

Lesson Learn



Dust Explosions (Active metals)

April. 2022

I. Case Description

According to publicly available information from the Asset and Laboratory Management Office of Central South University, a deflagration accident occurred on April 20, 2022 in the university's School of Materials Science and Engineering, resulting in injury to a doctoral student in the School.

Note: According to an informed netizen, the injured person was doing experiments due to the explosion of metal powder, covering more than 80% of the body's skin continued to burn, extensive skin burns, the current laboratory has been closed.

Upon inquiry, in October 24 last year, the laboratory of another university in China also occurred in a burst of fire, the accident caused 2 deaths, 9 people injured tragic results. According to informants, the accident was caused by the explosion of magnesium powder.

In fact, in recent years, several major safety accidents have occurred in domestic laboratories. According to relevant statistics, from 2006 to 2017 there were 14 explosions in university chemical laboratories alone, nine of which involved casualties.

II. The metal (explosive) dust why will explode?

The metal itself, represented by aluminum monomers, is extremely reactive chemically. The reason why aluminum can be relatively stable under normal circumstances, due to its formation of oxide film in the air, the surface help it isolated from oxygen. However, when the aluminum powder reaches a certain concentration in the air, and the surface

encounters electric sparks are pierced, it is easy to violent oxidation reaction and rapid diffusion, resulting in explosion and combustion. General aluminum powder in the following cases prone to explosive accidents.

① **Spontaneous combustion in wet and grease.** A large number of aluminum powder encounter moisture, water vapor, due to the increase in the specific surface area of aluminum grains, some surfaces have not formed an oxide film, exothermic reaction will occur and produce spontaneous combustion phenomenon. Long-term pile storage of aluminum powder sticking to grease, heat set does not disperse, also prone to spontaneous combustion or explosion.

② **Burning or explosion in flame.** Aluminum powder in contact with flame will occur a violent redox reaction, quickly releasing a large amount of heat, making the surrounding environment temperature and pressure rise sharply, forming a shock wave, damaging the surrounding buildings and equipment, resulting in casualties.

③ **Form an explosive environment.** Aluminum powder and air to form an explosive mixture, when it reaches LEL, it will explode when it meets a spark.

④ **The presence of chemically reactive substances.** With fluorine, chlorine, etc. will be violent chemical reactions, and acids or contact with strong bases can produce hydrogen gas, causing combustion and explosion.

III. What are the measures to deal with metal (explosive) dust?

- 1) Should complete the experimental hazard analysis (EHA);
- 2) Completion of pre-experimental risk identification involving dust explosion hazards such as dust clouds and ignition sources;

- 3) Determine the location and scope of the dust explosion hazard sites, and according to the dust explosion characteristics and the number of people involved in powder operations and other key elements;
- 4) Evaluate the risk level of experiments related to explosive dust hazard sites, and develop and implement control measures;
- 5) Identify the responsible departments and responsible personnel, and maintain information files on safety risk identification, assessment, and control processes;
- 6) Should be set up in the dust experimental sites safety warning signs;
- 7) Dust explosion hazard sites should be set up in accordance with different process sub-areas relatively independent, combustible dust and combustible gases and other media that can exacerbate the risk of explosion shall not share a dust removal system;
- 8) Dust removal systems in different fire protection zones are prohibited from interconnecting;
- 9) There is a risk of dust explosion experimental equipment should be used to discharge, explosion isolation, inerting, explosion suppression, anti-explosion and other one or more explosion control measures, but shall not take separate explosion isolation measures;
- 10) Aluminum and magnesium and other metal dust should be used in a negative-pressure dust removal; combined with the actual process, the installation and use of locked gas unloading ash, spark detection and extinguishing, wind pressure monitoring devices, as well as related safety equipment monitoring and early warning

information system to strengthen the possible existence of ignition sources and dust clouds of dust explosion risk environment of real-time monitoring;

11) Aluminum and magnesium and other metal dust wet dust removal system should be installed with grinding and polishing equipment interlock, monitoring and alarm devices, and to maintain good ventilation in the workplace and dust collector body, the timely specification of cleaning up the precipitated dust slurry.

12) Should standardize the use of explosion-proof electrical equipment appropriate to the explosion hazard area.

Finally, in addition to the configuration of the relevant explosion control measures, in places or spaces where explosive dust is generated, control dust concentration below the explosive concentration limit of 20-25%, eliminate all types of ignition sources, standardize the storage and use of scientific management tools, is also a key measure to effectively reduce and eliminate the occurrence of explosive dust accidents.

Note: Refer to the "Dust explosion-proof safety regulations for industrial and trade enterprises" published by the Ministry of Emergency Management Order No. 6 dated July 25, 2021

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