

DUST DANGERS

A deadly problem - causes and cures

by Vaughn Entwistle, Features Editor, Milling and Grain

Dust explosions have posed a long-standing threat to the grain and milling industry. One of the earliest documented accounts harkens back to the 18th century in Turin, Italy. An explosion occurred at Mr Giacomelli's Bakery Warehouse, and was recorded by a Count Morozzo, who described how flour dust was ignited by an ignition source in the form of a lamp mounted to help flour handlers see. The resulting explosion propagated in multiple directions injuring two employees working in the warehouse. We learn in Morozzo's report that the flour was extremely dry, and therefore had less moisture than usual.

This tragic scenario has been repeated time and again right up to the modern day. And even though the causes are now readily understood, dust explosions keep happening.

Causes of dust explosions

There were seven reported grain dust explosions at U.S. food and agricultural facilities in 2017, two more than in 2016, but still below the 10-year average of 9.3 explosions per year.

According to an annual report issued by Purdue University's Department of Agricultural and Biological engineering. The number of incidents has steadily declined over the years, thanks largely to observing good prevention practices such as keeping facilities clean, training employees, keeping equipment in good working order and more recently by the use of dust detection systems, and dust explosion suppression systems.

Experts in the field created the "Dust Explosion Pentagon" to describe the five constituent elements common to dust explosions:

Oxygen. (a major component of the air we breathe)

Ignition. A lit cigarette, a spark from static electricity, malfunctioning machinery, or even overheated equipment—all can trigger a fireball.

Confinement. When dust particles are contained, such as in a grain silo or inside a mill, they can accumulate. Dust particles can remain suspended in confined spaces for days. When it finally combusts, the confinement will cause intense pressure to build and push the explosion through the entire

facility. Confined dust explosions have the power to lift roofs from buildings or buckle solid concrete floors.

Fuel. Flour dust explosions are well-known, but almost anything in the form of dust can burn: dried milk powder dust, fishmeal dust, sugar dust, flavourings dust, wheat dust, corn dust, and even non-food-stuffs such as phenolic resin dust, and metal dusts, to provide just a partial list.

Dispersion. Dust explosions typically occur when the amount of dust suspended in the air reaches a critical threshold. Too little dust in the air and nothing happens. Similarly, too much dust with too little air might actually suppress an explosion. However, when the critical ratio of dust to air is reached, a simple spark can create a huge fireball. As the explosion propagates through a mill or similar facility, it will often raise more clouds of confined dust, causing a chain reaction of explosions.

Trouble at the mill

In 2004, nabim (National Association of British and Irish Millers) commissioned a study which tested 10 samples common to bread making for their explosive characteristics:

- A high protein white breadmaking flour (no added gluten)
- A Chorleywood breadmaking flour
- A biscuit flour
- A heat-treated cake flour
- Wholemeal
- Gluten
- Dust collector stock (mill head end)
- Wheatfeed
- Wheat dust
- Screen room filter dust

Their study concluded that gluten had the highest explosive risk, being more sensitive to electrostatic sources of ignition. And while the potential for a dust explosion is present at all mills, risks can be mitigated by following some basic steps:



- Avoidance of dust clouds
- Elimination of ignition sources
- Containment
- Suppression
- Venting

An elevated level of danger

The problem is even worse in grain elevators and silos. Because grain is being moved in quantity, grain elevators continue to have the highest incidences of dust explosions, often with tragic results. Most accidents happen in the latter half of the year when grain is drier and also more likely to be moved.

The worst grain elevator explosion in recent times was the December 22, 1977, blast at Continental Grain Co. in Westwego, La. USA, that killed 36 people.

A U.S. Bureau of Mines study found that mixed grain dust is nine times more explosive than coal dust, corn-starch 35 times more explosive and wheat starch 50 times more explosive. Temperatures in a blast area can exceed 1,000 degrees Fahrenheit!

Modern solutions to this age-old risk

Thankfully, many modern technologies have evolved that can either warn of, prevent, or greatly mitigate the risk of a dust explosion, while others can actively contain and suppress an explosion. The four basic strategies are:

- Detection
- Isolation
- Extraction
- Suppression

There is now a website: www.mydustexplosionresearch.com that is endeavouring to create a database of these incidents.