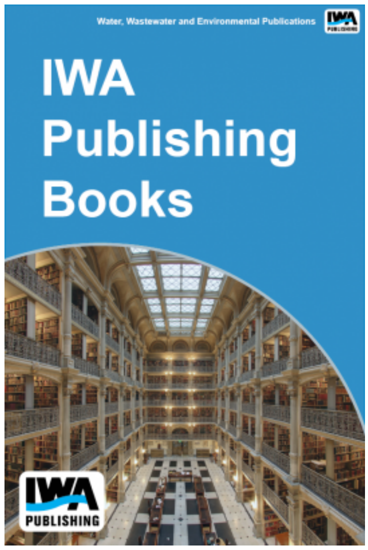
Research Digest: Toxicity Screening of Influents Using Bioluminescent Reporter Technology



Influent toxicity can be a critical problem for publicly owned treatment works that use the activated sludge process as part of their treatment regime. In this project, the researchers developed two protocols for the screening of wastewater treatment plant influent for toxicity. Both protocols are based on a genetically engineered bioluminescent bacterium designated Shk1.

Scientists at the University of Tennessee's Center for Environmental Biotechnology constructed Shk1 from a host Pseudomonas strain isolated from an industrial wastewater treatment plant (WWTP). The first of the two Shk1-based assays that were developed utilizes a batch-wise sampling technique for analyzing grab-samples from industrial effluent, WWTP influent, and the various operations in an activated sludge WWTP (aeration basin, clarifier, etc.). The second method utilizes a continuous sampling technique and is designed for continuous monitoring of the wastewater treatment plant influent upstream of the activated sludge process. The researchers used the batch Shk1 assay to test the influent, activated sludge, and clarifier supernatant in a bench-scale wastewater treatment plant subjected to shock loads of metals (zinc, copper, nickel, and cadmium) for toxicity. They compared data on the repression of bioluminescence to activated sludge respirometry and conventional measures of plant performance (effluent ammonia and chemical oxygen demand, COD).

During the time of the field study, no significant event occurred during which the operation of the plant was seriously impaired. Therefore, the researchers compared the Shk1 signal to the operations data provided by the plant personnel to determine if any correlation existed between the signal from Shk1 and minor fluctuations in the operations data. They found no simple quantitative relationship between the signal from the toxicity monitoring system and the plant performance data. They applied principal component and factor analysis to the Shk1data and 20 additional plant variables. The results of these analyses showed that 10 principal components were needed to account for 90% of the variability of the data and that the signal from Shk1 was therefore not sufficient to predict the system state in the absence of a major toxic event without knowledge of the values of other operating variables. In summary, these analyses indicated that the Shk1 signal would be a valuable addition to models to predict the future system state from the influent, operating, and effluent variables but it is not a sufficient variable by itself.

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