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OFFICE OF RESEARCH AND DEVELOPMENT

TECHNOLOGY SUPPORT PROJECT

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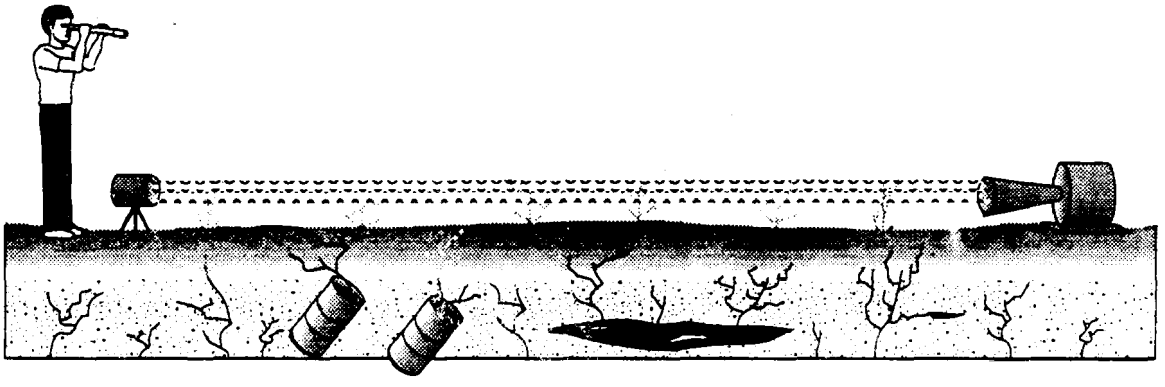
Open Path FT-IR Use in Environmental Monitoring



INTRODUCTION

A major environmental concern is the identification, location, and extent of volatile organic compound (VOC) contamination in the air at hazardous waste sites. Open path (or long path) FT-IR was adapted to environmental use to address the need for information about VOC levels and to improve upon costlier and more time-consuming current methods. Open path FT-IR is useful at many stages of screening and remediation because VOC contamination can result from many sources, including underground storage tank leaks, chemical spills, and off-gassing at air stripping plants. A mobile system has been developed at Kansas State University through a cooperative agreement with EMSL-LV and Region 7. The mobile laboratory set-up provides an on-site, quick turnaround means of obtaining data that can guide remediation decisions. The outlook for expanded use of open path FT-IR is excellent, with research in the area responding to the needs of field scientists and Agency personnel.

INSTRUMENTATION

The FT-IR spectrometer being used for developmental work is a Bomem DAO2 system equipped with a KBr/Ge beam splitter, a mercury-cadmium-telluride detector that is liquid nitrogen cooled, an adjustable tripod, and a collection telescope (10-inch Cassegrainian). The source is an air cooled and quartz shielded Nernst glower operating at 2,000 Kelvin. This source is located at the focal point of a 20-inch Newtonian telescope in order to generate a collimated beam of infrared radiation.

The mobile laboratory is driven to one side of the site to be surveyed and the FT-IR spectrometer with its collection telescope is set up adjacent to the station. The IR source and its collimating telescope are positioned on the opposite side of the site to be surveyed so that the collimated beam of infrared radiation may be sent across to the collection telescope of the FT-IR spectrometer. A laboratory calibration is usually sufficient for field sampling.

An alternative arrangement is to place both the source and the spectrometer adjacent to the laboratory station. Then a reflector is placed on the opposite side of the site so the collimated beam of infrared radiation is sent across the site to the reflector and bounced back to the spectrometer. In either arrangement, the IR absorption spectrum of the atmosphere above the site is used to identify any VOC present in the path of the beam.

SCOPE

Open path FT-IR is useful for the qualitative and quantitative measurement of VOC and low-boiling semivolatile compounds. To date, the spectral database contains 35 VOC files, with a total of 70 compounds expected to be included by the end of 1990. The instruments can be positioned at varying heights above the soil by using tripods. Though this technology is sensitive to meteorological factors such as wind, particulate matter, and rain, most of these affect point sampling by canister as well. Open path FT-IR is faster and cheaper than the canister methods while providing a greater likelihood of locating the pollutant plume and should be the favored technique when time and budgetary constraints are considerations.

ADVANTAGES AND LIMITATIONS

Using open path FT-IR to analyze the atmospheric concentration of VOC and solvents is a newly developed and emerging technology. It has many advantages and some limitations that are presented here as an aid to methodology decision-making.

Advantages	Limitations
Low analysis cost	In development stage
Computerized operation	Equipment is customized
Rapid results	Sensitive to meteorological changes
	Provides average concentration along pathway

It is obvious that the Data Quality Objectives (DQO) of a site must drive the decisions on instrumentation so that the necessary data are not compromised. As with any new method, specialized equipment and expert advice is fundamental to the site-specific applicability of the technique.

FUTURE PLANS

As open path FT-IR gains stature as an environmental screening tool, work will be underway to refine its capabilities in quantitation. A growing database that will include more VOC and some semivolatile compounds will increase the usefulness of this method. The anticipated demand for instrumentation will result in the development of more sensitive, integrated systems. Better computerized formats may enable extrapolation from atmospheric to subsurface concentration. The first two limitations listed above are not intrinsic to the method and will be solved with the advent of commercially available systems. In general, the outlook is very positive for increased need for screening technologies such as FT-IR and the demand is expected to guide researchers to promising refinements of these techniques.

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