Use of Monitoring Data for Detection Limit Determination- Practical Suggestions for the Limit of Detection Dilemma

William C. Sonzogni[1] and Michael E. Zorn[2]

[1] Environmental Chemistry and Technology Program and Environmental Health Laboratory (Wisconsin Laboratory of Hygiene), University of Wisconsin-Madison, 660 N. Park St., Madison, WI 53706, USA
[2] Chemistry Program, Department of Natural and Applied Sciences, University of Wisconsin- Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, USA

Biographical Sketch of Authors

William Sonzogni is a professor of Environmental Chemistry and Technology (formerly Water Chemistry) within the Department of Civil and Environmental Engineering. He also directs the Environmental Health Laboratory, an environmental testing laboratory that is part of Wisconsin's public health laboratory system. Michael Zorn, a recent graduate of the Environmental Chemistry and Technology Program, is now an assistant professor of chemistry in the Department of Natural and Applied Sciences at the University of Wisconsin- Green Bay. The authors have worked together for a number of years on detection limit issues, including means to measure lower concentrations of analytes in environmental samples. As part of this work they have helped develop statistically rigorous techniques to calculate detection limits, and they discuss in this paper how those techniques can be practically applied to monitoring data.

Abstract

Because many environmental monitoring studies involve measurements near analytical detection limits, the limit of detection has become an extremely important statistic. Limits of detection are most commonly calculated based on variability in analyte response at a single spiked concentration. However, more statistically rigorous approaches to calculating detection limits use replicates spiked at a series of concentrations (i.e., calibration-based methods). Unfortunately, these multiple spiking concentration methods require a substantial laboratory effort and may not be practical for routine application, especially if frequent recalculation is necessary. An option for reducing the labor requirement is to use routinely generated monitoring data, and the quality control (QC) data associated with them (e.g., matrix spikes, calibration samples and calibration verification samples), in the statistical calculations. For example, in the analysis of arsenic by atomic absorption, laboratory-fortified QC data, gathered from long term monitoring, could be used to apply the more statistically rigorous method without a substantial increase in laboratory effort. With advanced planning, QC samples could be fortified at different concentrations providing multiple concentration data. An added advantage of using extant monitoring data generated over a period of time is that day-to-day variability is incorporated into the detection limit determination.