## **Hazard Summary**

Phosphine is used as an insecticide for the fumigation of grains, animal feed, and leaf-stored tobacco. Acute (short-term) inhalation exposure to phosphine may cause headaches, dizziness, fatigue, drowsiness, burning substernal pain, nausea, vomiting, cough, labored breathing, chest tightness, pulmonary irritation, pulmonary edema, and tremors in humans. Convulsions may ensue after an apparent recovery. Chronic (long-term) occupational exposure of workers to phosphine may cause inflammation of the nasal cavity and throat, weakness, dizziness, nausea, gastrointestinal, cardiorespiratory, and central nervous system symptomology, jaundice, liver effects, and increased bone density. EPA has classified phosphine as a Group D, not classifiable as to human carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (4), which contains information on inhalation chronic toxicity and the RfC, oral chronic toxicity and the RfD, and the carcinogenic effects of phosphine, and EPA's Health and Environmental Effects Document for Phosphine. (3)

### Uses

- Phosphine is used as an insecticide for the fumigation of grains, animal feed, and leaf-stored tobacco, and as a rodenticide. (1,3)
- Phosphine is also used as an intermediate in the synthesis of flame retardants for cotton fabrics, as a doping agent for n-type semiconductors, a polymerization initiator, and a condensation catalyst. (1,3)

## Sources and Potential Exposure

- Occupational exposure to phosphine may occur during its manufacture or use. (1-3)
- The general public may be exposed via the inhalation of contaminated ambient air or via the consumption of food contaminated with phosphine residues. (3)

# **Assessing Personal Exposure**

• No information was located regarding the measurement of personal exposure to phosphine.

### Health Hazard Information

#### Acute Effects:

- Acute inhalation exposure to phosphine can result in respiratory, neurological, and gastrointestinal effects. Symptoms may include headaches, dizziness, fatigue, drowsiness, burning substernal pain, nausea, vomiting, gastrointestinal distress, cough with fluorescent green sputum, labored breathing, chest tightness, pulmonary irritation, pulmonary edema, and tremors in humans. Convulsions may ensue after an apparent recovery. (1,2,4)
- Numbness and paraesthesia in the fingers were reported in workers after touching phosphine tablets. (4) In
- rabbits acutely exposed to high levels of phosphine via inhalation, dyspnea, paralysis, convulsions, effects to the liver, kidneys, and spleen have been reported. (3)
- Acute animal tests in rats have demonstrated phosphine to have extreme acute toxicity via inhalation. (5)

#### Chronic Effects (Noncancer):

- Chronic occupational exposure of workers to phosphine may cause inflammation of the nasal cavity and throat, weakness, dizziness, nausea, gastrointestinal, cardiorespiratory, and central nervous system symptomology, jaundice, liver effects, and increased bone density. (3,4)
- Decreased body weight and kidney and liver effects have been reported in animals exposed to phosphene via inhalation. (4)
- No significant toxic effects were observed following chronic oral exposure to phosphine in rats 1. (1,3,4)
- The Reference Concentration (RfC) for phosphine is 0.0003 milligrams per cubic meter (mg/m ) based on decreased body weight in mice. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (4)
- The EPA has low confidence in the RfC based on: 1) medium confidence in the principal study because it was performed and reported in a thorough manner and provided both a no-observed-adverse-effect-level (NOAEL) and lowest-observed-adverse-effect-level (LOAEL) for an effect that was consistent with other studies; and 2) low confidence in the database because of the absence of chronic studies and a multigeneration reproductive study. (4)
- The Reference Dose (RfD) for phosphine is 0.0003 milligrams per kilogram body weight per day (mg/kg/d) based on body weight and clinical parameters in rats. (4)
- EPA has medium to low confidence in the study on which the RfD was based because only a moderate number of animals per dose and one dose group was used, but an extensive methodology was employed to ensure proper administration of the test compound and an extensive number of parameters were measured; medium to low confidence in the database because the effectiveness and safety of this chemical has long been reported, but few experimental oral studies are available; and, consequently, medium to low confidence in the RfD. (4)

#### Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of phosphine in humans.
- No reproductive or developmental effects were observed in female rats or male mice exposed to phosphine via inhalation. (4)
- No impairment in reproductive function was observed in a study of rats exposed to phosphine in their diet.
   (3)

#### Cancer Risk:

- No information is available on the carcinogenic effects of phosphine in humans.
- In two studies of rats exposed to phosphine in their diets, no difference in tumor incidence was observed between treated rats and controls. (3,4)
- EPA has classified phosphine as a Group D, not classifiable as to human carcinogenicity. (3,4)

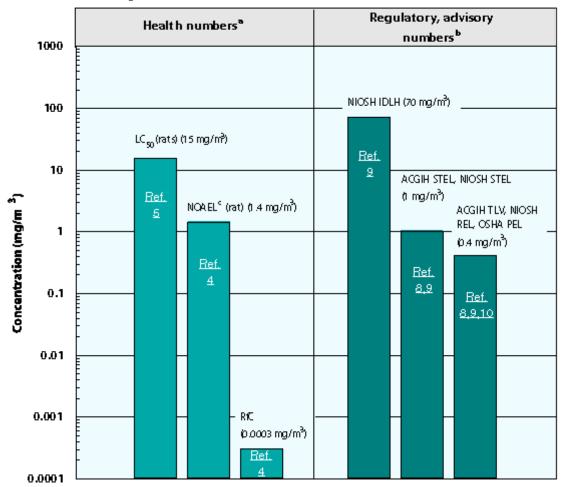
### **Physical Properties**

- The chemical formula for phosphine is PH , and its molecular weight is 34.0 g/mol. (3,6)
- Phosphine occurs as a colorless, flammabl $^{3}$  e gas that is slightly soluble in water. (1-3,6)
- In its purest form, phosphine is almost odorless, but its commercial grade has a disagreeable, garlic-like odor or that of decaying fish; the odor threshold is 0.15 parts per million (ppm). (1,3,6,7)

To convert concentrations in air (at 25 °C) from ppm to mg/m: mg/m = (ppm) × (molecular weight of the compound)/(24.45). For phosphine: 1 ppm = 1.39 mg/m<sup>3</sup>.

### Health Data from Inhalation Exposure

# **Phosphine**



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

ACGIH STEL--ACGIH's threshold limit value short-term exposure limit; a 15-minute TWA exposure which should not be exceeded at any time during a workday.

LC (Lethal Concentration  $_{50}$ ) -- A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH REL--National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

NIOSH STEL--NIOSH's recommended short-term exposure limit; a 15-minute TWA exposure which should not be exceeded at any time during a workday.

NIOSH IDLH — NIOSH's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

The NOAEL is from the critical study used as the basis for the RfC.

### References

Summary created in April 1992, updated in January 2000

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