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Project Summary

Evaluation of Portable Multisorbent Air Samplers for Use With An Automated Multitube Analyzer

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The objective of this study was to evaluate the operational characteristics of two portable ambient air samplers. Both the Perkin Elmer Sequential Tube Sampler (Model STS 25) and the IITRI/IIT (IIT Research Institute/Illinois Institute of Technology) Total Isolated-by-Microenvironment Exposure (TIME) monitor made use of multisorbent carbon-based sampling tubes to collect volatile organic compounds in air samples. In order to process the collection tubes, methods development was performed using a Perkin Elmer Auto Thermal Desorption System (Model ATD 400). The volatile organic compounds (VOCs) listed in the EPA TO-14 method were the target species. Details of the study are presented along with recommendations for further evaluation and developmental efforts for these samplers and the sorbent/analytical methodology.

This report was submitted in fulfillment of Contract No. 68-D0-0007 by Battelle Columbus Operations under sponsorship of the U.S. Environmental Protection Agency. This report covers a period from March 1992 to September 1992, and work was completed as of September 15, 1992.

Introduction

Recognition of the importance of trace-level VOCs in breathing-zone air and their potential impact on human health has stimulated interest in methods for characterizing these compounds. Most techniques in use today for measuring VOC concentrations have their origin in industrial hygiene monitoring methods. They generally rely on solid sorbents or canisters to collect whole-air samples.

Long term integrative sample collection is the preferred approach for measuring relatively constant emissions and for assessing average exposure, such as in studies of chronic health effects. However, to obtain detailed documentation of temporal or spatial changes, as in the case of intermittent emissions or acute exposures, short and frequent sampling periods in various locations in which exposure may occur are more appropriate. To this end, portable air sampling devices, such as the STS 25 and TIME monitor, are being developed to permit the collection of toxic air pollutants on a schedule best suited to identify and characterize exposure occurrences.

Objective

The objective of this study was to evaluate the performance of the STS 25 and TIME monitor for collecting VOCs on carbon-based sorbent tubes and processing these tubes using the Perkin Elmer (ATD 400) system. Methods development and validation of the sorbent system used in this study were completed before the sampler evaluations were undertaken.

Evaluation

Carbon-based sorbents were examined for their ability to collect the TO-14 compounds in humidified air samples up to 3 L in volume. In addition, an analytical procedure was developed using the Perkin ATD 400 desorption system to process the sample collection

tubes in an automated fashion. The ATD 400 was coupled to a gas chromatograph that was fitted with a thick-film capillary column. This analytical scenario was investigated to determine if it was possible to resolve the target compounds without the use of cryogen.

Two portable air samplers were evaluated using the multisorbent collection tube and analytical method developed during the first phase of this study. The STS 25 was subjected to mechanical tests, collecting samples under controlled laboratory conditions, and indoor/outdoor sampling. The TIME monitor was operated to confirm its ability to recognize different environments and used to collect air samples.

Conclusions and Recommendations

Laboratory tests confirmed that the TO-14 compounds could be collected on a three-stage sorbent bed composed of Carbotrap C, Carbotrap, and Carbosieve S-III. Indications were that only partial breakthrough for the most volatile target species was taking place for sample volumes up to 3 L. The analytical method developed was able to resolve the TO-14 compounds without the use of cryogen with very good precision. A limitation of the analytical system was that misidentification of compounds occurred when complex samples were analyzed. The qualitative and quantitative results were obtained using only a flame ionization detector (FID) that relied upon retention times for peak identification. If coeluting non-target compounds were present in a sample, they were mistakenly identified as compounds of interest.

The STS 25 performed without any mechanical problems during its evaluation. During the laboratory chamber tests, the STS 25 showed that it could collect TO-14 compounds on the multisorbent tubes under various sampling conditions. However, the confined environment of the chamber indicated that the STS 25 has the potential of introducing artifacts into the sampling environment. When the STS 25 was used to collect indoor and outdoor samples, under more realistic operating conditions, the results obtained for the target compounds were in good agreement with those obtained with conventional canisters, and the artifact effects were no longer observed. The limitation of the FID was again noted during these air sampling tests.

The TIME monitor was redesigned before undergoing any evaluation. The response time of the sensing transducer to a change in environment was shortened, and the size and weight of the unit was reduced. The system showed that it recognizes changes in its environment as it is transported from outdoor to indoor locations. The air samples collected were processed and provided information on specific environments as the source of exposure to selected toxic compounds.

We recommend that to more precisely evaluate the capabilities of the sorbents and samplers used during this study, the ATD 400 be connected to an analytical system that incorporates a mass selective or ion trap detector. We also suggest that field tests of the STS 25 and TIME samplers continue, along with the development of collection tubes and analytical methods that will provide data on other compounds such as polar organics and the C_2-C_4 ozone precursors.

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The complete report, entitled "Evaluation of Portable Multisorbent Air Samplers for Use With An Automated Multitube Analyzer," (Order No. PB93-172930; Cost: $19.50), will be available only from:

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