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EPA **Project Summary**

Superfund Innovative Technology Evaluation, The Delaware SITE Study, 1989

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The Delaware SITE (Superfund Innovative Technology Evaluation) Study was carried out by personnel from the Atmospheric Research and Exposure Assessment Laboratory (AREAL), U.S. EPA, and AREAL contractors, Battelle Columbus Laboratory, ManTech Environmental Technology, Incorporated (formerly NSI Environmental Sciences), and Tecan Remote, Incorporated. Personnel of the Delaware Department of Natural Resources and Environmental Control (DNREC) hosted the operation and obtained permission to use local sites for monitoring. The objective of the study was to field test several monitoring methods that have progressed through a feasibility testing stage and appear ready for predemonstration testing at Superfund sites. Monitoring occurred near four Superfund sites in the vicinity of New Castle, Delaware, and at the Delaware Reclamation Plant located just north of the Delaware Memorial Bridge. Several different types of new monitoring equipment were deployed including: (1) automated gas chromatographs, (2) canister-based sequential samplers, (3) personal sampling devices, (4) canister-based sector samplers, (5) long path infrared transmission monitors, and (6) solid sorbent-based phenolic compound samplers.

This Project Summary was developed by EPA's Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title. (See Project Report ordering information at back.)

Introduction

The Superfund Innovative Technology Evaluation (SITE) Program promotes the development, acceptance, and use of promising innovative technologies capable of meeting the objectives of the overall Superfund program. One objective of the program is to provide the means for developers of technology to demonstrate innovative technologies at Superfund sites as alternatives to the systems currently in use. A second objective is to provide support to stimulate the development of promising concepts and technologies to the point that they are suitable for demonstration at Superfund sites. In the case of the Delaware SITE program, a proposal was made by AREAL to the SITE program coordinator to carry out predemonstration testing of new monitoring techniques. After acceptance, a schedule was established for the testing in the summer of 1989.

The schedule of the SITE project consisted of the following items:

- Selection of a field site
- Predemonstration plan preparation
  a. Planning/coordination meeting with participants, and
  b. Preparation of plans for predemonstration testing.
     1. Documentation of experimental design, and
     2. Preparation and clearance of a quality assurance plan.
- Preliminary field screening study
- Preparation of a target compounds list for each test site

- Performance of the field testing
- Review of data and preparation of a highlight report
- Presentation of preliminary data at the 1990 EPA/AWMA Symposium on Measurement of Toxic and Related Air Pollutants
- Development of information products for the SITE program

The site proposed by J.J. Kliment of the Delaware Department of Natural Resources and Environmental Control (DNREC) was selected. The site was near New Castle, Delaware, and included four Superfund sites and one site near the Delaware Reclamation Plant. A map of all the sites is shown in Figure 1. Figure 1 shows the Superfund sites: Army Creek, Delaware Sand and Gravel, Halby, and Standard Chlorine along with the Pigeon Point site which is near the Delaware Solid Waste Authority. The location of a monitoring site in the residential area referred to as Llangollen Estates and the P4 monitoring site maintained by the state of Delaware are also shown. The Standard Chlorine plant site was part of a large industrial complex.

Experimental Plan

The experimental plan called for five methods of monitoring to be tested in the field. An automated gas chromatograph (GC) using a solid sorbent to preconcentrate volatile organic compounds (VOCs) from the ambient air was placed in the P4 station. The unit cycled through an automated sample and analysis sequence every hour. The objective of this monitoring method was to evaluate the use of a solid sorbent as a VOC preconcentrator and further to demonstrate the use of automated GCs as a means to establish the variability of VOC concentrations in time.

The P4 site was also used for placement of sector samplers. These units were placed at the P4 and S20 sites to characterize the industrial complex near Standard Chlorine. Data was also taken near the Army Creek and Delaware Sand and Gravel site using the sector samplers.

Personal sampling devices (PSDs) were used as fenceline dosimeters at several of the sites. These units sample by diffusion and are small and convenient to use. Since the units are less than two inches in diameter, they can be attached to any convenient structure and used to obtain a time-integrated ambient air sample. To establish the validity of the fenceline monitors for screening of VOCs, they were used in side-by-side tests with canisters.

Long path monitors based on selective absorption of infrared radiation by target gases were used at four of the sites. The objective was to define the field capabilities of FTIR-based long path monitors. These monitors use source and receiver at one end of a monitoring path and a retroreflector at the other end. The pathlength is typically 300 m long, giving a total pathlength of 600 m.

New solid sorbents specifically chosen for retention of phenolic compounds were also used at the Superfund sites. However, the field study was intended as a scoping study in this case since only laboratory studies had been done up to this point.

Results and Discussion

The main field study was carried out during the period 24 July through 9 August 1990 at the Superfund sites as planned. Individual experiments and experimental results are summarized below.

Automated Gas Chromatograph

- AREAL's new automated GC using a multisorbent bed for preconcentration operated successfully when cycled on an hourly basis over two weeks.
- The automated GC was calibrated daily for 12 consecutive days with a relative standard deviation (RSD) of response that was less than 10% for all but dichlorodifluoromethane.
- Use of the automated GC data in the Temporal Profile Analysis (TPA) approach resulted in the identification of groups of compounds originating from nearby sources.

Fourier Transform Infrared Long Path System

- An independent calibration of the Fourier transform infrared (FTIR) system, in which a mixture of seven gases was presented to the system, demonstrated that the results are compound-dependent and differ by 2 to 35% from the nominal calibration standards.
- The precision of the FTIR was determined by presenting the same mixture of gases to the FTIR on 16 occasions. The results again show a compound dependency, with RSD values from 4 to 41%.
- The detection limits of this instrument are compound-specific but can generally range from 20 to 100 ppb.
- The comparison of the FTIR data with the results from the canister technique was complicated by the rapidly changing concentrations caused by the movement of a small plume of industrial emissions that touched down intermittently along the monitoring path. The comparison for *p*-dichlorobenzene was good, the results of point sampling and long path monitoring being statistically the same. For chlorobenzene, the FTIR was operating very close to the theoretical detection limit, and the average difference between results was 34%. The error bars on the FTIR data for this compound are large enough to conclude that no statistical difference really exists.
- Canister samples taken simultaneously but transported in opposite directions along the path show differences of up to a factor of 2. Canister samples taken simultaneously and side by side in the traversal of the path show variabilities of about 15%.

Sector Sampling

- Sector sampling was used to identify the major compounds emitted from an industrial complex.

Sequential Sampler

- A set of 25 compounds was analyzed by using the TPA technique, and a subset of these compounds showed strong correlation (>0.85). The air mass carrying these compounds was seen to have passed over the industrial complex prior to its arrival at the sampler.

Personal Sampling Devices

- Eleven sampling events were monitored at three sites, and data were analyzed for six volatile compounds. The analysis shows good agreement with the canister data. The PSDs can be used as fenceline dosimeters around landfills.

Anion Exchange Resin

- This was the first field test of sorbent sampling with anion exchange resins. The technique was the least developed technique to be tested in the Delaware field study. Interpretation of results is limited and complicated by the lower-than-expected sample concentrations.

One of the most interesting observations was that the dominant concentrations noted in monitoring near "old" Superfund sites were due to local (within 5 km) industrial emissions.

The Delaware SITE Study of 1989 has shown the feasibility for field monitoring for five of the six monitoring techniques that were tested for organic compounds. Automated gas chromatographs, canister-based sequential samplers, personal sampling devices for VOCs, canister-based sector samplers, and long path infrared transmission monitors were successfully used to monitor target compounds at ambient air concentrations. Comparisons between per-

sonal sampling devices and canisters, and between long path infrared transmission monitors, were effective in providing for a strong quality assurance program. Based on results of the study, four articles for submission to peer-reviewed journals have been prepared. Information from the Delaware study is already being used in EPA Region I (sector samplers), in EPA Region VII (long path infrared transmission monitors), and in EPA Region IV (automated gas chromatographs).

Conclusions and Recommendations

Automated Gas Chromatograph

- This system should be redesigned so that liquid nitrogen is no longer required.
- A single supplier of an integrated system including both the GC and the preconcentrator should be identified.
- Different sorbents such as the Supelco triple bed sorbent should be evaluated as a preconcentrator of VOCs.

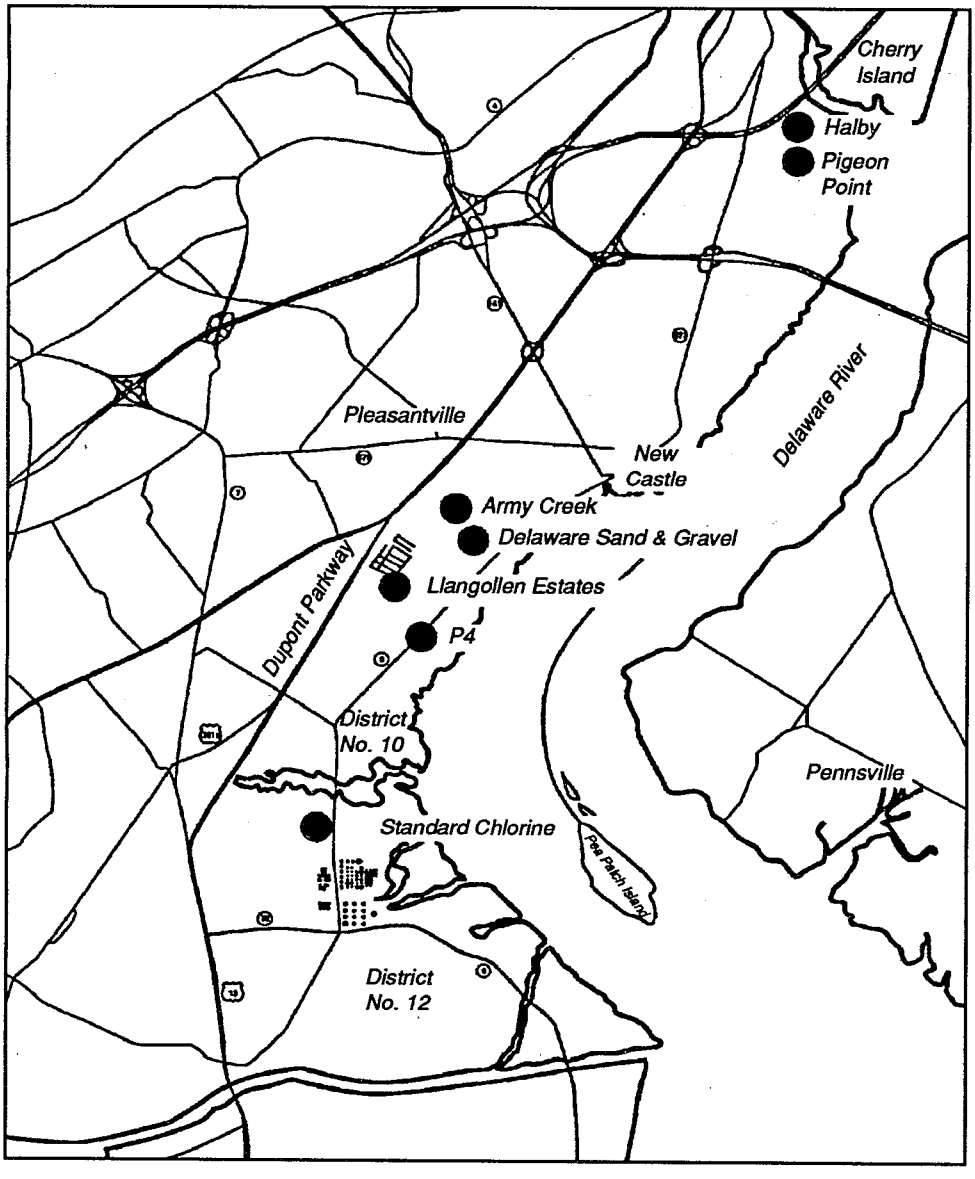

Figure 1. Monitoring sites for the 1989 Delaware SITE study.

Fourier Transform Infrared Long Path System

Several changes to the instrument design need to be addressed to improve the detection capability of this technique. These include

- Recoat the retro-reflector with a coating that is nonabsorbing across the spectral region of interest.
- Direct the beam through the interferometer before it traverses the path in order to eliminate the background emission.
- Identify and install a smaller light source.
- Develop a procedure for determining the precision and accuracy of the FTIR data.

Sector Sampling

- The design of this instrument should be altered to include sector limits that can be reset rather than being fixed at 90°.
- The instrument should be provided with a threshold for wind speed.
- Technology transfer to the regional offices should be initiated.

Sequential Sampler

- The difficulty with the accumulation of water vapor in the instrument's valve system must be solved.
- A portable, battery-operated wind speed/wind direction sensor must be identified for use with the sampler at monitoring sites.
- Technology transfer of this technique to the EPA regional offices should be initiated.

Personal Sampling Devices

- The use of sorbents other than Tenax GC should be evaluated. This requires both laboratory and field testing.
- An investigation should be made into the use of supercritical fluid extraction of VOCs from solid sorbents.
- The use of these devices as a screening technique for a wider range of volatile compounds at Superfund sites should be investigated.

Anion Exchange Resin

- A sealable field sampling cartridge should be developed that is capable of sustaining sample flow rates up to 1 L/min.
- The sampling technique should be retested at a site with known high concentrations of phenolic compounds.
- A series of both laboratory and field tests should be conducted in which the impinger method (EPA Method TO-8), given in the *Compendium of Methods for the Determination of*

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Toxic Organic Compounds in Ambient Air, is used as a comparison.

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The complete report, entitled "Superfund Innovative Technology Evaluation, The Delaware SITE Study, 1989," (Order No. PB92-125749/AS; Cost: $26.00, subject to change) will be available only from:

National Technical Information Service
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