



## *Project Summary*

# Cadmium and Endrin Toxicity to Fish in Waters Containing Mineral Fibers

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Taconite tailings and their component asbestiform minerals in Lake Superior water had no demonstrable effect on the chronic toxicity of cadmium to the flagfish *Jordanella floridae*. Maximum acceptable toxicant concentrations determined in life cycle tests, where effects on survival, growth, reproduction, and bioconcentration were used as endpoints, were between 3.3 to 7.4, 3.0 to 6.5, and 3.4 to 7.3  $\mu\text{g}$  cadmium/L at 0.004, 0.008, and 0.95 mg/L taconite tailings concentrations, respectively. Similarly, in two tests (A and B) exposing recently hatched fathead minnows, *Pimephales promelas*, for 45 days to several concentrations of endrin, taconite tailings had no observable effect on survival, growth and bioconcentration. No observable effect concentrations (NOEC(s)) for endrin at 0.02 mg/L taconite tailings concentration were between 0.30 and 0.60  $\mu\text{g}$ /L for group A fish and 0.15  $\mu\text{g}$ /L for group B fish. At 0.05 mg/L taconite tailings concentration, the NOEC(s) were between 0.30 and 0.60  $\mu\text{g}$ /L for group A fish and 0.15 and 0.30  $\mu\text{g}$ /L for group B fish. At the 0.95 mg/L taconite tailings concentration the NOEC(s) were between 0.15 and 0.30  $\mu\text{g}$ /L for group A fish and 0.30 and 60  $\mu\text{g}$ /L for group B fish.

*This Project Summary was developed by EPA's Environmental*

*Research Laboratory, Duluth, MN, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).*

### Introduction

Lake Superior is the source of the experimental water supply at the Environmental Research Laboratory (ERL) of the U.S. Environmental Protection Agency located at Duluth, Minnesota. The suspended solids content of this water varies with climatological conditions. It contains diatom fragments, organic debris, quartz particles, some clay minerals and amphibole particles, ranging from blocky cleavage fragments to asbestiform fibers. The source of these amphibole particles has been traced to the Reserve Mining Company effluent to the lake at Silver Bay, Minnesota. These materials are known as taconite tailings.

The amphiboles are hydrated silicates which include the commercially important asbestos minerals: amosite, crocidolite, anthophyllite, tremolite, and actinolite. The predominant amphibole present in the tailings fraction of the suspended solids is cummingtonite-grunerite  $[(\text{Mg}, \text{Fe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2]$  with smaller amounts of tremolite-actinolite and hornblende present. Commercial amosite is an asbestiform cummingtonite-grunerite amphibole and is

nondistinguishable by present methods of identification from many of the asbestiform mineral fibers found in the tailings fraction of suspended solids in the lake water.

In general, little is known about the long-term effects of suspended fine particles, or, more specifically, the asbestiform amphibole minerals in the aquatic environment. It is not known how fine particles, such as those present in the tailings, influence the long-term toxicity of a substance to fish, yet such information is important in establishing meaningful water quality criteria

Daily analysis of amphibole (taconite tailings) and suspended solids concentrations in the Duluth water supply were begun in 1973 at the ERL-Duluth. Duluth's water intake is located approximately 4 km up-current from the intake of ERL-Duluth's experimental water supply and is similar in design and placement in the lake. Intermittent comparative measurements have indicated that the taconite tailings content of these water supplies were similar, even though at times suspended solid concentrations varied considerably. The taconite tailings concentration of the municipal water supply, measured daily from March 1973 to January 1974, was used as a guide in planning this study. The average tailings concentration during

this period was 0.19 mg/L and ranged from 0.04 to 0.8 mg/L; the total suspended solid concentrations averaged 0.83 mg/L.

The purpose of this study was to determine if the presence of the taconite tailings in Lake Superior water significantly alters the toxicity of an inorganic (cadmium) and organic (endrin) compound in fish.

### Conclusions

The flagfish *Jordanella floridae* was exposed to several concentrations of cadmium throughout a life cycle and effects on survival, growth, reproduction, and bioconcentration were used to determine maximum acceptable toxicant concentrations (MATC) at three taconite tailings concentrations. It was concluded that

mean taconite tailing concentrations ranging from 0.004 to 0.95 mg/L had no demonstrable effect on the chronic toxicity of cadmium to flagfish based on MATC analysis. Similarly, in tests exposing recently hatched fathead minnows for 45 days to endrin, taconite tailings concentrations ranging from 0.02 to 0.93 mg/L had no demonstrable effect on endrin toxicity. There was also no effect of taconite tailings on the bioconcentration of cadmium or endrin by the fish studied.

Information gained from these toxicity tests in regard to direct effects of taconite tailings was inconclusive. Taconite tailings at concentrations tested did not demonstrably alter the effect threshold concentrations for cadmium and endrin as determined by previous experience in this laboratory.

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*The complete report, entitled "Cadmium and Endrin Toxicity to Fish in Waters Containing Mineral Fibers," (Order No. PB 82-225 038; Cost: \$7.50, subject to change) will be available only from:*

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