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Innovative Technology Verification Report

HNU-HANBY PCP Imunoassay Test Kit

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Executive Summary

This innovative technology evaluation report (ITER) presents information on the demonstration of the HNUHanby Environmental Test Kit for determining pentachlorophenol (PCP) contamination in soil. This screening kit was demonstrated in Morrisville. North Carolina, in August 1993. The demonstration was conducted by PRC Environmental Management, Inc. (PRC), under contract with the Environmental Protection Agency's (EPA) Environmental Monitoring Systems Laboratory- Las Vegas (EMSL-LV). The demonstration was developed under the Monitoring and Measurement Technologies Program (MMTP) of the Superfund Innovative Technology Evaluation (SITE) Program.

This technology was demonstrated in conjunction with four other field screening technologies: (1) the Penta RISc Test System developed by EnSys Incorporated, (2) the EnviroGard PCP Test Kit developed by the Millipore Corporation, (3) the Penta RaPID Assay developed by Ohmicron Corporation, and (4) the Field Analytical Screening Program PCP Method developed by EPA's Region 7 through its Superfund Program. The results of the demonstrations of these other technologies are presented in separate reports similar to this one.

The objective of this demonstration was to evaluate the HNU-Hanby test kit for accuracy and precision at detecting high and low levels of PCP in soil samples by comparing its results to those from a confirmatory laboratory that used standard EPA-approved analytical methods. These EPA-approved methods are used to provide legally defensible analytical data for the purpose of monitoring or for the enforcement of environmental regulations. Because these EPA-approved methods are used by the regulatory community, they also were used for this demonstration for comparison of results. While these methods may include inherent tendencies which may bias data or may include procedures with which developers disagree, they are the best methods for providing legally defensible data as defined by the regulatory community. To remove as much of these inherent tendencies as possible, PRC used post hoc residual analysis to remove data outliers. The HNU-Hanby test kit also was qualitatively evaluated for the length of time required for analysis, ease of use, portability, and operating cost.

The site selected for demonstrating this technology was the former Koppers Company (Koppers) site in Morrisville, North Carolina. This site was selected because a Risk Reduction Engineering Laboratory (RREL) SITE demonstration was planned for this site allowing for a conjunction of logistical and support efforts between RREL and EMSL-LV. However the PCP at the former Koppers site was not introduced using a petroleum hydrocarbon carrier. Because the HNUHanby test kit provides results only for soil in which a petroleum hydrocarbon carrier is present, samples were collected from the Winona Post site in Missouri and shipped to the former Koppers site for inclusion as demonstration samples. PCP contamination at the Winona Post site had been introduced using a diesel fuel carrier solvent.

The HNU-Hanby test kit is designed to provide quick, semiquantitative and quantitative results for PCP concentrations in soil samples. The test kit can provide PCP results only in samples which also contain a petroleum hydrocarbon carrier such as gasoline, kerosene, diesel fuel, or fuel oil. It cannot be used to determine PCP results for samples in which no petroleum hydrocarbon carriers are present. The HNU-Hanby test kit measures PCP indirectly by measuring the petroleum hydrocarbons carrier solvent remaining in the soil. The ratio of PCP in a petroleum hydrocarbon carrier may vary due to manufacturing processes, dilution variances, and the volatility and weathering of the petroleum hydrocarbon carrier. Therefore, site samples must be obtained so that site-specific calibration data can be prepared. This can be done by analyzing the samples

both by EPA-approved methods and using the test kit. Calibration data can then be generated by correlating the PCP confirmatory results against the kit's corresponding response. The test kit uses the Friedel-Crafts alkylation reaction to detect the petroleum hydrocarbons. This reaction is colorimetric. A reflective photometer is used to quantitatively measure the reaction color. A sitespecific calibration is needed to determine the ratio of PCP to carrier solvent. This ratio is then used to correct the results from the reflective photometer.

The HNU-Hanby test kit is portable and can be operated outdoors. Temperature extremes and humidity do not seem to affect its performance. The reagents used with the test kit do not require refrigeration. The reflective photometer requires electricity but can be operated using a rechargeable battery pack. The test kit was found to be easy to operate by individuals with no prior environmental testing experience.

The test kit costs $1,195. This test kit provides enough reagent and glassware to perform 30 soil sample analyses. The reflective photometer used to provide quantitative data costs $3,500. Other equipment, such as extraction vials and pipettes, may need to be purchased when using the test kit. The cost of these items will vary depending upon the number of samples that will be analyzed. The detection limits reported by the test kit's developer is 1 .O part per million (ppm) for soil samples. A 5.0 ppm detection limit was used for this demonstration. The elevated detection limit was the result of reducing the sample mass used for extraction.

During the demonstration, 47 soil samples were extracted and analyzed in two 8-hour days. The average time to analyze one soil sample was about 21 minutes. The precision of the test kit was determined to be statistically the same as the precision of the confiitory laboratory. The kit's data set was evaluated for accuracy as a whole and by concentrations less than and greater than 100 ppm PCP. When the entire data set was evaluated, the test kit's results were determined to be statistically different from the confirmatory results. This was also the case for samples in which the PCP concentrations were greater than 100 ppm. The test kit's data for samples containing less than 100 ppm PCP was shown to be statistically similar to the corresponding confirmatory data. Based on this evaluation, the test kit produced Level 1 data for samples containing greater than 100 ppm PCP and Level 2 data for samples containing less than 100 ppm PCP. This indicates that there was a concentration effect on the test kit's accuracy. The test kit showed greater comparability to the confirmatory data when PCP concentrations in samples were below 100 ppm.