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WATER QUALITY ADVISORY

DCPA

Criteria and Standards Division

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WATER QUALITY ADVISORY
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Office of Water Regulations and Standards
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The advisory concentration for DCPA in ambient water for the protection of freshwater aquatic life is estimated to be 14.3 mg/L. No saltwater data were reviewed, and no advisory concentration for the protection of saltwater aquatic organisms is estimated. Care should be taken in the application of this advisory, with consideration of its derivation, as stated in the attached support document.

A value given to protect aquatic life can be derived from no observed effect levels (NOEL), the lowest concentration found in the data which has been observed to cause acute or chronic toxicity or other experimental data which may be applicable. When there is no valid experimental evidence, a value may be derived from a model which uses structure-activity relationships (SAR) as its basis. The advisory concentrations should be used with caution, since they are derived from minimal experimental evidence, or in the case of SAR derived values, no data on the specific chemical.

The advisory concentration for DCPA in ambient water for the protection of human health is estimated to be 0.008 ug/L, based on data and information which are available to the U.S. EPA. Care should be taken in the application of this advisory, with consideration of its derivation, as stated in the attached support document.

An advisory concentration can be derived from a number of sources: The Office of Drinking Water Health Effects Advisories; Acceptable Daily Intake(ADI) values from EPA; Office of Pesticides and Toxic Substances risk assessments; Carcinogen Assessment Group (CAG) cancer risk estimates; risk estimates derived from the open literature; or other sources which will be given in the support document. The advi-sory concentrations derived from these sources will vary in confidence and usefulness, based on the amount and quality of data used as well as the assumptions behind the original estimates. The user is advised to read the background information carefully to determine the strengths or deficiencies of the values given in the advisory.

HUMAN HEALTH AND AQUATIC LIFE LITERATURE SEARCH AND DATA BASE EVALUATION FOR DCPA

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER REGULATION AND STANDARDS
CRITERIA AND STANDARDS DIVISION
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TABLE OF CONTENTS

LIST OF TABLES

HUMAN HEALTH AND AQUATIC LIFE LITERATURE SEARCH AND DATA BASE EVALUATION FOR DCPA

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INTRODUCTION

Dimethyl tetrachloroterephthalate (DCPA) is a chlorinated benzoic acid used as a selective pre-emergent herbicide for control of annual grasses, and certain broadleaf weeds (McEwen and Stephenson, 1979; WSSA, 1974). DCPA is used commercially on turf, ornamentals, strawberries, soy and field beans, onions, cabbage, and cotton. The basic producer of DCPA is Diamond Shamrock, U.S.A., and the most frequently encountered common and trade names are Dacthal, DCPA, DAC 893, chlorathal dimethyl, and Fatal. DCPA has an estimated half life of 100 days in most soil types and is either adsorbed to or absorbed by organic matter (WSSA, 1979).

DCPA is an odorless, white crystalline compound with the following physical and chemical properties:

Molecular weight	332
Melting point	156 C
Vapor pressure	<0.01 mm Hg at 40 C
Solubility in water at 25 C	0.5 ppm.

Hexachlorobenzene may be a contaminant of DCPA (8-9 percent). The toxicity of hexachlorobenzene may need to be considered for criteria calculation (Burns et al., 1974).

SCOPE OF SEARCH

Computerized literature searches and printed abstracts of TOXLINE, TOXBACK, NTIS, and the Toxicology Data Base were used as primary

sources for identifying data on aquatic toxicity and human health effects, focusing primarily on laboratory studies of dose-response of aquatic organisms and mammalian species. The quality assurance/ quality control measures used in these studies were evaluated for their use of positive and negative controls, replication, and chemical analysis of test concentrations.

Additionally, the quality of experimental methods was evaluated by comparison to guidelines established by the U.S. EPA in "Guidelines and Methodology Used in Preparation of Health Effect Assessment Chapters of the Consent Decree Water Quality Criteria Documents" (FR 45:79347, November 28, 1980) and the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Life and Their Uses" (Stephan et al., 1985). Data other than dose-response relationships (e.g., metabolic studies and field observations) were also collected to provide ancillary information relevant to aquatic toxicity and human health effects.

SUMMARY OF FINDINGS

Aquatic Toxicity

Few data are available concerning the toxicity of DCPA to aquatic life (Table 1). In general, the herbicide is reported to be of low toxicity to these species tested (WSSA, 1979).

An LC50 (estimated concentration at which 50 percent of the test animals die) of DCPA for Tubifex tubifex, an aquatic oligochaete worm, was reported at 286 ppm, indicating low toxicity (Voronkin and Loshakov, 1973). However, DCPA inhibited the activity of the enzyme succinate dehydrogenase in these worms.

Only one study was found that reported the toxicity of DCPA to fish (>500 ppm); however, neither the species tested nor the original study was cited (WSSA, 1979).

Miller and Gomes (1974) collected five species of fish from the lower Rio Grande River Valley, Texas, and analyzed them for tissue residues of DCPA. The herbicide was used in this region for weed control in onions and cotton. From this study, a bioconcentration factor was estimated for menhaden (Brevoortia tyrannus) by averaging the mean waterborne and fish residue levels of DCPA per month for a 2-year period (Table 1). These data indicate that DCPA concentrates significantly in fish (about 3,000 times the concentration of the surrounding water).

DCPA residues in fish tissues from waters averaging 0.5 ppb DCPA concentration showed maximum concentrations ranging from 132 ppb in testes to 555 ppb in liver (Table 1).

TABLE 1. SUMMARY OF AQUATIC TOXICITY LITERATURE REVIEW OF DCPA

Aquatic Toxicity Test Species	$LC_{50}/LD_{50}/EC_{50}$ (ppm)	Test Duration	Exposure Medium	Quality Assurance Specifications	Miscellaneous Observed Effects	Reference
Tubifex tubifex	LC_{50} 286	48 hrs	water	NR(b)	inhibition of succinate dehydrogenase	Voronkin and Loshakov, 1973 (Abstract)
Fish	--	--	--	NR	no toxicity at 500 ppm	WSSA, 1979
Menhaden (Brevoortia tyrannus)	--	--	Collected from two streams in the lower Rio Grande Valley, Texas. This region was exposed to DCPA for weed control of onions and cotton.	Residue analysis with GLC	Menhaden concentrated DCPA at 3,000 times waterborne levels (water = 0.5 ppb; fish residue = 1.59 ppm)	Miller and Gomes, 1974
Speckled sea trout (Cynoscion nebulosus)	--	--				Miller and Gomes, 1974
Mullet (Mugil sp.)	--	--			Tissue levels (ppb) for all species	Miller and Gomes, 1974
Rio Grande perch (Chiclasoma cyanoguttatum)	--	--			Liver 18-555; Ovaries 107-420; Testes 132	Miller and Gomes, 1974
Red drum (Sciaenops ocellata)	--	--			Flesh 159-217; Viscera 231	Miller and Gomes, 1974

(a) LC_{50} = Lethal concentration for 50 percent of test organisms

(b) NR = Not reported in source

TABLE 2. SUMMARY OF HEALTH EFFECTS LITERATURE REVIEW OF DCPA

Test Species	Exposure level	Test Duration	Rate and Exposure Medium	Quality Assurance Specifications	Miscellaneous Observed Effects	Reference
Rats	LD_{50} 3000 mg/kg		oral	NR(a)		NIOSH, 1982
Mice	LD_{50} 320 mg/kg		intraperitoneal	NR		
Mice		NR		NR	1000 mg/kg caused an increase in the number of metaphases with multiple aberrations in bone marrow cells	Kurinnyi et al., 1982
Rabbits	LD_{50} 10,000 mg/kg		percutaneous	NR		NIOSH, 1982
Dogs Rabbits	NOEL(b) 10,000 ppm	2 years	oral in diet	NR		WSSA, 1979
Humans	Probable oral lethal dose 500-5,000 mg/kg			NR		CTCP, 1976

(a) NR = Not reported in source

(b) NOEL = No-observed effect level

Health Effects

The toxicity of DCPA to mammals appears to be relatively low, with LD50 (estimated dosage at which 50 percent mortality occurs) values ranging from 320 mg/kg for mice to 3,000 mg/kg for rats (Table 2). Additionally, a no-observed-effect level (NOEL) of 10,000 ppm in diet was found for dogs and rabbits fed DCPA for a 2-year period. A probable oral lethal dose of 500-5,000 mg/kg was reported for humans (CTCP, 1976). Cytogenetic toxicity of DCPA is indicated by an increase in the number of metaphase stages with multiple aberrations in bone marrow cells of mice (Kurinnyi et al., 1982). All literature sources from which health effects data were collected either cited results from other studies (WSSA, 1979) or did not document methods adequately (Kurinnyi et al., 1982). Thus, these data were difficult to evaluate with respect to quality assurance, quality control, and other parameters.

DCPA exposures may have public health significance because hexachlorobenzene (HCB) has been found to be an important contaminant of DCPA. One study has found that HCB increased the incidence of hepatomas and hemangioendotheliomas in golden hamsters and mice fed 50 to 200 ppm HCB in diet for durations between 80 weeks to the entire life span of the animals (Cabral et al., 1977 and 1978). A study of residues in workers exposed to DCPA detected no levels of DCPA in blood, whereas concentrations of HCB averaged 40 ppb in blood, with a maximum level of 310 ppb (Burns et al., 1974). Although no adverse effects were detected in these workers, HCB may be carcinogenic (Cabral et al., 1977 and 1978).

CRITERIA EVALUATION AND RECOMMENDATIONS

No water-quality criterion for DCPA was found in the literature search or in various water quality criteria documents. The lack of adequate data makes recommendation of criteria difficult. No verifiable toxicity data were found for aquatic organisms although there is an indication (see Table 1) that levels as high as 500 ppm DCPA are not toxic to fish. Furthermore, the formulas stipulated by the guidelines (Stephan et al., 1985) are not operable because of the lack of data.

However, because fish can concentrate DCPA at waterborne levels of 0.5 ppb, bioaccumulation of DCPA in aquatic organisms may pose a health risk to humans who consume these animals from areas where the herbicide is used regularly (Miller and Gomes, 1974). Consumption of fish with these levels may result in exposure to elevated levels of DCPA although the toxicity to humans of DCPA may be quite low (500-5,000 mg/kg).

The potential for cytogenetic toxicity (mutagenesis) of DCPA has been implied (Kurinnyi et al., 1982); however, the methods of these determinations and the significance of these results for human health was not reported. Furthermore, no appropriate data were found concerning carcinogenicity or long-term effects for mammals. The absence of appropriate chronic parameters (i.e., NOAEL, LOEL, LOAEL) does not allow calculation of a water quality criterion for human health.

Potential carcinogenicity of hexachlorbenzene (HCB), a contaminant of DCPA, has been reported for hamsters and mice at levels of 50 ppm during long exposures (Cabral et al., 1977 and 1978). Because HCB comprised 8-9 percent of DCPA used for weed control in Texas during the early 1970's (Burns et al., 1974), it may be an important contaminant of DCPA for human health. The U.S. EPA (1980) has established a recommended criteria for HCB of 0.72 ng/L based on a cancer risk of 10^{-6} for a lifetime exposure. This should be taken into account if HCB contamination is suspected.

In summary, no adequate data were found for any aquatic species (Table 3) nor were any found for adequately assessing human health effects (Table 4). Given the minimal data base, it is suggested that the advisory be based on the LC50 concentrations found in the aquatic data, that of 286 ppm for Tubifex tubifex. The advisory concentration would be calculated by dividing this value by 2, to approximate an LC1, then by 10 to estimate a possible chronic value. This would mean a maximum allowable concentration of 14.3 mg/L to protect aquatic life.

A value designed to protect human health should take into account the bioconcentration factor, and potential contamination by HCB. If HCB is assumed to comprise 9% of DCPA by weight, assuming consumption of contaminated organisms and water, then, the maximum concentration which would not exceed the 10^{-6} risk level is 8 ng/L. This value, derived from the AWQ Criteria Document for Chlorinated Benzenes (U.S. EPA, 1980) takes into account a bioconcentration potential for HCB of 8,690.

TABLE 3. DATA REQUIREMENTS FOR CALCULATION OF AQUATIC LIFE INTERIM CRITERIA--DCPA

Criterion Requirements Aquatic Toxicity	Available Data	Data Acceptability
Acute Test Results from tests on:		
A salmonid (class Osteichthyes)	NO	--
A warm water species commercially or recreationally important (class Osteichthyes)	NO	--
Another family in the phylum Cordata (fish, amphibian, etc.)	NO	--
A planktonic crustacean (cladoceran, copepod, etc.)	NO	--
Benthic crustacean (ostracod, isopod, scud, crayfish, etc.)	NO	--
Insect (mayfly, dragonfly, damselfly, stonefly, mosquito, etc.)	NO	--
Phylum other than Arthropoda/ Chordata (Rotifera, Annelida, Mollusca)	YES	NO; QA/QC not reported
Another family of insect	NO	--
Acute-chronic ratios with species from three different families:		
One fish	NO	--
One invertebrate	NO	--
Acutely sensitive freshwater animal species	NO	--
Acceptable test results from a test with:		
Freshwater algae	NO	--
A vascular plant	NO	--
Bioaccumulation factor with a freshwater species (if a maximum permissible tissue concentration is available)	YES	NO; not a freshwater species

TABLE 4. DATA REQUIREMENTS FOR CALCULATION OF HUMAN INTERIM CRITERIA--DCPA

Criterion Requirements Human Health Effects	Available Data	Data Acceptability
Non-Threshold:		
Carcinogen	NO	--
Tumor incidence tests (Incidence of tumor formation significantly more than the control for at least one dose level, or	N/A	--
Data set which gives estimate of carcinogenetic risk, or	N/A	--
Lifetime average exposure tests, or	N/A	--
Human epidemiology studies (if available, not required)	N/A	--
Threshold:		
Non-carcinogens	YES*	--*
No observed adverse effect level (at least 90-day), or	NO	--
Lowest observed effect level	NO	--
Lowest observed adverse effect level	NO	--
Acceptable Daily Intake:		
Daily water consumption	YES	YES (EPA assumption)
Daily fish consumption	YES	YES (EPA assumption)
Bioconcentration factor	NO	--
Non-fish dietary intake	YES	YES (EPA assumption)
Daily intake by inhalation	NO	--
Threshold Limit Value: (Based on 8-hour time-weighted average concentrations in air)	NO	--
Inhalation Studies:		
Available pharmacokinetic data	NO	--
Measurements of absorption efficiency	NO	--
Comparative excretion data	NO	--

N/A = Not Applicable
* NOEL available (not acceptable data)

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