Hazard Assessment

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Assessment of the explosion hazard associated with the pneumatic transport of powders as used by the PTS of Dietrich Engineering Consultants S.A.

Customer

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1 Introduction and Objective

A general assessment of the electrostatic ignition hazards associated with the Powder Transfer System of Dietrich Engineering Consultants S.A. (PTS) was given in an earlier report on the PTS dated January 2nd 1998. In this report it is concluded that

> *"...the PTS as described in the report dated 15. Dec. 1997 FD/rev 0, represents a substantial improvement of safety when powder has to be filled into a vessel precharged with a flammable solvent. Earthing of all conductive parts of the PTS is very important. This requirement is however not different from any other situation where sensitive powder has to be handled or processed. Even if the powder is only poured out by gravity, earthing of all conductive parts is essential. After earthing all conducting parts no further ignition hazards associated with the PTS have to be expected."*

Since it is well known that pneumatic transport of powders may lead to a substantial build-up of static electricity and since pneumatic transport is one of the operations performed in the PTS, the question arises whether the PTS can safely be used in case of powders with low minimum ignition energy.

Therefore, in the following the electrostatic ignition hazards associated with the pneumatic transport of powders will be outlined and discussed more in detail.

2 Assessment Electrostatic Ignition Hazards Associated with Pneumatic Transport

Charge build-up is intrinsically related to the handling and processing of powders. Since most powders used in the chemical and pharmaceutical industry are of organic nature and

therefore highly insulating, charge build-up is even observed when such powders are handled and processed in earthed metallic equipment.

In every serious hazard assessment of electrostatic ignition hazards both types of charges, those accumulated on the equipment or on parts of it and those accumulated on the powder itself have to be analysed. If the equipment is made from conductive material without any insulating parts or insulating coatings the charge generated on the equipment is suddendly released to earth by bonding and earthing of the equipment. This applys to the Powder Transfer System of Dietrich Engineering Consultants S.A. (PTS).

As far as the charge on the powder is concerned the following assessment can be made: In industrial operations involving high speed separation processes between particles and walls of equipment such as e.g. in pneumatic transport, typically a charge to mass ratio between 10^{-4} to 10^{-6} C/kg is observed. Operations with a lower speed of separation such as e.g. pouring may lead to a charge to mass ratio in the range of 10^{-7} to 10^{-9} C/kg. It must, however, be emphasized that the decisive factor in such a hazard assessment is not only the charge to mass ratio but, to the same amount, the size of the powder accumulation and the bulk density. This can easily be verified by the calculation of the radial electrical field from a zylindrically symmetric charge distribution (see /1/). This electrical field E_s at the wall is proportional to the charge to mass ratio q of the powder in the heap as well as to the radius R of the heap and the bulk density d:

$$E_S = \frac{Rqd}{2\varepsilon_0\varepsilon} \tag{1}$$

with ε_0 = permittivity of the vacuum and ε = relative permittivity of the bulked powder. As a result from this analysis it is obvious, that the electrical field in a transport pipe of typically 25 mm to 50 mm diameter is far from the dielectric strength of the air under normal conditions (30kV/cm). This means that discharges with sufficient energy to ignite powders with a minimum ignition energy of more than 3 mJ will not occur under these circumstances within the transport pipe.

Furthermore, based on the newest results obtained from silo filling experiments in production /2/, no ignition hazard exists from the bulked product in the intermediate container (diameter 200 mm) of the PTS if the mie is not less than 3 mJ.

4 Conclusions

Based on the hazard evaluation described in an earlier report dated January 2nd 1998, the PTS as described in the report dated 15. Dec. 1997 FD/rev 0 represents a substantial improvement of safety when powder has to be filled into a vessel precharged with a flammable solvent. After earthing of all conductive parts of the PTS the pneumatic transport does not represent an electrostatic ignition hazard even for sensitive powders. If the minimum ignition energy of the powder lies below 3 mJ, expert advice in form of a more detailed analysis is recommended.

5 References

/1/ M. Glor, "Electrostatic Hazards in Powder Handling", Research Studies Press Ltd., Letchworth, Hertfordshire, England 1988.

/2/ M.Glor and K.Schwenzfeuer, Journal of Electrostsatics 40& 41 (1997) 511

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