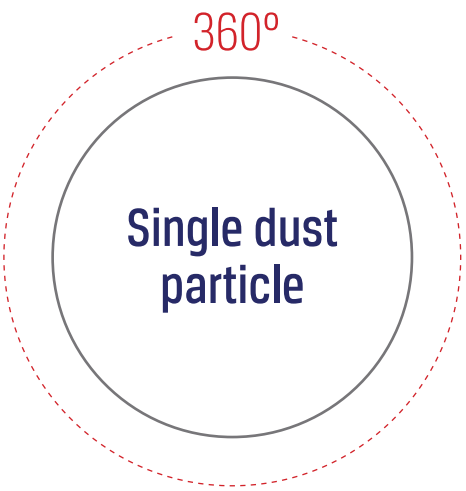
"Combustible dust is a solid material composed of distinct particles or pieces [...] which presents a fire or deflagration hazard when suspended in air. Combustible dusts are often either organic or metal dusts that are finely ground into very small particles, fibers, chips, chunks, or flakes."

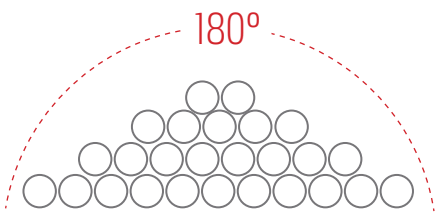
- OSHA
Hazard Communications Guidance for Combustible Dusts



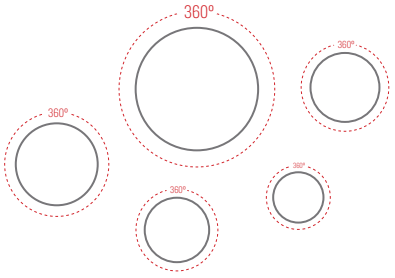
Molecular Misfortune

You're probably familiar with common flammable materials (wood, paper, coal, and more). Combustible dust can come from these *and* it can come from hundreds of other materials that may not be top of mind when you think "flammable." That's because organic materials of most varieties, once broken down into a dust-sized particle, have 360 degrees of surface area with microscopic diameters (420 microns or less). **Their small size makes them more flammable and the potential for combustion occurs once they're dispersed in the air.**





Settled dust on a flat surface



Multiple dust particles in the air

If you were to light a pile of sugar dust on a table on fire, it would burn. But, it will likely self-extinguish because half of its surface area isn't exposed to oxygen. If those same particles were thrown in the air and lit, they can combust.

Combustible Products & Materials

Wondering what combustible dust made is out of? Below is a list created by OSHA to highlight common industrial products and materials that can create combustible dust. While extensive, the list is neither whole nor exclusive. **Be aware that most organic or metallic materials can become combustible dust.**

Agricultural Products

- Egg white
- Beet sugar
- Corn starch
- Milk (powdered, dry, nonfat)
- Milk sugar
- Soy flour
- Rice (flour, starch)
- Sugar
- Tapioca
- Wheat (starch, grain, flour)
- Whey
- Wood flour

Agricultural Dusts

- Alfalfa
- Apple
- Beet root
- Carrageen
- Carrot
- Cocoa (powder, bean dust)
- Coconut shell
- Coffee
- Corn meal
- Cornstarch
- Cotton
- Cottonseed
- Garlic powder
- Gluten
- Grass
- Hops (malted)
- Lemon (peel & pulp)
- Linseed
- Locust bean gum
- Malt
- Oat grain
- Olive pellets
- Onion powder
- Parsley (dehydrated)
- Peach
- Peanut meal and skins
- Peat
- Potato (flour, starch)
- Raw yucca seed
- Rye flour
- Semolina
- Soybean
- Spice
- Sunflower
- Tea
- Tobacco
- Tomato
- Walnut
- Xanthan gum

Carbonaceous Dusts

- Cellulose (paper)
- Charcoal
- Coal
- Coke (petroleum)
- Cork
- Lampblack
- Lignite
- Soot

Chemical Dusts

- Adipic acid
- Anthraquinone
- Ascorbic acid
- Calcium acetate
- Calcium stearate
- Carboxy-methylcellulose
- Dextrin
- Lactose
- Lead stearate
- Methyl-cellulose
- Paraformaldehyde
- Sodium ascorbate
- Sodium stearate
- Sulfur
- Zinc stearate

Metal Dusts

- Aluminum
- Bronze
- Iron carbonyl
- Magnesium
- Zinc

Plastic Dusts

- (poly) Acrylamide
- (poly) Acrylonitrile
- (poly) Ethylene
- Epoxy resin
- Melamine (resin, molded)
- (poly) Methyl acrylate
- Phenolic resin
- (poly) Propylene
- Terpene-phenol resin
- Urea-formaldehyde
- (poly) Vinyl acetate
- (poly) Vinyl alcohol
- (poly) Vinyl butyral
- (poly) Vinyl chloride

References: NCDOL, "A Guide to Combustible Dusts"; OSHA Poster, "Combustible Dust"

Non dairy creamer is commonly used to create special effect explosions in movies and productions.

Sources of Dust and Ignition

Workplace conversations about dust are often about inhaling it to prevent health problems. While a worthy concern, this has lead to some misunderstandings about where dust comes from, where it collects, and what can cause an explosion.

Processes that can create combustible dust

While your facility may not directly produce a dust-sized product, common tasks can break larger particles into combustible dust. Some of these tasks and processes include:

- Blasting
- Cutting
- Polishing
- Crushing
- Conveying
- Mixing
- Screening
- Rolling/unrolling
- Slitting
- Sweeping
- Blowing
- Vacuuming
- Grinding
- Shaping
- Transporting
- Sieving

Spaces combustible dust can collect

Dust explosions have occured in many different types of workplaces and industries. Some of the common structural elements amongst them show where dust can hide. These areas include, but aren't limited to:

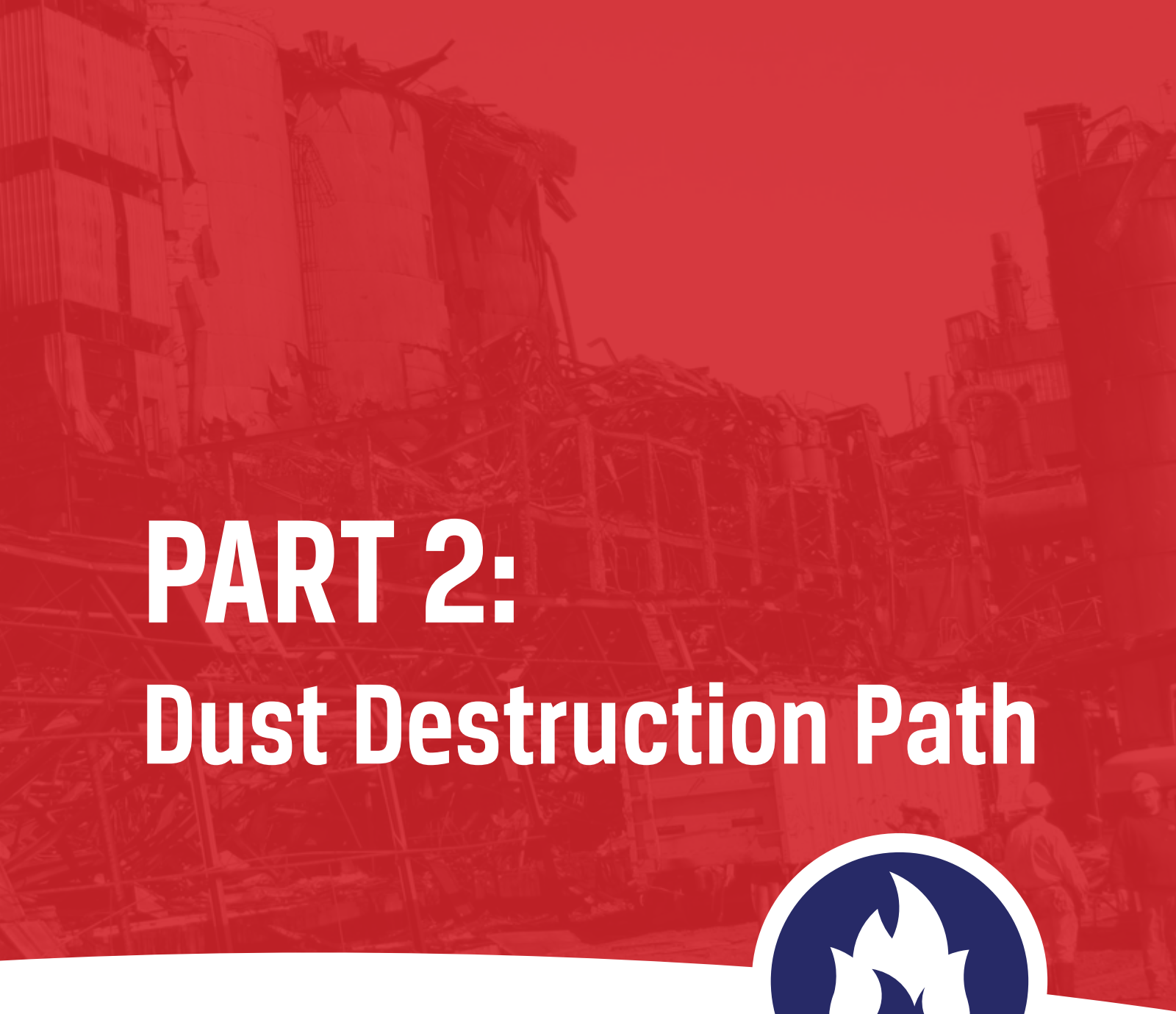
- Rafters
- Suspended ceilings
- Ducts
- Furnaces
- Dust collectors
- Horizontal surfaces
- Silos
- Grain elevators
- Vacuums
- Under/above equipment
- Around conveyors
- Roofs

Sources of ignition

Not all fires come from flames. In fact, many of the explosions listed in the Introduction didn't begin near open flames. The following are some ignition sources that may trigger/feed an explosion:

- Sparks
- Friction
- Arcing
- Hot surfaces
- Fire/flames
- Welding
- Stoves/ovens
- Kilns
- Cigarettes
- Engines
- Machines
- Electrostatic discharge

Ever used a vacuum at home and realized it has dirt stuck to its nozzle or canister? Maybe it feels warm when you're done? The movement of small particles causes static electricity and friction. This same energy can propel explosions on a larger scale.



PART 2:
Dust Destruction Path

How one explosion
can lead to facility-wide
devastation.

Primary Explosion

The five elements of the Combustible Dust Formula (fuel, oxygen, ignition, confined space, and dispersed particles) combine to **trigger an explosion inside equipment or in a confined area** where dust has accumulated (false ceilings, dust collectors, below conveyor belts, etc.). This explosion can **damage equipment and injure nearby employees.**

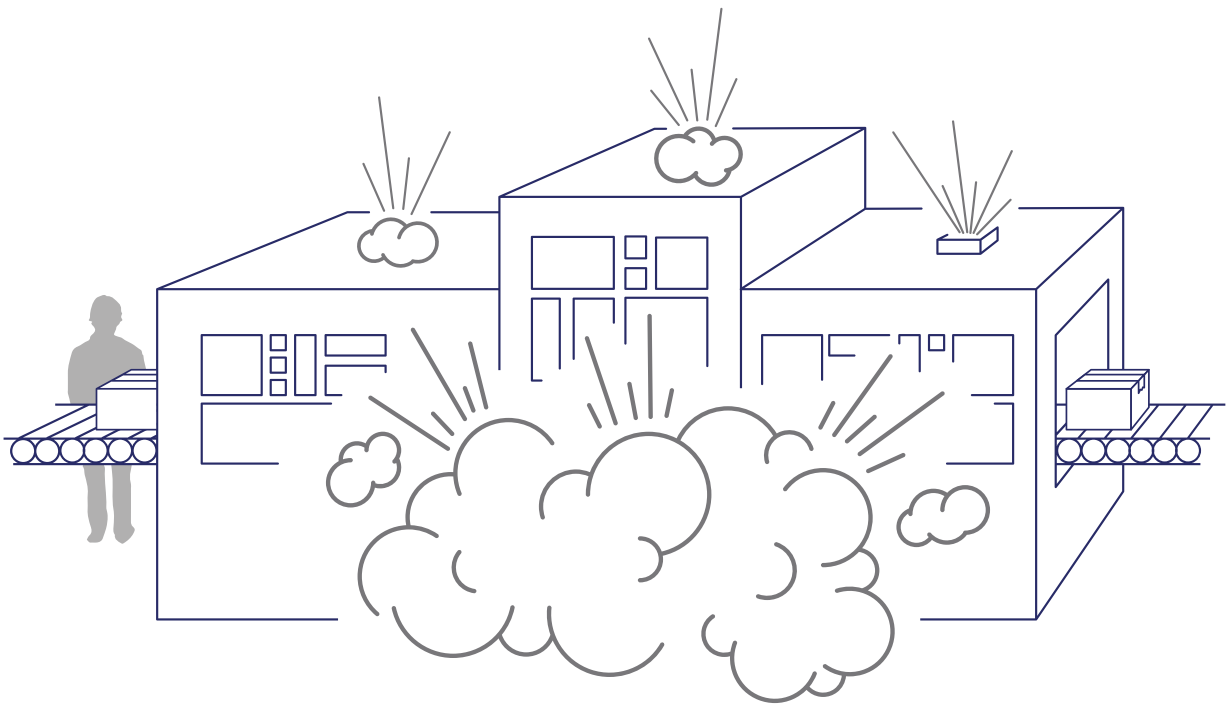


Figure 1:
Primary explosion inside equipment

The 2008 Imperial Sugar Refinery explosion began when sugar dust collected beneath a network of conveyor belts.

Disturbance and Dust Cloud

Like an earthquake, the energy from the primary explosion can shake nearby rooms, attached equipment, or the entire facility. If the facility hasn't been cleaned consistently with the correct tools, this disturbance can **dislodge hidden dust, send it into the air, and form a dust cloud above unsuspecting employees.**

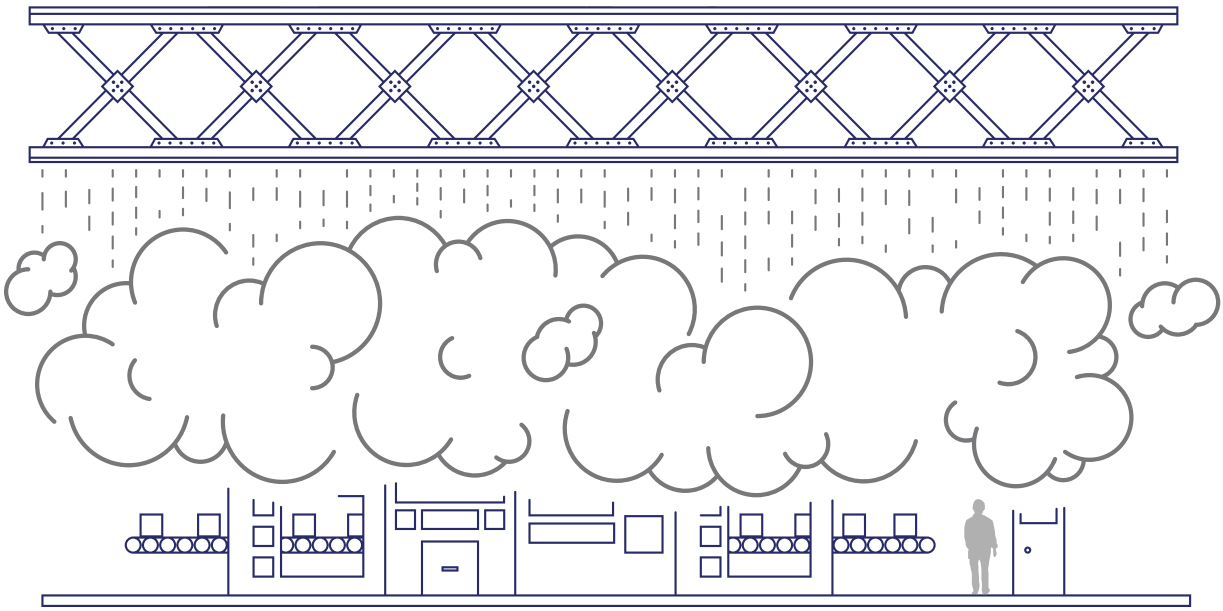


Figure 2:
Dust from above neighboring equipment and ceiling collects in the air

In 1999, a Michigan power plant had a natural gas fire. The flames reached coal dust, caused a secondary explosion, and killed six people.

Secondary Explosion

If the dust cloud meets any ignition source, it can explode with extreme force. (Ignition can be heat or flame from the primary explosion, or static electricity or friction within the facility). This fireball, or secondary explosion, will be significantly more destructive, **risking the lives of all employees** as it tears through a facility.

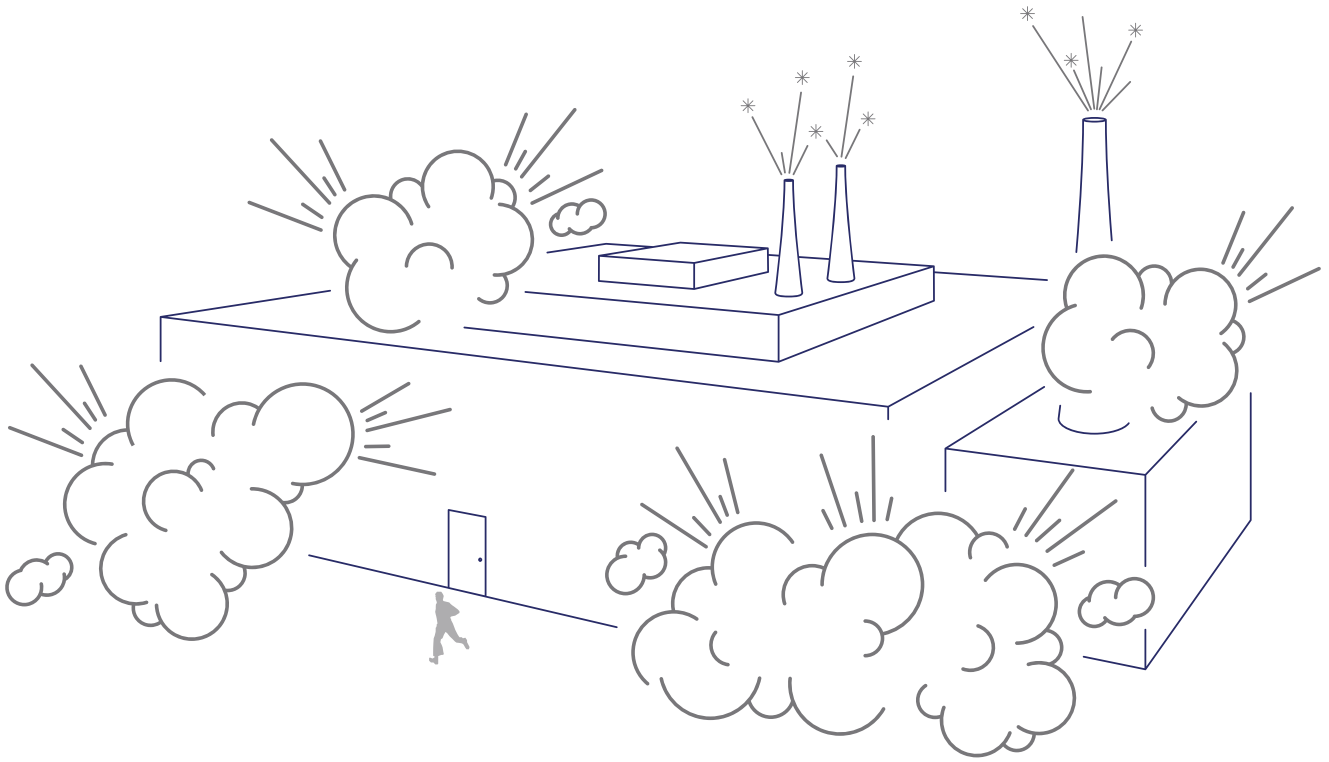


Figure 3:
The dust cloud erupts and sends a fireball through the entire facility

At the 2003 West Pharmaceutical Plant explosion, a chain reaction of explosions ignited rubber dust hidden in a suspended ceiling. The explosions killed six people and injured dozens of others.

Proactive and Prepared

Combustible dust accidents are preventable. Unfortunately, housekeeping neglect, improper training, and incorrect handling can lead to property damage, injuries, and loss of life. The following guidelines from OSHA and the NFPA can help your facility begin to mitigate this hazard.

Dust Control and Cleaning

- Minimize the escape of dust from process equipment or ventilation systems
- Use dust collection systems and filters
- Use surfaces that reduce dust accumulation and help with cleaning
- Provide access to all hidden areas to permit inspection
- Conduct regular inspections for dust in open and hidden areas
- Clean dust residues at regular intervals
- Use cleaning methods that do not generate dust clouds if ignition sources are present
- Use only vacuum cleaners approved for combustible dust collection
- Locate relief valves away from dust hazard areas
- Develop and implement a written program for hazardous dust inspection, housekeeping, and control
- Conduct strict screening processes for cleaning vendors

Ignition Prevention

- Use appropriate electrical equipment and wiring methods
- Control static electricity, including bonding of equipment to the ground
- Control smoking, open flames, and sparks
- Separate heated surfaces and heating systems from dust
- Inspect your spark detection and suppression systems

Safety and Awareness

- Create an emergency action plan specifically for dust explosions
- Educate all team members on the risks of combustible dust
- Put into effect a hot work permit system that addresses how hot work is performed
- Contact your local OSHA office with questions about ways to improve your dust safety

Class II wiring methods and equipment (such as "dust-ignition-proof" and "dust-tight") should be used as noted in NFPA 70 Article 500.

Dirty. Difficult. Done.

The Performance Industrial team is expertly trained to help protect your facility from a potentially devastating dust explosion.

The proof is in the facts:

- We're the only OSHA SHARP recognized service contractor in NYS
- We know where dust hides and how to get to it
- We know the federal regulations and risks you face with dust
- We have the correct cleaning equipment to combat dust

Be proactive. Give us a call.

518.793.9274
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