Rule 57 Aquatic Values Data Sheet

6/13/08

Chemical or product name: Lithium
Manufacturer (WTAs): -----
C.A.S #: 7439-93-2

Developed by: Christopher Hull
Approved by: D. Bush
Approval date: 6/16/08
CAS, AQUIRE, QSAR: 10/25, 21/04, --
Clearinghouse search date: -----

FAV: 1,800 ug/l* *(Tier: I)*
AMV: 910 ug/l* *(Tier: I)*
FCV: 440 ug/l* *(Tier: II)*
Acute CF: ---- *Chronic CF: ----*

ACUTE DATA

Species	Endpoint (EC or LC50)	Duration (hours)	Test Type (FT,M, etc.)	Hardness mg/L	Test Chemical	LC50/EC50 ug/L	SMAV ug/L	GMAV ug/L	Rank	Reference
Rainbow Trout	EC50	96	S,U	-----	LiCl	2,171	2,171	2,171	1	1
(*Oncorhynchus mykiss*)										
Water Flea	EC50	48	SR,U	182	LiCl	3,945	3,945	3,945	2	2
(*Daphnia magna*)	LC50	64	S,U	-----	LiCl	< 7,200 [1]				3
Amphipod	LC50	96	S,U	-----	LiCl	4,389	4,389	4,389	3	4
(*Hyalella azteca*)										
Fathead Minnow	LC50	96	SR,U	72	LiCl	6,875	6,511	6,511	4	5
(*Pimephales promelas*)	LC50	96	SR,M	100-124 [2]	LiCl	6,167				6
Water Flea	LC50	48	SR,M	100-124 [2]	LiCl	8,727	8,727	8,727	5	6
(*Ceriodaphnia dubia*)										
Snail	LC50	96	S,U	-----	LiCl	11,961	11,961	11,961	6	4
(*Physa integra*)										
Colorado Squawfish	LC50	96	S,U	197	LiCl	16,900	16,900	16,900	7	7
(*Ptychocheilus lucius*)	LC50	96	S,U	197	LiCl	28,000 [3]				7
	LC50	96	S,U	197	LiCl	41,000 [3]				7
Brown Planarian	LC50	96	S,U	84-92 [2]	LiCl	20,380	20,380	20,380	8	8
(*Dugesia tigrina*)										

(Cont'd.)

Bonytail Chub	LC50	96	S,U	197	LiCl	22,000	22,000	22,000	9	7
(*Gila elegans*)	LC50	96	S,U	197	LiCl	62,000 [3]				7
	LC50	96	S,U	197	LiCl	65,000 [3]				7
Razorback Sucker	LC50	96	S,U	197	LiCl	25,000	25,000	25,000	10	7
(*Xyrauchen texanus*)	LC50	96	S,U	197	LiCl	53,000 [3]				7
	LC50	96	S,U	197	LiCl	186,000 [3]				7
Midge (*Chironomous tentans*)	LC50	48	S,U	-----	LiCl	75,863	75,863	75,863	11	4
Bluegill Sunfish (*Lepomis macrochirus*)	LC50	96	S,U	-----	LiCl	214,019	214,019	214,019	12	4

(cont'd.)

CHRONIC DATA

Species	Test type (ELS, etc.)	Duration (days)	Study Conditions (FT,M etc.)	Hardness mg/L	Test Chemical	MATC ug/L	SMCV ug/L	GMCV ug/L	Rank	Reference
Water Flea (*C. dubia*)	LC	6	SR,M	96-132 [2]	LiCl	2,678 [4]	2,678	2,678	1	6
Fathead Minnow (*P. promelas*)	LSG	7	SR,M	96-132 [2]	LICl	5,017 [5]	5,017	5,017	2	6

*Value rounded to 2 significant figures.

[1] Value not used to calculate SMAV because definitive values are preferred, and available.

[2] Lithium increased hardness, so the hardness reported here constitutes the range between the control and highest test concentration values found.

[3] Value not used to calculate SMAV, because values from most sensitive life stages are preferred.

[4] For MATC and ACR calculations, see Table 1.

[5] For MATC and ACR calculations, see Table 2.

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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: Lithium
C.A.S. #: 7439-93-2

AQUATIC MAXIMUM VALUE CALCULATIONS, 6/08

A. ~~Minimum 8 species requirement is **not** met (Tier II). Minimum requirements met = ___~~
~~Minimum requirements missing for Tier I =~~
~~Acute factor = ____~~

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

~~a. FAV calculation~~

~~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: FIG. 1 ; FAV = 1,829.94 ug/l

~~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: $AMV = \frac{FAV}{2} = \frac{1,829.94\ ug/l}{2}$

$= 914.97\ ug/l$

LITHIUM :

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FINAL CHRONIC VALUE CALCULATIONS, 6/08

[FOR TIER II, GMCV ROUTE]

A. Minimum 8 species requirement is not met (Tier II). Minimum requirements met = 2
Minimum requirements missing for Tier I = 6 (i, ii, v, vi, vii, viii) (GMCV Route).
1 (ACR ROUTE).

ACR ROUTE:

1. Acute to chronic ratio

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

b. Acute to chronic ratio = $\bar{X}_g$ (C. dubia ACR (Table 1), FHM ACR (TABLE 2), DEFAULT VALUE)
= $\bar{X}_g$ (3.2593140 ~~0584~~, 1.2292395, 18) = 4.1624121 ~~3033~~.

2. Toxicity is not dependent on a water characteristic

TIER II FCV = $\frac{\text{TIER II FAV}}{\text{TIER II ACR}} = \frac{1{,}829.94\ \mu g/l}{4.1624121}$ = 439.635 µg/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~~

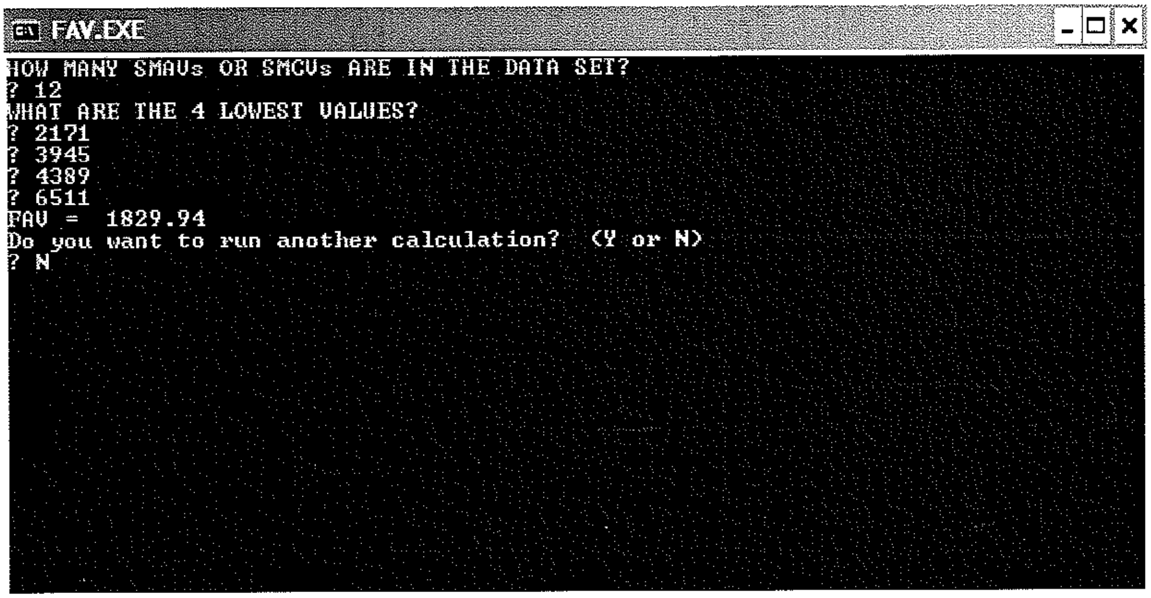
~~a. Slope = (Table __)~~

~~b. Ranked genus mean chronic intercepts: Table ___~~

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

~~d. FCV equation =~~

Figure 1. Lithium Tier I FAV calculation, 6/08.



LITHIUM, 5/05/08

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Table 1. MATC and ACR calculations for *Ceriodaphnia dubia* from Ref. #6.

Acute:

48-hr. LC50 = 8,727.40 ug/l.

Chronic:

6-day Reproduction NOEC = 1,972.86 ug/l; LOEC = 3,634.29 ug/l;

MATC = $\bar{X}_g$ = 2,677.89 ug/l.

$$ACR = \frac{\text{48-hr. LC50}}{\text{6-day Reproduction MATC}} = \frac{8{,}727.40\ \text{ug/l}}{2{,}677.~~89~~ 66\ \text{ug/l}} = 3.259~~0584~~ 3140$$

Table 2. MATC and ACR calculations for Fathead Minnow from Ref. #6

Acute:

96-hr. LC50 (Ref. #5) = 6,167.07 ug/l.

Chronic:

7-day Growth NOEC = 3,634.29 ug/l; LOEC = 6,925.71 ug/l;

MATC = $\bar{X}_g$ = 5,016.98 ug/l.

$$ACR = \frac{\text{96-hr. LC50}}{\text{7-day Growth MATC}} = \frac{6{,}167.07\ \text{ug/l}}{5{,}016.98\ \text{ug/l}} = 1.2292395$$

Attachment 1
Michigan Department of Environmental Quality Aquatic Toxicity Evaluation Laboratory
Dugesia tigrina Lithium Aquatic Toxicity Test
June, 2008

MDEQ Aquatic Toxicology Laboratory *Dugesia tigrina* Lithium Aquatic Toxicity Test

- Test dates: 6/6-10/08
- Test performed by William F. Dimond
- Test Method: SWAS Procedure # 24 with following modifications:
  - 10 animals/concentration
  - 1 animal/replicate
  - 25 ml test solution/replicate
- Chemical source: A.C.S. Reagent grade Lithium chloride hydrate (Sigma-Adrich *****; chemical formula $LiClH_2O$
- Dilution water: Moderately hard reconstituted water (MH) (target hardness 80 mg/l as $CaCO_3$), prepared using reagent grade chemicals (per USEPA EPA-821-R-02-013)
- To prepare initial test concentration, added 1,007 mg chemical to 1 L of MH
- Prepared successive dilutions by diluting initial concentration with MH at 0.6 dilution factor
- Test concentrations are nominal
- Static test
- Source of test organisms: Carolina Biological Supply; ages varied

Copies of raw data and statistical analyses attached.

Author: William F. Dimond 11 June 2008

LC_{50} = 20.38 mg/l Li

* Reagent lot information attached at back.

MDEQ Aquatic Toxicity Laboratory 96-h ASTM E7~~3~~29 Acute Toxicity Test

Test Organism: Dugesia tigrina
Test Chemical: Li as $LiCl \cdot H_2O$
Dilution Water: Reagent-grade MH Recon

Test Start (Date/Time): 6/6/08, 1450
Test End (Date/Time): 6/10/08, 1450

Concentration of Chemical (units): mg/L as Li	Day	Mortality in Replicate (0 = alive, X = Dead) A	B	C	D	E	F	G	H	I	J	Total Dead
0	1	O	—	—	—	—	—	—	—	—	—	
	2	O	—	—	—	—	—	—	—	—	—	
	3	O	—	—	—	—	—	—	—	—	—	
	4	O	—	—	—	—	—	—	—	—	—	
	Σ	O	—	—	—	—	—	—	—	—	—	0
15.00 (~~14~~ BD)	1	O	—	—	—	—	—	—	—	—	—	
	2	O	—	—	—	—	—	—	—	—	—	
	3	O	—	—	—	—	—	—	—	—	—	
	4	O	—	—	—	—	—	—	—	X	O	
	Σ	O	—	—	—	—	—	—	—	X	O	1
24.99	1	O	—	—	—	—	—	—	—	—	—	
	2	O	—	—	—	—	—	—	—	—	—	
	3	X	O	—	X	O	O	O	X	O	O	
	4		O	X		X	X	X		O	X	
	Σ	X	O	X	X	X	X	X	X	O	X	8
41.65	1	O	—	—	—	—	—	—	—	—	—	
	2	O	—	—	—	—	—	—	—	—	—	
	3	X	X	X	O	X	X	O	X	X	X	
	4				X			X				
	Σ	X	X	X	X	X	X	X	X	X	X	10
69.42	1	O	—	—	—	—	—	—	—	—	—	
	2	O	X	O	X	—	—	—	—	—	—	
	3	X		O								
	4			X								
	Σ	X	X	X	X	X	X	X	X	X	X	10
115.7	1	O	—	—	—	—	—	—	—	—	—	
	2	X	—	—	—	—	—	O	O	X	—	
	3							X	X			
	4											
	Σ	X	X	X	X	X	X	X	X	X	X	10

Staff making observation on day: 1	2	3	4
BD	BD	BD	BD

Form Revised 6 11 08

MDEQ ASTM E729 Test Chamber Water Quality

Test Organism: Dugesia tigrina
Test Chemical: Li as $LiCl \cdot H_2O$
Test Dates: 6/6 - 10/08

Test Concentration (units: mg/l Li)	Dissolved Oxygen (mg/l)		
	0h	48h	96h
Control	8.2	8.0	8.0
15.00	8.2	8.0	8.0
41.65 ~~24.99~~	8.2	8.0	8.0
115.7	8.2	8.0	8.0

Test Concentration (units: mg/l Li)	pH (s.u.)		
	0h	48h	96h
Control	8.12	8.10	8.04
15.00	8.13	8.08	8.15
41.65	8.13	8.08	8.15
115.7	8.10	8.08	8.12

	Bench Temperature (°F)			
	24h	48h	72h	96h
Minimum	75	75	75	75
Maximum	80	80	80	80

	0h	24h	48h	72h	96h
Analyst	BD	BD	BD	BD	BD

Control Water Chemical Parameters *		
Alkalinity (mg/l as $CaCO_3$)	76	
Hardness (mg/l as $CaCO_3$)	84	
Conductivity (umhos/cm)	320	@ 25.5°C

Form Revised: 6/11/08

* Parameters at max. test concentration attached at back.

EPA PROBIT ANALYSIS PROGRAM
USED FOR CALCULATING LC/EC VALUES
Version 1.5

Dugesia tigrina Li 6 6 08

Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Proportion Responding Adjusted for Controls
15.0000	10	1	0.1000	0.1000
24.9900	10	8	0.8000	0.8000
41.6500	10	10	1.0000	1.0000
69.4200	10	10	1.0000	1.0000
115.7000	10	10	1.0000	1.0000

Chi - Square for Heterogeneity (calculated) = 0.015
Chi - Square for Heterogeneity
(tabular value at 0.05 level) = 7.815

Dugesia tigrina Li 6 6 08

Estimated LC/EC Values and Confidence Limits

Point	Exposure Conc.	95% Confidence Limits Lower	Upper
LC/EC 1.00	11.744	4.823	15.036
LC/EC 50.00	20.385	16.603	24.858

LC_{50} = 20.38 mg/l Li

From: William Dimond
To: Christopher Hull
Date: 6/11/2008 1:18:52 PM
Subject: Lithium Chloride H20 Identifiers

Sigma/Aldrich Lithium Chloride, A.C.S. Reagent Grade, 310468-100g lot # 09628DE

From: William Dimond
To: Christopher Hull
Date: 6/11/2008 11:45:59 AM
Subject: Lithium Highest Concentration Chemistries

Per your request, I measured wq parameters of the highest test concentration of Lithium in the 6/6-10-08 ATL LiClH20 test (115.7 mg/l Li). I composited the top ½ of each test chamber, and the chemistry cup to obtain sufficient sample volume for the analysis. I avoided pouring visible solids into the composite, but please note the test animals had died on days 1-3, so the animals were entirely decomposed at the time I composited the sample.

The results of the water parameter measurements:
Alkalinity: 104 mg/l as CaCO3
Hardness: 92 mg/l as CaC3
Conductivity: 2,554 umhos/cm @ 25.0 oC

CC: Dennis Bush

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*For abbreviations used, see Appendix, attached.

APPENDIX: REFERENCE ABBREVIATIONS USED, 6/08

AMD = ambient monitoring data.
BCF = bioconcentration factor.
D = data (as a suffix to other abbreviations listed here).
DEP = depuration data.
DO = data only (as a suffix to other abbreviations listed here).
EF = environmental fate.
GWD = groundwater data.
IITM/C = insufficient information on test methods / conditions.
ISD = *in situ* data.
LD = leachate data.
LSER = Linear Solvation Energy Relationship.
MCD = microcosm data.
MIX = mixture (not chemical-specific) test data.
MED = model ecosystem data.
MET = metabolism
MOD = model (theoretical) data / analysis.
NA = not available at this time.
ND = no data (on this chemical).
NIL = not in (MDEQ) Library.
NR = not reviewed.
NUE = no useable endpoint.
O = only (as a suffix to other abbreviations listed here).
PD = phytotoxicity data.
PHYS = physiological data.
QSAR = Quantitative Structure-Activity Relationship.
RWD = receiving water data.
SD = secondary data.
SED = sediment data or testing.
SW = saltwater.
TATO = test animals too old.
TDI = test duration inappropriate.
TM/CU = test methods / conditions unacceptable.
TONNA = test organisms not North American.
TONS = test organisms not suitable.
UD or UP = uptake data.
WET = whole-effluent testing.