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Grain Dust Explosions

Grain dust explosions are often severe, involving loss of life and substantial property damage. Grain dust is highly combustible and the main fuel source for explosions in grain handling facilities.

Dust explosions are far too common in the United States. In the past 10 years, there have been an average of 8 explosions reported per year. It is speculated there are several additional explosions that go unreported as well. In the past 10 years, grain dust explosions have occurred in the following types of facilities:

For a grain dust explosion to occur, several conditions must be present:

- Dust must be fine enough for the particles to become airborne.
- There must be sufficient oxygen to allow combustion.
- Dust cloud must be of explosive concentration which is between the lower and the upper explosive limit for that particular type of dust.
- Dust must have a low moisture content.
- Dust must be in a confined environment.
- There must be a source of ignition.

There are two types of dust explosions, primary and secondary. The primary explosion usually takes place in a confined area such as a grain leg, conveyor, storage bin, or other handling/processing equipment. The shock wave from the explosion can damage and destroy walls allowing burning dust and gases to be expelled into other areas of the facility. Oftentimes, it will disturb dust that has settled in the facility. When this dust becomes airborne, it can be ignited causing additional explosions which are referred to as secondary explosions. There can be numerous secondary explosions and they can be larger and cause more damage than the primary depending on the amount of dust that is ignited.

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Explosions usually start at grain transfer points such as grain legs and enclosed conveyors. Dust concentrations in grain legs almost always exceed the minimum limits meaning explosive conditions are almost always present. These confined areas create turbulent grain movement which causes high levels of suspended dust in the airspace often near a hot bearing, a spark from tramp metal, or friction from a leg belt slipping on the head pulley.

Explosion Prevention:

Proactive prevention is the best defense against an explosion. Grain facilities must develop and implement housekeeping and preventive maintenance programs to reduce grain dust and prevent ignition sources.

Good housekeeping programs can reduce the severity of an explosion by removing as much dust from the facility as possible. This reduces how much fuel is available for an explosion and can prevent secondary explosions. OSHA regulation 1910.272 requires grain facilities to develop, implement and maintain a written housekeeping program. The program must prevent dust accumulations from exceeding 1/8 of an inch in priority areas, which are identified as:

- Floor areas within 35 feet of inside bucket elevators
- Floors of enclosed areas containing grinding equipment
- Floors of enclosed areas containing grain dryers that are located inside the facility

It is important to note that the use of compressed air to blow dust from ledges, walls, and other areas shall only be permitted when all machinery that presents an ignition source in the area is shut-down and all other known potential ignition sources in the area are removed or controlled.

Dust and oil systems reduce fugitive dust or prevent it from occurring. Dust collection systems installed at grain transfer points help remove dust before it accumulates. They can also be connected to legs and conveyors to reduce suspended dust inside confined areas. Oil systems that apply food-grade mineral oil to the grain help reduce the amount of dust created when it is being moved.

Controlling ignition sources is the most effective means of preventing explosions, and preventive maintenance is a major component. Equipment such as bearings, belts, buckets, conveyors, and milling equipment are potential ignition sources. Periodic inspection and lubrication through a scheduled preventive maintenance program are key in ensuring this equipment operates safely. This should be based on the manufacturer's recommendations as well as from experience with how the equipment operates. The schedule should include a frequency to allow for prompt identification and correction of any problems before they create an unsafe situation.

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Grain facilities should have a hot work program that employees and contractors follow when performing tasks like welding, cutting, or other similar spark and flame-producing tasks. Before hot work occurs, all equipment in the facility that causes grain dust to become suspended in the air should be shut down and the dust should be allowed to settle out of the air. Dust and other combustible materials should be removed from the area where the hot work is to be performed, then a fire watch should be performed to ensure that no sparks ignite anything in the area.

Along with a preventive maintenance program, hazard monitoring equipment can help ensure the safe operation of key equipment in grain handling facilities. Bearing temperature monitors, leg belt speed monitors, and rub sensors can all identify potential problems before they occur. Additionally, the implementation of thermographic inspections can benefit in identifying hotspots in equipment and electrical distribution gear prior to failure resulting in possible interruption of service.

Resources:

Ellison, J. (2022). Agricultural Dust Explosions in 2021 [Review of Agricultural Dust Explosions in 2021]. Purdue University College of Agriculture. https://ag.purdue.edu/stories/2021-grain-dust-explosions/

Occupational Safety and Health Administration. (1987). Occupational safety and health standards: Occupational health and environmental control (Standard No. 1910.272). Retrieved from https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.272

Preventing Grain Dust Explosions - Oklahoma State University. (2017, February 1). Extension.okstate.edu. https://extension.okstate.edu/fact-sheets/preventing-grain-dust-explosions-2.html?Forwarded=pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2604/BAE-1737web.pdf

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