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SECONDARY VALUES FOR PHENANTHRENE (CAS # 85-01-8)

A search was conducted for information on the chemical properties and toxicity of phenanthrene (to human health and to fish and aquatic life) using the following databases and search engines: ECOTOX (toxicity to fish and aquatic life), IRIS (Integrated Risk Information System; toxicity to human health), CHEMFATE (environmental fate), BIOLOG (microbial degradation/toxicity), DATALOG (environmental fate bibliography), HSDB (Hazardous Substances Data Bank), CCRIS (Chemical Carcinogenesis Research Info System), GENE-TOX (mutagenicity database), TOXLINE (toxicology bibliography), TERA (Toxicology Excellence for Risk Assessment), and Ingenta (journal article search engine; since 1988). This search yielded some information on phenanthrene's properties (vapor pressure, log octanol/water partition coefficient, Henry's Law, and water solubility), its biodegradation, and some information on its toxicity.

FISH AND AQUATIC LIFE

To derive an acute toxicity criterion for aquatic life, acute toxicity test results are required for at least one species in each of eight different families. Specific requirements and the data found suitable to meet these requirements are found in Table 1. Following a search for information on the toxicity of phenanthrene to fish and other aquatic life, it was determined that data are available to meet only three out of the eight requirements; but because there are data for *Daphnia* sp., it is possible to calculate a secondary acute value for phenanthrene.

Cold Water

To calculate a secondary acute value (SAV), the lowest genus mean acute value (GMAV) in the database is divided by the secondary acute factor (SAF; an adjustment factor corresponding to the number of satisfied requirements).

SAF for three out of eight requirements met = 8.0

Lowest GMAV = 490 µg/L (*Chironomus tentans*)

SAV = GMAV/SAF
= 490/8
= 61.2500

There are currently no chronic data for phenanthrene (freshwater or saltwater). Therefore, a secondary chronic value may be calculated only by using default acute-chronic ratios.

SACR = Geometric mean of 18, 18, and 18 = 18

SCV = SAV/SACR
= 61.2500/18
= **3.4028**

So, for phenanthrene, the **secondary acute value is 61 μg/L** (rounded from 61.2500) and the **secondary chronic value is 3.4 μg/L** (rounded from 3.4028) for **cold water.**

Table 1. Requirements for calculation of an acute toxicity criterion for protection of aquatic life for phenanthrene, and corresponding acute toxicity data.

Species Name	Common Name	Duration/ Endpoint	Value µg/L	Reference #[a]	Source
1. At least one salmonid fish in the family Salmonidae, in the class Osteichthyes.					
Oncorhynchus mykiss	**rainbow trout**	**96-h/LC50**	**3200**	**4**	**AQUIRE**
2. At least one non-salmonid fish from another family in the class Osteichthyes, preferably a commercially or recreationally important warmwater species.					
3. At least one planktonic crustacean (e.g., cladoceran, copepod).					
Daphnia magna	**water flea**	**48-h/LC50**	**700**	**6**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/LC50**	**843**	**3**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**6.6 mmol/m^3 = 1176.38 µg/L**	**2**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**1.16 mmol/m^3 = 206.76 µg/L**	**1**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**1.16 mmol/m^3 = 206.76 µg/L**	**1**	**AQUIRE**
Species Mean Acute Value (SMAV; geometric mean of LC50 values for this species):			494.8588		
Daphnia pulex	**water flea**	**48-h/EC50**	**734**	**7**	**AQUIRE**
Daphnia pulex	**water flea**	**48-h/EC50**	**350**	**8**	**AQUIRE**
Species Mean Acute Value (SMAV; geometric mean of LC50 values for this species):			506.8530		
Genus Mean Acute Value (GMAV; geometric mean of SMAVs for this genus):			500.8200		
4. At least one benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).					

5. At least one insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

Chironomus tentans	**midge**	**48-h/LC50**	**490**	**6**	**AQUIRE**

6. At least one fish or amphibian from a family in the phylum Chordata not already represented in one of the other subdivisions.

7. At least one organism from a family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).

8. At least one organism from a family in any order of insect or any other phylum not already represented in subdivisions 1 through 7.

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[7] Passino, D.R.M. and S.B. Smith. 1987. Acute bioassays and hazard evaluation of representative contaminants detected in Great Lakes fish. Environmental Toxicology and Chemistry 6(11):901-907.

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ADDITIONAL REFERENCES

National Institute of Health. Hazardous Substances Data Bank (HSDB). http://toxnet.nlm.nih.gov

Syracuse Research Corporation. CHEMFATE database. http://esc.syrres.com/efdb.htm

U.S. EPA. Aquatic Toxicity Information Retrieval (AQUIRE) database. http://www.epa.gov/med/databases.html

U.S. EPA. 1999. National recommended water quality criteria- correction. EPA 822-Z-99-001. U.S. Environmental Protection Agency, Washington, D.C.

HUMAN HEALTH

To calculate a criteria or secondary value for the protection of human health, it is first necessary to determine if the substance has been shown to be carcinogenic (which will result in the calculation of a human cancer criteria or secondary value) or not (which will result in the calculation of a human threshold criteria or secondary value). Phenanthrene is currently classified as "D", not classifiable, by the U.S. EPA (IRIS, 1998) based on inadequate data from animal bioassays and no human data. While U.S. EPA considers phenanthrene a Priority Pollutant, it has not recommended any water quality criteria (U.S. EPA 1999), and no Great Lakes states have established any criteria or secondary values for this substance for the protection of human health. A search for information on phenanthrene was conducted. Bioconcentration factors are available for the fathead minnow (5,100 from Carlson et al. 1979, and 2,630 from Veith et al. 1979) and zebra fish (1,259 from Petersen and Kristensen 1998). However, because there are no oral RfD or inhalation RfC references available it is not possible to calculate a human threshold secondary value for the protection of human health at this time.

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National Institute of Health. Hazardous Substances Data Bank (HSDB). http://toxnet.nlm.nih.gov

Oak Ridge National Laboratory. Risk Assessment Information System (RAIS). http://risk.lsd.ornl.gov

Petersen, G.I. and P. Kristensen. 1998. Bioaccumulation of lipophilic substances in fish early life stages. Environmental Toxicology and Chemistry 17(7):1385-1395**. NOTE: While the BCF presented in this article was converted to a wet-weight basis, the lipid % appears to have not been converted, and so this information may not be useable.**

Syracuse Research Corporation. CHEMFATE database. http://esc.syrres.com/efdb.htm

U.S. EPA. Aquatic Toxicity Information Retrieval (AQUIRE) database. http://www.epa.gov/med/databases.html

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