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SITE
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TECHNOLOGY EVALUATION

Demonstration Bulletin

Field Analytical Screening Program: PCP Method

U.S. Environmental Protection Agency

Technological Description: The Superfund Innovative Technology Evaluation (SITE) Program evaluates new technologies to assess their effectiveness. This bulletin summarizes results from the 1993 SITE demonstration of the Field Analytical Screening Program (FASP) Pentachlorophenol (PCP) Method to determine PCP in soil and water. The demonstration was conducted by the National Exposure Research Laboratory, Las Vegas, Nevada. The U.S. Environmental Protection Agency (EPA) Superfund Section developed the FASP PCP Method.

The FASP PCP Method uses a gas chromatograph (GC) equipped with a megabore capillary column and a flame ionization detector (FID) and an electron capture detector (ECD) to identify and quantify PCP. Gas chromatography is an EPA-approved method for determining PCP concentrations in soil, water, and waste samples. The FASP PCP Method is an abbreviated, modified version of these EPA-approved methods.

Soil and water samples are extracted with methyl tert-butyl ether before GC analysis. To remove interferences caused by petroleum hydrocarbons, which are common PCP carriers, an acid-base partition cleanup step is used. In this step, the petroleum hydrocarbons are removed from the reagent water, while the potassium phenates remain in the reagent water. Then the solution is acidified and the pentachlorophenates are transformed back into PCP. The acidified solution is then solvent extracted. The sample extracts are concentrated and used for GC analysis.

Instrumentation and equipment required for the FASP PCP Method are not highly portable. However, when mounted in a mobile laboratory trailer, the method can be operated on or near most sites relatively easily. Use of this method requires electricity, and PCP standards require refrigeration. An exhaust hood and GC carrier gases also are needed. For the method to produce reliable results, it must be operated by a trained and experienced operator. A minimum of 6 mo experience in using a GC and a minimum of 1 mo experience in analyzing phenols is suggested for the operator. The total cost of the analytical equipment is $23,214. The costs of renting comparable equipment should range from $1,500 to 2,500 per month. The reagents and equipment needed to perform the extraction, preparation, and analysis of soil and water samples was estimated to be $5,000.

Waste Applicability: The FASP PCP Method is designed to provide quick, accurate results for PCP concentrations in soil and water in the field. This method also can detect and quantify other phenols. The detection limit for the method for soil samples is 0.8 mg/kg; for water samples it is 200 µg/L using the FID and 0.5 µg/L using the ECD. The average number of samples analyzed in a 10-hr day during the demonstration was 14.

The FASP PCP Method can provide quantitative results with relatively low detection limits at sites where PCP contamination is suspected or known. This method is specific to PCP; however, it is susceptible to interferences such as PCP carrier solvents (diesel fuel). Where high levels of diesel fuel are suspected, a rigorous cleanup step is needed to minimize the effects of interferences. The FID detector will provide only high parts per billion detection levels of PCP. To achieve a lower detection limit, the sample extracts must be analyzed using an ECD.

Advantages

- Inexpensive when compared to formal laboratory analysis
- High sample throughput
- Quick quantitative results
- Detection limit for water less than maximum contaminant level of 1.0 µg/L
- Specific to PCP; can identify other phenols as well
- Gas chromatography is an EPA-approved method for determining PCP in soil and water

Limitations

- Not very portable; requires a trailer, electricity, and refrigeration
- Relative high initial equipment cost
- Requires experienced GC operator
- Susceptible to interferences, especially from carrier solvents such as diesel fuel
- Uses hazardous chemicals for extraction and analysis

Demonstration Results: This demonstration consisted of analyzing 112 soil samples, 16 water samples, 14 soil field duplicates, 10 water field duplicates, two soil performance evaluation (PE) samples, and three water PE samples. Samples were col-

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lected and analyzed from two sites to evaluate the effects of different sample matrices and different PCP carriers, diesel fuel and isopropyl ether-butane. Each sample was evaluated by both the FASP PCP Method and by confirmatory laboratory analysis according to EPA SW-846 methods or by EPA 500 Series Methods for Organics In Drinking Water.

In a comparison of the FASP PCP Method's results to those of a confirmatory laboratory, it was found that the method produced Level 2 data for soil and water samples in which the PCP carrier was isopropyl ether. Level 1 data was produced for soil and water samples in which diesel fuel was the PCP carrier.

The accuracy of the FASP PCP Method was assessed by analyzing PE, matrix spike (MS), and matrix spike duplicate (MSD) samples, and by direct comparison to data from the confirmatory laboratory. Precision for this technology was assessed by analyzing laboratory duplicate, field duplicate, and MS/MSD samples. Operational characteristics, performance factors, and specificity of the FASP PCP Method also were evaluated.

The GC must undergo an initial calibration (ICAL), which involves analyzing standards containing three different concentrations of PCP. When an acceptable ICAL has been completed, sample analysis can begin. Microliter amounts of the extracts are injected into a GC, which is equipped with a megabore capillary column. Sample peak retention times and peak responses are then compared to the PCP standards to identify and quantitate the concentrations of PCP in the sample. Samples with concentrations outside the calibration range must be diluted and rerun. Daily continuing calibrations are used to monitor the performance of the GC.

An Innovative Technology Evaluation Report (ITER) describing the complete demonstration will be available in late 1995.

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