Working With Powders

Working with powders can cause fine particles (dust) to be released into the air. Breathing fine particles in sufficient quantity can cause ill health, even if the substance is insoluble or is not toxic. If the substance is toxic or corrosive the risk may be greater than for gases or vapours because the fine particles present a more concentrated exposure. Air laden with fine particles may also present an explosion risk.

The risk assessment for work with powders will therefore also need to consider the risk of creating airborne particles (dust): dusts may present hazards separate from, and more severe than, those of the bulk material. This guidance is primarily concerned with the hazard arising from particle size. Especially reactive/toxic substances will require measures over and above those in this guide.

The Hazards
Inhaled particles may deposit somewhere in the respiratory tract, or may be exhaled. Particles may cause damage close to where they deposit, either by direct action (for example, if corrosive) or by causing a biological effect. Dust particles may be hazardous regardless of the solubility or chemical reactivity/toxicity of the bulk material. Thus the inhalation of dust particles small enough to enter the lungs, even where the substances are insoluble and inert, may cause lung damage (scar tissue enveloping particles) which in extreme cases can lead to chronic ill health, such as silicosis and asbestosis. Dusts may also present fire and reactive hazards – many dusts can form explosive atmospheres - though the bulk material does not readily ignite.

The Risks
The special feature of dusts that generates hazard regardless of solubility/reactivity of the substance is particle size. Hazardous dust is therefore defined by both concentration and particle size.
Health Risks Only a fraction of airborne particles near to the nose and mouth are inhaled. The size of this fraction is influenced by several factors (for a fuller explanation see BS EN 481:1993). By convention it is assumed the inhalable fraction will be about 50% for particles with an aerodynamic diameter of 100 micrometres. Only particles less than 18 micrometres are small enough to penetrate deep into the lungs (respirable fraction). The inhalable fraction is important if the dust causes harm wherever it deposits in the respiratory tract. The respirable fraction is important if the dust causes harm only if it deposits in the alveoli of the lungs. It is important to note that the average resolution of the human eye is 100 micrometres - inhalable dust is likely to be invisible!

The Workplace Exposure Limits (WEL) for dusts of any kind are:

Inhalable, 10 mg/metre cubed, 8 h time weighted average (TWA)
Respirable, 4 mg/metre cubed, 8 h TWA

For shorter exposures these figures should be multiplied by three.

However, particularly dangerous substances are assigned individual limits, E.g.:

Cadmium and compounds, 0.025 mg/metre cubed, 8 h TWA
Chromium (VI) compounds, 0.05 mg/metre cubed, 8 h TWA
Cobalt compounds, 0.1 mg/metre cubed, 8 h TWA
Mica, 10 mg/metre cubed, 8 h TWA (inhalable) and 0.8 mg/metre cubed, 8 h TWA (respirable)
Paraquat dichloride, 0.08 mg/metre cubed, 8 h TWA (respirable)
Nickel and its inorganic compounds, 0.1 mg/metre cubed, 8 h TWA (water soluble) and 0.5 mg/metre cubed, 8 h TWA (water insoluble)

Except where specified, the above are inhalable limits and, where applicable, relate to the metal element.

Fire/explosion Risks The reactivity of dusts arises from a hugely increased surface area, and therefore contact with oxygen, compared with the bulk material. The median particle size for an explosive atmosphere is generally less than about 200 micrometres.

Assessing the risk of creating airborne particles
In order to assess the risk of creating airborne particles it is necessary to consider:

- the form of the material being used, for example, the coarseness of particles, the hardness of the material, etc
- the process that is to be used, for example, weighing, grinding, etc.

In cases where mixed solids are ground it is also possible that chemical reactions will give rise to particles of their products.

If it is considered that there is a significant risk that a hazardous concentration of airborne particles will be created procedures must be employed either to prevent these particles from being produced or to contain them and control other relevant factors such as sources of ignition. Prevention and control procedures must also be employed when using materials that are classified as being toxic and are required by law for carcinogens or sensitisers. (see Hazardous Substances Policy)

Preventing the creation of airborne particles
If an experimental procedure involves, for example, the grinding of powders using a mortar and pestle, and it is concluded that there is a significant risk that a hazardous concentration of airborne particles will be produced, one method of preventing particles becoming airborne is as follows:

> use a small amount of liquid to damp down the powder in the mortar, as it is being ground. Any hazards associated with the liquid being used must also be considered.

Containment of airborne particles
If, in the case above, it is not possible to use a liquid to prevent the creation of airborne particles or if another process such as weighing is to be used and again it is concluded that there is a significant risk that a hazardous concentration of airborne particles will be produced, the procedure must be performed in a suitable containment cabinet fitted with a filter system. Such as a Waysafe enclosure.

In general, a high airflow:

- ✔ is appropriate if dust is being generated and ejected forcibly by a process;
- ✘ is not appropriate if dust is being generated from a passive operation such as weighing out small amounts of light powders.

A specially designated cabinet must be used for processes involving powders of materials classified as being toxic, a carcinogen or a sensitisers.