DEKRA Dust Explosion Guidance Series

NUMBER 4: PNEUMATIC CONVEYING OF POWDERS

Note: ***This guidance note is produced in good faith and may not cover all risks and eventualities with all equipment of this type. If in doubt, our process safety specialist team will be delighted to help you navigate risk assessment, basis of safety definition and testing requirements.***

POTENTIAL FIRE AND EXPLOSION CONSEQUENCES

- Ignition of a dust cloud resulting in a flash fire causing potentially serious burns.
- Agitation of powder and entrainment in the air stream generates flammable dust cloud, resulting in blast effects including, flame ejection, pressure effects and/or projectiles with possible explosion propagation into upstream interconnected equipment.

OVERVIEW

This method of transferring powders is often used in many industries such as the chemical, energy-from-waste, and food industries, to convey large amounts of powdered material quickly. The tanker will often use an on-board compressor, or sometimes the site will use their own for hygiene reasons, which generates a fast moving stream of compressed air which entrains the powder from the tanker and carries it along a transfer line to the intended vessel. Once inside the vessel the powder disengages from the air and settles, while the air can be exhausted via a filter plenum. Pneumatic conveying need not be to a silo or from a tanker but will often be between two vessels with similar risks. The agitation of the powder and entrainment in the air stream will generate a flammable dust cloud by definition with flammable powders.

Photograph: Silos and road tankers

Most likely intrinsic ignition sources	Most common basis of safety	Test required to Support Basis of safety
• Unsuitable or malfunctioning electrical apparatus; • Mechanical friction and hot surfaces; • Mechanically generated sparks; • Static electricity.	Control of Ignition Sources and Explosion Protection (for connected vessels)	• Ignition temperature of cloud and layer (MIT and LIT); • Minimum ignition energy (inductive spark); • Minimum ignition energy (capacitive and inductive spark); • 20L Sphere

Peripheral / associated risks to consider:

- If the filters that exhaust the air to atmosphere are blocked the vessel being filled can be exposed to the full pressure of the conveying compressor. This can be significant and can either rupture the vessel vent panel or even rupture the vessel if it is not protected.
- Although the compressors that provide the air flow will not normally contain any dust, sources of ignition produced by them will be conveyed into the powder.

RISKS

- The fast movement of material in pneumatic transport gives rise to a lot of charge being generated, especially when using hoses made of insulating material. For plants handling foodstuff, food safe materials will be required. An example of this is food grade rubber conveying hoses that connect tankers to the filling line for silo. These will have a metal braid running though the wall that is bonded to the metal fixing on each end, in turn ensuring no conducting metal components are left isolated from earth. In this situation, a propagating brush discharge can occur where the accumulated charge punctures the wall to flow to earth. This form of discharge has a very high energy which will ignite almost all know flammable powders.
- Other ignition sources will likely not be directly from the transported powder but by other objects that may be entrained in it. An example of this is foreign objects such as loose bolts etc. that are bought in with the bulk material. High speed impacts between these items and, for example, the walls of the conveying line can form incendive sparks. Any ignition sources that are produced by the blower such as impact sparks from a fan malfunction may escape down the blowing line and be introduced to a flammable dust cloud.

To control these ignitions sources blowers should be installed such that the air passes through two filters in series.

- It is not common practice to use Explosion Protection techniques such as Explosion Venting, rather if some ignition sources cannot be controlled it is possible to operate conveying lines with flow though inerting. Due to the peripheral asphyxiation risks of using inert gases such as nitrogen, this should no be seen as preferable to ignition source control.

POTENTIAL SOURCES OF IGNITION

From the 13 identified sources of ignition taken from EN 1127-1, those which are considered most likely to occur with silo emptying and filling are:

1. Flames and hot gases (including hot particles)

2. Unsuitable or malfunctioning electrical apparatus

3. Mechanical friction and hot surfaces

4. Mechanically generated sparks

5. Static electricity

TESTING REQUIRED TO MITIGATE THE POTENTIAL SOURCES OF IGNITION

- Minimum Ignition Energy (Capacitive assessment) – to assess the potential of incendive spark discharges from isolated conductors and potential propagating brush discharges in transfer lines.
- Minimum Ignition Energy (Mechanical spark assessment) – to assess the potential of mechanical sparks.
- Minimum Ignition Temperature (dust cloud) – for correct specification of Temperature Class rating of ATEX equipment and used in conjunction with MIE (mechanical) to assess the potential of mechanical sparks.
- Layer Ignition Temperature (5 mm layer) – used with MIT (dust cloud) for the correct specification of Temperature Class rating of ATEX equipment.

Typical Basis of Safety

A proposed Basis of Safety for a Pneumatic Conveying would be the Control of Ignition Sources by using full metal construction and connecting of all items to earth.This basis of safety can be supplemented with nitrogen inerting but is not often recommended due to peripheral risks this introduces.

Other Considerations

Nitrogen inerting may be used to further control ignition sources should normal control measures as discussed not be sufficient to reduce the risk. Should this be the case then for any sections of the conveying line which passes though occupied and enclosed area, an asphyxiation risk assessment should be carried out considering scenarios of leaks of inert gas leading to oxygen depletion.