SCIC
SINGAPORE CHEMICAL INDUSTRY COUNCIL

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PreDigest

Dust Explosion

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Historical Dust Explosion Incidents

Dust explosion and fire incidents can cause fatal injuries and significant financial loss to industry. In the past 15 years, several severe combustible dust explosion and fire incidents have been reported in industrial sites worldwide. Those reported incidents include the 2003 Aluminium Metal Solution incident in West Virginia, the 2008 Imperial Sugar accident near Savannah, Georgia and the 2014 Aluminium Metal Dust Blast explosion in Kunshan, China. Formosa Fun Coast Water park dust fire incident in New Tapei, Taiwan is another reminder of the tragic and deadly consequences of combustible dust accidents. The series of explosion incidents were initially fuelled by dispersed or accumulated combustible dust that resulted in propagation of dust flames in the facility which resulted in a much larger secondary explosion arising from dust that had settled/accumulated in an open surface area over time. Such dust explosions are preventable if dust hazards are clearly understood among industry players and good engineering standards are practiced.

Also refer to Singapore MOM Circular on the Hazards and Controls of Combustible Dusts dated 23 July 2015.

https://www.channelnewsasia.com/singapore/tuas-explosion-potato-starch-powder-ignite-fire-combustible-dust-373846

Dust Explosion Pentagon

A dust explosion is a rapid combustion of suspended fine dust that has the potential of resulting in a deflagration hazard in enclosures. Dust explosions occur when five key elements exist:

1. Combustible dust
    a. A finely divided combustible particulate solid that presents a flash – fire hazard or explosion hazard when suspended in air e.g. metal powder
2. Oxidant
    a. Oxygen is a typical oxidant available in the atmosphere.
3. Dispersion of dust
    a. The concentration of dispersed dust must be equal to or higher than Minimum Explosive Concentration (MEC)
4. Ignition source
    a. Ignition source e.g. static charge which has energy equal to or higher than Minimum Ignition Energy (MIC)
5. Enclosure or confinement of dust

A dust explosion may not be result in a credible scenario if any of above stated elements is eliminated / mitigated in a safe manner. However, dust fires may still occur when the first four elements exist, even in the absence of confinement of dust. Effective prevention of dust explosions or fire hazards entails managing at least two contributors shown in the dust explosion pentagon.

What can you do?

1. Replace combustible dust with alternative material with higher MIC value or increase particles size with a higher MIC value so as to decrease the probability of ignition
2. Use inert gas as a conveying medium instead of air (only if practicably safe)
3. Proper bonding and grounding with a lower resistance to avoid static charge accumulation; perform regular preventive maintenance of bonding and grounding systems
4. Perform regular housekeeping and apply centralized vacuum system instead of air blow for periodic or continuous dust cleaning
5. Develop operating and maintenance procedures, and conduct periodic refresher trainings to enhance awareness of hazards at the work place reiterating the importance of periodic maintenance of safety protective system maintenance and housekeeping.

For further details, refer to the below Combustible Dust Standards:

a. ***SS 667 : 2020 Code of practice for handling, storage and processing of combustible dust***
b. *https://www.nfpa.org/News-and-Research/Publications-and-media/NFPA-Journal/2021/Spring-2021/Features/Dust-Explosion*
c. *NFPA 654 Prevention of Fire and Dust Explosion From Combustible Particulate Solids*

Process Safety is Everybody's Responsibility!

An initiative of the Process & Engineering Committee

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