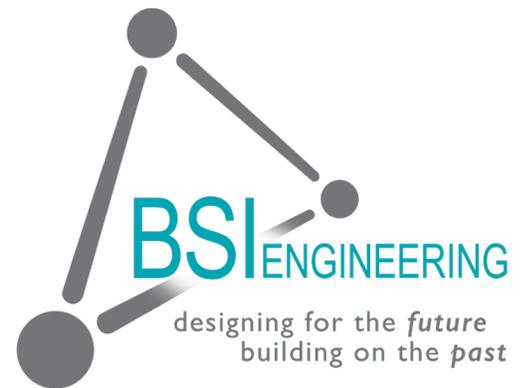


# Common Causes for Dust Explosions



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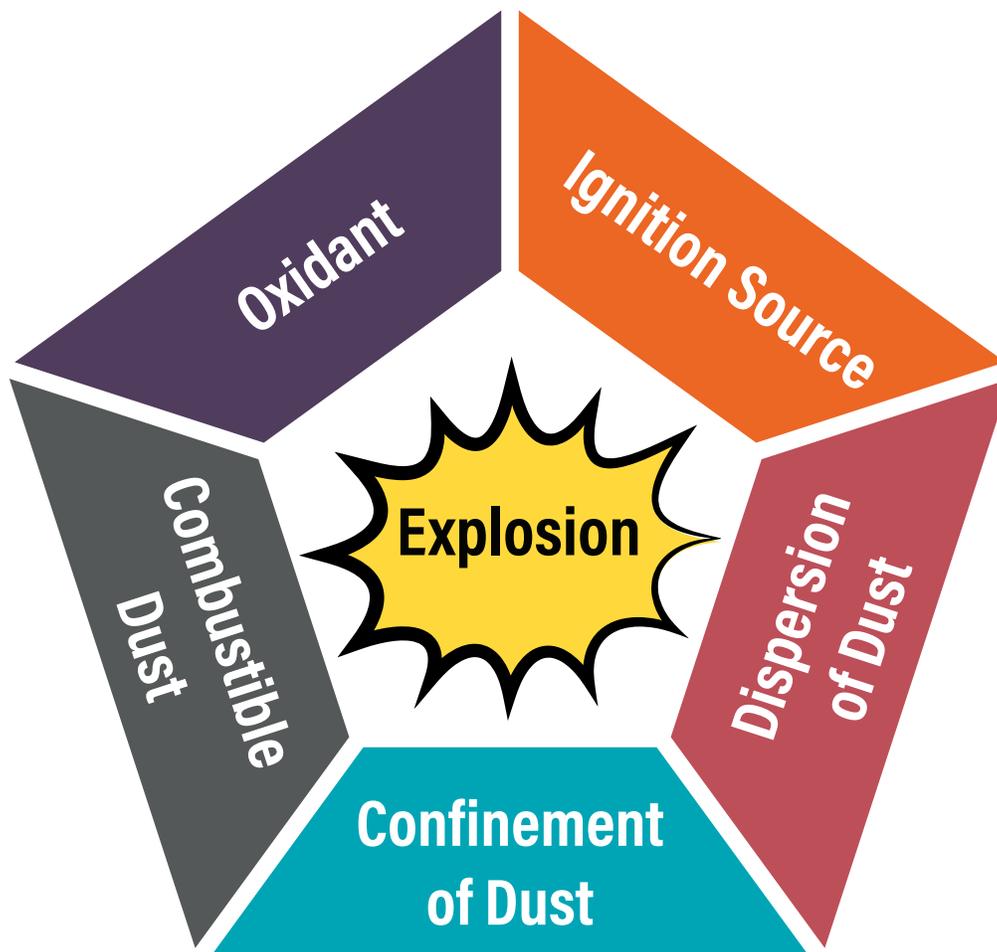
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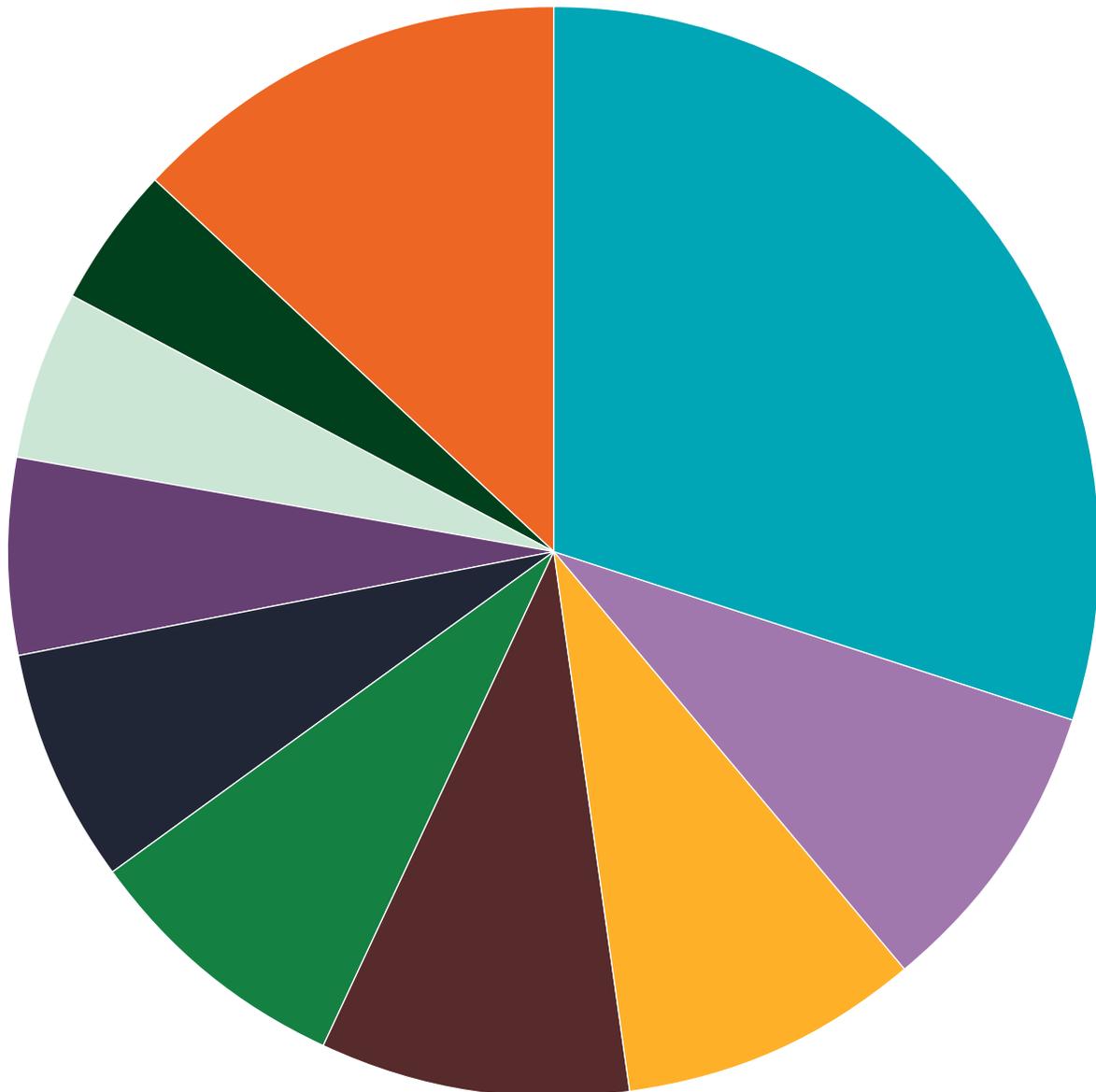
Dust in normal life is commonplace; we find it in our homes, cars, and offices. When dealing with dust in a manufacturing process facility, the type of dust can be significantly more dangerous than the dust we find under the bed at home. Companies deal with combustible dust in a wide range of industries, like food and beverage, pharmaceutical, chemical, agricultural, power generation (coal) industries. However, the risks of combustible dust explosions and hazards are not always understood. This paper sheds light on what factors are needed for a dust explosion to occur and the unfortunate common causes that can spark a dust explosion incident.

# DUST EXPLOSION PENTAGON

1. **Dust** - The air born particles in the atmosphere are the fuel for the dust explosion. Material in dust form, compared to a larger piece of the material has more surface area available. The amount of energy to ignite a dust particle is significantly less than a solid piece of material.
2. **Ignition** - The source that causes the combustion to occur can be as small as static electricity.
3. **Dispersion** - When the dust that is in the atmosphere is spread out in the air that makes a dust cloud. Dispersion can also occur when a shockwave from an initial explosion loosens settled dust into the air. The right concentration/dispersion needs to be present for a dust explosion to occur. For a safe atmosphere, the minimum concentration of dust in the atmosphere should be at or below 25% of the LEL (lower explosive limit).
4. **Oxidant** - Fire needs oxygen to burn, which is readily available in air, is hard to remove entirely. Oxygen sources can also be found in peroxides, chlorates, nitrates, and dichromates.
5. **Confinement** - An enclosed area like a vessel, a building, mine...etc.



# COMMON IGNITION SOURCES



 Mechanical Spark - 30%

 Hot Surface - 7%

 Static Electricity - 9%

 Self-Ignition - 6%

 Friction - 9%

 Welding - 5%

 Smolder Spots - 9%

 Electrical Equipment - 4%

 Fire - 8%

 Other - 13%

# COMBUSTIBLE DUST EXAMPLES FROM OSHA

<b>Agricultural Products</b> Egg white Milk, powdered Milk, nonfat, dry Soy flour Starch, corn Starch, rice Starch, wheat Sugar Sugar, milk Sugar, beet Tapioca Whey Wood flour	Cottonseed Garlic powder Gluten Grass dust Green coffee Hops (malted) Lemon peel dust Lemon pulp Linseed Locust bean gum Malt Oat flour Oat grain dust Olive pellets Onion powder Parsley (dehydrated) Peach Peanut meal and skins Peat Potato Potato flour Potato starch Raw yucca seed dust Rice dust Rice flour Rice starch Rye flour Semolina	Soybean dust Spice dust Spice powder Sugar (10x) Sunflower Sunflower seed dust Tea Tobacco blend Tomato Walnut dust Wheat flour Wheat grain dust Wheat starch Xanthan gum  <b>Carbonaceous Dusts</b> Charcoal, activated Charcoal, wood Coal, bituminous Coke, petroleum Lampblack Lignite Peat, 22% $H_2O$ Soot, pine Cellulose Cellulose pulp Cork Corn	<b>Chemical Dusts</b> Adipic acid Anthraquinone Ascorbic acid Calcium acetate Calcium stearate Carboxy-methylcellulose Dextrin Lactose Lead stearate Methyl-cellulose Paraformaldehyde Sodium ascorbate Sodium stearate Sulfur  <b>Metal Dusts</b> Aluminum Bronze Iron carbonyl Magnesium Zinc  <b>Plastic Dusts</b> (poly) Acrylamide (poly) Acrylonitrile (poly) Ethylene (low-pressure process)	Epoxy resin Melamine resin Melamine, molded (phenol-cellulose) Melamine, molded (wood flour and mineral filled phenol- formaldehyde) (poly) Methyl acrylate (poly) Methyl acrylate, emulsion polymer Phenolic resin (poly) Propylene Terpene-phenol resin Urea-formaldehyde/ cellulose, molded (poly) Vinyl acetate/ ethylene copolymer (poly) Vinyl alcohol (poly) Vinyl butyral (poly) Vinyl chloride/ ethylene/vinyl acetylene suspension copolymer (poly) Vinyl chloride/ vinyl acetylene emulsion copolymer *
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\*If used in powder form, a dust explosion is possible.

**Source:** <https://www.osha.gov/Publications/combustibledustposter.pdf>

## COMMON CAUSES OF DUST EXPLOSIONS

- Lack of process/building maintenance allows for accumulation of dust in a confined space.
- Escaped dust from process equipment/ventilation systems.
- Dust collection systems not being utilized, maintained, or inspected.
- Lack of hazardous dust knowledge and awareness.
- Lack of grounding, bonding, and dissipation of electrical charge.
- Electrical equipment that is not rated for hazardous areas.
- Not identifying heat sources or keeping them under control and away from combustible dust hazards.



## IDENTIFYING DUST EXPLOSION RISK - QUESTIONS TO CONSIDER

- Is combustible dust present at any point in a process?
- Can a normally non-dusty substance become dusty under certain conditions?
- What are the ignition and fire hazards?
- Is the process well maintained?
- Are there dust removal systems in place?
- Are proper ventilation systems installed?
- Are the dust removal systems maintained, inspected, and serviced regularly?
- Does regular inspection of confined areas and unused spaces occur?
- Are employees trained and knowledgeable on combustible dust risks?
- Is proper PPE provided to employees?

# DUST EXPLOSION MITIGATION

## MAINTAINING THE PROCESS AREA

- Combustible dust cleaning (take away the fuel source).
- Service, maintain, and inspect dust removal systems regularly.
- Identify unused and confined areas where unnoticed dust may accumulate.

## IDENTIFY AND UNDERSTAND THE POTENTIAL IGNITION SOURCES/HAZARDS

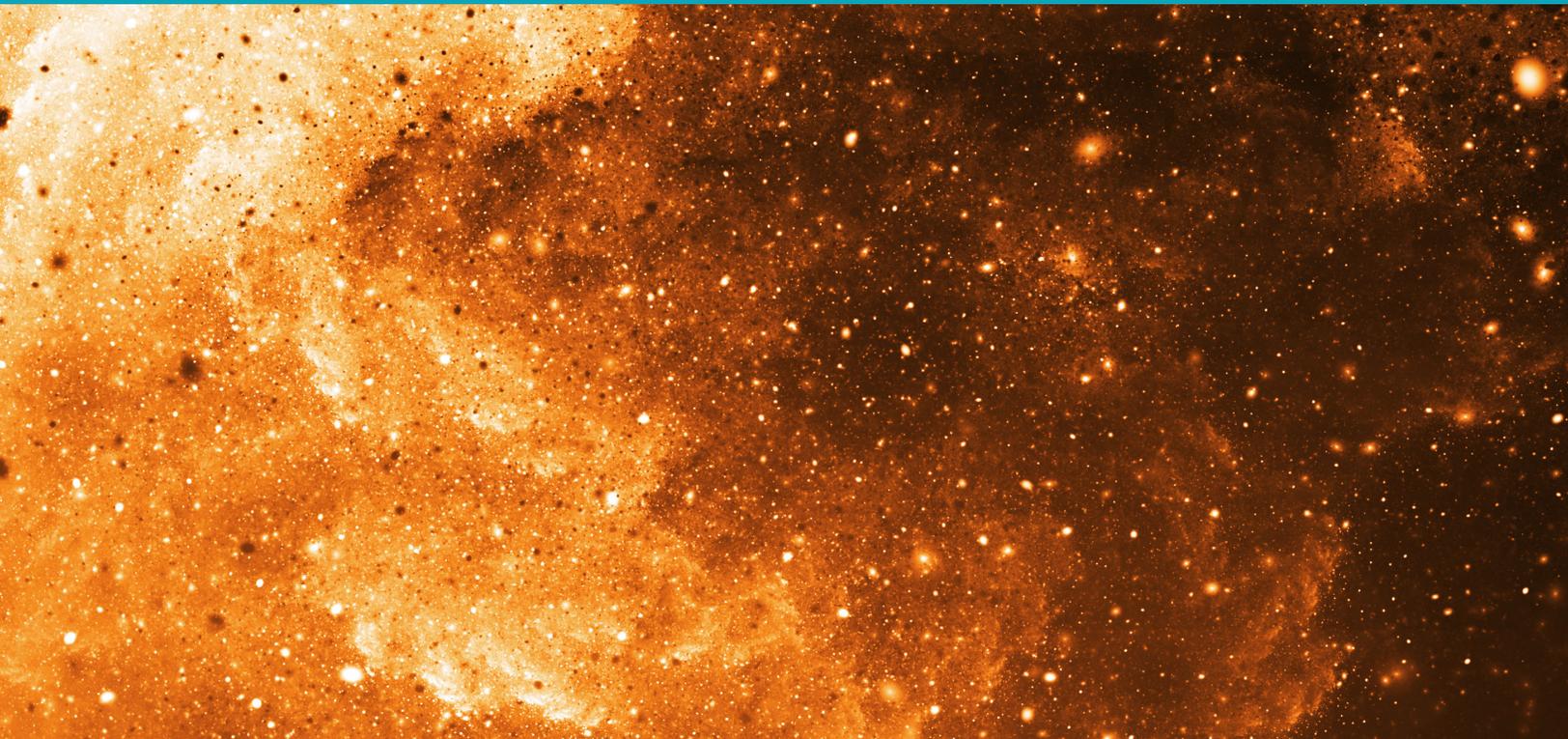
- Do not allow smoking.
- Identify hot work and require hot work permits and procedures.

## INSTALL PROPER VENTILATION AND DUST REMOVAL SYSTEMS

- Consider a wet-type dust collector (be mindful of what type of dust is being trapped, mixing with water or other chemical could release unintended flammable gasses).
- Consider use of fogging system to reduce levels of combustible dust (also be aware of what type of dust is being controlled).
- Avoid material transfer equipment that would create dust clouds, like bucket elevators.

## BE KNOWLEDGEABLE ABOUT COMBUSTIBLE DUST

- Understand which combustible dust(s) that are present in the process.
- Understand and identify the hazards associated with combustible dust and factors needed for an explosion to occur.
- Train employees to successfully identify, report, and mitigate combustible dust hazards.
- Perform a dust hazard analysis.
- Provide employees with proper PPE.



## LINKS TO INDUSTRIAL DUST EXPLOSION EXAMPLES

<https://www.osha.gov/news/newsreleases/region1/05202014>

<https://www.ehstoday.com/standards/osha/article/21917596/osha-cites-georgia-manufacturer-after-worker-injured-in-flash-fire>

<https://www.theobserver.ca/2017/07/12/fireball-set-off-explosion-in-veolia-shop/wcm/bda3ef44-8e14-2e59-4079-076bb58697b8>

[https://azdailysun.com/news/local/state-fines-nestle-purina-for-september-explosion/article\\_30037549-d219-51b4-bcd8-18cef0d5aaa6.html](https://azdailysun.com/news/local/state-fines-nestle-purina-for-september-explosion/article_30037549-d219-51b4-bcd8-18cef0d5aaa6.html)

<https://www.csb.gov/imperial-sugar-company-dust-explosion-and-fire/>

<https://www.csb.gov/csb-names-poor-design-and-failure-to-test-dust-collection-system-among-causes-of-us-ink-new-jersey-flash-fire-that-burned-seven-workers-in-2012-osha-again-urged-to-issue-new-combustible-dust-regulations/>

<https://www.csb.gov/hoeganaes-corporation-fatal-flash-fires/>

<https://www.princegeorgecitizen.com/news/local-news/fines-upheld-for-babine-sawmill-explosion-1.23095178>

<https://youtu.be/70fzqhsedmo>

## SUMMARY

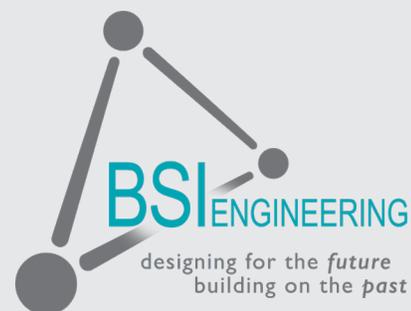
In summary, a combustible dust explosion can only happen when all five items on the combustible dust explosion pentagon are present. There are ways to identify and mitigate the risk of a dust explosion and there are several common causes that are found in many plants that can cause an unintended dust explosion. Causes include not being aware that there is a dust explosion hazard, having faulty machinery, and bad maintenance habits. In the end, it is about keeping the employees safe, and keeping the process running. Taking the steps to, understand, identify, and mitigate the dust concerns now, will save heartache, destruction, and money in the long run.



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