DEKRA Dust Explosion Guidance Series

NUMBER 2: POWDER BLENDING

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.***

OVERVIEW

Blending of powers occurs frequently across a wide range of industrial sectors and using a range of different proprietary mixers, blenders and 'one pot' processors. Mixing of the powders is generally achieved by rotating the powder by some means. This can be by way of impellors, blades, augers or by rotation of the mixing chamber itself. Some blenders incorporate high speed 'choppers' which aid in the dispersal of the powder.

Air is usually present within the mixer and movement of the powder will rouse the powder and form a flammable dust atmosphere within the equipment. Batch mixers involve charging and discharging operations which can also result in localised dust releases into the workplace environment.

Photograph 2: Ribbon Blender

Photograph 1: Plough Mixer & high speed 'choppers'

SUMMARY OF DUST EXPLOSION RISKS

Most likely intrinsic ignition sources	Most common basis of safety	Test required to support Basis of safety
•Mechanical friction and hot surfaces •Mechanically generated sparks •Static electricity •Unsuitable or malfunctioning equipment.	Avoidance of ignition sources and/or Avoidance of Flammable Atmospheres (inerting)	•Minimum ignition energy (inductive spark) •Minimum ignition energy (capacitive spark) •Ignition temperature of cloud and layer (MIT and LIT) •Limiting Oxygen Concentration

Peripheral / associated risks to consider:

- Flammable dust atmosphere external to the mixer due to spills during loading / unloading – adjacent equipment may require ATEX certification (e.g. weigh scales).
- Potential for incendive spark discharge from personnel if manual tipping of flammable powders is undertaken.

•Any residual solvent on powders can dramatically enhance ignition sensitivity.

RISKS

- When manual charging of flammable powders is undertaken there is a risk of rousing the dust to form a flammable dust concentration in air - especially for fine, free flowing powders. Where effective extraction is provided, the extent and duration of any dust cloud should be limited. However, problems arise when forced extraction is not present or effective and the dust cloud extends out of the station encompassing the operator.

- Owing to the close proximity during powder discharging operations, there is the potential of spark discharge to occur from operators who are isolated from ground. If the powder has a high sensitivity to ignition from spark discharges, this could result in ignition of the dust cloud.

- Powder spillages are always a possibility and could result in a localised flammable dust cloud external to the mixer where there could be non ATEX compliant equipment present which would pose a potential ignition risk.

- Often powders are pneumatically conveyed via a lance into the mixer. During conveying of the powder there will be a flammable atmosphere within the conveying line and cyclone receiver. Spark discharges could occur from isolated conductors associated with this equipment.

- If the mixer is non ATEX compliant and contains rotating components there is the potential of mechanical spark/friction or hot surface ignition source occurring in a failure scenario.

- Solvent wetted powders can result in a flammable 'hybrid' atmosphere. Under such circumstances expert advice should always be sought. Even a few percent by weight of solvent can have a dramatic effect.

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 sack rip and tip stations 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 personnel.
- 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 (5mm layer) – used with MIT (dust cloud) for the correct specification of Temperature Class rating of ATEX equipment.
- Limiting Oxygen Concentration – the LOC value is used for the determination of the Maximum Permissible Oxygen Concentration (MPOC) within the mixer if an inert atmosphere is present.

Typical Basis of Safety

A proposed Basis of Safety for a powder blender would be the Avoidance of Ignition Sources by way of correct ATEX equipment specification or by retrospective equipment suitability assessment (MEIRA) combined with precautions to avoid incendive electrostatic discharges

or

The Avoidance of a Flammable Atmosphere by way of inerting.

Other Considerations

Where a proprietary dust filter is used this will require a separate DSEAR risk assessment including Hazardous Area Classification and ignition source review to allow for a robust Basis of Safety to be determined. The potential for propagation of an explosion between interconnected vessels should also be assessed and addressed, where appropriate.