

Controlling Static Electricity in Powder Handling Operations



Static Electricity is capable of causing many undesirable effects during powder handling operations. The types of industries affected by these problems include chemical, pharmaceutical, paints, coatings, food and beverage, and the extent of the problem ranges from small scale unreported incidents, right through to devastating explosions causing injury or fatalities, lost production through plant downtime and other financial costs to the business.

In potentially explosive atmospheres, the amount of energy contained in spark discharges from plant, equipment and even people may be sufficient to ignite many fine dusts produced during handling loose solids such as powder, granules, pellets and flakes.

The minimum energy required to ignite any given powder (MIE) depends on the fineness of the powder, with the lowest values tending to relate to very fine powder. If the MIE is above 10 J, and there are no flammable gases and vapours present, special measures to minimise static electricity are usually not necessary, however precautions could still be necessary with conductive plant and equipment capable of storing high levels of static charge, to minimise electric shock risks for operators. In the chemical and pharmaceutical industries the typical energies required for ignition can be relatively low (especially in flammable dust/vapour hybrid atmospheres), whilst in the food industry, MIEs are usually somewhat higher. Table A shows some typical MIE ratings of common generic powdered materials.

Contact charging occurs extensively in powders, for example during mixing, grinding, sieving, pouring, micronising and pneumatic transfer. Buildup and retention of charge on the powder or equipment therefore creates a hazard if the charge is released in a discharge that is capable of causing an ignition. **Some types of handling and processing equipment that are particularly susceptible to static charge accumulation during powder handling operations are as follows:-**

TABLE A	
Powder	MIE(mJ)
Paracetamol	< 10
Magnesium	20
Sugar	30
Wheat Flour	50
Zinc	200

- Dryers
- Bulk Tankers
- Pneumatic Conveying Systems
- Conductive FIBC's, Kegs and Linings
- Filling and Discharge Systems
- Special Purpose Powder Handling Equipment

Eliminating all potential ignition sources in hazardous atmospheres is the obvious starting point for designing plant and machinery. The main areas for concern are what are often termed as "isolated conductors". These are conductive objects that are either inherently or accidentally insulated from earth, so as to prevent any static electricity generated from safely discharging, resulting in accumulation of charge on the object. These isolated conductors may be any from a large list of commonly used items, including metal couplings, flanges, fittings or valves in piping and ducting systems; portable drums, containers, hoppers and even people! Isolated conductors are probably the most likely source of static ignition incidents in industry, ranging from small-scale fires through to major damage and injury to personnel.

It is also important to note that charge can build up on the powdered materials being handled, so it is necessary to make sure that these are in sufficient contact with earthed, conductive containers, vessels, piping etc, thus providing a safe discharge path. In reality this may involve building periods of "rest" into the process, since many powders are highly resistive,

meaning charge decay will not be instantaneous. In some cases, a detailed study of charge relaxation time may be necessary, taking into account the volume resistivity of the powder, and additional factors such as humidity and moisture content. It should also be recognised that in some processes it is not possible to completely avoid having an explosive atmosphere and a build up of charge. In these cases additional measures should be taken to protect against or prevent explosions, including inerting, explosion resistant equipment, explosion venting or explosion suppression.

Conclusions

To avoid incendive spark discharges from conductors and powdered materials which could become charged, all metal and static dissipative plant, low resistivity products and persons should be earthed. This should only be ignored if the object is never charged during normal operations and possible malfunction or the maximum energy that could be stored on the conductor is lower than the MIE of the explosive atmosphere.

Fixed Plant - Special earthing connections across sections of fixed metal systems are recommended when the plant design or usage make it difficult to maintain a low resistance to earth. This could be where there are any insulating parts, seals or gaskets present, vibration or movement, and also wherever sections need to be taken apart periodically for maintenance or cleaning etc.

Movable Plant - Special, purpose designed temporary earthing connections should be provided, with the absolute minimum requirement being that each item should be earthed whenever a flammable mixture could be present.

Monitoring, Testing and Maintenance - It is necessary for all earthing and bonding measures to be tested periodically and in safety critical applications this will often take the form of constant monitoring via special certified Intrinsically Safe systems, which provide the additional security of continuous feedback, control and interlock. These may be used to monitor combinations of conductive and static dissipative plant, either as part of a complete machine structure or as discrete items.

Any complete Static Safety Audit should also consider non-conductive materials (plastics etc) in use either as part of plant and equipment, or as packaging materials brought into the hazardous area. In a flammable dust atmosphere or in the presence of explosive gases and vapours with an MIE of less than 30mJ, persons should be earthed (usually via static dissipative shoes and flooring).

The new European ATEX 137/DSEAR safety directives cover all operations involving hazardous atmospheres, and are designed to increase safety for operators working within these areas.

Useful reference material

- British Standard BS5958: Control of undesirable static electricity
- Cenelec Technical Report CLC/TR 50504: Electrostatics - code of practice for the avoidance of hazards due to static electricity
- ATEX 137/DSEAR regulations - <http://www.hse.gov.uk/spd/dsear.htm>

The advice contained in this article is designed as a general guide only - for more detailed information or for a specific discussion about any particular application please contact Newson Gale Ltd.