DUST EXPLOSIONS IN THE FOOD INDUSTRY – A SAFETY FOCUS

By Dr Vahid Ebadat & Dr Paul Cartwright, Chilworth Technology Ltd

Powder explosions and fires in the food industry tend to be treated as rather private affairs by most companies. After all, which company would like to have their new snack or drink associated with explosions and stigma attached? In general, it is only those events of sufficient consequence that get reported to the authorities (under RIDDOR in the UK). Yet, it is important for everyone to know what can go wrong, where it can happen and what the consequences can be. Everyone has a vested interest in preventing explosions and fires be it on grounds of health and safety or good business sense to avoid loss of customer confidence and loss of market share caused by an extensive plant down time situation.

So what do we know about dust explosions and powder fires in the food and animal feed sector? Firstly, we know from reported data that this sector of industry experiences more explosions than any other. Over 30% of all explosions involve food or animal feed. But we also know that in general many foodstuffs can be quite difficult to ignite in dust cloud form compared with say pharmaceutical industry products and intermediates. As an example, the reported minimum ignition energies of sugar, milk powder and flour are 30 mJ, 50 mJ and 50 mJ respectively compared with less than 10 mJ for paracetamol from the pharmaceutical industry.

But in terms of consequence of ignition, the food industry often comes off worse in terms of scale of event. Large capacity sugar, grain or starch silos of 50 or 100 tons and up are common in food manufacture, but less so in pharmaceuticals. It is true that the rate of pressure rise when many of the large complex organic molecules found in pharmaceuticals are involved in an explosion can be very high, but it is equally true that there is not too much difference in developed explosion pressure comparing the two. Process plants that are not properly explosion protected are vulnerable in both cases.

Explosions are not the only concern even though their immediate impact is perhaps the most dramatic. Fires associated with powder decomposition are also surprisingly common, particularly where heat is applied either deliberately during drying or as a consequence of incidental energy input such as occurs in many size reduction processes. A number of common foodstuffs are susceptible to self heating, leading to spontaneous combustion. Many milk powders will, for example, self heat at temperatures a little over 100°C - often depending on fat content; some spices are known to be thermally unstable and even teas containing flavouring oils have been known to self ignite.

So how should we prevent our plant becoming the next reported (or unreported) subject of dust explosion or fire? The approach adopted by operational hazard assessors at Chilworth Technology is to conduct specialist audit work - with the hardware, software and human factor recommendations being slotted within a client's safety management system.

The audit work inevitably begins with a hazard identification exercise which draws on the experience of the assessor, on published standards and guidelines and usually on fire, explosion and thermal stability data on the processed powders - which are obtained in

laboratory tests. Test data are particularly useful to identify if a fire risk exists, if spontaneous combustion is possible and indeed, if the dusts concerned can support an explosion.

Having identified the hazards, fire and explosion prevention measures can be taken, taking care to control the less well understood sources of ignition such as static electricity, friction and impact sparks, as well as the obvious hot surfaces, electrical fires and fires caused by ineffective permit to work systems. (It is worth noting that dust explosions caused by welding and cutting operations or illicit smoking are comparatively common).

Minimum Ignition Temperature Test

As well as preventive measures, protective measures are generally required in all situations where flammable dust clouds can exist. Explosion relief vents, whose design is based on the 20 litre sphere dust explosion test data (Kst value), is the most common protective measure employed in the food industry. As safety awareness develops, however, protective techniques more usually found in the chemicals industry are being applied to protecting food plant. These include dust explosion suppression, containment of explosion pressure and even the use of inert gas.

Finally, it should go without saying that whatever preventative and protective measures are identified (hardware or procedural) in the audit, they have to be effectively implemented, installed and maintained. Broken earthing cables, welded up explosion doors and non-maintained suppression systems are an all too common discovery. In fact, our safety management system advisors regularly report examples where the findings of technical safety assessments are not effectively implemented because management structures are not in place. Clearly, training of staff to understand the fire and explosion risk is also important.

For further information on products and services available from Chilworth Technology please telephone or write to :-
Marketing Department
Chilworth Technology Ltd
Beta House, Chilworth Science Park, Southampton, SO16 7NS, UK
Tel: +44 (0)23 8076 0722 Fax: +44 (0)23 8076 7866
Web: www.chilworth.co.uk Email: info@chilworth.co.uk

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