

95-e05

DEPARTMENT OF ECOLOGY

March 8, 1995

TO: Steve Saunders, WQ
FROM: Art Johnson, EILS ^{aq.}
SUBJECT: Toxicity and Persistence of Acrolein

Summary

Newer data indicate the EPA water quality criteria for acrolein of 68 ug/L acute and 21 ug/L chronic are not protective of aquatic life. EPA guidelines were used to calculate a Criterion Maximum Concentration of 3 ug/L from more recent data. Conclusions of an industry-sponsored study of acrolein applications to Washington state irrigation canals that treated waters can be safely released after 48 hours do not appear supportable.

Literature Search

At your request, I conducted a literature search on the aquatic toxicity and persistence of the biocide acrolein. The search focused on information published since EPA issued "Ambient Water Quality Criteria for Acrolein" (1980).

The following information sources were searched with the help of Barbara Calquhoun and Linda Thompson of HQ library:

- Current Contents
- Water Resources Abstracts
- Toxnet
- EPA On-line Catalog
- Uncover
- Hazardous Substances Data Base
- Aquire

Four noteworthy environmental reviews on acrolein were found:

- Health and Environmental Effects Profile for Acrolein (EPA, 1985)
- Health Effects Assessment for Acrolein (EPA, 1987)
- Toxicological Profile for Acrolein (USPHS, 1990)
- Environmental Health Criteria 127: Acrolein (WHO, 1992)

Pertinent information obtained from these and other references is summarized below.

Toxicity

The EPA aquatic life criteria for acrolein are 68 ug/L acute and 21 ug/L chronic. These values were based on very limited data published on or before 1978. Acute toxicity data was limited to two values for *Daphnia magna*, and three values for two fish species of the same family, bluegill and largemouth bass. The chronic criterion was based on a similar amount of data. EPA concluded there was little difference between the acute and chronic toxicity of acrolein.

Table 1 summarizes more recent toxicity data found in the literature. The newer data indicate acrolein is acutely toxic to a variety of aquatic organisms, including local species or genera, at concentrations of 7 - 93 ug/L.

Table 1. Acute Toxicity of Acrolein to Freshwater Organisms [Data published since 1978]

<u>Species</u>	<u>Method</u>	<u>Duration</u>	<u>Concentration (ug/L)</u>	<u>Effect</u>	<u>Reference</u>
Tadpole, <i>Xenopus laevis</i>	FT	96 hours	7	LC50	Holcombe et al., 1987
White sucker, <i>Catostomus commersoni</i>	FT	96 hours	14	LC50	Holcombe et al., 1987
Fathead minnow, <i>Pimephales promelas</i>	FT	96 hours	14	LC50	Holcombe et al., 1987
Rainbow trout, <i>Oncorhynchus mykiss</i>	FT	96 hours	16	LC50	Holcombe et al., 1987
Bluegill, <i>Lepomis macrochirus</i>	FT	96 hours	33	LC50	Holcombe et al., 1987
Bluegill, <i>Lepomis macrochirus</i>	ST	96 hours	90	LC50	Buccafusco et al., 1981
Coho salmon, <i>Oncorhynchus kisutch</i>	ST	96 hours	68	LC50	Lorz et al., 1979
Cladoceran, <i>Daphnia magna</i>	FT	48 hours	51	LC50	Holcombe et al., 1987
Cladoceran, <i>Daphnia magna</i>	ST	48 hours	83	LC50	LeBlanc, 1980
Cladoceran, <i>Daphnia magna</i>	ST	48 hours	93	EC50 (immobilized)	Randall & Knopp, 1980
Midge, <i>Tanytarsus dissimilis</i>	FT	48 hours	>151	LC50	Holcombe et al., 1987
Snail, <i>Aplexa hypnorum</i>	FT	96 hours	>151	LC50	Holcombe et al., 1987

FT = flow through
ST = static

The Holcombe et al (1987) study, conducted at the EPA Duluth laboratory, was specifically designed to obtain data on acrolein and twelve other chemicals that met requirements for deriving numerical national water quality criteria (Stephan et al., 1985). The Holcombe data fall short of meeting all requirements for acrolein by not having tested its effect on a benthic crustacean.

I used the Holcombe LC50's to calculate an acute criterion for acrolein, following the EPA guidelines in Stephan, and obtained a Criterion Maximum Concentration (CMC) of 3 ug/L, an order of magnitude lower than either of the EPA 1980 criteria. Stephen concluded that "aquatic organisms and their uses should not be affected unacceptably if the one-hour average concentration does not exceed the CMC more than once every three years on the average."

These results indicate that the present EPA criteria for acrolein are not protective of aquatic life and are a poor basis on which to judge the environmental impact of acrolein releases to state waters.

Persistence

No new information was found that would alter previously held conclusions that acrolein is both non-persistent and non-bioaccumulative. A report was found of one study that did extensive monitoring of acrolein (Magnacide H) applications to Washington state irrigation canals (Baker Performance Chemicals, 1986).

The primary objective of the Baker Performance Chemicals (BPC) study was to demonstrate the safety of reducing the six-day holding restriction for treated water before release. BPC monitored acrolein concentrations in the field using differential pulse polarography and achieved a detection limit of 20 ug/L (the BPC report shows a value of zero for non-detects). The following acrolein lifetimes were measured:

- 39.0 hours - East Low Canal, East Columbia Irrigation District
- 34.5 hours - Potholes Canal, South Columbia Basin Irrigation District
- 45.5 hours - Roza Main Canal, Roza Irrigation District
- 27.0 hours - Town Ditch Canal, Ellensburg Water Company

BPC concluded that a 48-hour holding time was adequate.

Although this study appeared to be well done, when viewed in light of the newer toxicity information and taking into account that toxicity occurs well below the study's method detection limit, the conclusion that treated waters can be released after 48 hours is not supportable.

References

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