



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EDISON, NEW JERSEY 08837

July 8, 1986

40079

MEMORANDUM

SUBJECT: Available ERT Experience and Capabilities

FROM: Royal J. Nadeau, Chief
Environmental Impact Section
Environmental Response Branch

TO: Kirk Stoddard, RPM
N.J. Remedial Action Branch (EERD-NJRA)

Kirk, it was good speaking with you this morning. We will forward the results from the remaining bioassay tests as soon as we receive them from the Corvallis Laboratory. I believe that the earthworm tests are the only data outstanding for the Combe South site.

Enclosed are fact sheets on some of our procedures and capabilities, plus copies of journal articles written by ERT members.

We would appreciate your passing these materials along to your colleagues. Our forte lies in our capacity to get things done quickly in the field.

We would be happy to come over to Federal Plaza and make a brief presentation on some of the latest newly developed field techniques (e.g., soil gas survey, etc.). This might be useful for designing more cost effective field investigations at some of your sites.

Let us know when would be a good time to do this. You can contact me by calling FTS 340-6740; ask for Steve Dorrier (our chief) or myself.

Enclosure

303160

MEASURING SOIL VAPORS FOR DEFINING SUBSURFACE CONTAMINANT PLUMES

ROYAL J. NADEAU and JOSEPH P. LAFORNARA, U.S. Environmental Protection Agency, Environmental Response Branch's, Environmental Response Team, Woodbridge Avenue, Edison, New Jersey 08837, USA. GEORGE S. KLINGER, Jacobs Engineering Inc, Edison, New Jersey 08837, USA. TIMOTHY STONE, IT Corporation, Edison, New Jersey 08837, USA.

1. SUMMARY

Volatile organic compounds, if present in ground water or soil, will occupy the interstices or voids in soil. These vapors can be sampled and characterized using a portable gas chromatograph.

Soil vapor analysis can be a useful and rapid method for tracing plumes of leaks and spills of many volatile organic compounds (VOC's). This method is particularly useful for compounds more volatile than xylene (vapor pressure >5mm Hg). Ground water contamination can also be assessed indirectly using this method.

Determinations of contaminant concentrations down to the low parts-per-billion can be made with this system. In addition to providing same-day or quicker results, substantially more samples can be analyzed at a much lower cost per sample compared to well drilling and GC/MS analysis. In addition, the system can be shipped virtually anywhere overnight, and can be ready to run within hours of arrival on-site.

2. BACKGROUND

Within the past few years, soil vapor measurements are being used more extensively for defining subsurface contamination plumes particularly for volatile organic compounds (Albertsen & Matthess, 1978; Glaccum et al, 1983 and Lappola & Thompson, 1984). Various systems have been devised to sample subsurface vapors; however, each system employs a hollow soil probe that is driven into the ground to the desired depth.

The Environmental Response Team of the U.S. Environmental Protection Agency, uses a solid spring steel single piston storm bar (1.75m x 16.7mm diameter) to make a vertical hole in soil. Other methods have been attempted, however, this length and diameter probe is optional for making holes in disturbed soils (e.g., landfills, construction sites)(Flower, 1976).

Another advantage of using the solid probe is that its small diameter allows sampling in otherwise inaccessible areas, e.g., through cracks and crevices in sidewalks and asphalted parking lots.

3. METHODOLOGY

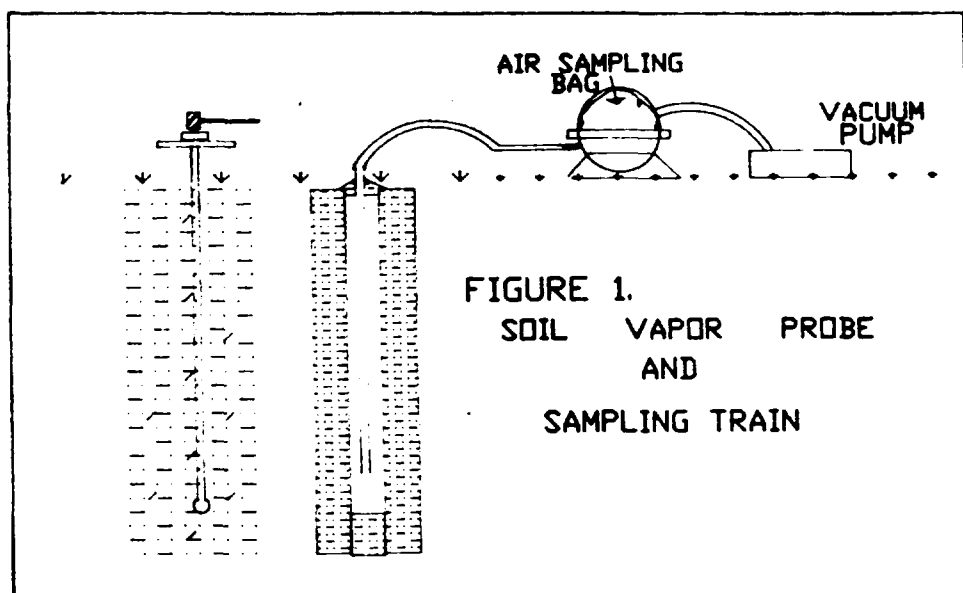
3.1 Sampling Methodology

After the hole is made, the probe is carefully withdrawn to prevent collapse of the walls of the hole. It is necessary to

303161

take precautions to prevent plugging the sampling tube, especially for the deeper holes. To do this, the sampling tube (63mm o.d. stainless steel pipe) is inserted in the hole with a Teflon® tube slightly longer than the sampling tube inside. Attached to the end of the Teflon® tube is a nail whose point just fits into the Teflon® tube, and the head of the nail is just large enough to cover the end of the stainless steel tube. This arrangement is then inserted into the hole nail-end first. When the tube is fully inserted, (i.e., the desired depth is reached), the Teflon® tube is pulled up causing the nail to drop to the bottom of the hole. The Teflon® tube is then removed and the sampling tube is withdrawn 15 to 30 cm. The top dirt is packed around the tube to minimize infiltration of ambient air.

The probe of a photoionization detection instrument is attached to the stainless steel sampling tube. Levels of organic vapor greater than background (1-2ppm is usually attributed to soil moisture present) is recorded upon equilibration (about 45-60 seconds). Following this, the instrument is disconnected and an air sampling bag inside a vacuum dessicator is connected to the sampling tube. An air pump evacuates the dessicator filling the bag with 200-700ml of vapor drawn from greater than a meter down the borehole (see Figure 1). The bagged vapor samples are then analyzed within one to two hours from collection using a portable photoionization gas chromatograph.



Under most conditions, the sampling train can be decontaminated simply by drawing ambient air through it using the air pump. More persistent contamination can be washed out using isopropanol followed by distilled water, then air dried.

3.2 Detection

The method in soil vapor is a valid sampling technique and after which open chromatography detecting ionization of soil vapor in the absence of a technique of /Mass Spectrometry.

The quality of the data is in accordance with the method employed; ionization at the bottom of the borehole.

The procedure is led by a vacuum pump and a bag.

The G... ever, a time of... componen... with sup... loop wer... grammed... is much... ning, li...

4. ANALYSIS

The sampling train is different from the accuracy of the sampling location is not warranted.

The sampling bag with photoionization detector can identify when the sample is found.

hour. ever, a having

The samples

303162

3.2 Detection Methodology

The methodology used for detection of volatile contaminants in soil vapors is based on a system which: 1) ensures that a valid sample is being taken; 2) "screens" the soil gas, before and after a sample is taken; 3) includes a rapid analytical technique - the portable photoionization gas chromatograph, which operates on the traditional method of packed-column gas chromatography for separating the components of a mixture and detecting sequentially in their "elution order" with a photoionization detector; and 4) a second line of analysis of the soil vapor sample, which confirms or denies the presence or absence of contaminants in the sample by utilizing the technique of Cryogenic Trapping Capillary Column Gas Chromatography/Mass Spectrometry.

The quality control used in the analytical procedures varied in accordance with the complexity of the analytical methods employed; the least effort being given towards the total photoionization detector which was calibrated with a calibration gas at the beginning of each day.

The portable gas chromatograph analysis is quality controlled by calibration with a certified gas standard mixture purchased from a speciality gas supplier.

The GC/MS analysis uses the same gas standard mixture, however, a surrogate standard is also added to the samples at the time of analysis. In cryogenically trapping the compounds, components are trapped on a capillary loop cooled to -160°C with supercooled nitrogen gas. The contents of the trapping loop were then valved to a 25 meter capillary column for a programmed temperature separation. The procedure from this point is much the same as standard methodology employing period scanning, library searching and reconstructing single ion profiles.

4. ANALYTICAL SCHEME

The scheme allows for samples to be analyzed with three different levels of rapidity, with corresponding increasing accuracy of results. For immediate results, a portable photoionization detector is attached to the soil gas probe. Within a minute or so a rough estimate of the total organics present in the sample can be made. This method allows prescreening of a location to determine if further sampling and analysis is warranted.

The second level of analysis consists of filling a sampling bag with the sample, which is then analyzed by a portable photoionization gas chromatograph. This gas chromatograph can operate either on-line current or its own rechargeable battery, and can be easily set up in a hotel room, command post, or other convenient location. It can provide relatively accurate identification and quantitation of contaminants, especially when there is prior knowledge of the contaminants expected to be found. Analyses can easily be completed in less than an hour. Samples can also be taken on sorbent tubes. These, however, are not amenable to on-site gas chromatograph analysis having to be solvent extracted before analysis.

The third level of analysis consists of saving selected bag samples for confirmation by mass spectrographic analysis. This

303163

analysis should, ideally, be completed within 48 hours because of possible sample attenuation; however, bag samples analyzed up to two weeks or even longer after collection, can provide useful data on contaminant identification and relative extent of contamination within a particular set of samples.

REFERENCES

1. Albertsen, M. and G. Matthess, "Ground Air Measurements As A Tool For Mapping And Evaluating Organic Ground Water Pollution Zones". International Symposium On Ground Water Pollution By Hydrocarbons, Prague, 1978, pages 235-251.
2. Flower, F.B., "Case History Of Landfill Gas Movement Through Soils". Proceedings Of A Research Symposium Held At Rutgers University, New Brunswick, New Jersey, March 25-26, 1975. EPA-600/9-76-004, March 1976.
3. Glaccum, R., M. Noel, and L. McMillan, "Correlation of Geophysical And Organic Vapor Analyzer Data Over A Conductive Plume Containing Volatile Organics". Proceedings Of The Third National Symposium On Aquifer Restoration And Ground Water Monitoring, National Water Well Association, 1983, pages 421-427.
4. Lappala, E. and G. Thompson, "Detection Of Ground Water Contamination By Shallow Soil Gas Sampling In The Vadose Zone Theory And Applications". Proceedings Of The Fifth National Conference On Management Of Uncontrolled Hazardous Waste Sites, Washington, D.C., 1984, pages 20-28.

RAPID

ir. J

Heider
6800 ?

In add
be ver

Heidemi
analysis

FIGURE 1.

303164