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Project Summary

Simplified Volatile Organics Sampler

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The volatile organic sampling train (VOST) was originally designed to sample very low levels of volatile materials in incinerator effluents. Sampling systems are needed to support hazardous-waste engineering projects that require many semiroutine sampling tests. This study provided a design for a simplified sampling system for medium levels of volatile organic compounds (VOCs).

Most of this study has involved the evaluation of sorbents and mixed sorbent sampling tubes for a rugged, compact VOC collection system. This report describes the evaluation of sorbent materials, the development of a sampling tube, and the laboratory evaluation of the sampling system of a single tandem-bed sorbent tube containing Tenax GC and Spherocarb sorbents. Direct thermal desorption into a GC/FID or GC/MS provided a rugged and simple sampling and analysis system.

This Project Summary was developed by EPA's Air and Energy Engineering Research 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 results of trial burns of hazardous-waste incinerators suggest that volatile principal organic hazardous constituents (POHCs) and volatile products of incomplete combustion (PICs) may be important components in incinerator effluents. The collection and determination of VOCs boiling at less than 100 °C has been achieved by using bags, bulbs, and the volatile organic sampling train (VOST). A methods manual provides information on these methods. A protocol for the VOST has been developed which allows the sampling and analysis of POHCs with sufficient sensitivity to calculate a DRE of equal to or greater than 99.99% when the POHCs are present in the waste feed at 100 micrograms/g or higher. The VOST thus provides increased sensitivity to low-level concentrations of volatile POHCs because of its ability to concentrate the gaseous effluent.

This study provides the foundation for a simplified sampling-and-analysis system for medium concentration levels of VOCs. Sorbent systems were examined that would reduce the number of sorbent tubes and the complexity of the sampling system. Also examined were desorption methods that would eliminate the need for purge-and-trap (PAT) desorption of sorbent tubes. The objective was to provide sensitivity sufficient to permit calculating a DRE equal to or greater than 99.99% when POHCs are present in the waste feed at 1000 micrograms/g or higher.

Experimental

Selection of Solid Sorbents

After reviewing the literature, five sorbents were selected that had been used successfully in sampling and were prime candidates for use in semi-routine sampling to support engineering projects. Five sorbents were screened (Tenax-GC, Spherocarb, Ambersorb XE-340 and -347, and Carbosieve G) using 3.8 cm of the sorbent material in 3- and 8-mm-OD sampling tubes. In the final sorbent-tube

design, tandem-bed sorbents were used in the sampling tubes.

Evaluation of Solid Sorbents

The five sorbents were screened by spiking prepared tubes with 4 microliters of a working standard solution. This resulted in the following amounts of each compound on the tubes: tetrahydrofuran, 350 ng; toluene, 347 ng; and chlorobenzene, 442 ng. Charcoal-filtered air was pulled through the tubes at 0.28 L/min for 3-mm tubes and 0.5 L/min for 8-mm tubes to simulate sampling of standard atmospheres. Each tube was thermally desorbed and analyzed by GC/FID to determine the recovery of VOCs from the sorbent when compared with direct injections of the standard solution in a GC.

Prepared sorbent tubes were used to collect VOCs from an audit cylinder provided by EPA. The cylinder contained low concentrations of vinyl chloride, chloroform, carbon tetrachloride, benzene, and perchloroethylene in nitrogen. From the audit cylinder, 2.5, 5, and 10 L were sampled at 0.5 L/min. The sorbent tubes were then thermally desorbed and analyzed using GC/FID and GC/MS. Concentrations were determined by comparing area responses of the audit cylinder samples to area responses obtained from calibration standards of VOCs. Calibration curves were prepared by spiking 2, 4, 6, and 8 microliters of a standard solution (containing 294 microliters/mL chloroform, 317 micrograms/mL carbon tetrachloride, 175 micrograms/mL benzene, and 325 micrograms/mL perchloroethylene in carbon disulfide) on sorbent tubes. The sorbent tubes were thermally desorbed for analysis.

Conclusions

The sampling system developed in this study should be a useful addition to existing protocols for sampling and analyzing VOCs in incinerator effluents. This sampler is not a replacement for VOST but is intended to provide a simple method of sampling for use when extremely low levels of detection for POHCs are not required. It allows the sampling and analysis of compounds boiling under 150 °C with adequate recoveries (45 to 102%) and detection capabilities (LOD 5 to 50 ng). The simplified sampling system consists of a single tandem-bed sorbent tube containing Tenax-GC and Spherocarb sorbents. Direct thermal desorption into a GC/FID or GC/MS provides a rugged and simple sampling and analysis system.

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The complete report, entitled "Simplified Volatile Organics Sampler," (Order No. PB 87-133 468/AS; Cost: $13.95, subject to change) will be available only from:
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