

INVESTIGATOR'S



FIELDBOOK

FIELD & BENCH SCALE COMPARISON OF PHOTOIONIZATION DETECTORS

J.P. Hoffer, K.S. Koptiuch, & R.L. Parker

INTRODUCTION

Portable photoionization detectors (PIDs) are widely used in site contamination investigations to measure vapor concentrations of volatile organic compounds (VOCs). These measurements are conducted to comply with health and safety regulations requiring air monitoring of worker air space, as well as

to determine the relative concentration of contaminants. PIDs provide real-time detection of the most frequently encountered VOCs at many hazardous waste sites.

The State of Vermont Sites Management Section (SMS) of the Hazardous Materials Management Division (HMMD) has developed guidelines for discriminating petroleum contaminated soil from soil that may be backfilled during underground storage tank (UST) closures. These guidelines are based on a PID response threshold of 20 parts per million (ppm) for gasoline, and 10 ppm for diesel, kerosene, and #2 fuel oil. While the Vermont guidelines recognize that instrument responses and sensitivities vary according to PID model and manufacturer, the type of PID to be used for field screening activities is not specified.

The authors will present the complete text, with results and graphical interpretation, of this study in a poster session at the 1994 NGWA Focus Conference on Eastern Regional Ground Water Issues, October 3-5 at the Radisson Hotel in Burlington.

This study was conducted to define whether or not a linear correlation between the response factor for PIDs of different manufacture can be identified. This information could then be applied interpretively when reviewing investigative results from different petroleum hydrocarbon hazardous waste sites.

METHODOLOGY

Two commonly used PIDs were chosen for this study: a Photovac MicroTip HL-2000 (10.6 eV) and a HNU PI-101 (10.2 eV). Each unit was calibrated with 100% isobutylene to respond to benzene in parts per million (ppm) of calibration gas equivalents (CGE).

Bench scale measurements of fresh diesel, kerosene, and gasoline samples were evaluated by closed-loop, head-space methodology to prevent product loss through volatilization. Each sample consisted of one (1)-ounce of pure product injected into a sealed and sanitized, eight (8)-ounce, glass sample jar containing three (3)-ounces of washed, #2 Whitehead sand. The Teflon-lined jar lids were modified with two (2) 1/4" diameter, threaded Teflon bulkhead fittings. Each fitting was controlled with a Teflon needle valve. A method blank, identical to

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the other samples in construction, was prepared; no product was injected in the blank. The samples were agitated by shaking for five (5)-seconds each prior to running through the test.

Each product sample was tested a total of five times with each PID; the instruments were allowed to return to zero, or to stabilize if zero could not be achieved, between each sampling event. The method blank was tested before and after each product series with each PID.

Field headspace determinations were made on samples collected from a gasoline contaminated soil stockpile under normal field screening conditions.

Results were tabulated and graphed using QuattroPro and Freelance Graphics. Linear correlations were defined through slope determination of lines of best fit.

RESULTS

Bench scale measurements of diesel, kerosene, and gasoline headspace samples ranged from 122 to 1800 ppm on the MicroTip, and from 78 to 450 ppm on the HNU. The data from all three (3) petroleum hydrocarbon products was tabulated together. A strong linear correlation exists for the data and can be expressed as:

$$\text{HNU} = (\text{MicroTip} \times 0.23) + 72$$

In addition, the data for gasoline was tabulated separately. The linear correlation for gasoline alone can be expressed as:

$$\text{HNU} = (\text{MicroTip} \times 0.18) + 120$$

Field headspace measurements from the gasoline contaminated soil stockpile ranged from 8.8 to 929 ppm on the MicroTip, and from 2.0 to 240 ppm on the HNU. Two distinct linear correlations were defined. For HNU readings below 200 ppm the linear correlation can be expressed as:

$$\text{HNU} = (\text{MicroTip} \times 0.35) + 8.8$$

For HNU readings below 20 ppm, the linear correlation is expressed as:

$$\text{HNU} = (\text{MicroTip} \times 0.40) - 0.22$$

CONCLUSIONS

The results of this study are not intended to be authoritative in nature. By conducting this experiment, the authors hope to make field investigators and regulatory personnel aware that, although response from instruments of different manufacture will vary, relative correlations can be defined and applied to compare these responses. The logi

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cal extension of this experiment is to conduct similar comparisons with additional PIDs of different manufacture, and to compare the results to those yielded through laboratory chemical analyses of the same test media.

Consultants have long been aware of the intrinsic differences between PIDs of various manufacture. This information could theoretically be applied advantageously to limit, or to maximize, the quantity of soils segregated for hazardous waste disposal during subsurface investigations. As a result, field screening of soils by PID invokes an inherent level of mistrust.

The method offered here could be employed to define qualitative values and performance curves for various PIDs. This information could then be incorporated into the standards set forth by the SMS in their guidance documents for site investigations and UST closures.

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