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Project Summary

Recovery of Principal Organic Hazardous Constituents and Products of Incomplete Combustion from a Volatile Organic Sampling Train

Esther V. Robb, James F. McGaughey, Alston L. Sykes, and Denny E. Wagoner

This report describes an investigation of the recovery efficiencies of selected principal organic hazardous constituents (POHCs) from the Volatile Organic Sampling Train (VOST) under laboratory conditions. Analytical procedures discussed in the text include preparation of the standard solution, resin, and sampling traps; sample generation; sampling; analysis; and quality asssurance. Calibration development and treatment, as well as analysis validation, are discussed in detail. The discussion of the results includes the POHCs recovery efficiencies and POHC distribution through a set of sampling traps. Additionally, detailed precision and accuracy estimates are presented.

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).

The Report

The Resource Conservation and Recovery Act of 1976 requires that owners and operators of facilities which treat hazardous waste by incineration ensure that the incinerators are operated in an environmentally responsible manner. Such incinerators are required to have a destruction and removal efficiency (DRE) of 99.99% for each POHC designated in the Trial Burn Permit. The DRE standard, thus, requires that the POHCs be quantified by the sampling and analysis of the waste feed material and the stack gas effluent. Methods commonly used for the collection and analysis of volatile organics are the VOST followed by thermal desorption and GC analysis of the VOST traps. Any such methods used in the evaluation of the incinerator's DRE should be evaluated and shown to provide accurate and precise data for each POHC designated in the Trial Burn Permit.

To ensure that the above mentioned methods provide accurate DRE data, the recovery efficiencies of selected POHCs from the VOST were investigated in this work. The compounds included vinyl chloride, carbon tetrachloride, trichloroethylene, benzene, toluene, perchloroethylene, monochlorobenzene, methyl vinyl ketone, tetrahydrofuran, and chloroform. To determine the compound recoveries, a VOST train and an in-house organic vapor generation system were used. The generation system, shown in Figure 1, was used to produce known steady state levels of the chosen POHCs. The vaporized and gaseous POHCs were collected by the VOST, shown in Figure 2, and concen-

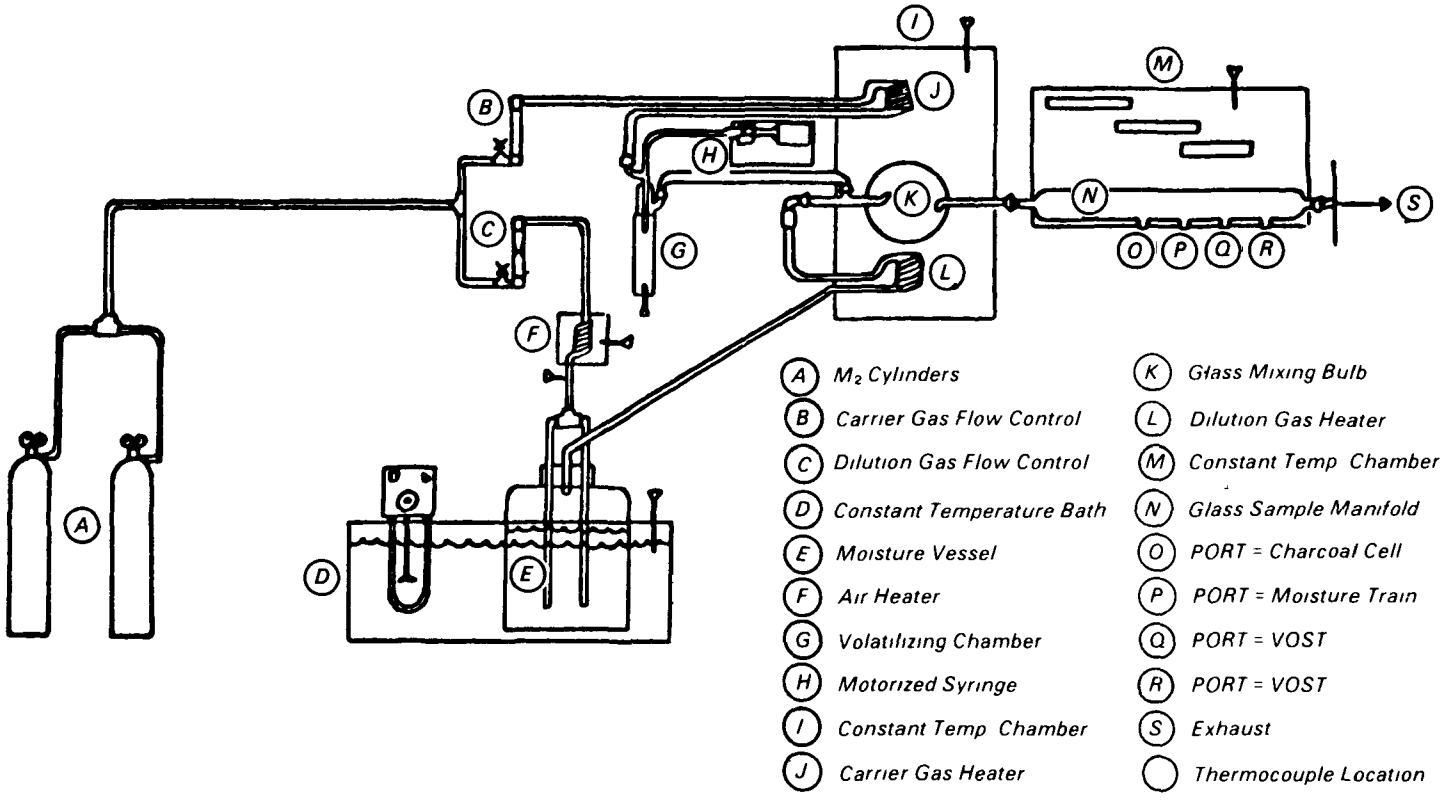

Figure 1. *Organic vapor generation system.*

trated in the polymeric resin, Tenax®. Inside/Inside (I/I) VOST sampling traps were used for sampling analyses. Three traps were used in tandem for all sampling: Tenax® (1.6 g), Tenax® (1.0 g), and charcoal (1.0 g). The traps were then separately thermally desorbed and analyzed using GC/FID and GC/MS detection.

Four-point calibration curves were initially developed using the VOST traps. All response curves were developed by linear regression, except in the event of a non-linear response. Control samples, treated identically to the VOST samples, were used as a check on the instrument calibration. Each sample and standard trap were spiked with a known amount of the internal standard, bromofluorobenzene (BFB), prior to analysis. BFB was then used not only to provide an analysis system check, but also to validate the analyses. The BFB analysis validation limit was ±3 of the overall mean BFB response value.

To determine the recovery efficiencies, the expected total nanograms of POHCs were compared to the total nanograms found by the GC/FID analysis. Excluding vinyl chloride and methyl vinyl ketone, the overall mean percent recovery for the individual compounds ranged from 81.03% for tetrahydrofuran to 118.1% for chloroform. Vinyl chloride had an overall mean percent recovery of 55.23%, most likely since thermal desorption does not tend to drive off vinyl chloride from activated charcoal as effectively as other organics from Tenax®. Methyl vinyl ketone also had a poor overall mean percent recovery of 37.82%, which was likely due to an apparent degradation of methyl vinyl ketone in the POHCs solution.

The mean percentage breakthrough of compound past the first sampling trap into the second or third trap for all compounds, except vinyl chloride, was found to be less than 5%. Individually, the overall mean percentage breakthrough of each compound ranged from 0.0 to 9.6%, except for vinyl chloride which had a constant breakthrough of 100% past Tenax® onto the activated charcoal.

The precision was found by pooling the coefficients of variation for all the compounds in the daily calibration checks or control standards. The accuracy was found by comparing the excepted amounts of POHCs in the generation system to those found by GC/FID analysis. The precision for the POHCs, including all compounds, was found to be 15.871%. Excluding methyl vinyl ketone and vinyl chloride, the overall mean percent accuracy for each compound ranged from −18.97% for tetrahydrofuran to +18.08% for chloroform. Vinyl chloride had an overall mean accuracy of −44.76%, while methyl vinyl ketone had an overall mean accuracy of −62.18%, for which the likely causes are mentioned above.

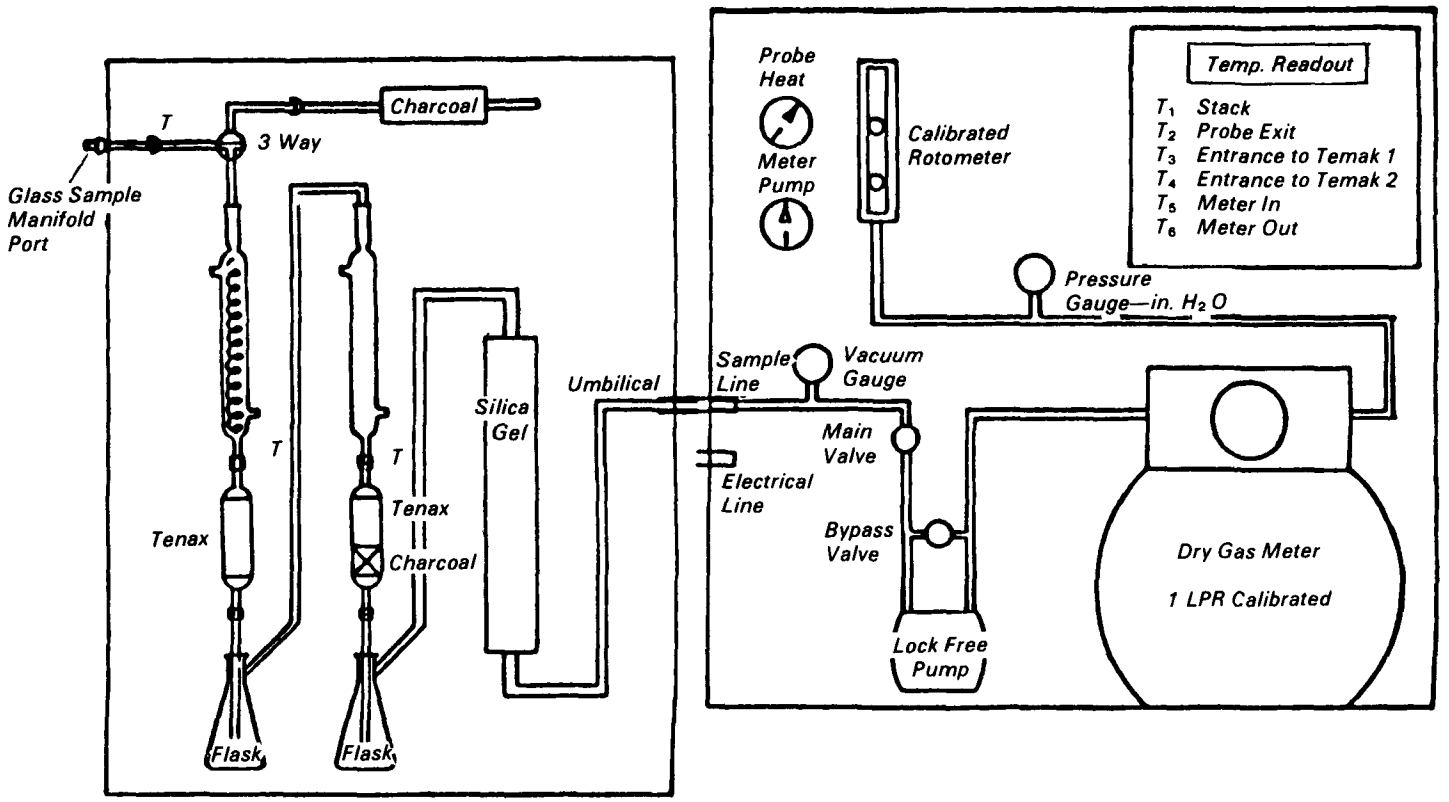

Figure 2. *Schematic of the VOST and control module.*

E. V. Robb, J. F. McGaughey, A. L. Sykes, and D. E. Wagoner are with Radian Corp., Research Triangle Park, NC 27709.
***Robin Anderson** is the EPA Project Officer (see below).*
The complete report, entitled "Recovery of Principal Organic Hazardous Constituents and Products of Incomplete Combustion from a Volatile Organic Sampling Train," (Order No. PB 86-219 003/AS; Cost: $11.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Air and Energy Engineering Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

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