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Project Summary

Effects on Toxicity of Volatile Priority Pollutants Added to a Conventional Wastewater Treatment System

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Static acute, unaerated, toxicity tests using fathead minnows and *Daphnia magna* and a bacterial toxicity assay, Microtox™, were conducted on samples of influent and effluent from two conventional activated sludge pilot wastewater treatment systems. The two pilot treatment systems (A and B) were constructed and operated in an identical manner except that a mixture of 16 volatile priority pollutants was continuously added to the influent of the experimental, B system. The common, unspiked influent for both systems was a mixed industrial and domestic wastewater. The volatile priority pollutants were added to system B to obtain a nominal concentration of 50 μg/l each. The toxicity tests were performed on the influent, primary effluent, and secondary effluent samples to determine the acute toxicity of the various samples and to compare the reduction in toxicity across the two treatment systems. The results of these tests indicated that there was no difference in toxicity reduction between the two pilot treatment systems at the level of pollutants added. Toxicity for pairs of similar samples, influent A and B, primary effluent A and B, and secondary effluent A and B, was essentially the same. Even the influent samples, where the highest concentration of pollutants would be expected in the B samples, were not different.

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

Static acute, unaerated, toxicity tests using fathead minnows, *Pimephales promelas,* and an invertebrate, *Daphnia magna,* and a bacterial toxicity assay, Microtox™* (Beckman Instruments, Inc.) were conducted on influents and effluents from two conventional activated sludge pilot wastewater treatment systems. The treatment systems were identical except that a mixture of 16 volatile organic priority pollutants, at a concentration of 50 μg/l each , was continuously added to one of the systems. A concentration of 50μg/l each was chosen because it was measurable and was at the high end of concentrations of pollutants typically found in municipal treatment plant influents. The toxicity testing was conducted by staff of the Environmental Research Laboratory-Duluth/Newtown (ERL-D/N) as part of a joint research project with staff of the Municipal Environmental Research Laboratory-Cincinnati (MERL). The pilot treatment systems were designed, constructed and operated by MERL staff at the U.S. Environmental Protection Agency's Test and Evaluation Facility (T&E Facility) Cincinnati, Ohio.

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Objectives

The volatile organic priority pollutant study was one of a series of MERL projects designed to determine the capacity of conventional waste treatment systems to treat or remove "priority pollutants." The primary objective of the toxicity testing was to biologically determine toxicity and toxicity removal across the treatment systems. The biological data were then to be used to supplement MERL's chemical and physical evaluation of the treatment systems.

Approach

Two series of toxicity tests were conducted on weekly grab samples of influent and effluents. Only fathead minnow 96-hr and *Daphnia* 48-hr unaerated static tests were conducted on influent and secondary effluent during the first test series, June 1 through July 27, 1981. Fathead minnow and *Daphnia* acute tests, along with Microtox™, bacterial assays, were conducted on influent, primary effluent, and secondary effluent in the second series of tests, August 11 through September 14, 1981.

Results

Although test procedures for the two series of tests were somewhat different and test conditions varied slightly, the results of the testing were similar.

Influent samples for both series of tests with the fathead minnows and the *Daphnia* were moderately toxic. In the first series of tests, fathead minnow LC50 values for system A influent ranged from 9.7 to >50% and for system B influent ranged from 9.7 to >50%. *Daphnia* EC50 values for system A influent ranged from 5.3 to >50% and for system B influent from 8.6 to 46.2%. In the second series of tests, fathead minnow LC50 values for system A influent ranged from 20.9 to 50.8% and for system B influent ranged from 20.9 to >50%. *Daphnia* EC50 values for system A influent ranged from 15.9 to 66.3% and for system B influent ranged from 14.2 to >50%. Microtox values for the influent, available only for the second series of tests, were lower than fathead minnow and *Daphnia* test values. For system A, Microtox EC50 values ranged from<6.3 to 15.7% and for system B from 6.3 to 11.7%.

Results for the primary effluent samples were available only for the second series of tests. Fathead minnow LC50 values for system A ranged from 23.6 to >50% and for system B ranged from 20.9 to >50%. *Daphnia* EC50 values for system A ranged from 22.9 to 72.6% and for system B ranged from 21.7 to 62.1%. Microtox values were again lower than fathead minnow and *Daphnia* test values and for system A ranged from <6.3 to 13.9% and for system B ranged from <6.3 to 20.5%.

For all the fathead minnow and *Daphnia* tests for secondary effluent, LC50 and EC50 values were >100% effluent for both A and B systems. All Microtox EC50 values were >50% which was the highest concentration tested in the early part of the second test series. For the last three tests, in which a 100% effluent was tested, there was no effect.

It should be noted that in only 3 of more than 70 comparisons of similar samples taken from system A and B did the 95% confidence limits of the LC50 or EC50 values not overlap. Also, in only 8 of more than 60 comparisons of test values for fathead minnow and *Daphnia* for the same samples did the 95% confidence limits for the two species not overlap. Further, in only one *Daphnia* test comparison and one Microtox comparison were the influent and primary effluent samples taken the same week different.

Discussion

The results of the toxicity tests indicate that there was no difference in toxicity reduction between the control and the experimental system at the level of volatile organic priority pollutants added. The systems were essentially duplicates. There was no difference in toxicity, with a few exceptions, between similar samples taken at the same time from the two treatment systems. This was true even of the influent samples, where the concentration of the priority pollutants was highest in system B. The data also indicate, with a few exceptions, that there was no reduction in toxicity between samples of influent and primary effluent. There was, however, a significant reduction in toxicity between influent and secondary effluent and between primary and secondary effluent.

In terms of relative sensitivity of the test systems or organisms, the fathead minnow 96-hr and *Daphnia* 48-hr tests gave similar values for toxicity for comparable samples. The Microtox™ 15-min assay consistently gave lower EC50 values than the other tests for the influent and primary effluent. This apparent greater sensitivity may result from a greater sensitivity of the Microtox™ assay, a sublethal test, or it may have been caused by the use of the Microtox Reagent Diluent, the standard diluent for the Microtox test, rather than the dilution water used for the other tests.

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The complete report, entitled "Effects on Toxicity of Volatile Priority Pollutants Added to a Conventional Wastewater Treatment System," (Order No. PB 83-259 721; Cost: $7.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
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