18 November 2022

WSH ALERT

SERIOUS ACCIDENT/ INCIDENT

Flash fire from combustible dust explosion leaves worker with burn injuries

On 20 July 2022, a dust explosion occurred inside a grain dryer, causing a flash fire at the relief vent. A worker who was near the vent at the time of the explosion suffered burn injuries on his elbow.

The dryer was intended to heat spent grains within its container to remove moisture. During handling and movement, the grains generated smaller grain particles. As the grains and their particles were heated, a combustible dust cloud formed within the confined space of the dryer. Preliminary investigation revealed that an ignition source was present within the dryer and the inadequate explosion protection for the dryer led to inadvertent venting, causing the worker's burn injuries.

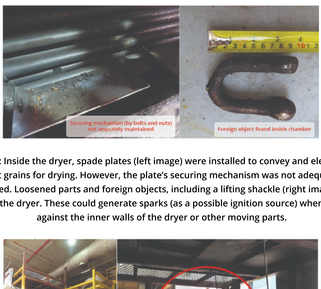

Figure 1: Dryer machine used to dry spent grains. CCTV footage confirmed a flash fire had occurred.

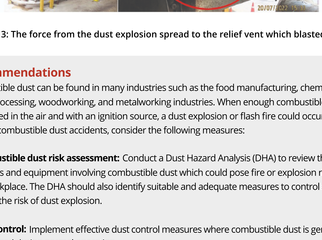

Figure 2: Inside the dryer, spade plates (left image) were installed to convey and elevate the spent grains for drying. However, the plate's securing mechanism was not adequately maintained. Loosened parts and foreign objects, including a lifting shackle (right image), were found in the dryer. These could generate sparks (as a possible ignition source) when knocked against the inner walls of the dryer or other moving parts.

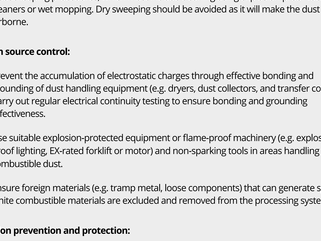

Figure 3: The force from the dust explosion spread to the relief vent which blasted open.

Recommendations

Combustible dust can be found in many industries such as the food manufacturing, chemical, plastic processing, woodworking, and metalworking industries. When enough combustible dust is suspended in the air and with an ignition source, a dust explosion or flash fire could occur. To prevent combustible dust accidents, consider the following measures:

● **Combustible dust risk assessment:** Conduct a Dust Hazard Analysis (DHA) to review the processes and equipment involving combustible dust which could pose fire or explosion risk at your workplace. The DHA should also identify suitable and adequate measures to control and mitigate the risk of dust explosion.

● **Dust control:** Implement effective dust control measures where combustible dust is generated or dispersed during normal operation.

Examples of dust control measures include

- Enclosure of the process or work;
- Effective local exhaust ventilation system to remove any generated dust, from the source as far as possible;
- Suitable dust suppression system; and
- Housekeeping procedures, which must include cleaning using explosion-proof vacuum cleaners or wet mopping. Dry sweeping should be avoided as it will make the dust airborne.

● **Ignition source control:**

- Prevent the accumulation of electrostatic charges through effective bonding and grounding of dust handling equipment (e.g. dryers, dust collectors, and transfer conduits). Carry out regular electrical continuity testing to ensure bonding and grounding effectiveness.
- Use suitable explosion-protected equipment or flame-proof machinery (e.g. explosion-proof lighting, EX-rated forklift or motor) and non-sparking tools in areas handling combustible dust.
- Ensure foreign materials (e.g. tramp metal, loose components) that can generate sparks to ignite combustible materials are excluded and removed from the processing system.

● **Explosion prevention and protection:**

- Install sensors to detect heat or pressure build-up within the combustible dust storage facilities or dust handling equipment. The sensor may be interlocked with the dust handling equipment to automatically stop and/or release an explosion suppression agent.
- Equip dust handling equipment with relief vents to safely vent energy in the event of a dust explosion. Vent dimensions must be adequately sized to withstand the maximum force(s) expected should an explosion occur.
- Install isolation valves to protect connecting equipment and flame arrestors at dust handling units that could be activated in an emergency, to stop the flame from spreading.
- Locate explosion relief vents away from work areas and walkways to protect persons at work.
- Separate areas handling combustible dust from other work areas either with distance or isolation enclosure.

● **Preventive maintenance:** Implement a regular inspection regime to ensure no loose parts in any dust handling equipment, and a preventive maintenance programme to ensure equipment is fit for continued service. Ensure dust collection systems and filters are also properly maintained and operating effectively.

● **Training and awareness:** Provide training including refreshers on combustible dust hazards and their controls. Clearly communicate the risks of combustible dust and safe handling practices e.g. through toolbox briefings, warning signs, and safety data sheets.

● **Personal Protective Equipment (PPE):** Provide workers handling combustible dust with the necessary PPE as specified in the safety data sheet, such as fire-retardant clothing and static-dissipative safety shoes.

An earlier workplace accident involving combustible dust occurred on 24 February 2021, where a mixer machine exploded. The surrounding combustible dust was stirred up and ignited, leading to flash fires. This accident claimed three lives and saw seven workers injured. Read the Summary of Inquiry Committee Report for the accident here.

For more information, please refer to SS 667: 2020 Code of Practice for handling, storage, and processing of combustible dust, and the Ministry of Manpower's Circular on the Hazards and Controls of Combustible Dusts.

* Please note that the recommendations provided here are not exhaustive and they are meant to enhance workplace safety and health so that a recurrence may be prevented. The information and recommendations provided are not to be construed as implying liability on any party nor should it be taken to encapsulate all the responsibilities and obligations under the law.