U.S. Army Center for Health Promotion and Preventive Medicine

USACHPPM

Wildlife Toxicity Assessment for Acetylene

JANUARY 2006

Prepared by
Health Effects Research Program
Environmental Health Risk Assessment Program

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Readiness Thru Health

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Acknowledgements

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Department of the Army
U.S. Army Center for Health Promotion and Preventive Medicine

Wildlife Toxicity Assessment for Acetylene

CAS No. 74-86-2 **January 2006**

1. Introduction

Acetylene is a gas that is used as feedstock in the manufacture of vinyl chloride, vinylidene chloride, vinyl acetate, and acrylates, among others. The compound is an intermediate in the synthesis of acrylic acid, tetrahydrofuran, and some chlorinated solvents. When mixed with air acetylene is used in oxyacetylene torches, for example, in welding, cutting, or soldering metals (HSDB 2001). Key to its use in metallurgy is the intense heat with which acetylene/oxygen mixtures burn (>2500^{o}C). In fact, gaseous acetylene is explosive when compressed or heated, a danger emphasized by Lewis (1992) who pointed out that while the compound dose not constitute a serious toxic hazard, acetylene is a very dangerous fire hazard when exposed to heat, flame, or oxidizers. Also, the compound is incompatible with a substantial number of chemical substances, mixtures with which may become violently explosive. Examples of these agents include copper, halogens, molten potassium, silver, and mercury.

This Wildlife Toxicity Assessment summarizes current knowledge of the toxicological impacts of acetylene on wildlife. Evaluating the toxicity of acetylene is intended to contribute to the derivation of toxicity reference values (TRVs) that could serve as screening-level benchmarks for wildlife in the vicinity of contaminated sites. The protocol for the performance of this assessment is documented in the U.S. Army Center for Health Promotion and Preventive Medicine Technical Guide 254, *Standard Practice for Wildlife Toxicity Reference Values* (USACHPPM 2000).

2. Toxicity Profile

2.1 Literature Review

Relevant biomedical, toxicological, and ecological databases were electronically searched May 2, 2001, using Dialog, to identify primary reports of studies and reviews on the toxicology of acetylene. Separate searches were carried out linking the compound to laboratory mammals, birds, reptiles and amphibians (combined), and wild mammals. In general, a two-tiered approach was used in which all citations were first evaluated as titles and "key words in context." All available abstracts of those articles

that were selected in the first tier as possibly relevant to TRV development were then evaluated for relevancy and retention for evaluation in the second tier. For acetylene, no articles were marked for retrieval from 101 initial hits, reflecting an overall lack of applicable toxicological information on acetylene in the environmental and biomedical literature. Details of the search strategy and results are documented in Appendix A.

In addition to Dialog searching, the Defense Technical Information Center (DTIC) was searched for reports on acetylene. A secondary reference and source of information on the compound was the National Library of Medicine's Hazardous Substances Databank (HSDB 2001).

2.2 Environmental Fate and Transport

Acetylene is released to the atmosphere from such sources as internal combustion engines, in particular the diesel engine, from which it has been reported to constitute greater than 14 percent of released hydrocarbons (HSDB 2001). Consequently, the compound is a ubiquitous component of urban air, with reported concentrations ranging to 300 ppb. Because it is used as a feedstock in the manufacture of vinyl chloride and other substances, it can also be lost to the environment during chemical processing and waste disposal. Eleven chemical companies are listed in HSDB as manufacturers of the gas, some at multiple sites. Volatilization of soil-borne acetylene is likely, based on the compound's high vapor pressure of 5.24×10^3 mm Hg at 25°C (HSDB 2001). As listed in Table 1, these and other physical-chemical characteristics contribute to the volatilization of acetylene from the surface of marine and freshwater systems. HSDB (2001) also discusses the terrestrial fate of acetylene in the context of its possible degradation by abiotic or biotic processes. For example, many plants and bacteria convert acetylene to ethylene via their nitrogen-fixing mechanisms.

Table 1. Summary of Physical-Chemical Properties of Acetylene

CAS No.	74-86-2
Molecular weight	26.02
Color	None
Physical state	Gas
Melting point	-84°C (sublimes)
Boiling point	-84°C (sublimes)
Odor	Faint, ethereal
Solubility in water	1.2 g/L at 20-25 °C:
Solubility in other solvents	soluble in ethanol, diethyl ether, benzene, chloroform

Partition coefficients:	
Log K_{ow}	0.37
Log K_{oc}	No data
Vapor pressure at 25 ^{o}C	5.24×10^{3} mm Hg
Henry's Law constant at 25 ^{o}C	No data
Vapor density	0.91 (air = 1)
Conversion factors	1 ppm = 1.07 mg/m^3
	1 mg/m^3 = 0.94 ppm

Source: HSDB (2001)

2.3 Summary of Mammalian Toxicity

Given the gaseous nature of acetylene at ambient temperatures and pressures, there are no data on the toxicological effects of the compound when administered via the oral route. Furthermore, no reports of studies on the toxicology of acetylene via the inhalation route were identified in biomedical and environmental literature, although Lewis (1992) describes acetylene as a simple asphyxiant that, at sufficient concentrations, will dilute the available oxygen (partial O2 pressure) in the air to a level that will not support life. An asphyxiant (example: Argon) may reach 33 percent of the air gas mixture that is breathed, reducing the pO2 to about 75 percent of normal before appreciable symptoms develop (Lewis, 1992). First symptoms are rapid respiration and air hunger; impaired muscular coordination and nausea follow. 75 percent asphyxiant in air is fatal. Note however that impurities in commercial acetylene may cause symptoms before an asphyxiating concentration of C2H2 is reached; and 10 percent in air may cause slight intoxication (HSDB; Lewis, 1992). The NIOSH recommended exposure ceiling value is 2500 ppm (0.25 percent), a figure that may be of some value in assessing significance of environmental concentrations.

2.4 Summary of Avian Toxicology

No toxicological data for the effects of acetylene on avian species was located.

2.5 Amphibian Toxicology

No toxicological data for the effects of acetylene on amphibian species was located.

2.6 Reptilian Toxicology

No toxicological data for the effects of acetylene on reptiles was located.

3. RECOMMENDED TOXICITY REFERENCE VALUES

3.1 Toxicity Reference Values for Mammals

3.1.1 TRVs for Ingestion Exposures for the Class Mammalia

At this time it is not possible to derive a TRV for oral route of exposure for acetylene since there are no studies on the toxicity of this compound when administered orally. Due to the gaseous nature of the compound, it cannot be administered orally.

3.1.2 TRVs for Inhalation Exposures for the Class Mammalia

Not available at this time.

3.1.3 TRVs for Dermal Exposures for the Class Mammalia

Not available at this time.

3.2 Toxicity Reference Values for Amphibians

Not available at this time.

3.3 Toxicity Reference Values for Reptiles

Not available at this time.

4. IMPORTANT RESEARCH NEEDS

The lack of data on the toxicity of acetylene to wildlife species precludes the development of a TRV. Hence, more toxicological studies of the compound and its derivatives are recommended. Also, chronic toxicity studies on non-mammalian wildlife such as birds, reptiles and amphibians are particularly warranted.

5. References

Hazardous Substances Databank (HSDB). 2001. On-line Database. National Library of Medicine. Washington, DC.

Lewis, R.J., Sr. 1992. In: *Sax's Dangerous Properties of Industrial Materials*. Eighth Edition. Van Nostrand Reinhold, New York, NY.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2000. *Standard Practice for Wildlife Toxicity Reference Values*, Technical Guide 254.

APPENDIX A
LITERATURE REVIEW

A search in DIALOG was carried out on acetylene May 2, 2001, with the following files examined:

File 155 Medline, File 156 Toxline, File 535 Thomas Register Online, File 76 Life Sciences Collection, File 185 Zoological Record Online, File 5 Biosis Reviews.

The structure was as follows:

For **Laboratory Animals**

- CAS. Number
- AND (rat or rats or mice or mouse or hamster? or (guinea()pig?) or rabbit? or monkey?)
- AND (reproduc? or diet or dietary or systemic or development? or histolog? or growth or neurological or behav? or mortal? or lethal? or surviv? or (drinking()water))
- RD (Reduce Duplicates)

For **Birds**

- CAS. Number
- AND chicken? or duck or duckling? or ducks or mallard? or quail? or (japanese()quail?) or coturnix or (gallus()domesticus) or platyrhyn? or anas or aves or avian or bird? or (song()bird?) or bobwhite? or (water()bird) or (water()fowl)
- RD (Reduce Duplicates)

For **Wild Mammals**

- CAS. Number
- And (didelphidae or opossum? or soricidae or shrew? Or talpidae or armadillo? or dasypodidae or ochotonidae or leporidae) or canidae or ursidae or procyonidae or mustelidae or felidae or cat or cats or dog or dogs or bear or bears or weasel? or skunk? or marten or martens or badger? or ferret? or mink? or aplodontidae or beaver? or sciuridae or geomyidae or heteromyidae or castoridae or equidae or suidae or dicotylidae or cervidae or antilocapridae or bovidae arvicolinae or mycocastoridae or dipodidae or erethizontidae or sigmodon? or (harvest()mice) or (harvest()mouse) or microtus or peromyscus or reithrodontomys or onychomys or vole or voles or lemming?
- RD (Reduce Duplicates)

For **Amphibians/Reptiles**

- CAS. Number

- AND (amphibi? or frog or frogs or salamander? or newt or newts or toad? or reptil? or crocodil? or alligator? or caiman? snake? or lizard? or turtle? or tortoise? or terrapin?)

- RD (Reduce Duplicates)

As noted in Section 2.1, 101 hits on acetylene were obtained in the initial searches, of which none were selected for retrieval.