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Research and Development
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Project Summary

Validation of SW-846 Methods 8010, 8015, and 8020

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A hierarchical approach is being implemented for the development and validation of analytical methods for the determination of the over 400 RCRA Appendix VIII and Michigan List compounds in wastes. The first phase of this approach involved testing GC/MS methods for the detection and measurement of these compounds. Next, semivolatile compounds determined to be amenable to GC/MS were used to evaluate the performance of SW-846 Method 3510. In the study described in the full report, volatile organic compounds determined to be amenable to GC/MS were used to evaluate the performance of SW-846 Method 5030.

The performance of Method 5030 was evaluated in conjunction with SW-846 Methods 8010, 8015, and 8020. In these studies, purge-trap-desorb sample introduction techniques were used for synthetic aqueous and solid samples, and direct liquid injection was used for synthetic nonaqueous liquid wastes. The results of these studies are presented, including purging efficiencies and estimated method detection limits for compounds in aqueous samples and method detection limits for compounds in nonaqueous liquid wastes.

This Project Summary was developed by EPA's Environmental Monitoring and Support Laboratory, Cincinnati, OH, 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 Resource Conservation and Recovery Act specifies over 300 toxic organic compounds in its Appendix VIII to 40 CFR 261 listing that may be used to identify hazardous wastes. In response to a petition by the State of Michigan, the U. S. Environmental Protection Agency (EPA) has proposed the amendment of RCRA Appendix VIII[1] by adding over 100 other organic compounds to give a total of over 400 organic constituents. Various gas chromatographic (GC) methods for determining Appendix VIII compounds in wastes are given in SW-846, *Test Methods for Evaluating Solid Wastes*[2]. In many cases, these methods are modifications of procedures cited under the Clean Water Act for determining some, but not all, of Appendix VIII and Michigan List compounds in wastewater. The EPA is currently attempting to validate the appropriate SW-846 analytical methods for as many of the 400 plus target compounds as possible. A hierarchical approach to these validation efforts is being pursued.

A schematic illustration of the hierarchical approach to the development and validation of analytical methods for the determination of over 400 organic compounds in wastes is presented in Figure 1. The first phase of this approach was conducted under Work Assignment 4 of EPA Contract Number 68-03-3224[3] and involved identifying volatile and semivolatile compounds that are amenable to GC separation and mass spectrometric (MS) detection. Next, the semivolatile compounds determined to be amenable to GC/MS were then used to evaluate the performance of SW-846 Method 3510[4]. This work focussed on the recovery from water and aqueous stability of the semivolatile compounds

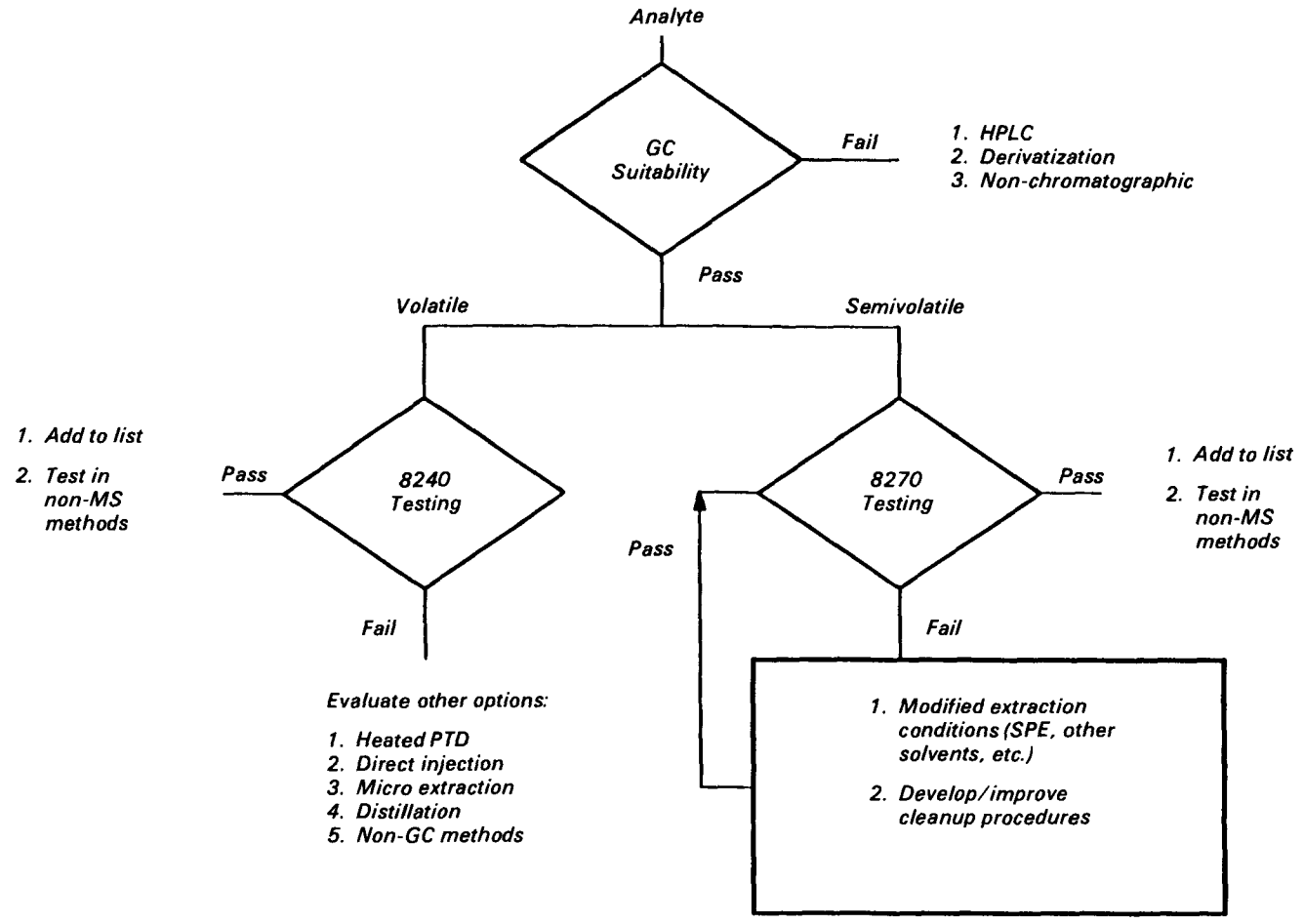

Figure 1. *Hierarchical approach for analytical method development for organic RCRA analytes.*

using standardized storage and extraction procedures. These experiments were conducted under Work Assignment 8 of EPA Contract Number 68-03-3224. In the study described in the full report, volatile compounds determined to be amenable to GC separation were used to evaluate SW-846 Method 8010, 8015, and 8020. Evaluating these methods was one of the major objectives of this Work Assignment. These experiments which comprised these evaluations and the results obtained are presented in the full report. Recommendations for further effort in the evaluation of methods for the determination of volatile organic compounds (VOCs) in waste samples are also provided in the report. The other major objective of this Work Assignment was to use the results of Methods 8010, 8015, and 8020 testing to formulate recommendations for including specific compounds is the scope of Method 5030 for the validation of Method 8240. These recommendations are made based on the recovery and precision of the determination of these analytes using procedures specified in Methods 8010, 8015, and 8020.

Methods 8010, 8015, and 8020 provide packed-column GC conditions for the determination of certain VOCs. Waste samples are analyzed using these Methods in conjunction with purge-trap-desorb (PTD), Method 5030; direct liquid injection (DLI); or headspace sampling, Method 5020, sample introduction techniques. Temperature programs are used in the GC to separate organic compounds. Detection is achieved by halogen specific detector for Method 8010, a flame ionization detector for Method 8015, and a photoionization detector for Method 8020.

These Methods were evaluated using procedures described in the *Single Laboratory Method Validation Protocol* (SLMVP)[5] which was developed under Work Assignment 1 of EPA Contract Number 68-03-3224. While the SLMVP specifies six steps for full method validation, only the first tw steps, Instrumentation Range Determi ation and Preliminary Method Evaluatic were used in these evaluations. Th approach was taken because EF anticipated that many laboratories wou soon have the capability to conduct PT analysis using capillary column G Consequently, full validation of packe column methods was not considere necessary or appropriate. Researc results provided in the full report a intended to define the scope of the thre packed-column methods and establis a basis for testing of capillar columnbased methods for th determination of VOCs in waste sample

Experimental Approach

Compounds initially considered f inclusion in the Methods 8010, 8015, ar 8020 testing are listed in Table 1. Base on preliminary evaluations, a number these analytes were excluded from thes experiments because of poor purgir efficiency, poor chromatograph

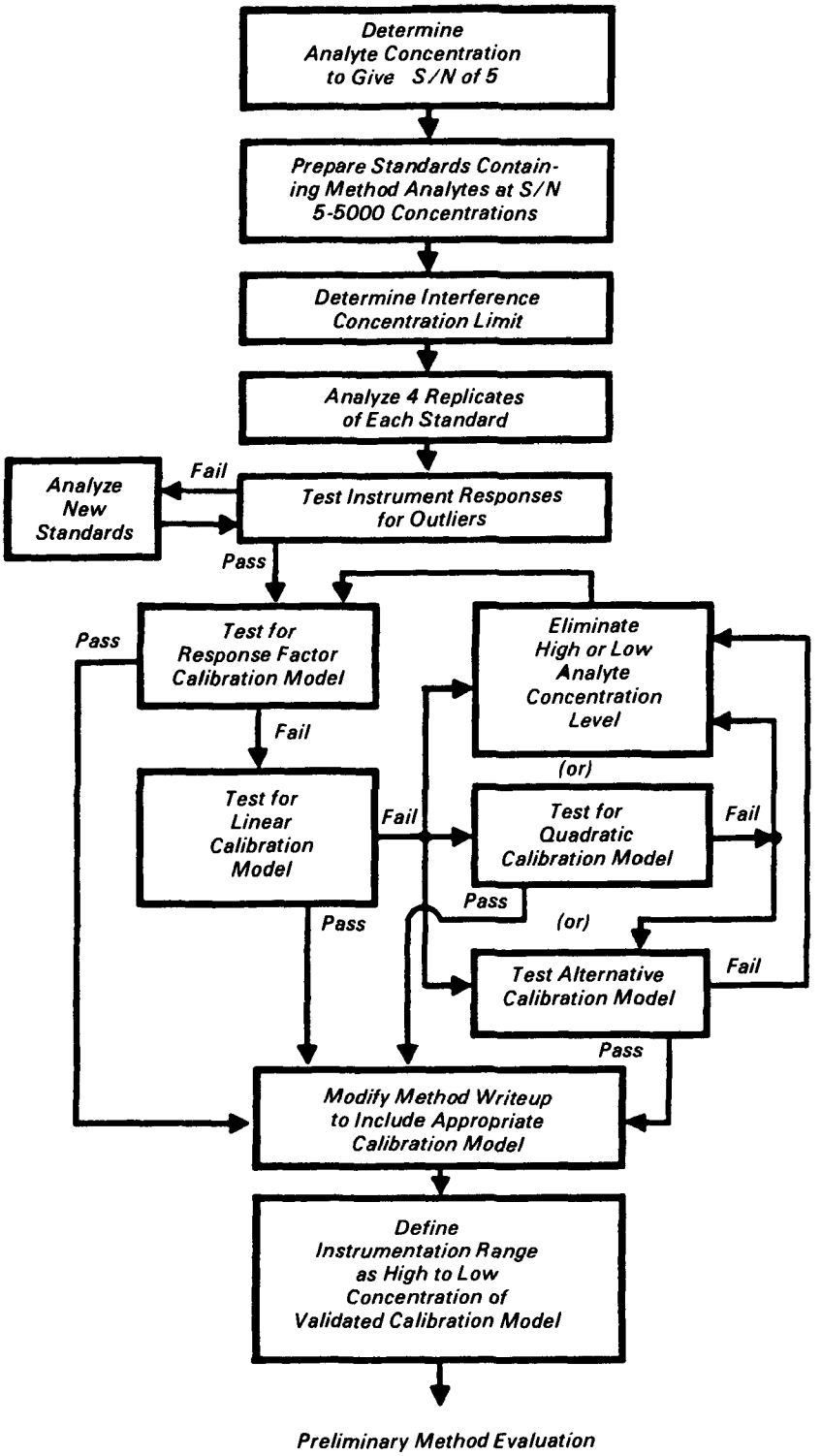

Figure 2. *Instrumentation range determination.*

behavior, or lack of pure standard material. These compounds are listed in Table 2 along with the reason for elimination from testing.

The first phase of method evaluation was the Instrumentation Range Determination step of the SLMVP. These experiments involved replicate analysis of aqueous calibration standards using the PTD sample introduction technique and of nonaqueous liquid calibration standards using the DLI sample introduction method. In these studies, at least four replicate standards were analyzed at each of seven concentration levels. The concentrations were selected to cover a three-orders-of-magnitude range. Results obtained in this validation step establish a basis for determining the test concentrations and the calibration function to be used in later steps of the validation. A flow diagram illustrating specific activities of the Instrumentation Range Determination step is shown in Figure 2.

The second phase of the method testing was the Preliminary Method Evaluation step of the SLMVP. These studies involved the analysis of eight replicates of synthetic aqueous and solid samples that had been fortified with the known amounts of the compounds of interest. In these experiments, only the PTD sample introduction technique was used. The synthetic aqueous samples consisted of reagent water which was spiked as a 500 mL batch, divided into 40 mL aliquots, and stored in Teflon-lined septum screw cap vials overnight at 4°C. The synthetic solid sample was composed of equal parts of Celite 503 and Kaolin. Two gram aliquots of this sample were spiked, mixed thoroughly, and stored overnight at 4°C. This step of the validation is conducted to determine if the method performs adequately for specified analytes before actual validation begins. This preliminary evaluation ensures that no major technical difficulties are inherent in the method, that reasonable results can be obtained for method analytes, and that the time, effort, and cost of a validation study will not be spent on an unsatisfactory method. A flow diagram illustrating specific activities of the Preliminary Method Evaluation step is shown in Figure 3.

Analyses of all standards and samples in these studies were conducted exactly according to the procedures presented in Method 5030. The chromatographic columns and conditions used for the analyses were those described in Method 8010, 8015, and 8020.

Results and Discussion

A summary of the results obtained from the evaluations of Methods 8010, 8015, and 8020 is provided in Table 3 which presents the compounds for which each of these Methods was found to be suitable. These results are discussed below.

Method 8010

A total of 53 compounds were originally considered for inclusion in the evaluations of Method 8010. Preliminary experiments were conducted to evaluate purging efficiencies and chromatographic behavior of these compounds. Based on these experiments a number of analytes were excluded from the PTD and/or the DLI portions of Method 8010 testing. Chloroacetaldehyde was excluded from all testing because a commercial source could not be identified. Bis (2-chloroisopropyl) ether was excluded from all experiments because the standard material obtained was not pure and another batch could not be obtained in time for use in these studies. Of the remaining 51 compounds, seven were excluded from the PTD portion of the experiments because of poor purging efficiencies. These compounds including bis (2-chloroethoxy) methane; bromoacetone; 2-chloroethanol; 2-chloroethyl vinyl ether; chloromethyl methyl ether; 1,3-dichloro-2-propanol; and epichlorohydrin were used in the DLI portion of the method performance testing. Four analytes including bis(2-chloroethyl) sulfide; chloral, 3-chloropropionitrile; and pentachloroethane were excluded from both the PTD and the DLI portions of these studies because of poor chromatographic behavior under the Method 8010 conditions. Chloroprene was excluded from the DLI experiments because of apparent decomposition in the injector. This analyte was included in the PTD portion of these studies in which this effect was not observed. Based on the results of these preliminary experiments, a total of 40 compounds, including 26 priority pollutant compounds, was included in the PTD portions of these studies. Forty-six compounds, including 27 priority pollutants were used in the DLI portion of the Method 8010 evaluations.

Based on the results of the Instrumentation Range Determination and the Preliminary Method Evaluation experiments, Method 8010 was determined to be suitable for the determination of 36 of the 40 t compounds used in the PTD portion these studies. The compounds for wh the performance of this Method w considered unacceptable included metl iodide, benzyl chloride, 4-chlorotolue and dichlorodifluoro-methane. For t determination of these analytes aqueous and solid matrices, Meth 8010 did not achieve the criteria recovery and precision that we established with the priority pollutar which were used as referen compounds throughout these studies.

Based on the results of t Instrumentation Range Determinati experiments, the performance of Meth 810 was considered to be acceptable all 46 of the analytes used in the D portion of these studies.

Method 8015

A total of 21 compounds we originally considered for inclusion in t evaluations of Method 8015. Due to t results of preliminary experiments, tv compounds including acrylamide and hydroxypropionitrile were excluded fro both the PTD and the DLI portions these studies because of po chromatographic behavior under tl Method 8015 conditions. A number compounds were excluded from the PT experiments because of poor purgi efficiencies. These analytes includ acetonitrile; allyl chloride; carbo disulfide; 1,2,3,4-diepoxybutane; 1, dioxane; ethylene oxide; isobutan malononitrile; methyl mercapta paraldehyde; propargyl alcohol; propiolactone; and propionitrile. The compounds were included in the D experiments of Method 8015 testin Based on the results of these prelimina experiments, six analytes were used the PTD portion of Method 8015 testi and 19 compounds were used in the D experiments. None of these compoun were priority pollutants.

Based on the Instrumentation Ran Determination and the Preliminar Method Evaluation experiments, Metho 8015 was considered to perfor acceptably for five of the six compoun used in the PTD portions of the testin Methyl isobutyl ketone was eliminate from these experiments when th performance of the Method for th compound was not found to b sufficiently reproducible for reliab instrument calibration. Based on th Instrumentation Range Determinatio experiments, Method 8015 wa

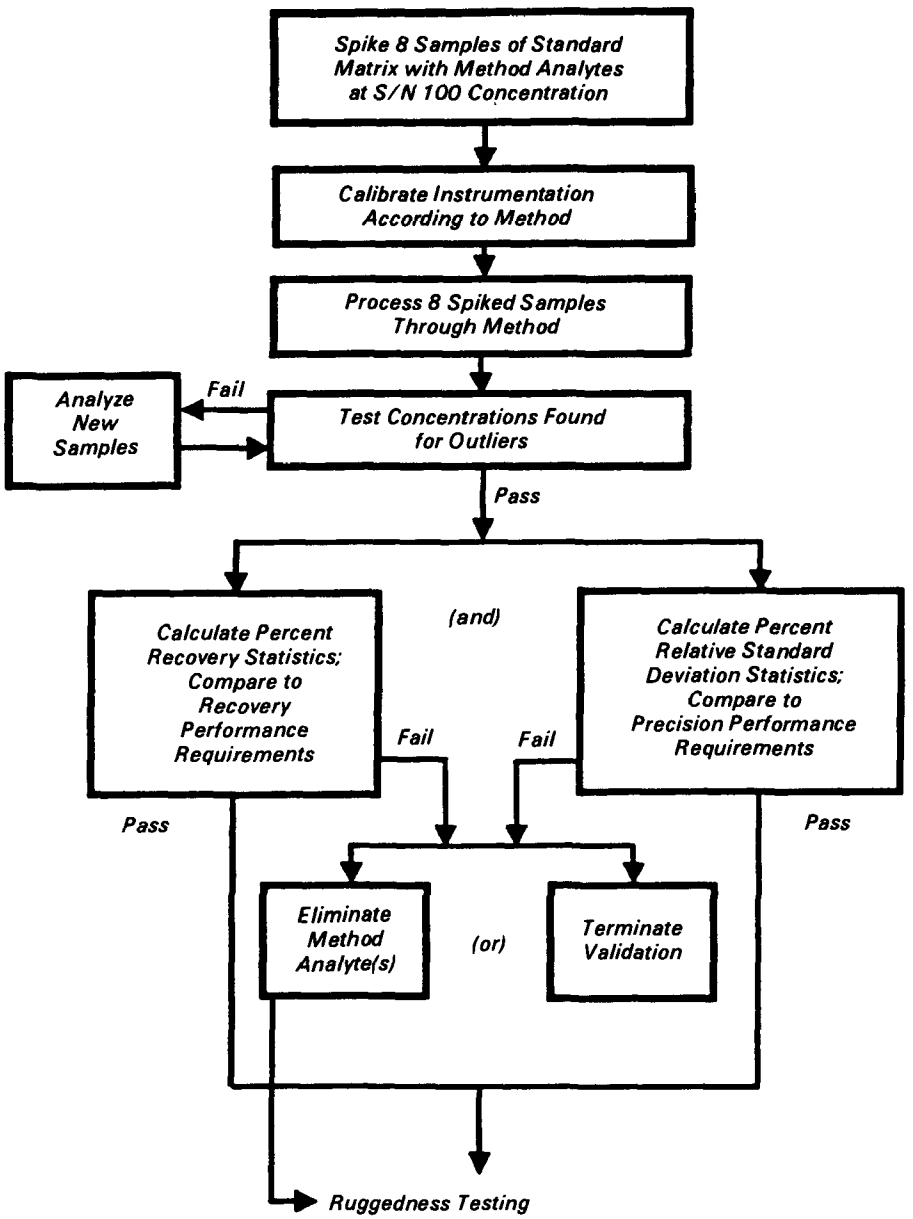

Figure 3. *Preliminary method evaluation.*

considered to be suitable for 16 of the 19 compounds used in the DLI portions of these studies. The performance of this Method appeared to be unsuitable for the determination of carbon disulfide, malononitrile, and β-propiolactone in nonaqueous liquid matrices primarily because of the very low response of the flame ionization detector used in this Method for these analytes.

Method 8020

A total of 14 analytes were initially considered for inclusion in the evaluation of Method 8020. Based on the results of preliminary experiments, pyridine and thiophenol were eliminated from both the PTD and the DLI portions of these studies due to poor chromatographic behavior under the conditions specified by Method 8020. In addition, 2-picoline was eliminated from the PTD experiments because of poor purging efficiency. This compound was included in the DLI studies. Data obtained during these preliminary experiments resulted in the use of 11 compounds in the PTD portion of Method 8020 testing and 12 analytes in the DLI studies. In each case, seven of the compounds used were priority pollutants.

Based on the results of the Instrumentation Range Determination and the Preliminary Method Evaluation steps of method testing, Method testing was considered to be suitable for the determination of all 11 compounds in aqueous and solid matrices. These experiments involved the use of the PTD sample introduction technique and the criteria for acceptable method performance was based on results obtained for the seven priority pollutant compounds. Method 8020 was considered to be suitable for the determination of all 12 of the analytes

used in the DLI portion of these experiments.

Conclusions and Recommendations

Based on the studies described and the results presented in the full report, the following conclusions are drawn:

- Using the PTD sample introduction technique, Method 8015 was found to be suitable for the determination of five of the 21 test compounds in aqueous and solid samples. This Method, in combination with DLI sample introduction, was demonstrated to be successful for the determination of 19 of the 21 analytes in nonaqueous liquid samples.
- Method 8020 was determined to be suitable for the determination of 11 of the 14 test compounds in aqueous and solid samples using PTD sample introduction. Using DLI sample introduction, this Method was demonstrated to be successful in the determination of 12 of the 14 compounds in nonaqueous liquid samples.
- Poor purging efficiency and poor chromatographic behavior for a number of test compounds prevented Methods 8010, 8015, and 8020 from performing successfully for these analytes.

Table 1 lists the compounds for which these Methods were determined to be suitable based on the experiments conducted during these studies. Table 4 lists the compounds for which the performance of these Methods was found to be unacceptable. This table also provides a brief comment of the difficulties encountered with each of these compounds.

Based on the experiments described and the results presented in the full report, the following recommendations are made.

- Pending further method suitability testing, the compounds listed in Table 1 should be included in the scopes of Methods 8010, 8015, and 8020 as indicated.
- A total of 51 compounds was used to evaluate Method 8010. This Method was determined to be suitable for the determination of 36 of these analytes in aqueous and solid samples using the PTD sample introduction technique. When the DLI sample introduction technique was used, Method 8010 was found to be suitable for the determination of 46 of the test compounds in nonaqueous liquid samples.
- At this time, compounds listed in Table 4 should be excluded from the scopes of Methods 8010, 8015, and 8020.
- Further method suitability testing should involve the use of capillary columns and should include those analytes excluded from this study on the basis of poor chromatographic behavior.
- Further evaluations of these Methods should include analysis of actual waste samples, rigorous determination of method detection limits for all analytes, and the conduct of the referee validation step of the SLMVP.
- Compounds listed in Table 5 have been determined to purge with acceptable efficiency and precision from aqueous samples. These compounds should be included in performance testing of SW-846 Method 8240.
- For future studies involving these and other methods for the determination of volatile compounds, more reliable procedures for the preparation of spiked aqueous and solid samples should be developed and implemented. Emphasis should be placed on minimizing analyte losses during the preparation of replicate samples.

References

1. Federal Register, 49, No. 247, December 21, 1984, pp 49784-49793.
2. *Test Methods for Evaluating Solid Waste*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, SW-846, Third Edition, November, 1986.
3. *GC-MS Suitability Testing*, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory - Cincinnati, EPA Contract Number 68-03-3224, Work Assignment 1-04.
4. *Screening of Semivolatile Organic Compounds for Extractability and Aqueous Stability by SW-846 Method 3510*, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory - Cincinnati, EPA Contract Number 68-03-3224, Work Assignment 2-08.
5. *Development of a Single Laboratory Method Validation Protocol*, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory - Cincinnati, EPA Contract Number 68-03-3224, W
Assignment 1-01.

Table 1. Compounds Considered for Inclusion in the Suitability Testing of Methods 8010, 8015, and 8020

Compound	CAS Number	List[a]	Source
Method 8010			
Allyl chloride	107-05-1	8, 9, M	Aldrich Chemical Company
Benzyl chloride	100-44-7	8	Fisher Scientific Company
Bis(2-chloroethoxy)methane	111-91-1	8, 9	Pfaltz and Bauer, Inc.
Bis(2-chloroethyl)sulfide	505-60-2	8, M	Chem Services, Inc.
Bis(2-chloroisopropyl)ether	108-60-1	8	Chem Services, Inc.
Bromoacetone	598-31-2	8	Chem Services, Inc.
Bromobenzene	108-86-1	--	Fluka AG Chemical Company
Bromodichloromethane	75-27-4	PP, 8, 9	Aldrich Chemical Company
Bromoform	75-25-2	PP, 8, 9	Eastman Organic Chemical Products
Bromomethane	74-83-9	PP, 8, 9	Matheson Gas Products
Carbon tetrachloride	56-23-5	PP, 8, 9	Fluka AG Chemical Company
Chloroacetaldehyde	107-20-0	8	No commercial source
Chloral	75-87-6	8	Fisher Scientific Company
Chlorobenzene	106-90-7	PP, 8, 9	Matheson, Coleman, and Bell
Chloroethane	75-00-3	PP, 9	Chem Services, Inc.
2-Chloroethanol	107-07-3	M	Eastman Organic Chemical Products
Chloroform	67-66-3	PP, 8, 9	Burdick and Jackson Laboratories
1-Chlorohexane	544-10-5	--	Fluka AG Chemical Company
2-Chloroethyl vinyl ether	100-75-8	PP, 8	Aldrich Chemical Company
Chloromethane	74-87-3	PP, 8, 9	Matheson Gas Products
Chloromethyl methyl ether	107-30-2	8	Sigma Chemical Company
Chloroprene	126-99-8	8, 9, M	Alfa Products
3-Chloropropionitrile	542-76-7	8	Aldrich Chemical Company
4-Chlorotoluene	106-43-4	--	Chem Services, Inc.
Dibromochloromethane	124-48-1	PP, 9	Alfa Products
1,2-Dibromo-3-chloropropane	96-12-8	8, 9	Chem Services, Inc.
Dibromomethane	74-95-3	8	Analabs
1,2-Dichlorobenzene	95-50-1	PP, 8, 9	Aldrich Chemical Company
1,3-Dichlorobenzene	541-73-1	PP, 8, 9	Aldrich Chemical Company
1,4-Dichlorobenzene	106-46-7	PP, 8, 9	Aldrich Chemical Company
1,4-Dichloro-2-butene	764-41-0	8, 9	Aldrich Chemical Company
Dichlorodifluoromethane	75-71-8	8, 9	Matheson Gas Products
1,1-Dichloroethane	75-34-3	PP, 8, 9	Aldrich Chemical Company
1,2-Dichloroethane	107-06-2	PP, 8, 9	Burdick and Jackson Laboratories
1,1-Dichloroethylene	75-35-4	PP, 8, 9	Fluka AG Chemical Company
Trans-1,2-dichloroethylene	156-60-5	PP, 8, 9	Fluka AG Chemical Company
Dichloromethane	75-09-2	PP, 8, 9	Burdick and Jackson Laboratories
1,2-Dichloropropane	78-87-5	PP, 8, 9	Aldrich Chemical Company
1,3-Dichloro-2-propanol	96-23-1	8	Aldrich Chemical Company
Cis-1,3-dichloropropylene	10061-01-5	PP	Fluka AG Chemical Company
Epichlorohydrin	106-89-8	8	Aldrich Chemical Company
Ethylene dibromide	106-93-4	8	Fluka AG Chemical Company
Methyl iodide	74-88-4	8, 9	Aldrich Chemical Company
Pentachloroethane	76-01-7	8, 9	Aldrich Chemical Company
1,1,2,2-Tetrachloroethane	79-34-5	PP, 8, 9	J. T. Baker Chemical Company
1,1,1,2-Tetrachloroethane	630-20-6	8, 9	Aldrich Chemical Company
Tetrachloroethylene	127-18-4	PP, 8, 9	Aldrich Chemical Company
1,1,1-Trichloroethane	71-55-6	PP	Fisher Scientific Company
1,1,2-Trichloroethane	79-00-5	PP, 8, 9	Aldrich Chemical Company
Trichloroethylene	79-01-6	PP, 8, 9	Aldrich Chemical Company

(Continued)

Table 1. (Continued)

Compound	CAS Number	List[a]	Source
Method 8010 *(Continued)*			
Trichlorofluoromethane	*75-69-4*	*PP, 8, 9*	*Aldrich Chemical Company*
1,2,3-Trichloropropane	*96-18-4*	*8, 9*	*Aldrich Chemical Company*
Vinyl chloride	*75-01-4*	*PP, 8, 9*	*Matheson Gas Products*
Method 8015			
Acetonitrile	*75-05-8*	*8*	*Burdick and Jackson Laboratories*
Allyl alcohol	*107-18-6*	*8*	*Aldrich Chemical Company*
Acrylamide	*79-06-1*	*8*	*Aldrich Chemical Company*
Carbon disulfide	*75-15-0*	*8, 9*	*Matheson, Coleman, and Bell*
1,2,3,4-Diepoxybutane	*1464-53-5*	*8*	*Sigma Chemical Company*
Diethyl ether	*60-29-7*	--	*Burdick and Jackson Laboratories*
1,4-Dioxane	*123 -91-1*	*8*	*Burdick and Jackson Laboratories*
Ethylene oxide	*75-21-8*	*8*	*Matheson Gas Products*
Ethyl methacrylate	*97-63-2*	*8, 9*	*Aldrich Chemical Company*
2-Hydroxypropionitrile	*78-97-7*	*M*	*Aldrich Chemical Company*
Isobutanol	*78-83-1*	*8*	*Aldrich Chemical Company*
Malononitrile	*109-77-3*	*8*	*Aldrich Chemical Company*
Methacrylonitrile	*126-98-7*	*8*	*Aldrich Chemical Company*
Methyl ethyl ketone	*78-93-3*	*8, 9*	*Burdick and Jackson Laboratories*
Methyl isobutyl ketone	*108-10-1*	--	*Aldrich Chemical Company*
Methyl mercaptan	*74-93-1*	*8*	*Matheson Gas Products*
Methyl methacrylate	*80-62-6*	*8, 9*	*Matheson Gas Products*
Paraldehyde	*123-63-7*	*8*	*Sigma Chemical Company*
Propargyl alcohol	*107-19-7*	*8*	*Aldrich Chemical Company*
β-propiolactone	*57-57-8*	*M*	*Sigma Chemical Company*
Propionitrile	*107-12-0*	*8*	*Aldrich Chemical Company*
Method 8020			
Benzene	*71-43-2*	*PP, 8, 9*	*Burdick and Jackson Laboratories*
Chlorobenzene	*106-90-7*	*PP, 8, 9*	*Matheson, Coleman, and Bell*
1,2-Dichlorobenzene	*95-50-1*	*PP, 8, 9*	*Aldrich Chemical Company*
1,3-Dichlorobenzene	*541-73-1*	*PP, 8, 9*	*Aldrich Chemical Coompany*
1,4-Dichlorobenzene	*106-46-7*	*PP,8, 9*	*Aldrich Chemical Company*
Ethyl benzene	*100-41-4*	*PP, 9*	*Poly Science Corporation*
2-Picoline	*109-06-8*	*8,9*	*Aldrich Chemical Company*
Pyridine	*110-86-1*	*8, 9*	*Aldrich Chemical Company*
Styrene	*100-42-5*	*9, M*	*Chem Services, Inc.*
Thiophenol	*108-98-5*	*8*	*Aldrich Chemical Company*
Toluene	*108-88-3*	*PP, 8, 9*	*Burdick and Jackson Laboratories*
o-Xylene	*95-47-6*	*9*	*Burdick and Jackson Laboratories*
m-Xylene	*1477-55-0*	*9*	*Chem Services, Inc.*
p-Xylene	*106-42-3*	*9*	*Matheson, Coleman, and Bell*

(a) PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List; -- = not on any list.

Table 2. *Compounds Not Included in Evaluations of Methods 8010, 8015, and 8020*

Compound	Reasons for Exclusion	Portion of Study From Which Compound Excluded	
		PTD	DLI
Method 8010			
Bis(2-chloroethoxy)methane	*Poor purging efficiency*	X	
Bis(2-chloroethyl)sulfide	*Poor chromatographic behavior*	X	X
Bis(2-chloroisopropyl)ether	*Standard impure*	X	X
Bromoacetone	*Poor purging efficiency*	X	
Chloroacetaldehyde	*Standard not available*	X	X
Chloral	*Poor chromatographic behavior*	X	X
2-Chloroethanol	*Poor purging efficiency*	X	
Chloroethyl vinyl ether	*Poor purging efficiency*	X	
Chloromethyl methyl ether	*Poor purging efficiency*	X	
Chloroprene	*Poor chromatographic behavior*		X
3-Chloropropionitrile	*Poor chromatographic behavior*	X	X
1,3-Dichloropropanol	*Poor purging efficiency*	X	
Epichlorohydrin	*Poor purging efficiency*	X	
Pentachloroethane	*Poor chromatographic behavior*	X	X
Method 8015			
Acetonitrile	*Poor purging efficiency*	X	
Allyl alcohol	*Poor purging efficiency*	X	
Acrylamide	*Poor chromatographic behavior*	X	X
Carbon disulfide	*Poor purging efficiency*	X	
1,4-Dioxane	*Poor purging efficiency*	X	
Ethyl oxide	*Poor purging efficiency*	X	
2-Hydroxypropionitrile	*Poor chromatographic behavior*	X	X
Isobutanol	*Poor purging efficiency*	X	
Malononitrile	*Poor purging efficiency*	X	
Methyl mercaptan	*Poor purging efficiency*	X	
Paraldehyde	*Poor purging efficiency*	X	
Propargyl alcohol	*Poor purging efficiency*	X	
β-Propiolactone	*Poor purging efficiency*	X	
Propionitrile	*Poor purging efficiency*	X	
Method 8020			
2-Picoline	*Poor purging efficiency*	X	
Pyridine	*Poor chromatographic behavior*	X	X
Thiophenol	*Poor chromatographic behavior*	X	X

Table 3. *Compounds Recommended for Inclusion in the Scopes of Methods 8010, 8015, and 8020*

Compound	List[a]	Sample Matrix for Which Method Was Found to Be Suitable: Aqueous/Solids Sample Matrices[b]	Sample Matrix for Which Method Was Found to Be Suitable: Nonaqueous Sample Matrices[c]
Method 8010			
Allyl chloride	8,9,M	X	X
Benzyl chloride	8	(d)	X
Bis(2-chloroethoxy)methane	8,9	(e)	X
Bromoacetone	8	(e)	X
Bromobenzene	--	X	X
Bromodichloromethane	PP,8,9	X	X
Bromoform	PP,8,9	X	X
Bromomethane	PP,8,9	X	X
Carbon tetrachloride	PP,8,9	X	X
Chlorobenzene	PP,8,9	X	X
Chloroethane	PP,9	X	X
2-Chloroethanol	M	(e)	X
Chloroform	PP,8,9	X	X
1-Chlorohexane	--	X	X
2-Chloroethyl vinyl ether	PP,8	(e)	X
Chloromethane	PP,8,9	X	X
Chloromethyl methyl ether	8	(e)	X
Chloroprene	8,9,M	X	(f)
4-Chlorotoluene	--	(d)	X
Dibromochloromethane	PP,9	X	X
1,2-Dibromo-3-chloropropane	8,9	X	X
Dibromomethane	8	X	X
1,2-Dichlorobenzene	PP,8,9	X	X
1,3-Dichlorobenzene	PP,8,9	X	X
1,4-Dichlorobenzene	PP,8,9	X	X
1,4-Dichloro-2-butene	8,9	X	X
Dichlorodifluoromethane	8,9	(d)	X
1,1-Dichloroethane	PP,8,9	X	X
1,2-Dichloroethane	PP,8,9	X	X
1,1-Dichloroethylene	PP,8,9	X	X
Trans-1,2-dichloroethylene	PP,8,9	X	X
Dichloromethane	PP,8,9	X	X
1,2-Dichloropropane	PP,8,9	X	X
1,3-Dichloro-2-propanol	8	(e)	X
Cis-1,3-dichloropropylene	PP	X	X
Epichlorhydrin	8	(e)	X
Ethylene dibromide	8	X	X
Methyl iodide	8,9	(e)	X
1,1,2,2-Tetrachloroethane	PP,8,9	X	X
1,1,1,2-Tetrachloroethane	8,9	X	X

(Continued)

Table 3. *(Continued)*

Compound	List[a]	Sample Matrix for Which Method Was Found to Be Suitable: Aqueous/Solids Sample Matrices[b]	Sample Matrix for Which Method Was Found to Be Suitable: Nonaqueous Sample Matrices[c]
Method 8010 *(Continued)*			
Tetrachloroethylene	PP,8,9	X	X
1,1,1-Trichloroethane	PP	X	X
1,1,2-Trichloroethane	PP,8,9	X	X
Trichloroethylene	PP,8,9	X	X
Trichlorofluoromethane	PP,8,9	X	X
1,2,3-Trichloropropane	8,9	X	X
Vinyl chloride	PP,8,9	X	X
Method 8015			
Acetonitrile	8	(e)	X
Allyl alcohol	8	(e)	X
1,2,3,4-Diepoxybutane	8	(e)	X
Diethyl ether	--	X	X
1,4-Dioxane	8	(e)	X
Ethylene oxide	8	(e)	X
Ethyl methacrylate	8,9	X	X
Isobutanol	8	(e)	X
Methacrylonitrile	8	X	X
Methyl ethyl ketone	8,9	X	X
Methyl isobutyl ketone	--	(d)	X
Methyl mercaptan	8	(e)	X
Methyl methacrylate	8,9	X	X
Paraldehyde	8	(e)	X
β-Propiolactone	M	(e)	X
Propionitrile	8	(e)	X
Method 8020			
Benzene	PP,8,9	X	X
Chlorobenzene	PP,8,9	X	X
1,2-Dichlorobenzene	PP,8,9	X	X
1,3-Dichlorobenzene	PP,8,9	X	X
1,4-Dichlorobenzene	PP,8,9	X	X
Ethyl benzene	PP,9	X	X
2-Picoline	8,9	(d)	X
Styrene	9,M	X	X
Toluene	PP,8,9	X	X
o-Xylene	9	X	X
m-Xylene	9	X	X
p-Xylene	9	X	X

(a) *PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List; -- = not on any list.*

(b) *Method testing with aqueous and solid samples involved the use of PTD sample introduction.*

(c) *Method testing with nonaqueous liquid samples involved the use of DLI sample introduction.*

(d) *Method determined to be unsuitable for determination of this compound in the sample matrix indicated.*

(e) *Compound not included in this portion of testing due to poor purging efficiency.*

(f) *Chloroprene not included in this portion of testing due to poor chromatographic behavior with DLI sample introduction under conditions specified in method. See text for discussion.*

Table 4. *Compounds Recommended for Exclusion from the Scopes of Methods 8010, 8015, and 8020*

Compound	List[a]	Sample Matrix for Method was Found to be Unsuitable: Aqueous Solid[b]	Sample Matrix for Method was Found to be Unsuitable: Nonaqueous Liquid[c]	Comments
Method 8010				
Benzyl chloride	8	X	(d)	Method not suitable[f]
Bis(2-chloroethoxy)methane	8,9	X	(d)	Poor purging efficiency
Bis(2-chloroethyl)sulfide	8,M	X	X	Poor chromatographic behavior
Bis(2-chloroisopropyl)ether	8	X	X	Standard impure
Bromoacetone	8	X	(d)	Poor purging efficiency
Chloroacetaldehyde	8	X	X	Standard not available
Chloral	8	X	X	Poor chromatographic behavior
2-Chloroethanol	M	X	(d)	Poor purging efficiency
Chloroethyl vinyl ether	PP,8	X	(d)	Poor purging efficiency
Chloromethyl methyl ether	8	X	(d)	Poor purging efficiency
Chloroprene	8,9,M	(e)	X	Poor chromatographic behavior
3-Chloropropionitrile	8	X	X	Poor chromatographic behavior
Chlorotoluene	--	X	(d)	Method not suitable[f]
Dichlorodifluoromethane	8,9	X	(d)	Method not suitable[f]
1,3-Dichloropropanol	8	X	(d)	Poor purging efficiency
Epichlorohydrin	8	X	(d)	Poor purging efficiency
Methyl iodide	8,9	X	(d)	Method not suitable[f]
Pentachloroethane	8,9	X	X	Poor chromatographic behavior
Method 8015				
Acetonitrile	8	X	(d)	Poor purging efficiency
Allyl alcohol	8	X	(d)	Poor purging efficiency
Acrylamide	8	X	X	Poor chromatographic behavior
Carbon disulfide	8,9	X	(d)	Poor purging efficiency
1,4-dioxane	8	X	(d)	Poor purging efficiency
Ethyl oxide	8	X	(d)	Poor purging efficiency
2-hydroxypropionitrile	M	X	X	Poor chromatographic behavior
Isobutanol	8	X	(d)	Poor purging efficiency
Malononitrile	8	X	(d)	Poor purging efficiency
Methyl mercaptan	8	X	(d)	Poor purging efficiency
Paraldehyde	8	X	(d)	Poor purging efficiency
Propargyl alcohol	8	X	(d)	Poor purging efficiency
β-Propiolactone	M	X	(d)	Poor purging efficiency
Propionitrile	8	X	(d)	Poor purging efficiency
Method 8020				
2-Picoline	8,9	X	(d)	Poor purging efficiency
Pyridine	8,9	X	X	Poor chromatographic behavior
Thiophenol	8	X	X	Poor chromatographic behavior

(a) *PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List; -- = not on any list.*
(b) *Method testing with aqueous and solid samples involved the use of PTD sample introduction.*
(c) *Method testing with nonaqueous liquids involved the use of DLI sample introduction.*
(d) *Method suitable for this compound in nonaqueous liquids using DLI sample introduction.*
(e) *Method suitable for this compound in aqueous and solid samples using PTD sample introduction.See text for discussion.*
(f) See Section 5 for detailed discussions.

Table 5. Compounds Recommended for Inclusion in Method 8240 Performance Testing

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency (percent)	Estimated Detection Limit (µg/L)
Allyl chloride	107-05-1	10.17	88	0.272
Benzene	73-41-2	2.59	77	0.0554
Bromobenzene	108-86-1	29.05	81	0.278
Bromodichloromethane	75-27-4	15.44	107	0.138
Bromoform	75-25-2	21.12	65	0.951
Bromomethane	74-83-9	2.90	77	0.850
Carbon Tetrachloride	56-23-5	14.58	81	0.111
Chlorobenzene	106-90-7	25 49	51	0 701
Chloroethane	75-00-3	5.18	85	0 755
Chloroform	67-66-3	12.62	88	0.123
1-Chlorohexane	544-10-5	26.26	76	0.283
Chloromethane	74-87-3	1.40	73	0.258
Chloroprene	126-99-8	15.60	90	2.50
Dibromochloromethane	124-48-1	18.22	109	0.488
1,2-Dibromo-3-chloropropane	96-12-8	28 09	14	1.66
Dibromomethane	74-95-3	13.83	78	0.900
1,2-Dichlorobenzene	95-50-1	37.96	83	1.59
1,3-Dichlorobenzene	541-73-1	36.88	82	0.274
1,4-Dichlorobenzene	106-46-7	38.64	80	0.362
1,4-Dichloro-2-butene	764-41-0	23.45	30	0.488
1,1-Dichloroethane	75-34-3	11 21	86	0.164
1,2-Dichloroethane	107-06-2	13 14	103	0.129
1,1-Dichloroethylene	75-35-4	10.04	78	0.180
Trans-1,2-Dichloroethylene	156-60-5	11.97	107	0 897
Dichloromethane	75-09-2	7.56	86	2 93
1,2-Dichloropropane	78-87-5	16.69	90	0.300
Cis-1,3-Dichloropropylene	10061-01-5	17.00	100	0 317
Diethyl ether	60-29-7	11 24	90	0.013
Ethyl benzene	100-41-4	8 12	94	0.0957
Ethyl methacrylate	97-63-2	23 98	55	0.389
Ethylene dibromide	106-93-4	19.59	71	0.645
Methacrylonitrile	126-98-7	13.09	37	2.53
Methyl ethyl ketone	78-93-1	12.93	14	0.189
Methyl methacrylate	80-62-6	20.22	55	0.064
Styrene	100-42-5	11.60	86	0.118
1,1,2,2-Tetrachloroethane	79-34-5	23.12	102	0.140
1,1,1,2-Tetrachloroethane	630-20-6	21.10	85	0.117
Tetrachloroethylene	127-18-4	23.05	51	0.402
1,1,1-Trichloroethane	71-55-6	14.48	97	0.082
1,1,2-Trichloroethane	79-00-5	18.27	83	0.049
Trichloroethylene	79-01-6	17.40	85	0.124
Trichlorofluoromethane	75-69-4	9.26	82	0 191
1,2,3-Trichloropropane	96-18-4	22.95	50	0.346
Toluene	108-88-3	5.14	99	0.0867
Vinyl chloride	75-01-4	3.25	81	0.733
o-Xylene	95-47-6	10.54	92	0.0326
m-Xylene	1477-55-0	9.77	99	0.125
p-Xylene	106-42-3	9.18	98	0.0759

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The complete report, entitled "Validation of SW-846 Methods 8010, 8015, and 8020," (Order No. PB88-161 567/AS; Cost: $14.95, subject to change) will be available only from:

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