Dust Explosion

Picture showing Dust Explosion and Fire

The plant ***as seen above*** was ripped apart by a violent explosion. A sound like rolling thunder was heard which was later determined to be a chain reaction of explosions rapidly propagated. The shock wave broke windows at distances of up to 1,000 feet (330 m) away, and propelled debris as far as two miles (3 km) away, some of which started additional fires in wooded areas at this distance. The blast could be felt 25 miles away. A large fire raged for two days at the site of the plant itself. Damage to the plant was estimated to be in the region of $150 million. One half of the 150,000 square-foot (13,935 m^2) plant was completely destroyed. On investigation it was found that ventilation systems within one of the machine rooms dust had accumulated so much that it had been pulled up into the ceiling. Around 0.25 to 0.5 inches (6.3 to 12 mm) thick dust had gathered in this area. This explosion occurred when something disturbed the dust, creating a cloud, which then ignited.

Explosion hazards caused by dust:

Dusting substances used in production and dusty by-products cause fire and explosion risks that can easily go unnoticed. Dust transfer and handling systems often contain continuously explosive dust-air mixtures, but even a seemingly innocent-looking dust layer may cause a fire and explosion hazard.

A dust explosion is often described as an occurrence in which a pressure increase causes structural damage and a loud noise. However, this is not necessarily the case, since dust explosions also occur when the entire dust-air mixture ignites. Numerous major incidents have started from small, local dust-air mixture ignitions and flare-ups that have caused new, stronger dust explosions and the rapid spread of fire.

Such an explosion hazard arises from dust originating in a combustible substance whose particle size is typically less than 0.5 millimetres. When dust and air form a mixture, the concentration of which exceeds the lower explosive limit, the dust-air mixture becomes explosive. Dust-air mixture explosion limits are substance-specific, but often only a few dozen grams of dust per cubic metre of air suffices to generate an explosive mixture. The explosion is caused by an ignition source which can contain remarkably little energy, the finest dusts igniting due to as little energy as is required for igniting gases.

Formation of a dust explosion hazard:

Dust transfer and handling systems may contain explosive dust-air mixtures on a continuous basis. Since these are often closed systems, an explosion may cause structural damage and hurl splinters into the air that are very dangerous to those working nearby. Moreover, should a dust explosion occur in a dust transfer system, burning substances may burst into production facilities situated far from the original site of the incident, causing fires in several locations.

The threat posed by dust layer often goes unnoticed, a mere one-millimetre layer of dust originating from a combustible substance being sufficient to cause a hazard. When a dust layer mixes with air, the dust cloud concentration is sufficient to cause a dust explosion if a suitable ignition source comes into contact with the dust-air mixture. An explosive dust cloud can be generated, for example, by an air current or when cleaning using compressed air. Vibration may also shake off dust layers formed on structures, generating an explosive dust-air mixture.

Ignition sources:

For instance, a mechanical spark, hot surface, a spark generated by an electronic device or static electricity can act as an ignition source. The first dust explosion occurring in the premises may generate new dust clouds that can cause even more destructive dust explosions. An unexpected hazard often arises from attempts to extinguish the fire: if this is performed too close to the fire using a hand extinguisher discharge which is too powerful, the dust layer can create a dust-air mixture causing a major conflagration.

Risk Management Measures:

1. Area categorization:

– Areas where hazardous dust-air mixtures may occur must be categorized. Based on such categorization, special requirements apply to equipment

construction, installation, use and protection systems in order to ensure safe use in the said area.

– Areas where dust layers build up must often be categorized as hazardous areas on account of their explosive atmosphere, unless dust layers are removed through regular cleaning.

– Identify the production facility areas and parts of the production process involving a dust explosion hazard in order to target preventive measures at the places where they are most needed

2. Equipment requirements:

– Special requirements apply to electrical and mechanical equipment situated in dusty facilities. Dust build-ups must be prevented from catching fire by ensuring that the surface temperatures of such equipment do not rise.

– Dust ignition temperature is often lower than that of the substance from which the dust originates. Since dust also acts as an insulant, a dusty device, even if operating normally, may heat up to the extent that the dust on the device catches fire, unless this hazard was taken into account when selecting the device.

– Neither may a device located in dusty facilities generate other ignition sources that may cause the ignition of the dust-air mixture. For example, the device can be enclosed so that dust does not come into contact with its inner parts.

– Filters, silos and pipe work must be equipped with explosion pressure release systems that safely discharge pressure.

– Damage caused by a dust explosion and the resulting fire can be limited through structural measures and by implementing fire extinguishing systems.

– Spark detection and extinguishing systems have proven efficient protection systems since they are able to detect and extinguish hot particles within the process before they pose a risk.

– Implement protective measures to limit the consequences of a potential dust explosion.