Rule 57 Aquatic Values Data Sheet

Chemical or product name Fluoride
Manufacturer (WTAs):
C.A.S #: 16984-48-8

Developed by: D. Bush
Approved by: [signature]
Approval date: 3/13/07
Literature search date: 2/26/2007

FAV: 20,000 ug/L (Tier: 2)
AMV: 9,800 ug/L (Tier: 2)
FCV: 2,700 ug/L (Tier: 2)
Acute CF: ---- *Chronic CF:* ----

ACUTE DATA

Species	Test type (EC or LC50)	Duration (hours)	Test conditions (FT,M, etc.)	Hardness mg/L	Chemical	LC50/EC50 ug/L	SMAV ug/L	GMAV ug/L	Rank	Reference
Midge (*Chironomus tentans*)	LC50	48	FT,M	moderate	NaF	93,100	101,611	101,611	1	1
	LC50	48	FT,M	moderate	NaF	110,900				1
Fathead minnow (*Pimephales promelas*)	LC50	96	FT,M	moderate	NaF	112,200	112,200*	112,200	2	1
	LC50	96	FT,M	moderate	NaF	225,100				1
Rainbow trout (*Salmo gairdneri*)	LC50	96	S,M	22.4	NaF	107,500	113,651	113,651	3	2
	LC50	96	S,M	17	NaF	51,000				3
	LC50	96	S,M	49	NaF	128,000				3
	LC50	96	S,M	182	NaF	140,000				3
	LC50	96	S,M	385	NaF	193,000				3
Aquatic worm (*Lumbriculus variegatus*)	LC50	96	FT,M	moderate	NaF	93,500	119,160	119,160	4	1
	LC50	96	FT,M	moderate	NaF	113,100				1
Aquatic snail (*Physa spp.*)	LC50	96	FT,M	moderate	NaF	231,700	194,397	194,397	5	1
	LC50	96	FT,M	moderate	NaF	163,100				1
Water flea (*Daphnia magna*)	LC50	48	S,U	173	NaF	340,000	307,994	307,994	6	4
	LC50	48	S,M	169	NaF	279,000				5

* The value of 112,200 ug/L was considered the SMAV because it was based on a more sensitive lifestage (8-day old fish) than the lifestage (14-day old fish) used to derive the value of 225,100 ug/L.

CHRONIC DATA

Species	Test type (ELS, etc.)	Duration (days)	Study Conditions (FT,M etc.)	Hardness mg/L	Chemical	MATC ug/L	SMCV ug/L	GMCV ug/L	Rank	Reference
Water flea (*Daphnia magna*)	LC	21	S,M	169	NaF	30,439*	30,439	30,439	1	5
Fathead minnow (*Pimephales promelas*)	ELS	32	FT,M	89-96	NaF	94,575**	94,575	94,575	2	1

* MATC = the geometric mean of the NOEC (26,100 ug/l) and the LOEC (35,500 ug/L).
** MATC = the geometric mean of the NOEC (66,600 ug/L) and the LOEC (134,300 ug/L).

References:

1. Advent Group. 2000. Toxicity Test Results: Fluoride Water Quality Criteria. Prepared for U.S. Steel, Gary Works.

2. Camargo, J.A. and J.V. Tarazona. 1991. Short-term toxicity of fluoride ion (F-) in soft water to rainbow trout (*Salmo gairdneri*) and brown trout (*Salmo trutta fario*). Fluoride 24(2):76-83. (brown trout data were not used since race of fish are not native to North America)

3. Pimentel, R. and R.V. Bulkley. 1983. Influence of water hardness on fluoride toxicity to rainbow trout. Environ. Toxicol. Chem. 2:381-386.

4. Leblanc, G.A. 1980. Acute toxicity of priority pollutants to water flea (*Daphnia magna*). Bull. Environ. Contam. Toxicol. 24:684-691.

5. Fieser, A.H. et al. 1986. Effect of fluorides on survival and reproduction of *Daphnia magna*. J. Water Pollut. Control Fed. 58(1):82-86.

References Reviewed and Rejected:

1. Buikema, A.L., Jr. et al. 1977. Rotifer sensitivity to combinations of inorganic water pollutants. OWRT Project A-071-VA, VA Water Resources Res. Center, Bull. No. 92. (reject - insufficient discussion of results, mixed age groups used in toxicity tests, etc.)

2. Camargo, J.A. and J.V. Tarazona. 1990. Acute toxicity to freshwater benthic macroinvertebrates to fluoride ion (F-) in soft water. Bull. Environ. Contam. Toxicol. 45:883-887. (reject - animals were not early instars)

3. Camargo, J.A. et al. 1992. Sublethal effects of sodium fluoride (NaF) on net-spinning caddisflies (Trichoptera). Aquat. Insects 14:23-30. (reject - test species are not North American, animals were not early instars and inappropriate endpoint).

4. Camargo, J.A. et al. 1992. The relative sensitivity of competing hydropsychid species to fluoride toxicity in the Cache la Pourdre River (Colorado). Arch. Environ. Contam. Toxicol. 22:107-113. (reject - animals were not early instars)

5. Carmargo, J.A. and T.W. La Point. 1995. Fluoride toxicity to aquatic life: A proposal of safe concentrations for five species of palearctic freshwater invertebrates. Arch. Environ. Contam. Toxicol. 29(2):159-163. (reject - animals were not early instars and inappropriate endpoint)

6. Dave, G. 1984. Effects of fluoride on growth, reproduction and survival in *Daphnia magna*. Comp. Biochem. Physiol. 78C:425-431. (reject - excessive control mortality and possibly a fed test)

7. Kuhn, R. et al. 1989. Results of the harmful effects of water pollutants to Daphnia magna in the 21 day reproduction test. Water Res. 23(4): 501-510. (reject - unacceptable study design)

8. Smith, L.R. et al. 1985. Studies on the acute toxicity of fluoride ion to stickleback, fathead minnow, and rainbow trout. Chemosphere 14:1383-1389. (reject - no information on controls provided, precipitation issues, limited information provided on study design, d.o.?, age of animals?)

9. Wallen, I.E. et al. 1957. Toxicity to Gambusia affinis of certain pure chemicals in turbid waters. Sewage Ind. Wastes 29(6):695-711. (reject - test water used was highly turbid)

10. Wright, D.A. 1977. Toxicity of fluoride to brown trout fry (*Salmo trutta*). Environ. Poll. 12:57-62. (reject - actual LC50 not provided, may be a fed test, # of reps?, TRC?, etc.)

Table 1. Derivation of the Acute-to-Chronic Ratios (ACR) for *Daphnia magna* and Fathead Minnows using Fluoride.

Daphnia magna 48-hour LC50 (Fieser et al., 1986):

279,000 ug/L

Daphnia magna MATC:

30,439 ug/L

ACR:

(279,000 ug/L)/(30,439 ug/L) = 9.1659

Fathead minnow 96-hour LC50s (Advent Group, 2000):

112,200 ug/L
225,100 ug/L

Fathead minnow MATC:

94,575 ug/L

ACR:

(225,100 ug/L*)/(94,575 ug/L) = 2.3801

* According to R323.1057(2)(i)(ii)(A) of the Part 4 Water Quality Standards, priority is given to acute tests that are part of the same study as the chronic test when an ACR is derived. Since the LC50 of 225,100 ug/L was derived during the same test, it was used to derive the ACR for fathead minnows.

Min. data req. met	Acute Factor
2	13
3	8
4	7
5	6.1
6	5.2
7	4.3

Rule 57 Aquatic Values Work Sheet

Chemical Name: Fluoride
C.A.S. #: 16984-48-8

AQUATIC MAXIMUM VALUE CALCULATIONS

A. Minimum 8 species requirement is **not** met. Minimum requirements met = 6 (i, iii, iv, vi, vii, viii)
Minimum requirements missing for Tier I = 2 (ii, v)
Acute factor = 5.2

1. Toxicity **is not** dependent on a water characteristic

   a. FAV calculation $FAV = \frac{101,611 \text{ ug/L}}{5.2} = 19,541 \text{ ug/L} = 20,000 \text{ ug/L}$

2. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table ___)

   b. FAV equation:

3. Go to C.

B. Minimum 8 species requirement **is** met (Tier I)

1. Toxicity **is not** dependent on a water characteristic

   a. FAV calculation: Att. ___

2. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table ___)

   b. Ranked genus mean acute intercepts: Table

   c. Final acute intercept = (Att. ___)

   ln of final acute intercept =

   d. FAV equation =

C. Aquatic Maximum Value (AMV) calculation:

$$AMV = \frac{101,611 \text{ ug/L}}{5.2} \div 2 = 9,770 \text{ ug/L} = 9,800 \text{ ug/L}$$

FINAL CHRONIC VALUE CALCULATIONS

A. Minimum 8 species requirement is **not** met (Tier II). Minimum requirements met = 2
Minimum requirements missing for Tier I = 6

1. Acute to chronic ratio

   a. Number ACRs meeting minimum data requirements = 2 (Table 1)

   b. Acute to chronic ratio = $\sqrt[3]{18 \times 9.1659 \times 2.3801} = 7.3229$

2. Toxicity **is not** dependent on a water characteristic

   FCV = $\frac{101{,}611 \text{ ug/L}}{5.2} \div 7.3229 = 2{,}668 \text{ ug/L} = 2{,}700 \text{ ug/L}$

3. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table _)

   b. Aquatic chronic intercept = (Table _)

   ln of aquatic chronic intercept =

   c. FCV equation =

B. Minimum 8 species requirement **is** met (Tier I)

1. Toxicity **is not** dependent on a water characteristic

   a. FCV = ___ (Att. ___)

2. Toxicity **is** dependent on a water characteristic

   a. Slope = (Table _)

   b. Ranked genus mean chronic intercepts: Table ___

   c. Final chronic intercept = ____ (Att. ___); ln of final chronic intercept =

   d. FCV equation =