

Phosphorus or compounds thereof

Definition of causal agent

Phosphorous exists in three forms: white (yellow), red and black. The first is the most toxic.

Occupationally important phosphorous compounds include:

Phosphoric acid, phosphorus pentoxide, phosphorus pentachloride, phosphorus pentasulphide, phosphorus chloride, phosphorus oxychloride and phosphine gas (see below). The last can be produced from contact between phosphoric acid and metals or by heating phosphoric chloride.

Main occupational uses and sources of exposure:

White phosphorus is used in the manufacture of explosives, rodenticides and fertilisers. Red phosphorus is used in the manufacture of matches. Black phosphorous has not been used in industry.

Toxic effects

1. Local irritation

- The fumes of white phosphorus (which ignites spontaneously in air) are irritant to the eyes and respiratory tract. High exposures may induce pulmonary oedema; and prolonged exposures chronic bronchitis.
- Solid phosphorus can cause burns to the skin on direct contact.
- phosphoric acid, phosphorus pentoxide, phosphorus pentachloride, phosphorus chloride and phosphorus oxychloride are also irritant to the eyes, skin and respiratory tract.
- Inhalation of phosphorus pentoxide, phosphorus pentachloride, or phosphine gas can cause a delayed (maximum latent period 72 hours) pulmonary oedema.

minimum intensity of exposure: unknown

minimum duration of exposure: seconds

maximum latent period: immediate for local irritant/caustic effects. 72 hours for pulmonary oedema.

2. Systemic effects

- Prolonged exposure to white phosphorus at high concentrations causes anaemia and necrosis of the maxilla ('phossy jaw') with profuse salivation, loosening of the teeth and lesions on the oral mucosa.

Phosphine

Definition of causal agents

Phosphine is a colourless gas that can be produced by the reaction of water or acids with metallic phosphides. Accidental production can take place when phosphoric acid comes in contact with metals, when heating phosphorus chloride, and during the production of acetylene gas.

Main occupational uses and sources of exposure:

Phosphine is used as a fumigant and as a dopant in microelectronics manufacturing, in the semiconductor industry to introduce phosphorus into silicon crystals, as a fumigant (mainly in the past) and as a polymerization initiator.

1. Local effects

Phosphine exposure may cause toxic effects to brain, kidneys, heart, and liver with, in the most severe cases, cardiovascular collapse or pulmonary oedema (maximum latent period 72 hours from exposure), preceded by fluorescent green sputum and acute dyspnea.

When low concentrations are inhaled, headaches, dizziness, tremors, general fatigue, gastrointestinal distress, and substernal pain may be observed. Death may be preceded by tonic convulsions which may ensue after apparent recovery.

Exposure criteria:

Minimum intensity of exposure: Exposure confirmed and, if possible, assessed, by:

- History and study of working conditions providing evidence of acute exposure to arsine;
- And, if available:
 - Workplace air monitoring

Minimum duration of exposure: fatalities are possible in case of exposure of 30-60 minutes at concentrations not lower than 400-600 ppm, but serious health effects may take place also for exposures to 5 to 10 ppm for several hours.

TWA in different countries are comprised between 0,023 and 0,3 ppm, STEL values between 0,1 and 1, while ceiling values are 0,3 ppm.

Maximum latency period: from a few minutes to 72 hours, depending on the dose.