MRI REPORT

A REVIEW OF TETRACHLOROETHYLENE MONITORING STUDIES

DRAFT FINAL REPORT
TASK 1(J)

EPA Prime Contract No. 68-02-3938
MRI Project No. 8501-A(1)

September 23, 1985

Prepared for

U.S. Environmental Protection Agency
Office of Pesticides and Toxic Substances
Field Studies Branch
401 M Street, S.W.
Washington, DC 20460

Attn: Mr. Richard Kent

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By

David H. Steele
John M. Hosenfeld

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DISCLAIMER

This document is a preliminary draft. If has not been released formally by the Office of Toxic Substances, Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, and should not at this stage be construed to represent Agency policy. It is being circulated for comments on its technical merit and policy implications.

PREFACE

This draft final report presents a review of documents for MRI Project No. 8501-A(1)J, "A Review of Tetrachloroethylene Monitoring Studies," for the Environmental Protection Agency (EPA Prime Contract No. 68-02-3938). Mr. David Steele served as subtask leader and together with Mr. John Hosenfeld conducted this literature review. This report was prepared by Mr. Steele and Mr. Hosenfeld.

MIDWEST RESEARCH INSTITUTE

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I. INTRODUCTION

Midwest Research Institute (MRI) was directed by the Field Studies Branch of the Exposure Evaluation Division of the Environmental Protection Agency (EPA) to review current studies concerning exposure to and monitoring of tetrachloroethylene. The study involved two primary tasks:

1. Assess the results of field studies concerning exposure to tetrachloroethylene and

2. Review the analytical methods of these studies.

Documents were supplied by EPA through its subcontractor, Versar. For evaluation purposes, the documents were divided into categories. The reviews presented in this report are in the same order as in "Table 2 Summary of Perchloroethylene Monitoring Data" supplied by Versar as submitted to EPA. The reviews are presented in the following order according to matrix:

Section 1	Air
Section 2	Surface Water
Section 3	Groundwater
Section 4	Drinking Water
Section 5	Sediment
Section 6	Tissue

Several articles contained data that were cited in several sections. When this occurred, the reviews were duplicated in each section, as appropriate, for ease of interpretation and review.

Thirty-two articles were received on September 9, 1985. Since EPA needed the articles reviewed and a draft report prepared by September 24, 1985, the EPA work assignment manager instructed MRI to focus primarily on the analytical method and secondly on the reasonableness of the data reported. Evaluation of survey design, sample collection and to a lesser extent, quality assurance is to be completed at a later date pending direction by the EPA work assignment manager.

II. PROCEDURES

The primary objective of each review was to assess the quality of the analytical method used to obtain the data. Since QA/QC is an integral part of the analytical method, QA/QC aspects were also considered as part of the method evaluation. The reported data were also briefly examined for reasonableness, based on the methods used.

The reprint summary form shown in Figure 1 was used as the basis for this review. In each article, a specific list of items was looked for in the document and, if mentioned, the item provided a means of assessing the merit of that aspect of the study. An item was evaluated only if it was described in the document; i.e., an item was not evaluated in cases where reference was made to an analytical procedure but no actual documentation of the procedures used was contained in the article.

Media: _____

Citation: _____

_____

_____

Measurement Procedure: _____

Cleanup/fractionation: _____

Recovery: _____

Interferences: _____

Limit of detection: _____

Precision and Accuracy: _____

Problems: _____

Instrument: _____

Linear response: _____

Stability of response: _____

Problems: _____

Critique: _____

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Figure 1. Reprint summary form.

A sliding scale (1-5) was designed and used to evaluate the documents. The basic criteria for assigning a value to each paper are given below. Adjustments to the ratings were then made based on additional information contained in the document. For example, if a document contained a full description of analytical and quality assurance procedures but the QA/QC results were not reported, the document was given a basic rating of 2. However, if problems were noted (e.g. sampling problems, wide interlab variances, interferences, etc), the rating was lowered. Conversely, a data table, containing no reference to the analytical method used would be rated 5; however, if some QA/QC results (e.g. limit of detection, precision, etc) were reported, the rating was increased.

Rating	Criteria	Example
1.	Contains a full description of analytical and QA/QC procedures. QA/QC results reported.	Hunter and Sabatino, 1981
2.	Analytical and QA/QC procedures described, QA/QC results not reported.	Evans et al., 1979
3.	Analytical method referenced to a standard analytical method. QA/QC results not reported.	USEPA, 1982a
4.	Method referenced to a nonstandard method or to an earlier paper. QA/QC results not reported.	Lillian, 1975
5.	Method not stated or referenced.	data only (Plumb, 1985)

III. RESULTS

Forty-six documents were reviewed for this report. Thirty-two documents were submitted by EPA through its subcontractor, Versar. Five articles were obtained from EPA Region 7 library, eight through MRI's library, and one article was obtained from MRI archives. Sixteen were not received for review based on Versar's Table 2.

The results are presented in seven subsections. The first six are based on the order in Versar's Table 2, "Summary of Perchloroethylene Monitoring Data". The seventh section contains the results of the review of the NIOSH Method which were specifically requested by the EPA work assignment manager.

The comments included in these sections are brief descriptions of the more salient features of each review. The complete reviews and a bibliography of the documents are contained in Appendices A and B, respectively.

During the review process, several discrepancies were noted between the Versar Table 2 and the information contained in the articles reviewed.

The discrepancies are noted in Table 1 of the present missing report. Missing analytical methods, incomplete detection limit data, and 17 reference articles were the discrepancies noted.

A description of the physical and chemical properties of tetrachloroethylene is also contained in this section.

A. Background

The physical and chemical properties of tetrachloroethylene are given below.

Names: tetrachloroethylene, perchloroethylene, tetrachloroethene, ethylene tetrachloride, tetrachlorethylene, Nema, Tetrocap, Tetropil, Perclene, Ankilostin, and Didakene.

Molecular and structural formula: C_2Cl_4; $Cl_2C=CCl_2$

Molecular weight: 165.85

Melting point: -22°C

Boiling point: 121°C

Specific gravity: 1.6311 (20/4)

Refractive index: (N_D^{20}): 1.5055

Solubility: Soluble in 10,000 parts water; miscible with alcohol, ether, chloroform, and benzene.

B. Results

1. Air

Fourteen documents concerning tetrachloroethylene in air were reviewed. The ratings assigned are given below.

Reference	Rating
Evans, 1978	1.5
Pellizari & Bunch, 1979	1.5
ESCOR, 1982	2
Bozzelli & Kebbekus, 1982	2.5
MRI, 1976	3
USEPA, 1978	3.5
Brodzinsky & Singh, 1983	4
Singh, 1977	4
Lillian, 1975	4
Wentz, 1973	4
Clark, 1982	4
NRC, 1978	5
PEDCO, 1981	5
USEPA, 1980c	5

2. Surface Water

Twelve surface water documents were received. The ratings of these articles are given below.

Reference	Rating
Hunter & Sabatino, 1981	1
USEPA, 1977c	2
USEPA, 1982a	2
USEPA, 1982b	2
MRI, 1976	3
Bellar, 1974	4
Helz and Hsu	4
Kaiser & Comba, 1983	4
USEPA, 1977b	4
USEPA, 1982d	4
USEPA, 1980b	4.5
USPEA, 1982c	5

3. Groundwater

Eight papers concerning groundwater were reviewed. These documents were rated as follows.

Reference	Rating
Tomson, 1981	2
USEPA, 1984b	2.5
CEQ, 1981	5
Plumb, 1985	5
USEPA, 1980c	5
USEPA, 1982e	5
USEPA, n.d. (d)	5
USEPA, n.d. (e)	5

4. Drinking Water

Thirteen documents concerning drinking water were reviewed. The assigned ratings are given below.

Reference	Rating
Wakeham, 1980	1.5
Wallace, 1984	1.5
Minsley, 1983	3
Bellar, 1974	4
Clark, 1982	4
Larson, 1983	4
USEPA, 1975	4
JRB, 1982	4.5
Suffet, 1977	4.5

Reference	Rating
CEQ, 1981	5
MRI, 1979	5
USEPA, 1980c	5
USEPA, 1984c	5

5. Sediment

Two sediment documents were reviewed. The ratings assigned to these studies were as follows.

Reference	Rating
USEPA, 1984b	2.5
USEPA, 1980b	4.5

6. Tissue

Three articles concerning tissue were reviewed. The ratings for these documents were as follows.

Reference	Rating
USEPA, 1980a	1.5
JRB, 1982	4.5
McConnell, 1975	5

7. Analytical Method

Reference	Rating
NIOSH, 1977	1

IV. CONCLUSIONS

On the basis of the rating system, documents with values of 3 or lower were judged to be acceptable. Those with ratings greater than 3 were judged unacceptable. It should be noted that the data contained in unacceptable documents may be valid; however, the lack of documentation of analytical and quality assurance procedures precluded assessment of the quality of the data.

Of the 44 documents reviewed, only two were rated excellent. One of these was the standard NIOSH method for volatiles in air (NIOSH 1977). Any study conducted which strictly follows the procedures outlined in this method should produce data of high quality. The second document was an excellent water study conducted by Hunter and Sabatino (1981). Analytical procedures were outlined in a step-by-step fashion. In addition, calibration parameters, recovery and quality assurance data, and criteria for determining analytical system compliance were also reported. The data reported in this document are judged to be of high quality.

Five other documents (Evans 1978, Pellizari & Bunch 1979, USEPA 1980a, Wakeham 1980, and Wallace 1984) were judged to be of very good quality; however, they lacked the completeness of Hunter and Sabatino. Data contained in these documents are judged to be valid.

Eight documents (Bozzelli & Kebbekus 1982, ESCOR 1982, Minsley 1983, MRI 1976, Tomson 1981, USEPA 1978, USEPA 1980a, and USEPA 1984b) were judged to be acceptable.

Table 1. Comparison and Changes to Versar Table 2-1, Summary of Perchloroethylene Monitoring Data: Incorrect Information Given in Parentheses[a]

Description of study	Analytical methods[b]	Detection limit[b]	Reference
Section 1 - Air			Howil, 1980[c]
	Colorimetric (GC)		Wentz, 1973
			Thomas, 1979[c]
		0.0025 μg/m³ (NR)[d]	Pellizari & Bunch, 1979
			Pellizari, 1982b[c]
	GC/ECD[e] (GC/MS)[f]		Evans, 1979
			Hunt, 1985[c]
			Singh et al., 1978[c]
			Hwang, 1982[c]
		0.005 μg (0.005 μg/m³)	ESCOR, 1982
	GC/ECD (GC)		Clark et al., 1982
Section 2 - Surface Water			ADL, 1981[c]
	GC/ECD (GC)	0.04 μg/L (NR)	Kaiser & Comba, 1983
	GC/HECD[g] (GC/MS)		Helz & Hsu, 1978
			ADL, 1979a[c]
	GC/FID[h] (GC/MS)	0.1 μg/L (NR)	Bellar et al., 1974
	GC/HECD		
			Chian & Ewing, 1977[c]
			Pearson & McConnell, 1975[c]
	GC/FID (NR)		MRI, 1976
			Scott Environmental, 1976[c]
		1 μg/L (NR)	EPA, 1982a
		10 μg/L (NR)	EPA, 1982c
		10 μg/L (NR)	EPA, 1982d
		.05 (ND)	Hunter & Sabatino, 1981
Section 3 - Groundwater			
			Tucker, 1981[c]
	GC/FID (GC)		Tomson, 1982
		2 μg/L (NR)	USEPA, 1982e
		2 μg/L (NR)	USEPA, n.d (d)

Table 1 (continued)

Description of study	Analytical methods[b]	Detection limit[b]	Reference
Section 4 - Drinking Water			
			Dowty et al., 1975[c]
			USEPA, 1981a[c]
	GC/MS (NR)		Suffet et al., 1977c
			Zweidinger et al. n.d.[c]
	GC/FID (NR)		USEPA, 1975
	GC/MS		
	GC/HECD (GC)	2 µg/L ( )	USEPA, 1984c
	GC/ECD (GC)	50 ppt (NR)	Clark et al.[c], 1982
			Love et al.
		1 µg/L (NR)	Minsley, 1983
	GC/FID (GC/MS)		Wakeham et al., 1980
	GC (NR)	0.1 µg/L (NR)	Larson et al., 1983
			STORET data[c]
Section 5 - Sediment			
Section 6 - Tissue			
		0.6 µg/kg (NR)	USEPA, 1980a

[a]Review only addressed analytical methods and detection limits. No comment on concentration stated in articles.
[b]Correction stated (incorrect version in parentheses).
[c]Article not sent to MRI for review.
[d]NR - Not detectable.
[e]ECD = electron capture detector.
[f]MS = mass spectrometer detector.
[g]HECD - Hall electrolytic conductivity detector.
[h]FID = flame ionization detector.

APPENDIX A

COMPLETED REVIEW FORMS

Media: Drinking Water.

Citation: Bellar et al., 1974.

Measurement Procedure: Purge and trap.

Cleanup/fractionation: NA (not applicable).
Recovery: NR (not reported).
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ±20%
Problems: NR.

Instrument: GC/FID and GC/HECD

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: All of the analytes in this study (primarily trihalomethane) were quantitated using chloroform standards; therefore, the data obtained for tetrachloroethylene cannot be considered accurate.

Media: Air.

Citation: Bozzelli and Kebbekus, 1982.

Measurement Procedure: Collection on Tenax GC.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Details of experimental technique, recovery, and quality control procedures were presented in a previous paper. Data quality cannot be assessed without this information.

Media: Air.

Citation: Brodzinsky and Singh, 1983.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR, but document states that ± 25% is acceptable.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: A limited peer review of data quality rated the data for tetrachloroethylene as good to excellent. Quality assurance procedures are also described. Analytical methods, LOD, and standard deviation were recorded in a data base, but this information was not available in the document.

Media: Water.

Citation: Clark, 1982.

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/ECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Data are cited and summarized from a secondary source. Although electron capture gas chromatography is an appropriate instrumental choice, no comment can be made about the validity or accuracy of the data.

Media: Groundwater.

Citation: Council of Environmental Quality, 1981.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This document is a brief survey on contamination of groundwater. EPA and several state surveys are cited; however, analytical methodologies are not discussed.

Media: Air.

Citation: ESCOR, 1982.

Measurement Procedure: Modified EPA Method 624.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 5 ng.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The analytical procedure used is a modification of the EPA method for volatiles. The modification (elimination of the water purge step) should not affect the validity of the results. Interlab comparisons were in general agreement. If the QA/QC procedures outlined in Method 624 were followed, the data should be of good quality.

Media: Air.

Citation: Evans et al., 1979.

Measurement Procedure: Collection on charcoal/extraction with carbon disulfide.

Cleanup/fractionation: NR.
Recovery: Estimated at ~ 70%.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ~ 16% C.V.
Problems: NR.

Instrument: GC/ECD.

Linear response: 0.5 ng-10 ng; demonstrated with standards.
Stability of response: NR.
Problems: NR.

Critique: The methodology used for this study is basically the NIOSH P & CAM 127 procedure, which is well-established. Extensive internal and external quality assurance measures were utilized; therefore, the data are judged to be of high quality.

Media: Air.

Citation: Grimsrud and Rasmussen, 1975.

Measurement Procedure:

Cleanup/fractionation: Direct injection.
Recovery: NR.
Interferences: Tetrachloroethylene was present in the carrier gas.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Analytical procedures were described in an earlier publication. Traces of tetrachloroethylene in the carrier gas limited the accuracy of measurement. It is unknown whether the impurities were at a consistent level in carrier gas. If so, then the effect would be on the detection level. If the impurities showed up in a random pattern, then the entire data set would be questionable.

Media: Water.

Citation: Helz and Hsu, 1978.

Measurement Procedure: Headspace analysis.

Cleanup/fractionation: NA.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ± 4% for replicate injection.
Problems: NR.

Instrument: GC/HECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This is a study on the effects of chlorination on various types of water (river water and sea water). Headspace analysis is a fairly standard technique; however, the lack of quality assurance details makes assessment of the data quality difficult.

Media: Water.

Citation: Hunter and Sabatino, 1981.

Measurement Procedure: Purge and trap; pentane extraction.

Cleanup/fractionation: NA.
Recovery: 94% (purge and trap) 97% (pentane extraction).
Interferences: NR.
Limit of detection: 50 ppt.
Precision and Accuracy: 0.6% coefficient of variation; ± 10-20% (pentane extraction).
Problems: n-pentane from Fisher had the least amount of contamination.

Instrument: Purge and trap; HECD; ECD.

Linear response: Two calibration points.
Stability of response: NR.
Problems: NR.

Critique: An excellent report that details the analytical method used in a step-by-step fashion: the calibration parameters, the level of quality control samples, and the criteria for determining analysis system compliance. Recovery data were within the range of the method. Assuming that the quality control samples analyzed with the water samples were within specification, the data are judged valid.

Media: Drinking Water and Food.

Citation: JRB, 1982.

Measurement Procedure: Purge and trap.

Cleanup/fractionation: NA.
Recovery: NR.
Interferences: NR.
Limit of detection: 0.1-0.5 µg/L.
Precision and Accuracy: NR.
Problems: Extended sample storage periods (2 yrs) may have caused losses of analytes.

Instrument: GC/HECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This document is a summary of five federal surveys (NOSP, CWSS, RWS, NOMS, and GWSS). All but the GWSS study experienced extended sample storage periods, making the results suspicious. The GWSS study may have produced data of acceptable quality; however, no analytical details were provided to substantiate this.

Media: River Water.

Citation: Kaiser and Comba, 1983.

Measurement Procedure:

Cleanup/fractionation: Cited an earlier paper.
Recovery: NR.
Interferences: NR.
Limit of detection: 40 ng/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: ECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Cleanup procedures were not given in this paper, but rather were referenced in an earlier paper. The analytical procedures given appear to be good and the standard concentrations cited are reasonable for GC/ECD; however, data concerning analyte recovery, precision and accuracy are needed to fully assess the quality of the data reported.

Media: Drinking Water.

Citation: Larson et al., 1983.

Measurement Procedure: Collected on adsorbant, then analyzed by GC.

Cleanup/fractionation: Activated carbon or synthetic resin.
Recovery: NR.
Interferences: NR.
Limit of detection: 0.1 µg/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC (no detector stated).

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This article concerns the leaching of tetrachloroethylene from vinyl coated air conditioning lines. Few analytical details are given; therefore, it is not possible to estimate the quality of the data without additional information e.g., volume of sample collected, instrument standardization, etc.

Media: Air.

Citation: Lillian et al., 1975.

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ± 15%.
Problems: NR.

Instrument: GC/ECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Analytical details were presented in an earlier paper; therefore, it is difficult to assess the quality of the data. The values obtained appear reasonable for electron capture GC.

Media: Air.

Citation: Lovelock, 1975.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The analytical method is not cited in this paper; some of the language used would indicate that gas chromatographic analyses were employed. The data quality cannot be assessed without further documentation.

Media: Tissue.

Citation: McConnell et al., 1975.

Measurement Procedure: Summary statement with references.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: A summary paper on occurrence in environment, animals and humans including comments on emission and distribution pathways, absorption, metabolism, and excretion; effects on wildlife and degradation. No information stated in article to assess data validity.

Media: Groundwater.

Citation: Minsley, 1983.

Measurement Procedure: EPA Method 501.2.

Cleanup/fractionation: EPA Method 501.2.
Recovery: NR.
Interferences: NR.
Limit of detection: 1 µg/L.
Precision and Accuracy: NR.
Problems: None reported.

Instrument: GC/ECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The quality of the data cannot be assessed from the information contained in the paper; however, if the procedures outlined in EPA 501.2 were followed, the data should be of good quality.

Media: Wastewater/Air.

Citation: MRI, 1976.

Measurement Procedure:

Cleanup/fractionation: Benzene extraction for water samples; direct sampling for air.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ± 13% for 500-ppm standard.
Problems: NR.

Instrument: GC/FID.

Linear response: Calibration curve given in document.
Stability of response: NR.
Problems: NR.

Critique: These analyses were conducted according to the EPA method for the determination of perchloroethylene from stationary sources (Washington, Draft). The analytical techniques described indicate that the data should be of good quality.

Media: Air; Water.

Citation: MRI, 1979.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This presentation is from the "Proceedings of the Conference on Methyl Chloroform and Other Halocarbon Pollutants." Summary data are provided for ambient air around manufacturing plants, and unspecified cities which also had water levels reported. No analytical methods were presented, so no assessment of data quality can be made.

Media: Air.

Citation: NIOSH, 1977.

Measurement Procedure:

Cleanup/fractionation: 0.5 mL of carbon disulfide and a 30-min desorption period.
Recovery: Tests have indicated that desorption is complete in 30 min; however, desorption efficiency is determined with each set of samples.
Interferences: Any compound which has a similar gas chromatographic retention time.
Limit of detection: 0.06 mg/sample (maximum sample size: 25 L).
Precision and Accuracy: 10%.
Problems: NR.

Instrument: GC/FID.

Linear response: Established with standard solutions of tetrachloroethylene in carbon disulfide.
Stability of response: NR.
Problems: NR.

Critique: This method is designed for the determination of organic solvents in air. The limit of detection is 0.06 mg/sample. Maximum sample size is 25 L. The mean relative standard deviation of the analytical procedure is given as 8%. The total method, including field sampling, yields a mean relative standard deviation of 10%. The accuracy of the overall method is 10% when the sampling pump is calibrated with the tube in place. Since this is rarely the case, the accuracy and precision of the method are limited by the reproducibility of the pressure drop across the tubes. If the procedures outlined in this method are followed, data of high quality can be expected.

Media: Air.

Citation: NRC, 1978.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: No analytical details were presented in this report; therefore, an assessment of the analytical method and data quality cannot be made.

Media: Air.

Citation: PEDCO, 1981.

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This is a review document outlining the various methods for evaluation of volatile organics. The analytical procedures used to obtain the data contained in the document are not discussed; therefore, the quality cannot be assessed.

Media: Ambient Air.

Citation: Pellizzari and Bunch, 1979.

Measurement Procedure: Collection on Tenax.

Cleanup/fractionation: Purge and trap.
Recovery: NR.
Interferences: NR.
Limit of detection: 2.5 ng/m^3 (0.38 ppt).
Precision and Accuracy: From ± 10 to ± 30% for various substances; NR for tetrachloroethylene.
Problems: NR.

Instrument: GC/MS.

Linear response: Relative molar response factors were used for quantitation.
Stability of response: NR.
Problems: NR.

Critique: This paper is well-documented with analytical details. Based on the procedures outlined, data of good quality can be expected.

Media: Groundwater.

Citation: Memo from RH Plumb, Jr. (EPA) to D. Basko (Versar) dated 6/3/85.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This is a tabulation of monitoring data for 183 hazardous waste sites located throughout the United States. No information is given on the analytical method; therefore, no comments about the method or data quality can be made.

Media: Air.

Citation: Singh, 1977.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ± 10% for 20 ppt or greater; ± 15% for 10-20 ppt.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Analytical details were referenced to an earlier paper which was not submitted for review; therefore, the quality of the data cannot be assessed.

Media: Drinking Water.

Citation: Suffet et al., 1977.

Measurement Procedure:

Cleanup/fractionation: Ion exchange resin.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This is a qualitative study of organics in drinking water. The methods used to confirm the presence of the analytes are good; however, the lack of quantitative results limits the usefulness of this study.

Media: Water.

Citation: Tomson, 1981.

Measurement Procedure:

Cleanup/fractionation: XAD-2 resin.
Recovery: NR.
Interferences: NR.
Limit of detection: Unknown since document had data lined out.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/FID and GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: The compounds were calculated by relative FID response, but tetrachloroethylene was quantitated by an "authentic" standard.

Critique: The data may be valid based on the use of an "authentic" standard for tetrachloroethylene and confirmation by GC/MS. Precision and accuracy data were lacking.

Media: Drinking Water.

Citation: USEPA, 1975 (appendices).

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/FID and GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: An extensive amount of information is given on the methods and quality control results for six other volatile compounds but does not include tetrachloroethylene. There is an insufficient amount of information to judge the quality of the data for the compound of interest.

Media: Surface Waters.

Citation: USEPA, 1977b (appendix).

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 1 ppb.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The document reviewed was an appendix to the final report which was not available. The abstract contains general information about the study but contains no specifics on analytical methods. One disconcerting note is lack of relative retention times for the volatile compound results. The immediate questions are these: were standards used for quantitation, and why were no relative retention times reported for volatiles as were reported for the semivolatiles? The quality of the data cannot be assessed.

Media: Wastewater.

Citation: USEPA, 1977c.

Measurement Procedure: Modified EPA Method 624.

Cleanup/fractionation: NA.
Recovery: NR.
Interferences: NR.
Limit of detection: 1 µg/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Analytical parameters were well-defined. If the procedures outlined in EPA Method 624 were followed, the data should be of good quality.

Media: Air.

Citation: USEPA, 1978.

Measurement Procedure:

Cleanup/fractionation: Tenax GC cartridge.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: Capillary column GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The study involved optimizing Tenax GC for collection of nitrosamines and then characterizing ambient air concentrations within the United States. It appears that no authentic standards were used to quantitate perchloroethylene. Comparison of the mass fragmentograms and the use of the relative molar method were used for identification and quantitation.

Media: Mother's Milk.

Citation: USEPA, 1980a.

Measurement Procedure: Purge and trap.

Cleanup/fractionation: NA.
Recovery: 63 ± 2 (one standard deviation of three replicates).
Interferences: NR.
Limit of detection: 0.6 µg/kg based on 50-g sample for a typical organic compound.
Precision and Accuracy: ± 10% based on replicates.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The data should be valid based on the details reported. The headspace analysis resulted from previous method development work and was validated using four radiolabeled model compounds. The identification of perchloroethylene was obtained by comparison to the Eight Peak Index of Mass Spectra and interpreted. Quantitation was based on two external standards and the method of relative molar response. Only four volatile compounds were quantitated. However, the data are judged to be valid.

Media: Wastewater.

Citation: USEPA, 1980b (Interim Report).

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: A major gap exists in the copy of the report submitted for review; i.e., no analytical method section was given or referenced. No comments about the data quality or reasonableness can be made.

Media: Air.

Citation: USEPA, 1980c (Singh et al.).

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This paper was presented in the "Proceedings of the Conference on Methyl Chloroform and Other Halocarbon Pollutants.: Two data points are given, but no analytical methods are stated. No assessment of the data can be made.

Media: Wastewater.

Citation: USEPA, 1982a, Effluent Guidelines for Metal Finishing.

Measurement Procedure: "Performed in accordance with methods set forth in 40 CFR Part 136" by multiple labs, i.e., EPA and contractors.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 1 µg/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: If the analyses were performed according to 40 CFR Part 136 and all applicable quality assurance and controls were followed, then the data should be valid. However, no assumption can be made on the "reasonableness" of the data.

Media: Wastewater.

Citation: USEPA, 1982b, Effluent Guidelines - Pharmaceutical Industry.

Measurement Procedure: USEPA "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants," April 1977, and USEPA "Analytical Methods for the Verification Phase of the BAT Review," June 1977.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Based on the statements about the analytical methods and the extensive quality assurance/quality control procedures, the data may be valid. In addition, the Precision and Accuracy program was stated as used to substantiate the data. However, without actually reviewing the data, since they were not presented, no statement of quality on specific data can be made.

Media: Wastewater.

Citation: USEPA, 1982c.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 10 µg/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Since no analytical details were provided in this document, the quality of the methods and data cannot be assessed.

Media: Wastewater.

Citation: USEPA, 1982d.

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 10 µg/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: No analytical details were given; however, the document states that strict quality control techniques (standards, blanks, and spikes) were employed. The data reported in this paper may be valid; however, review of the quality control data would be necessary to confirm this.

Media: Groundwater.

Citation: USEPA, 1982e.

Measurement Procedure: NR.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 2 µg/L.
Precision and Accuracy: NR.
Problems: None reported.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: As no analytical details were contained in this document, an assessment of data quality is not possible.

Media: Groundwater.

Citation: USEPA, 1984b.

Measurement Procedure: Purge and trap/GC/MS as described by EPA.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 10
Precision and Accuracy: NR.
Problems: NR.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: These analyses appear to have been conducted according to EPA Method 624. If this is the case, and the procedures outlined in Method 624 were followed, the data should be of good quality. The data sheets contained in this document were well-documented.

Media: Groundwater.

Citation: USEPA, 1984c.

Measurement Procedure: Headspace analysis.

Cleanup/fractionation: NA.
Recovery: NR.
Interferences: NR.
Limit of detection: 2 µg/L.
Precision and Accuracy: NR.
Problems: Sampling problems were noted by EPA inspection.

Instrument: GC/HECD.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The data obtained appear to be reasonable; however, problems noted by EPA inspectors concerning inappropriate sampling materials and the possibility of cross-contamination would cast doubts on their validity.

Media: Groundwater.

Citation: USEPA n.d (d).

Measurement Procedure: VOA.

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 2 µg/L.
Precision and Accuracy: NR.
Problems: NR.

Instrument: NR.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Analytical procedures were not given; therefore, an assessment of data quality cannot be made. However, the document cites sampling deficiencies and discrepancies in the split-sampling results which would indicate that the data are of poor quality.

Media: Groundwater.

Citation: USEPA n.d. (e).

Measurement Procedure:

Cleanup/fractionation: NR.
Recovery: NR.
Interferences: NR.
Limit of detection: 0.1 µg/L.
Precision and Accuracy: NR.
Problems: The results obtained by the site's lab and the EPA varied widely, although both labs were using the same procedures.

Instrument: GC/MS.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The quality cannot be assessed without further analytical details; however, the discrepancies between the two labs would indicate that data quality may not be acceptable.

Media: Drinking Water.

Citation: Wakeham et al., 1980.

Measurement Procedure: GC peak area comparison with internal standard.

Cleanup/fractionation: Purge and trap/CS_2 extraction.
Recovery: NR, however, extended purge times did not increase the amount of tetrachloroethylene recovered.
Interferences: NR.
Limit of detection: NR, but 2 ppb was measured.
Precision and Accuracy: ± 10%.
Problems: NR.

Instrument: Capillary GC/FID.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: This appears to be a well-designed study. The use of surrogates and confirmation by GC/MS indicate that the quality of the data should be acceptable.

Media: Drinking Water.

Citation: Wallace et al., 1984.

Measurement Procedure: Purge and trap.

Cleanup/fractionation: Purge and trap.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: ± 30% interlab variation.
Problems: NR.

Instrument: GC/HECD/FID.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: Extensive quality assurance measures (spikes, blanks, replicates, and interlab comparisons) indicate that the data obtained are of high quality.

Media: Indoor Air.

Citation: Wentz, 1973.

Measurement Procedure: UV and color indicating tubes.

Cleanup/fractionation: NA.
Recovery: NR.
Interferences: NR.
Limit of detection: NR.
Precision and Accuracy: NR.
Problems: NR.

Instrument: Prototype instrument from Honeywell.

Linear response: NR.
Stability of response: NR.
Problems: NR.

Critique: The use of color indicating tubes is a fairly standard method of determining approximate concentration of pollutants in industrial settings. No information concerning the standardization of the UV instrument was contained in the article; therefore, the accuracy of these data cannot be assessed.

APPENDIX B

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