Technical Information | **Stepan**

Stepan Company

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ECOTOXICOLOGY OF ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDES (ADBAC)

Applicable to these current Stepan products:

BTC® 50 BTC® 824 BTC® 835 STEPANQUAT® 65 NF	BTC® 65 BTC® 8248 BTC® 8358 STEPANQUAT® 8358	BTC® 776 BTC® 8249 STEPANQUAT® 50 NF BTC® 8358 F

Applicable to these inactive Stepan products:

BTC® 2565 STEPANQUAT® 835	BTC® 2568	BTC® 824 P100

Toxicological Information:

Test/Conditions	Results/Classification	References
Acute Oral Toxicity (Quail)(14 day)	LD_{50}[1] = 164 mg a.i.[2]/kg b.wt. (highly toxic)	Stepan Study No. 93-021A
Acute Aquatic Toxicity (Bluegill sunfish) (96 hr.)	LC_{50}[3] = 0.515 ppm a.i. (highly toxic)	Stepan Study No. 91-029A
Acute Aquatic Toxicity (Rainbow trout) (96 hr.)	LC_{50} = 0.930 ppm a.i. (highly toxic)	Stepan Study No. 91-030A
Acute Aquatic Toxicity (D. magna) (48 hr.)	LC_{50} = 0.0058 ppm - 0.016 mg/l a.i. (extremely toxic)	Stepan Study No. 91-031A, 07-015A
Acute Aquatic Toxicity (Sheepshead minnow) (96 hr.)	LC_{50} = 0.860 ppm a.i. (highly toxic)	Stepan Study No. 92-016A
Acute Aquatic Toxicity (fathead minnow) (96 hr.)	LC_{50} = 0.028 ppm a.i. (highly toxic)	Stepan Study No. 94-015A

Acute Aquatic Toxicity (fathead minnow) (96 hr.) (C 20 mg/l of humic acid)	LC_{50} = 1.4 ppm a.i. (moderately toxic)	Stepan Study No. 92-017A
Acute Aquatic Toxicity (fathead minnow) (96 hr.)	LC_{50} = 1.4 mg/l w/20 mg/l humic acid (moderately toxic)	Stepan Study No. 94-020A
Acute Aquatic Toxicity (Embryo larvae-eastern oyster) (48 hr.)	LC_{50} = 0.055 ppm a.i. (extremely toxic)	Stepan Study No. 92-015A
Acute Aquatic Toxicity (Saltwater mysid) (96 hr.)	LC_{50} = 0.092 ppm a.i. (extremely toxic)	Stepan Study No. 92-017A
Early Life Stage Toxicity (Fathead minnow)(34 day)	NOEC[(4)] =0.032 ppm a.i. (survival) NOEC= 0.273 ppm a.i. (hatching)	Stepan Study No. 92-011A
Chronic Toxicity (21 day)(D. magna)	No effects on survival, growth or reproduction were observed at or less than 0.0042 ppm a.i.	Stepan Study 92-010A
Acute Aquatic Toxicity (algae) (96 hr.)	EC_{50}[(5)] = 0.063 mg a.i./L (cell density) NOAEC[(6)] = 0.035 mg a.i./l	Stepan Study 05-021A
Acute Aquatic Toxicity (plant) (7 days)	EC_{50} = 0.12 mg a.i./L (highly toxic) NOAEC = 0.019 mg a.i./l	Stepan Study 95-020A
Chronic Toxicity (midge) (28 days)	LC_{50} = 479 mg/kg (practically non-toxic) NOAEC = 520 mg/kg	Stepan Study 95-015A

(1) LD = Lethal Dose, (2) a.i.= active ingredient, (3) LC = Lethal Concentration, (4) NOEC = No Observed Effective Concentration, (5) Effective Concentration, (6) No Observed Adverse Effect Concentration

Discussion:
It should be noted that the above studies reflect acute toxicity of quaternary ammonium compounds (QACs) to aquatic organisms conducted in high quality laboratory water using test methods that do not consider the physical and chemical properties of these molecules in surface water; thus representing an unrealistic scenario. An aquatic safety assessment by Lewis and Wee have shown that when the aquatic studies were conducted in river waters toxicity to aquatic organisms was much reduced. For example the 96-hr. and 48 hr. LC_{50} values for bluegill sunfish and Daphnia magna for QACs determined in laboratory high quality waters ranged from 0.62 to 3.0 mg/l and 0.16 to 1.06 mg/l respectively. The acute toxicities of the same compounds for bluegill

sunfish and Daphnia magna in river water ranged from 10 to 24 mg/l and 3.1 mg/l respectively. The 96 hr. LC_{50} value for freshwater alga to these compounds in the laboratory water was 0.23 mg/l. In river water the algistatic concentrating for freshwater alga ranged from 0.71 to greater than 4.0 mg/l. When 20 mg humic acid was added to the test system aquatic toxicity was also mitigated as reflected in the results for fathead minnow (LC 50=0.028 ppm without, and LC50=1.4 mg with the addition of humic acid; as reflected in the Stepan study numbers 94-018A and 94-020A respectively). These results represent a 3 to greater than 17-fold reduction in toxicity compared to results from the tests using high-quality laboratory water. It is known that quaternaries adsorb to suspended solids and have a tendency to form complexes with anionic moieties (both of which are found in much greater concentrations in river waters). It is believed that these properties are responsible for substantially reducing bioavailability and subsequent toxicity of QACs to aquatic organisms in natural surface waters.

References:

*Boethling, R.S., 1984, Environmental Fate and Toxicity in Wastewater Treatment of Quaternary Ammonium Surfactants, Water Res. Vol. 18, No. 9, pp. 1061-1076.

*Cross, J., and Singer, E.J., Editors, 1994. Cationic Surfactants: Analytical and Biological Evaluation, Marcel Dekker, Inc., Vol. 53, pp. 95-135.

*Lewis, M.A., and Wee, V. T., (1983) Aquatic Safety Assessment for Cationic Surfactants, Environmental Toxicology and Chemistry, Vol. 2, pp. 105-118.

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