United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

EPA/540/R-08/002
February 2008

Performance of the CAPE Technologies DF1 Dioxin/Furan Immunoassay Kit for Soil and Sediment Samples

EPA/540/R-08/002
February 2008

Performance of the CAPE Technologies DF1 Dioxin/Furan Immunoassay Kit for Soil and Sediment Samples

Prepared by

Battelle
505 King Avenue
Columbus, Ohio 43201

Contract No. EP-C-05-057

Stephen Billets
Environmental Sciences Division
National Exposure Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Las Vegas, NV 89119

Notice

This document was prepared for the U.S. Environmental Protection Agency (EPA) Superfund Innovative Technology Evaluation Program under Contract No. EP-C-05-057. The document has met the EPA's requirements for peer and administrative review and has been approved for publication. Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use.

Abstract

A demonstration of screening technologies for determining the presence of dioxin and dioxin-like compounds in soil and sediment was conducted under the U.S. Environmental Protection Agency's (EPA's) Superfund Innovative Technology Evaluation Program in Saginaw, Michigan in 2004. The objectives of the demonstration included evaluating each participating technology's accuracy, precision, sensitivity, sample throughput, tendency for matrix effects, and cost. The test also included an assessment of how well the technology's results compared to those generated by established laboratory methods using high-resolution mass spectrometry (HRMS). The demonstration objectives were accomplished by evaluating the results generated by each technology from 209 soil, sediment, and extract samples. The test samples included performance evaluation (PE) samples (i.e., contaminant concentrations were certified or the samples were spiked with known contaminants) and environmental samples collected from 10 different sampling locations. The PE and environmental samples were distributed to the technology developers in blind, random order. One of the participants in the original SITE demonstration was CAPE Technologies, which demonstrated the use of the DF1 Dioxin/Furan Immunoassay Kit.

The developers and potential users of the technologies provided feedback after the demonstration. There was significant interest in evaluating the performance of these technologies on a site-specific basis. This would more closely represent the expected application of the technologies than was the case during the original demonstration, which targeted technology performance when challenged with a broad range of sample types. Consequently, a second test (referred to as the "site-specific study") was conducted in which the developers were given a total of 112 samples that were segregated by site of origin. In contrast to the original demonstration, in which all sample information was unknown, environmental information for each site was provided to the developers to more closely represent the background information that would be available to contractors supporting a site-specific application. Each batch included some samples previously analyzed as part of the SITE Dioxin Demonstration and some unique samples in archive that were not used as part of the SITE Dioxin Demonstration, along with replicates and quality control (QC) samples. Only dioxin and furan concentrations were evaluated in this study. The developers were given the HRMS data from the SITE Dioxin Demonstration so that they would have the opportunity to utilize a site-specific calibration and knowledge regarding typical congener patterns at a particular site. Data analysis focused on analytical performance on a site-specific basis, and included an evaluation of comparability to the HRMS total dioxin/furan toxicity equivalents ($TEQ_{D/F}$) results over a range of TEQ concentrations from 10 to 12,000 picogram/gram, precision on replicate analyses, and QC sample results.

This report describes the experimental design of the site-specific study, the analytical methods used, and comparisons of the $TEQ_{D/F}$ results from the HRMS data to those reported by CAPE Technologies. The data generated and evaluated during the site-specific study showed that the TEQ data produced by the DF1 was more comparable to the HRMS $TEQ_{D/F}$ data than was the data reported during the original SITE demonstration. The quantitative correlation with HRMS $TEQ_{D/F}$ was 0.94 for all the samples in the site specific study. The average percent recovery value was 122% with a range between 48% and 354%. The average relative standard deviation for the site specific study was 26%, with a range between 6% and 63%. These results show that the DF1 kit could be used as an effective screening tool to determine areas of greatest concern for cleanup at a site and could help to minimize the number of more expensive analyses needed for specific analytes, particularly considering that the cost and the time to analyze samples is significantly less than that of HRMS analyses.