

ARSINE

AsH₃

TLV, 0.05 ppm ($\approx 0.2 \text{ mg/m}^3$)

Arsine is a colorless gas with a disagreeable garlic odor. It has a molecular weight of 77.93, specific gravity of 2.695, melting point of -113.5°C , boiling point of -55°C , a vapor pressure of ≥ 1 atmosphere and decomposes at 230°C . It is soluble in water, slightly soluble in alcohol and alkalis.

It is used in organic synthesis; as a military poison gas; doping agent for solid state electronic compounds.

Most cases of arsine poisoning do not result from the manufacture or use of the gas itself; rather they come from formation of arsine as a byproduct of a chemical reaction involving, in most instances, a base metal, an arsenic impurity, and an acid, or, rarely, a strong alkali.

The extreme acute toxicity of arsine is well known; 250 ppm for 30 minutes is fatal, and 3 to 10 ppm can cause poisoning symptoms in a few hours.⁽¹⁾ Nau⁽²⁾ found that animals exposed three hours a day to concentrations between 0.5 and 2 ppm developed blood changes in a few weeks.

Published reports of occupational and other poisoning from arsine describe some 310 cases, 74 of them fatal, through 1959.⁽¹⁾ Several reports since 1960 record 28 cases, with two deaths, in this country⁽⁴⁻⁷⁾ and abroad.⁽⁸⁻¹⁰⁾ Typical cases resulted in hemoglobinuria, jaundice and hemolytic anemia.

While data on the actual concentrations causing acute intoxication are lacking, post event concentrations of 70 to 300 ppm (Morse and Setterlind, fatal cases,⁽¹¹⁾ 5 ppm Kipling and Fothergill⁽⁸⁾ and 0.5 ppm Elkins⁽¹²⁾) were reported. When urine samples were analyzed at early stages concentrations of arsenic ranging from 0.5 to 2 mg/L were the rule, but occasionally much higher values were found.

Bulmer et al⁽¹³⁾ reported a number of cases of chronic poisoning, with severe anemia. Urinary arsenic levels averaged 2.3 mg/L, dropping to 0.66 mg/L three days later. Greig et al⁽¹⁴⁾ recorded three relatively mild chronic cases with arsenic in urine levels of 0.5 mg/L.

In an extensive clinical study of 14 simultaneous cases of arsine poisoning,⁽¹⁴⁾ tissue arsenic levels, determined by neutron activation analysis, indicated a total body content

of arsenic one-third to one-half the lethal dose (300 mg), if one "assumes" that the poisoning action of the hydride follows to some extent that of the trioxide, none of the cases were fatal, but ranged from mild to very severe. Hemolysis and renal damage typified the toxic responses. The most severely poisoned had oliguria for 40 days and required hemodialysis 10 times, but hemolysis disappeared in a few days in all others. In four cases, renal function was impaired for a long time, but was finally restored.

Since arsenic appears to be excreted rather freely in the urine,⁽¹⁴⁾ the levels found in the urine of intoxicated workers could have resulted from inhalations of concentrations below 1 mg/m³ or 0.25 ppm. The recommended TLV of 0.05 ppm (0.2 mg/m³) is the same as that of other inorganic arsenic compounds, which are considered substantially less toxic.

Other recommendations: Cook (1945) 1 ppm; Smyth (1956) and Elkins (1959) 0.05 ppm; USSR (1966) 0.1 ppm; Czechoslovakia (1969) 0.06 ppm.

References:

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ASBESTOS

TLV, Appendix A1a— Recognized Carcinogen

- 0.5 fiber > 5 $\mu\text{m}/\text{cc}$ — Amosite
- 2.0 fibers > 5 $\mu\text{m}/\text{cc}$ — Chrysotile
- 0.2 fiber > 5 $\mu\text{m}/\text{cc}$ — Crocidolite
- 2.0 fibers > 5 $\mu\text{m}/\text{cc}$ — Other forms

According to recent authoritative mineralogical definitions,⁽¹⁾ asbestos is "1) A collective mineralogical term encompassing the asbestiform varieties of various minerals; 2) An industrial product obtained by mining and processing primarily asbestiform minerals."

For the purpose of considering a recommendation for a threshold value of asbestos dust in the workplace, only the second definition above is applicable. Although there are four types of natural mineral fibers that have been in industrial use, only three have been used in the United States: chrysotile, amosite, and crocidolite. The fourth, anthophyllite, is mined and used in Finland. Of the three types of asbestos that have been used in North America, Canadian chrysotile has formed 95% of all natural mineral fibers used, with amosite and crocidolite (both imported from South Africa) constituting the other 5%. It should be noted that chrysotile is classified as a serpentine mineral, whereas the other three types of asbestos are amphiboles.

It is now generally recognized that excessive inhalation of asbestos dust causes chronic inflammations of lung tis-