Recommendation from Scientific Expert Group on Occupational Exposure Limits for Hydrogen selenide

8 hour TWA	:	0.02 ppm (0.07 mg/m^3)
STEL (15 mins)	:	0.05 ppm (0.17 mg/m^3)
Additional classification	:	-

Substance:

Hydrogen selenide H-Se-H

Synonyms	:	Selane, selenium dihydride, selenium hydride.		
EINECS N°	:	231-978-9		
EEC N°	:	034-002-00-8	Classification :	T; R23/25 R33
CAS N°	:	7783-07-5		
MWt	:	80.98		

Conversion factor (20°C, 101kPa) : 3.37 mg/m^3 = 1 ppm

Occurrence/use:

Hydrogen selenide is a colourless gas at ambient temperature and pressure, with a foul pungent odour. It has a MPt of -66°C, a BPt of -41°C and a vapour pressure of 863 kPa at 20°C. It has a vapour density of 2.8 times that of air. The odour threshold is about 0.3 ppm (1 mg/m^3).

Hydrogen selenide can occur naturally and is formed by the reaction of acids or water with metal selenides, wherever hydrogen is in contact with soluble selenium compounds and by the reaction of selenium with organic matter. Hydrogen selenide is imported into the EEC in excess of 1,000 tonnes per annum. The main uses are in the electronic and photovoltaics industries. Typical occupational exposures are less than 0.0125 ppb (0.04 μg/m^3).

Health Significance:

There is very little valid data available on which to base an occupational exposure limit for hydrogen selenide. Little is known about its toxicokinetics or toxicodynamics. It is highly irritating to the mucous membranes and respiratory tract and is probably well absorbed through the lungs (Dudley and Miller, 1937, 1941). On contact with moist mucous membrane surfaces, hydrogen selenide is probably oxidised to red elemental selenium. Thus in considering health effects there are two aspects: a) the acute effects of hydrogen selenide itself; and b) the possible chronic effects of absorbed selenium.

The lead effect is irritation. A human study briefly reported by Dudley and Miller (1941) indicated a NOAEL over "several minutes" of 0.3 ppm (1 mg/m^3). A very strong irritant effect was observed at 1.5 ppm (5 mg/m^3).

Consideration of the chronic effects of absorbed selenium is complex because selenium is an essential element. "Normal" blood selenium levels are in the range 50-150 µg/l (Schaller and Schiele, 1989), whereas high levels without signs of toxicity are in the range 350-580 µg/l and levels greater than 600 µg/l can be interpreted as over-exposure (Magos and Berg, 1988). Thus 350 µg/ml may be considered as a blood level at which no adverse effect was observed. The maximum occupational contribution to blood selenium could therefore be 200 µg/l. From the data of Yang *et al* (1983), this would be achieved by limiting the maximum daily intake to 0.48 mg over a five-day working week. Assuming 100% absorption this would approximate to a 8-hour TWA of 0.015 ppm (0.05 mg/m^3).

In addition, the WHO has concluded that the LOAEL for selenium in laboratory rats is 0.2 mg/kg body weight per day (WHO, 1987). This approximates to a daily human intake of 20 mg over a five-day working week. Assuming 100% absorption by inhalation and 10 m^3 of air is inhaled in a working day, an equivalent occupational airborne concentration would be 2 mg/m^3. A 8-hour TWA of 0.015 ppm (0.05 mg/m^3) would provide an uncertainty factor of 40 to allow for the extrapolation from animal data to man.

Additional studies on systemic toxicity, carcinogenicity, reproductive toxicity, immunotoxicity and mutagencity are required.

Recommendation:

The human irritancy data for hydrogen selenide of Dudley and Miller (1941), taken into account with calculations of systemic no-effect levels for elemental selenium derived from human blood levels and animal data were considered to be the best available basis for setting occupational exposure limits. An uncertainty factor of 20 was applied to the NOAEL of 0.3 ppm (0.01 mg/m^3) established by Dudley and Miller to allow for the limitations of the reporting. The limit values were then rounded up in order to comply with the preferred value approach of the SEG. This was felt to provide as adequate mardin for protection because the calculation allowed for 100% absorption and the very steep dose response relationship is recognised as producing a more reliable NOAEL. This resulted in recommendation of a 8-hour TWA of 0.02 ppm (0.07 mg/m^3), which is not contradicted by the level indicated for systemic exposure to elemental selenium. A STEL (15 mins) of 0.05 ppm (0.17 mg/m^3) was recommended to limit peaks in exposure which could result in irritation.

At the levels recommended, no measurement difficulties are foreseen.

Bibliography:

Principal reference

~~SEG/CDO/18 (1991)~~. Criteria document for an occupational exposure limit for hydrogen selenide. Prepared by Industrial Toxicology Unit, Institute of Occupational Health, Birmingham.

Key Studies

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