QBE European Operations

Property Risk Solutions

Technical guide

Combustible Dusts

A wide range of powders and dusts have the potential to generate damaging explosions. In many industrial handling processes there will be a likelihood that an explosive atmosphere will exist either for long periods of time or during specific activities. Examples of these processes include silo filling, powder transfer, bucket conveyors, cyclones and high speed mixing. The failure to identify the hazard or manage the risk can lead to devastating explosions.

What materials are capable of generating a dust explosion?

An explosive atmosphere can normally be formed by any material that will burn (oxidise) in its finely divided form such as dust or powder. Examples include grains, flour, wood, sugar, metals, fibres and flock.

Assessing the Explosion Hazard

The starting point is to look at the supplier's MSDS. The information to look for is:

- Kst Value: A sample of dust is ignited in an instrument and the rate of pressure rise is measured. The maximum rate of pressure rise is known as the Kst value for the material.
- ST Class: The Kst value is used to establish a relative measure of the explosion potential for a substance, known as the ST class.

ST CLASS	KST VALUE BAR M/SEC	EXPLOSION POTENTIAL	EXAMPLES
Class 0	Zero	None	Sand
Class 1	Kst < 200	Weak	Sugar
Class 2	200 < Kst > 300	Strong	Wood flour
Class 3	Kst > 300	Very strong	Aluminium

Pmax: This is the maximum potential pressure generated in a dust explosion. Most substances have a Pmax of around 10 barg.

MIE: This the energy required to ignite a combustible atmosphere, ie. how easy it would be to ignite.

The values quoted are critically dependent on a number of factors such as particle size and moisture levels in the material. The results can be substantially different for nominally the same materials from different suppliers.

Managing the Explosion Risk

Identify areas where a combustible atmosphere may be present.

A detailed assessment (hazardous area classification) should be undertaken to identify the parts of the plant where a combustible atmosphere may be present and its persistence (expressed as zones 20, 21 and 22). These zones will be present inside equipment and outside where leaks are foreseeable. The QBE technical guidance on hazardous area classification contains a more detailed description of this process.

Avoid Ignition Sources

The following measures should be implemented to minimise the risk of exposure to ignition sources:

- All electrical equipment including instruments used within hazardous areas must be appropriately rated. Standard electrical equipment will be an ignition source for a combustible atmosphere.
- Tramp metal can create a spark within a pneumatic conveying system. Where this is a risk then the magnets should be installed to retain the metal fragments.
- All equipment should be earthed including tankers prior to offloading.
- A hot work permit system is essential. One of the most common causes of dust explosions is hot work, often due to ignition of surface deposits which act as the ignition source when the equipment is started.
- Poorly maintained equipment such as conveyors can become an ignition source due to excessive friction. The risk can be minimised by reducing relative speeds below 1 m/s. An effective preventative maintenance system should include lubrication schedules, monitoring of bearing temperatures and checks for tightness and alignment of conveying systems.

Develop and Implement a Basis of Safety for managing explosions

If a dust explosion occurs in a vessel then the pressure generated can be substantial. Appropriate measures to minimise the impact of an explosion include:

- Venting and containment should be provided to prevent vessel rupture due to the primary explosion and also from secondary explosions being generated in connected vessels as the flamefront travels through the process. This scenario is normally extremely damaging.
- Equipment can be designed to withstand an explosion but this is normally impracticable for large vessels. The emphasis is to provide explosion vents ducted to a safe location to ensure that the design pressures of the vessels are not exceeded. An alternative is to fit explosion suppression systems which inject a chemical suppressant within milliseconds. Techniques such as inerting with nitrogen or carbon dioxide could also be considered.
- An explosion must be prevented from travelling through the process. The vents from equipment should not be connected together.
- Rotary valves, fast acting valves, suppressant injecting systems and screw conveyors with one baffle removed can all be utilised to prevent explosion propagation.

Housekeeping

Good housekeeping is essential to minimising fire risks and also preventing secondary explosions. An explosion within a vessel may be safely vented with minimal damage but if there are deposits in the general area then these will be driven into the air by the force of the explosion creating another combustible dust cloud. The ignition source is usually already present and these secondary explosions are often responsible for loss of life and widespread damage.

- The risk of secondary explosions can be minimised by good housekeeping as even a layer 1 mm thick can create a combustible dust cloud and should be of concern.
- Housekeeping inspections should be undertaken at least weekly and must include high level equipment and building structures where dust may accumulate.
- Cleaning should be done by vacuuming not by blowing down. If combustible dusts are blown down this creates the opportunity for an explosive atmosphere to develop during the cleaning process so should not be permitted.

Summary

Dust explosions can be devastating, particularly when secondary explosions occur as these tend to be the most powerful.

If there is the potential for an explosive atmosphere to form then the equipment design must be adequate to minimise ignition risks as well as safely venting or containing an explosion. Housekeeping and adequate isolations between process units are essential to minimise the risk of secondary explosions. Contact QBE Risk Solutions if you require further guidance after reading this Technical Guide.

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