



Project Summary

Second Supplement to Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air

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The *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* was compiled to provide current, written, peer-reviewed procedures in a standardized format for determining concentrations of toxic organic compounds of importance in ambient air. This Second Supplement to the Compendium adds 5 new methods, bringing the number of procedures contained in the Compendium to 14. A complementary document titled *Technical Assistance Document (TAD) for the Determination of Toxic Organic Compounds in Ambient Air* provides general guidance for ambient monitoring of organic compounds.

The sampling procedures in the Compendium include liquid impingers, passivated steel canisters, and various adsorbent, cryogenic, and foam trapping technology. Analytical procedures include gas and liquid chromatography with various detectors including mass spectroscopy techniques. Many toxic organic compounds can be sampled and analyzed by several techniques, often with different interferences and detection limitations. This allows flexibility in selecting procedures to complement the user's expertise and laboratory capability.

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

Toxic air pollutants have been of concern for many years, primarily under Section 112 of the Clean Air Act, which establishes procedures for designating National Emission Standards for Hazardous Air Pollutants (NESHAP). NESHAPs are intended to provide control of source categories which emit pollutants that "may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness."

Likewise, public concern for protection from exposure to toxic substances has intensified over the last decade. Evidence of the presence of these substances in ambient air across the United States has been increasing for some time. Although many of these substances are presently controlled through occupational, consumer protection, water or waste disposal regulations, control of air pollution involving specific toxic substances has been limited. This is due, in part, to a lack of information on ambient air levels of these substances and the uncertainty of the sampling and analysis methods for their measurement.

Over the last several years, state and local air pollution control agencies have increased their efforts to measure the concentrations of toxic pollutants in ambient air. These activities have included monitoring around abandoned hazardous waste dump sites and solid waste land

fills, as well as other point source and urban area monitoring. For the most part, network design, siting, sampling, and analysis procedures used were based on professional judgments rather than adherence to any documented, uniform procedures and guidelines. The absence of standardized procedures raises serious concerns about the adequacy of the data collected for their intended use. Ensuring data adequacy is critical, since major decisions on control actions, health effects, and other significant issues could be based on the interpretation of such data.

To address the need for standardized measurement procedures, EPA has established a *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*. This Compendium contains current, peer-reviewed sampling and analytical procedures in a standardized format for analysis of selected toxic organic pollutants of primary importance in ambient air. The original Compendium (EPA 600/4-84-041, 1984) contained five methods, and a Supplement (EPA 600/4-87-006, 1986) added four more procedures. This Second Supplement adds five new methods to the Compendium, bringing the total number of methods in the Compendium to 14, covering a variety of toxic organic air pollutants. The five new procedures are applicable to pesticides (Method T010), formaldehyde (Method T011), total non-methane organic compounds (Method T012), benzo(a)pyrene and other polynuclear aromatic

hydrocarbons (PAHs) (Method T013), and various toxic volatile organic compounds (VOCs) (Method T014). General guidance regarding monitoring of ambient organic compounds is contained in a companion document titled *Technical Assistance Document (TAD) for the Determination of Toxic Organic Compounds in Ambient Air*.

Structure of the Compendium

Each procedure of the Compendium is written to be used independently from the others. In general, the procedures are divided into the following twelve sections:

- Scope
- Applicable Documents
- Summary of Method
- Significance
- Definitions
- Interferences
- Apparatus
- Reagents/Materials
- Assembly/Calibration
- Sampling
- Analysis
- Performance Criteria and Quality Assurance

The procedures are written in a standardized format used by the American Society for Testing and Materials (ASTM). Each procedure has been identified with a revision number and date to allow future modifications. Additional procedures, which may be compound-specific or of multiple analyte design, will be added to the compendium as they become available.

Nearly all the procedures have considerable flexibility and assume the analyst has substantial expertise. Commonly, users are responsible for preparing certain standard operating procedures (SOPs) to be employed in particular laboratory. Each procedure indicates those operations for which SOPs are required.

The Second Supplement contains new methods to be added to the Compendium and an update/correction to Method T09 (published in the first supplement). It also contains instructions for updating pages for merging the Second Supplement information with previously published material, and includes a revised Table of Contents. Updated Tables 1 and 2 to include the previous methods and the new methods. When so combined, the user will have a fully integrated Compendium covering all 14 methods. Updated Table 1 gives a brief description of each method and the types of compounds to which it is applicable. Updated Table 2 provides a partial listing of toxic organic compounds that can be determined and the applicable method or methods. Many of the procedures may be used to determine other toxic organics not indicated in Table 2. The user must be cautioned to evaluate the applicability of the method for other organic substances before use.

Table 1. Brief Method Description and Applicability

Method Number	Description	Types of Compounds Determined
01	Tenax GC Adsorption and GC/MS Analysis	Volatile, nonpolar organics (e.g., aromatic hydrocarbons, chlorinated hydrocarbons) having boiling points in the range of 80° to 200°C.
02	Carbon Molecular Sieve Adsorption and GC/MS Analysis	Highly volatile, nonpolar organics (e.g., vinyl chloride, vinylidene chloride, benzene, toluene) having boiling points in the range of -15° to +120°C.
03	Cryogenic Trapping and GC/FID or ECD Analysis	Volatile, nonpolar organics having boiling points in the range of -10° to +200°C.
04	High volume PUF Sampling and GC/ECD Analysis	Organochlorine pesticides and PCBs
05	Dinitrophenylhydrazine Liquid Impinger Sampling and HPLC/UV Analysis	Aldehydes and Ketones
06	High Performance Liquid Chromatography (HPLC)	Phosgene
07	Thermosorb/N Adsorption	N = Nitrosodimethylamine
08	Sodium Hydroxide Liquid Impinger with High Performance Liquid Chromatography	Cresol/Phenol
09	High Volume Polyurethane Foam Sampling with High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS)	Dioxin
010	Low Volume Polyurethane Foam (PUF) Sampling With Gas Chromatography/Electron Capture Detector (GC/ECD)	Pesticides
011	Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPCL) Detection	Formaldehyde
012	Cryogenic Preconcentration and Direct Flame Ionization Detection (PDFID)	Non-methane Organic Compounds (NMOC)
013	PUF/XAD-2 Adsorption with Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC) Detection	Polynuclear Aromatic Hydrocarbons (PAHs)
014	SUMMA® Passivated Canister Sampling with Gas Chromatography	Semi-Volatile and Volatile Organic Compounds (SVOC/VOCs)

Table 2. Method Applicability to Compounds of Primary Interest

Compound	Applicable Method(s)	Comments
Acenaphthene	T014	
Acenaphthylene	T014	
Acetaldehyde	T05, T011	Extension of T011.
Acetone	T011	Extension of T011.
Acrolein	T05, T011	Extension of T011.
Acrylonitrile	T02, T03	T03 yields better recovery data than T02.
Aldrin	T010	
Allyl Chloride	T02, T03	T03 yields better recovery data than T02.
Aroclor 1242, 1254 and 1260	T010	
Benzaldehyde	T05	
Benzene	T01, T02, T03, T014	T014 yields better recovery data.
Benzyl Chloride	T01, T03, T014	
Benzo(a)anthracene	T013	
Benzo(a)pyrene	T013	
Benzo(b)fluoranthene	T013	
Benzo(e)pyrene	T013	
Benzo(g,h,i)perylene	T013	
Benzo(k)fluoranthene	T013	
Butyraldehyde	T011	Extension of T011.
Captan	T010	
Carbon Tetrachloride	T01, T02, T03, T014	Breakthrough volume is very low using T01.
Chlordane	T010	
Chlorobenzene	T01, T03, T014	
Chloroform	T01, T02, T03, T014	Breakthrough volume is very low using T01.
Chloroprene		
(2-Chloro-1,3-butadiene)	T01, T03	The applicability of these methods for chloroprene has not been documente
Chlorothalonil	T010	
Chlorpyrifos	T010	
Chrysene	T013	
Cresol	T08	
Crotonaldehyde	T011	Extension of T011.
4,4'-DDE	T04	
4,4'-DDT	T04	
1,2-Dibromomethane	T014	
1,2-Dichlorobenzene	T014	
1,3-Dichlorobenzene	T014	
1,4-Dichlorobenzene	T01, T03, T014	
1,1-Dichloroethane	T014	
1,2-Dichloroethylene	T014	
1,2-Dichloropropane	T014	
1,3-Dichloropropane	T014	
Dichlorovos	T010	
Dicofol	T010	
Dieldrin	T010	
2,5-Dimethylbenzaldehyde	T011	Extension of T011.
Dioxin	T09	
Endrin	T010	
Endrin Aldehyde	T010	
Ethyl Benzene	T014	
Ethyl Chloride	T014	
Ethylene Dichloride		
(1,2-Dichloroethane)	T01, T02, T03, T014	Breakthrough volume very low using T01.
4-Ethyltoluene	T014	
Fluoranthene	T013	
Fluorene	T013	
Folpet	T010	
Formaldehyde	T05, T011	
Freon 11	T014	
Freon 12	T014	
Freon 113	T014	
Freon 114	T014	
Heptachlor	T010	
Heptachlor Epoxide	T010	
Hexachlorobenzene and α -Hexachlorocyclohexane	T010	

Table 2. (Continued)

Compound	Applicable Method(s)	Comments
Hexacholobutadiene	T014	
Hexachlorocyclopentadiene	T010	
Hexanaldehyde	T011	Extension of T011.
Indeno(1,2,3-cd)pyrene	T013	
Isovaleraldehyde	T011	Extension of T011.
Lindane (α -BHC)	T010	
Methoxychlor	T010	
Methyl Benzene	T014	
Methyl Chloride	T014	
Methyl Chloroform (1,1,1-Trichloroethane)	T01, T02, T03, T014	Breakthrough volume very low using T01.
Methylene chloride	T02, T03, T014	
Mexacarbate	T010	
Mirex	T010	
Naphthalene	T013	
Nitrobenzene	T01, T03	
N-Nitrosodimethylamine	T07	
trans-Nonachlor	T010	
Non-methane Organic Compounds	T012	
Oxychlorane	T010	
Pentachlorobenzene	T010	
Pentachlorophenol	T010	
p,p'-DDE	T010	
p,p'-DDT	T010	
Perchloroethylene (tetrachloroethylene)	T01, (T02?), T03, T014	T02 performance has not been documented for this compound.
Phenanthrene	T013	
Phenol	T08	
Phosgene	T06	
Polychlorinated biphenyls (PCBs)	T04, T09	
Propanal	T05	
Propionaldehyde	T011	Extension of T011.
Pyrene	T013	
Ronnel	T010	
1,2,3,4-Tetrachlorobenzene	T010	Using PUF in combination with Tenax® GC solid adsorbent.
1,1,2,2-Tetrachloroethane	T014	
o-Tolualdehyde	T011	Extension of T011.
m-Tolualdehyde	T011	Extension of T011.
p-Tolualdehyde	T011	Extension of T011.
Toluene	T01, T02, T03, T014	
1,2,3-Trichlorobenzene	T010, T014	Using PUF in combination with Tenax® GC solid adsorbent.
1,2,4-Trichlorobenzene	T014	
1,1,2-Trichloroethane	T014	
Trichloroethylene	T01, T02, T03, T014	
2,4,5-Trichlorophenol	T010	
1,2,4-Trimethylbenzene	T014	
1,3,5-Trimethylbenzene	T014	
Valeraldehyde	T011	Extension of T011.
Vinyl Benzene	T014	
Vinyl Chloride	T02, T03, T014	
Vinyl Trichloride	T014	
Vinylidene Chloride (1,1-dichloroethene)	T02, T03, T014	
o,m,p-Xylene	T01, T03, T014	

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The complete report, entitled "Second Supplement to Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air," (Order No. PB 90-116997/AS; Cost: \$39.00, subject to change) will be available only from:

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The EPA Project Officers can be contacted at:

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