



Project Summary

Superfund Innovative Technology Evaluation Demonstration Plan for Westinghouse Bio-Analytic Systems Pentachlorophenol Immunoassays

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This report has been prepared under the Superfund Innovative Technology Evaluation (SITE) Program and provides a detailed description of the SITE demonstration of the Westinghouse Bio-Analytic Systems (WBAS) immunoassay technologies specific to the analysis of pentachlorophenol. The immunoassays measure parts per billion concentrations of pentachlorophenol in environmental water samples.

The primary objective of this demonstration is to evaluate on site a semiquantitative immunoassay field kit for its utility as a rapid field screening tool. This demonstration plan provides the protocols required to obtain the information needed for the evaluation. Each aspect of the evaluation is described, including test site description, logistical and equipment considerations, sample collection, quality assurance, and data analysis.

This plan is submitted in partial fulfillment of contract number 68-03-3249 and contract number 68-CO-0049 by Lockheed Engineering & Sciences Company under the sponsorship of the U.S. Environmental Protection Agency.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Las Vegas, NV, 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

Two immunoassays will be tested in this evaluation, one formatted as a field kit and the other as a plate immunoassay. The field kit will be compared to a quantitative high-sample-capacity plate immunoassay developed by WBAS that was previously evaluated at the U.S. Environmental Protection Agency (EPA), Environmental Monitoring Systems Laboratory, Las Vegas, NV (EMSL-LV). Both of these immunoassay techniques will be compared to results from a standard EPA gas chromatography/mass spectrometry method for the analyses of pentachlorophenol in water. The demonstration will be conducted at the MacGillis & Gibbs Superfund Site in New Brighton, MN. This is a National Priorities List site known to have ground water contaminated with pentachlorophenol. The immunoassay demonstration will be performed in tandem with a separate SITE demonstration of a bioremediation technology (a bioreactor developed by BioTrol, Inc., Chaska, MN) that is designed to biodegrade pentachlorophenol in water.

Description of Immunoassay Technology

Immunoassays are based on receptor molecules called antibodies which are developed in response to a particular target analyte. Quantification of the extent of contamination in an environmental sample is based on the ability of a specific antibody to bind to its target analyte. Immunoassays are normally based on competi-



tion for antibody binding between a known amount of analyte labeled with an indicator, such as an enzyme, and an unknown amount of analyte from a sample. The indicator produces a colored product that is used for quantitation. Color intensity is determined by the amount of analyte present. Immunoassays can be configured for quantitative, semiquantitative, or qualitative analyses.

The field kit methodology requires about 30 minutes to perform and has a detection limit of about 3 ppb. It has a linear dynamic range from about 3 to 40 ppb and uses no more than 2 mL of sample to obtain analytical results. The kit immunoassay employs a portable spectrophotometer for standard curve generation and quantitation of pentachlorophenol concentrations and it requires a clean, sheltered work area (e.g., out of the wind and direct sunlight).

The quantitative (i.e., plate) immunoassay is based on a 96-well microtiter plate format. The minimum detectable level of pentachlorophenol is approximately 30 ppb; however, when the required sample dilutions are considered, the minimum detection level is 90 ppb, based on an 18-

mL sample. The method has a linear dynamic range of 30 to 400 ppb. Several 96-well microtiter plates can be processed in tandem. Thus, hundreds of samples can be analyzed during the 2.5-hour analysis time required for this method. The plate immunoassay also can be performed under field conditions in a mobile laboratory. However, for this demonstration, only the field kit will be evaluated under field conditions because this methodology is particularly suited for use by field personnel who may have limited analytical chemistry experience.

Sampling and Analysis Designs

The sample collection, sample analysis, and data analysis strategies presented in this plan are designed to address the critical issues related to assessing the general and practical applications of immunoassay technology in the measurement and monitoring aspects of the Superfund Program. Results obtained from on site sample analysis using the field kit immunoassay will be compared to results obtained by analyzing splits of the same samples by a more conventional analytical method. For this comparison, EPA

Method 8270, a gas chromatography/mass spectrometry method for semivolatile organics will be used to analyze for pentachlorophenol. Split field samples will also be analyzed off site by both immunoassay techniques (field kit and plate) at EMSL-LV and WBAS laboratories. A detailed quality assurance plan for this demonstration is provided in an appendix.

Data Analysis and Management

The demonstration plan includes detailed standard operating procedures for sample analysis and data management. The quality assurance plan is designed to ensure that important data quality and methodological performance criteria are examined. A series of performance evaluation (audit) samples, as well as blank and replicate samples, are incorporated in the analytical scheme to assess the within-method performance parameters of the immunoassay and to perform between-method comparisons. The data management system is tailored to the sample analysis and quality assurance programs to provide a timely means of performing the data analysis. Data management will also provide a mechanism for documenting and tracking the data generated from the different analysis sites and by the various methods.

Health and Safety

Pentachlorophenol is considered a toxic substance and a suspected carcinogen. The plan addresses health and safety aspects associated with handling and disposing of materials contaminated with pentachlorophenol.

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The complete report, entitled "Superfund Innovative Technology Evaluation Demonstration Plan for Westinghouse Bio-Analytic Systems Pentachlorophenol Immunoassays," (Order No. PB92-170190/AS; Cost: \$26.00; subject to change) will be available only from:

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