15 Powder hazards

Some of the hazards posed by powders should be obvious and several aspects have been covered in earlier chapters; e.g. powder floods in Chapter 10. From an operating point of view, the strongest motivation for the prevention of a powder hazard is the health and safety of the process operators and those in the surrounding environment. Health and safety legislation varies from country to country, and changes with new legislation and directives, so the following references to standards and procedures should be viewed only as an introduction to this topic. The main hazards posed by powders have been split into two: explosion within a process and personal health hazards.

15.1 Explosion hazards

Eighty percent of organic dusts have been found to be explosive, as are many very fine metal powders, e.g. magnesium and aluminium. Dust explosions are commonplace and it has been estimated that on average there is one accidental explosion per week within the UK. The main distinction between a vapour explosion (*detonation*) and dust is the lower flame velocity found in the latter case. Dust explosions are usually *deflagrations*; i.e. the flame speed is less than sonic velocity and usually ranges from a few m s^{-1} to low 100's m s^{-1}, sonic velocity is approximately 330 m s^{-1}. For explosion five conditions must be met:

- dust must be suspended in air or gas supporting combustion,
- must have a particle size capable of propagating a flame,
- dust concentration must be in the explosive range (the lower threshold ranging from 20 to 50 g m^{-3} for most dusts),
- must be above minimum ignition temperature – but this may be achieved in various ways, so use this only to compare dusts, and
- there must be an ignition source of sufficient energy (which may locally provide the heat for the last point).

The lower flame speed of a deflagration means that there is a better chance of pressure venting to control an explosion with powders, compared to vapour phase detonations.

Particle size is important and, in general, smaller particles are more likely to be explosive. They are also more likely to become airborne. In many cases a dust explosion is followed by a secondary explosion that can have even greater force than the first. This is due to finer particles, which previously rested on ledges and floors, becoming airborne in the first deflagration and creating the secondary explosion. Hence, *good housekeeping* by minimising particles on ledges and floors is important. In the UK powders have been classified into two: Group A and B. Group A is deemed to be the most dangerous and there are standard tests to determine in which group a powder belongs.