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VALIDATION OF SW-846 METHODS 8010, 8015, AND 8020

by

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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 this 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.

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FOREWORD

Environmental measurements are required to determine the quality of ambient waters and the character of waste effluents. The Environmental Monitoring and Support Laboratory-Cincinnati conducts research to:

- Develop and evaluate methods to measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid waste.
- Investigate methods for the concentration, recovery, and identification of viruses, bacteria and other microbiological organisms in water; and, to determine the responses of aquatic organisms to water quality.
- Develop and operate an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring water and wastewater.
- Develop and operate a computerized system for instrument automation leading to improved data collection, analysis, and quality control.

This report summarizes the evaluation of several SW-846 methods for the determination of volatile organic compounds in wastes.

Robert L. Booth, Director
Environmental Monitoring and Support
Laboratory-Cincinnati

ABSTRACT

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 organic 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 this 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.

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SECTION 1

INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) specifies over 300 toxic organic compounds in its Appendix VIII to 40 CFR Part 261 listing which may be used to identify hazardous wastes. In response to a petition by the state of Michigan, the U.S. Environmental Protection Agency (USEPA) has proposed the amendment of RCRA Appendix VIII (1) by the addition of 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. 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 the identification of volatile and semivolatile compounds which are amenable to GC separation and mass spectrometric (MS) detection. Next, the semivolatile compounds determined to be amenable to GS/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 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 this report, volatile compounds determined to be amenable to GC separation were used to evaluate SW-846 Methods 8010, 8015, and 8020. Evaluating these methods was one of the

also provided in this 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 inclusion of specific compounds in 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 a 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 two steps, Instrumentation Range Determination and Preliminary Method Evaluation, were used in these evaluations. This approach was taken because US EPA anticipated that many laboratories would soon have the capability to conduct PTD analysis using capillary column GC. Consequently, full validation of packed-column methods was not considered necessary or appropriate. Research results provided in this report are intended to define the scope of the three packed column methods and establish a basis for testing of capillary column-based methods for the determination of VOC in waste samples.

In evaluating Methods 8010, 8015, and 8020, the Instrumentation Range Determination was conducted for each of the Methods using PTD for aqueous calibration standards and DLI for nonaqueous calibration standards as sample introduction techniques. Sufficient data were collected using DLI to calculate an method estimated detection limit (EDL) for each analyte used in these evaluations. The Preliminary Method Evaluation step of the SLMVP was

performed for each of the Methods with synthetic aqueous and solid samples using only PTD as the sample introduction technique.

The analytes used in these evaluations included all those listed for each of the Methods in SW-846, including the priority pollutant compounds, the volatile compounds appearing in the Michigan List for which suitable GC behavior had been obtained in the earlier research, and other selected analytes. The priority pollutant compounds served as reference compounds throughout these studies. The Michigan List compounds were assigned to Methods based on the GC detector which was considered to be most appropriate.

SECTION 2

CONCLUSIONS

Based on the studies described and the results presented in this report, the following conclusions are drawn.

- A total of 51 compounds were 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.

- Using the PTD sample introduction technique, Method 8015 was found to be suitable for the determination of 5 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 the 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 2 lists the compounds for which the performance of these Methods was found to be unacceptable. This table also provides a brief comment on the difficulties encountered with each of these compounds. More thorough discussions are provided in Section 5 of this report.

SECTION 3

RECOMMENDATIONS

Based on the experiments described and the results presented in this 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.

- At this time, compounds listed in Table 2 should be excluded from the scopes of Methods 8010, 8015, and 8020 as indicated.

- 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 (MDLs) for all analytes, and the conduct of the referee validation step of the SLMVP.

- Compounds listed in Table 3 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.

SECTION 4

EXPERIMENTAL PROCEDURES

MATERIALS

Standards

Compounds considered for inclusion in the Methods 8010, 8015, and 8020 testing are listed in Table 4. This table is organized by Method and, for each compound, presents the Chemical Abstract Services (CAS) registry number, the regulatory list or lists on which the compound appears, and the commercial source of the standard material used in this research.

Solvents

Solvents used in this research included methanol, pentane, and oxylene which were designated as "high purity" quality obtained from Burdick and Jackson Laboratories. These solvents were used without further purification.

Sample Matrices

Aqueous Matrix--

The aqueous matrix used in these studies consisted of reagent grade (RG) water. The RG water was prepared from commercial distilled water with a Milli-Q system, boiled for 15 minutes, cooled to room temperature, and passed through a column of activated charcoal immediately prior to use. Sufficient RG water was prepared each morning for use in the laboratory that day and was stored in a Teflon-lined screw cap bottle until it was passed through activated charcoal and used. Any RG water unused at the end of the day was discarded and fresh water was prepared on the following day. This RG water was used both for the aqueous calibration standards and for the aqueous sample matrix used with PTD sample introduction in Preliminary Method Evaluation.

Solid Matrix--

A synthetic solid matrix was used in this research. A single batch of this solid matrix was prepared by combining 250 g of Celite 503 obtained from Aldrich with 250 g of Kaolin obtained from J. T. Baker in a wide-mouth 5 lb jar. To this mixture was added 625 mL of RG water. The mixture was stirred with a large spatula and the jar was sealed with a Teflon-lined screw cap. The jar was then tumbled manually end-over-end for 100 complete rotations and allowed to settle thoroughly. After decanting the excess water, the settled material was bottled in multiple aliquots in 4 oz Teflon-lined screw cap jars. For each experiment involving solid sample matrix, all of the sample used was taken from the same fresh, previously unused jar.

INSTRUMENTATION

PTD System

An automated PTD system was used in the portions of these studies involving Method 5030 as the sample introduction technique. The system used consisted of a Tekmar Automated Liquid Sampler (ALS) purging component coupled to either a Tekmar Model LSC 2 or a Tekmar Model 4000 trap and desorb unit. The Tekmar ALS has ten positions for purging vessels and accommodates any combination of standards, samples, and blanks. The automated PTD system was used because it operates unattended and, therefore, improved the cost-effectiveness of data acquisition. The PTD conditions used for each of the Methods were exactly as prescribed in SW-846 and are presented in Table 5.

Autosampler System

An autosampler was used in the portion of these studies involving DLI of the sample into the GC system. The system used was a Hewlett-Packard Model 7376A Automatic Sampler. This device has 100 positions and can accommodate any combination of standards, samples, and blanks. The autosampler was used because it operates unattended and, therefore, improved the cost-effectiveness of data acquisition.

Gas Chromatographs

Because a different detector is required for each of the Methods evaluated, several different GC systems were used. This approach permitted the PTD studies on one Method to be conducted simultaneously with the DLI studies on the same or on another Method. The GC columns and conditions used in evaluating these Methods were exactly as prescribed in SW-846 and are presented in Table 4 along with an identification of the GC system used for each Method.

Laboratory Data System

Data acquisition and peak area integration were accomplished using a Computer Automated Laboratory System (CALS) purchased from Smith-Beckman. CALS is implemented on a Hewlett-Packard Model 1000 computer.

METHODS

Preliminary Activities

Preparation of Stock Solutions--

Single component stock solutions of all compounds used in these evaluations were prepared in methanol at a concentration of 10 mg/mL. Stock standard solutions were stored headspace free at -10°C in screw cap vials with Teflon-faced septa until use. Stock solutions of compounds with boiling points less than 30°C were prepared weekly and stock solutions of compounds with boiling points greater than 30°C were prepared monthly.

Determination of Retention Times--

Retention times for each of the Method 8010, 8015, and 8020 analytes were determined using the GC conditions associated with the appropriate Method and the DLI sample introduction technique. Approximately 160 ng of each compound was injected into the GC system either as a single component methanol dilution of the stock solution or in simple mixtures prepared by methanol. For early eluting Method 8015 compounds which coeluted with combining appropriate aliquots of the stock solutions and diluting with

methanol, single component o-xylene stock solutions were prepared and diluted with this same solvent.

Determination of Purging Efficiency--

The purging efficiency of each compound used in these evaluations was determined using the PTD and GC conditions specified in the appropriate Method. DLI calibration solutions were prepared as single component solutions or simple mixtures in methanol by diluting the single component stock solutions or by combining appropriate aliquots of the single component stock solutions and then diluting. Aqueous calibration solutions were then prepared by adding an appropriate volume of the DLI calibration solution to 5 mL of RG water. For each compound, aqueous calibration standards were first prepared at approximately 40 ug/L. If no peak was observed from the analysis of this solution, another aqueous calibration solution containing the compound at a higher concentration was prepared and analyzed. Generally, the highest concentration tested for any compound was 400 ug/L. However, if a small signal was detected at this concentration, the compound was retested at a concentration of 800 ug/L. The results of triplicate analyses of each aqueous calibration solution were compared to the results obtained when the corresponding DLI calibration solution was analyzed and these data were used to calculate purging efficiency for each compound.

Establishment of Solution Sets--

Compounds previously reported to be unamendable to GC separation (3) or found to have a PTD recovery of less than 10 percent, were excluded from any further evaluation of the Methods using the PTD sample introduction technique. Compounds previously reported to be unamendable to GC separation were also excluded from Method evaluations using DLI as the sample introduction technique. However, compounds with low purging efficiency were included in the DLI Method evaluations. Based on information obtained in the retention time determinations, the compounds associated with each Method were divided into several solution sets. The goal in establishing these sets was

to avoid coelution of the analytes while generating the minimum number of solution sets possible for each Method to ensure cost-effective data acquisition. Since some compounds included in the DLI studies were not included in the PTD studies because of poor purging efficiency, the PTD and DLI solution sets were not identical.

Instrumentation Range Determination

The Instrumentation Range Determination studies for Methods 8010, 8015, and 8020 were conducted according to the procedures developed under EPA Contract Number 68-03-3224, Work Assignment 1 entitled, "Single Laboratory Method Validation Protocol." The initial step of the SLMVP is determination of the concentration range over which the analytical instrumentation will perform for the method analytes. 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. A brief summary of the activities included in this phase of the Method 8010, 8015, and 8020 Validation is presented below.

Determination of the Signal-to-Noise Ratio for the Standard--

For the PTD portion of these studies, an aqueous calibration standard of each of the solution sets for the three Methods was prepared. Each of these calibration standards contained the analytes included in that solution set at a concentration approximating the EDLs. Detection limits for each compound were estimated based on previous experience with the analyte including the anticipated response of the GC detector to the compound and the purging efficiency of the compound from water. The multicomponent working standard solutions were prepared by combining appropriate aliquots of the single component stock standard solutions and diluting with methanol. The analyte concentrations in the working standard solutions were selected so that addition of 5 uL of each solution into 5 mL of RG water produced the desired

concentration for the calibration standard. For the portion of the study involving DLI as the sample introduction technique, multicomponent calibration standards of late eluting compounds were prepared in methanol or pentane and multicomponent calibration standards of early eluting compounds were prepared in oxylene.

Four replicates of each of these calibration standards were analyzed along with a reagent blank. The PTD reagent blank was composed of RG water and the DLI reagent blank consisted of the appropriate solvent. As necessary, the multicomponent working standard solutions were remade with the concentration of specific analytes being adjusted to provide a signal-to-noise ratio (S/N) between 3 and 10. From the data generated in this experiment, the amount of each analyte required to give a S/N of 5 was calculated.

Preparation of Calibration Standard Solutions--

To prepare the aqueous calibration standard solutions for the PTD studies, the amount of each analyte required to produce a S/N of 5,000 was first calculated. Ten milliliters of each solution set standard was prepared by combining appropriate aliquots of the single component stock standard solutions to achieve the analyte concentrations corresponding to a S/N of 5,000. To prepare the 5, 15, 50, 150, 500, and 1500 S/N solution set standards, single dilutions of the 5,000 S/N solution set standards were made. The aqueous calibration standards were then prepared by adding 5 uL of one of these solutions to 5 mL of RG water. This procedure involved removing the plunger from a 5 mL gas-tight syringe equipped with a syringe valve and luerlock adapter, filling the barrel of the syringe to overflowing with the RG water, and replacing the plunger. The plunger was then adjusted to the 5 mL mark and the valve of the syringe was opened to allow introduction of 5 uL of the appropriate solution set standard. The contents of the syringe were then delivered into one of the purging tubes which was then connected to the Tekmar ALS.

To prepare the calibration standards for the DLI portion of the study for Methods 8010, 8015, and 8020, the amount of each analyte needed to produce an S/N of 5,000 was calculated. Ten milliliters of each solution set standard was prepared by combining appropriate aliquots of the single component stock standard solutions and diluting with methanol or pentane for the solution sets containing the late eluting compounds or with oxylene for the solution sets containing the early eluting compounds. The 5, 15, 50, 150, 500, and 1500 S/N solution set standards were then prepared by single dilutions of the 5,000 S/N solution set standard.

For the DLI portion of the Method 8015 validation, difficulties were encountered with trace impurities in the methanol which coeluted with some of the analytes. Since this Method involved the use of an FID detector, the presence of these impurities caused inaccurate integration of the GC peaks associated with the affected analytes. Consequently, the single component stock standard solutions used in these studies were prepared in pentane or o-xylene as appropriate for the solution set in which they were included. The 5,000 S/N was then prepared by combining appropriate aliquots of these solutions and diluting with the same solvent. The other solution set standards including the 5, 15, 50, 150, 500, and 1500 S/N were prepared by single dilutions of the 5,000 S/N standard using the same solvent.

Determination of Interference Concentration Limit--

The interference concentration limit for each analyte was determined as described in the SLMVP. This process was fairly straight forward for the DLI portion of these studies. However, for the PTD studies, carryover was also detected when a reagent blank was placed in the same position on the ALS previously occupied by some of the high level aqueous calibration standards. Carryover was not detected in the second reagent blank subsequently placed in that position. Consequently, reagent blanks were always placed in the positions occupied by certain of the high level aqueous calibration standards

to eliminate interferences in analyses of subsequent solutions placed in those positions. The concentrations of the aqueous calibration standards requiring reagent blanks was highly dependent on the specific analytes. Certain analytes required reagent blanks even after the 150 S/N standard.

Data Acquisition--

Data to be used in determining the Instrument Range for Methods 8010, 8015, and 8020 were acquired by analyzing four replicates of each level of the calibration standards for each Method. For the DLI portion of the study, at least eight replicates of the two lowest level calibration standards for each of the Methods was analyzed to provide data for calculation of an EDL for each analyte using the DLI sample introduction technique.

Evaluation of Results--

The data obtained as described above were evaluated according to the procedures described in the SLMVP. Evaluation of the instrumentation range determination results involves testing several calibration models for the method analytes. The following models are tested sequentially:

Response Factor: $X = b_1C + E$

Linear: $X = b_0 + b_1C + E$

Quadratic: $X = b_0 + b_1C + b_2C^2 + E$

where:

X = Instrument response for analysis

C = Concentration of standard or sample

E = Random error term

b_0 = Intercept parameter for linear and quadratic calibration models

b_1 = Slope parameter

b_2 = Quadratic coefficient for quadratic calibration model.

The calibration model parameters are estimated using the method of least squares after dividing both sides of the calibration equation by C. The models are evaluated sequentially for the ability to describe the experimental data. The criteria used in these evaluations are described in detail elsewhere (5). These statistical tests had originally been conducted with the use of a Computer Data Corporation mainframe computer. For this effort, the programs were transferred to an IBM PC compatible format to enhance the cost-effectiveness and efficiency of conducting these evaluations with such a large number of analytes.

Preliminary Method Evaluation

In these studies, the Preliminary Method Evaluation step of the single laboratory validation of Methods 8010, 8015, and 8020 consisted of the analysis of spiked liquid and solid samples using the PTD sample introduction technique. No experiments involving the use of DLI were conducted during the Preliminary Method Evaluation. This step of the SLMVP 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. A brief summary of the activities included in the phase of the Methods 8010, 8015, and 8020 validation are presented below.

Preparation and Analysis of Liquid Samples--

The liquid samples used in the Preliminary Method Evaluation experiments consisted of RG water spiked with the analyte at concentrations which gave a S/N of 100. These samples were prepared by adding 10 uL of the 5,000 S/N solution set standard to 500 mL of RG water and, after mixing, immediately

bottling 9 to 11 replicate samples in 40 mL vials sealed headspace free with Teflon-lined silicone septa and screw caps. These replicates were stored inverted overnight at 4°C prior to analysis. On the following day, at least eight of the samples were analyzed along with appropriate calibration standards as outlined in the Method being validated.

Preparation and Analysis of Solid Samples--

As described previously, spiked solid samples consisting of equal parts of Celite 503 and Kaolin were used in the Preliminary Method Evaluation of Methods 8010, 8015, and 8020. For each Method, eight replicate 2 g aliquots of the solid sample were spiked with 20 uL of the 5,000 S/N solution set standard. This spiking level was selected to provide an analyte concentration in the final extract that would give rise to a 100 S/N response. The mixtures were stirred thoroughly using a vortex mixer, sealed in screw cap vials equipped with Teflon-lined septa, and stored at 4°C overnight. On the following morning, the sample preparation procedures used were those specified in Method 5030. Each sample was dispersed in 40 mL of extracting solvent, agitated vigorously for 1 minute, and centrifuged to effect phase separation. Methanol was used as the extracting solvent for Methods 8010 and 8020. For Method 8015, polyethylene glycol (PEG) was used to extract the solid samples. A 100 uL portion of each sample extract was then added to 5 mL of RG water and this mixture was introduced into a purge tube attached to the Tekmar ALS. The samples were then analyzed along with 10, 30, and 100 percent recovery standards as described in the Method being validated. The recovery standards consisted of RG water spiked with the same solution used to fortify the solid samples at levels which spanned the expected range for recovery of analytes from the solid samples.

Data Acquisition--

Data to be used in conducting the Preliminary Method Evaluation for Methods 8010, 8015, and 8020 were acquired by analyzing at least eight

replicates of the aqueous and solid samples prepared as described above. All analyses in this step of the Method validation were conducted using the PTD sample introduction technique.

Evaluation of Results--

The data obtained as described above was evaluated according to the procedures described in the SLMVP. These evaluations involved determining the recovery and precision for each Method analyte. These values were then compared to the method performance obtained for the Priority Pollutant compounds.

SECTION 5

RESULTS AND DISCUSSION

PRELIMINARY ACTIVITIES

Preliminary activities in the validation of Methods 8010, 8015, and 8020 included the determination of retention times and purging efficiencies for each of the analytes being used in the evaluation of these Methods. The results of these activities for Methods 8010, 8015, and 8020 are presented in Tables 6, 7, and 8, respectively which also includes an estimated detection limit for each analyte using the PTD sample introduction technique and a method detection limits for each analyte calculated on the basis of replicate analyses of standards using the DLI sample introduction technique. Based on efforts to determine retention times and purging efficiencies, several compounds were excluded from the PTD and/or the DLI portions of these studies. These analytes are listed by Method in Table 9 along with the reason for each exclusion. These reasons for exclusion are discussed in greater detail below.

Method 8010

Chloroacetaldehyde was excluded from all Method 8010 testing because a commercial source could not be identified. Bis (2-chloroisopropyl) ether was also excluded from Method 8010 testing because the standard material that had been obtained was found to be impure and another batch could not be obtained in time for use. Bis (2-chloroethyl) sulfide, chloral, 3-chloropropionitrile, and pentachloroethane were excluded from all Method 8010 experiments because of poor chromatographic behavior when either PTD or DLI was used for sample introduction. Unacceptably low response factors had been determined for bis (2-chloroethyl) sulfide and chloral, or chloral hydrate, in the GC/MS

suitability testing conducted under Work Assignment 4 of EPA Contract Number 68-03-3224 suggesting that some difficulty had been encountered with these two compounds in this earlier work. The chromatographic column and conditions used in the Method 8010 testing were identical to those used in the GC/MS suitability testing with the exception that the column itself was metal, as specified in Method 8010, as opposed to the glass column used in the earlier work. Contact with this hot metal surface may be the cause of the low, broad chromatographic peaks observed for bis (2-chloroethyl) sulfide and for 3-chloropropionitrile. This contact may also have been responsible for the apparent decomposition of chloral and of pentachloroethane. Chromatograms of single component solutions of each of these analytes contained two peaks. These peaks were assumed to indicate the presence of decomposition products since impurities had not been observed in the GC/MS suitability testing which involved the use of standards from the same commercial supplier and lot number. Chloroprene was observed to have poor chromatographic behavior when DLI was used as the sample introduction technique. Similar difficulties were not observed with this compound when the sample introduction technique was PTD. Using DLI, chloroprene appeared to be decomposing in the injector when higher concentrations were introduced into the GC system. This process may not be significant when the analyte is introduced more gradually during the desorption cycle of the PTD sample introduction. Chloroprene was included in the PTD portion of the study but was excluded from the experiments involving DLI as the sample introduction technique.

Bis (2-chloroethoxy) methane, bromoacetone, 2-chloroethanol, 2-chloroethyl vinyl ether, chloromethyl methyl ether, 1,3-dichloro-2-propanol, and epichlorohydrin were eliminated from Method 8010 PTD studies because of poor purging efficiency. However, these compounds were included in the DLI studies of this Method. These seven compounds were not detected using the PTD sample introduction technique at the 400 ug/L level in reagent water. Poor purging efficiencies for these compounds are undoubtedly due to their

aqueous solubility. 2-chloroethyl vinyl ether, a priority pollutant, was not detected in the purging efficiency studies when tested at a concentration of 160 ug/L. This concentration is close to the reported detection limit of 130 ug/L. The purging efficiency for this compound should probably have been evaluated at higher concentrations.

Purging efficiencies determined for most of the other compounds used in the Method 8010 testing ranged from 70 to 110 percent. Analytes for which purging efficiencies outside this range were determined include several relatively polar, water-soluble compounds such as benzyl chloride and 1,4-dichlorobutene; and higher molecular weight, less volatile compounds such as bromoform, 1,2-dibromo-3-chloropropane, and 1,2,3-trichloropropane. These compounds were included in both the PTD and DLI portions of Method 8010 in order to develop method performance data for as wide a variety of compounds as possible. Anomalous data were obtained for chlorobenzene and tetrachloroethylene which were both determined to have a purging efficiency of 51 percent. These compounds are both priority pollutants and are known to purge more efficiently from aqueous samples. Because of this fact and because the relative standard deviation values of the purging efficiency measurements were relatively high, the assumption was made that the purging efficiency data were in error and these two compounds were included in the Method 8010 testing. No attempts were made to determine the cause of these erroneous data.

Based on these preliminary experiments, a total of 40 analytes including 26 priority pollutant compounds were initially used in the PTD portion of Method 8010 testing. In the DLI portion of these evaluations, a total of 46 compounds including 27 priority pollutants were used.

Method 8015

Acrylamide and 2-hydroxypropionitrile were eliminated from both the PTD and the DLI portions of Method 8015 testing because of poor chromatographic

behavior. These findings agree with those obtained in the GC/MS testing in which acrylamide, tested as a semivolatile compound, was not detected and 2-hydroxypropionitrile, tested as a volatile compound, was found to have an unacceptably low response. Under the Method 8015 chromatographic conditions, these two compounds were found to have a low response and to produce low, broad chromatographic peaks. A number of the analytes intended for Method 8015 testing were determined to have very poor purging efficiencies. Purging efficiencies of less than 10 percent were determined for acetonitrile; allyl alcohol; carbon disulfide; 1,2,3,4-diepoxybutane; 1,4-dioxane; ethylene oxide; isobutanol; malononitrile; methyl mercaptan; paraldehyde; propargyl alcohol; β-propiolactone; and propionitrie. These compounds were excluded from the PTD portion of this study, but were included in the DLI portion of Method 8015 testing. With the exception of diethyl ether, which was determined to have a purging efficiency of 90 percent, the measured purging efficiencies for the remaining compounds ranged from 14 to 55 percent. These compounds were included in the Method 8015 PTD studies to develop method performance data for as many compounds as possible.

Due to the results of these preliminary experiments, six analytes were used in the PTD portion of Method 8015 testing and 19 compounds were used in the DLI experiments. None of these compounds were priority pollutants.

Method 8020

Pyridine and thiophenol were excluded from Method 8020 PTD and DLI testing because of poor chromatographic behavior. Both of these compounds had been included in the GC/MS suitability testing and this approach was determined to be successful for these two analytes. The PID detector used in Method 8020 exhibited a relatively low response for both of these compounds; 2,000 ng of thiophenol was barely detectable by this Method. The relatively large amounts of material required for detection may have overloaded the chromatographic column and/or interacted with the hot metal surface of the

column resulting in decomposition or interfering with the chromatographic processes. In either event, broad low peaks were observed in the chromato grams resulting from the analyses of these two compounds. Only 2-picoline was eliminated from the Method 8020 PTD studies because of poor purging efficiency. Using the PTD sample introduction technique, this analyte was not detected at a concentration of 800 ug/L in reagent water. 2-picoline was included in the DLI portion of Method 8020 testing. The purging efficiencies determined for the other analytes used in this testing ranged from 77 to 99 percent with the exception of chlorobenzene. The purging efficiency for this compound was not reevaluated and data presented in the Method 8020 portion of Table 8 are the results of the same determinations reported in the Method 8010 section. As discussed, since chlorobenzene is a Priority Pollutant and known to purge efficiently, these data were judged to be in error and this compound was included in the Method 8020 PTD 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 are priority pollutants.

INSTRUMENTATION RANGE

Data used in establishing the instrumentation range for each Method are obtained by replicate analyses of standards for each Method analyte at concentrations which span three orders of magnitude. As described previously, evaluation of these data involve testing several calibration models for each of the compounds used in the Method testing. The calibration model which is the best fit of the data is selected for use in the subsequent steps of the method validation.

In these studies, four replicate standards of each method analyte were analyzed at each of seven concentrations. In the DLI portion of each study,

at least eight replicate standards of each compound were analyzed at the two lowest concentrations to permit calculation of an estimated detection limit. A summary of the data generated in these analyses is presented for the PTD and DLI studies, respectively, in Tables 10 and 11 for Method 8010, in Tables 12 and 13 for Method 8015, and in Tables 14 and 15 for Method 8020. Each of these tables presents the solution set in which each analyte was included and the concentration of each compound that gave rise to a signal equal to the instrumental noise, the mean response factor, and the relative standard deviation determined at each of the concentrations tested. These tables are included for reference during the discussions presented below.

Method 8010

PTD Studies--

The results of the Instrumentation Range Determination for Method 8010 using the PTD sample introduction technique are summarized in Table 16 which presents the concentration ranges over which each of the three calibration models was accepted for each analyte. A total of 26 priority pollutant compounds was included in the Method 8010 evaluations. For 18 of these compounds, either all three or two of the calibration models were accepted over the entire three-orders-of-magnitude concentration range tested. In cases in which two calibration models were accepted, the response factor model was the one rejected. The response factor model is a special case of the linear model. Given a graph of concentration versus response for an analyte, the response factor model requires that the y-intercept value be zero. For the linear model, the y-intercept on this graph is some non-zero value. Since these two calibration models are very similar, if the linear model was accepted, attempts were not made to determine the analyte concentration range over which the response factor model would be accepted. Two or three calibration models were accepted when the lowest concentration was excluded from the evaluations for four more priority pollutants including

chloroform, dichloromethane, 1,1,1-trichloroethane, and trichlorofluoromethane. As shown in Table 10, the response factor determined for each of these compounds at the lowest concentration tested was substantially higher those determined at other concentrations. For these compounds, the concentrations determined for the 5 S/N levels may have been too low for reliable instrument performance. However, an instrumentation range of two-and-a-half orders of magnitude is certainly acceptable, and in terms of this step of the evaluation, Method 8010 performed acceptably for these four compounds as well as for the other 18 compounds discussed previously. Since these 22 compounds are priority pollutants for which the Method has been demonstrated to perform well for aqueous samples, the suitability of Method 8010 for the determination of the other test compounds will be discussed in terms of these reference compounds.

For one priority pollutant, bromoform, only the quadratic calibration model was accepted after the lowest concentration had been eliminated from the concentration range being evaluated. Response factors determined for bromoform using the PTD sample introduction technique, presented in Table 10, seem to increase with analyte concentration. With the exception of the lowest level, response factors determined at each concentration are very reproducible. While the reason for this concentration dependence is not well understood, decomposition on the hot metal of the chromatographic column may be a contributing factor. This process would be most easily observed at the lower concentrations at which the amount of material being decomposed is a relatively larger fraction of the total amount of analyte introduced into the GC system. This effect is observed, but less pronounced, for other brominated compounds included in the Method 8010 testing. These materials are more thermally labile than the chlorinated compounds and, therefore, might be expected to be more affected by contact with hot metal. Use of a glass column or a fused silica capillary column is expected to provide better performance of Method 8010 for these compounds.

The performance of Method 8010 for the other three priority pollutants included in these evaluations was not as expected, although some of the discrepancies can be explained. Calibration models were accepted for chloroethane and for 1,1,2,2-tetrachloroethane only after the two lowest concentrations were removed from the concentration range tested. For both of these compounds, the two lowest concentrations tested were below previously reported estimated detection limits for these compounds in aqueous samples. These estimated detection limits are 0.52 and 0.03 ug/L for chloroethane and 1,1,2,2-tetrachloroethane, respectively. Again, for these compounds, Method 8010 should probably have been evaluated over a higher concentration range. None of the calibration models were accepted for bromomethane over the concentration range evaluated. Examination of the response factors, presented in Table 10, determined for this compound at each concentration tested indicate the dependence on concentration observed for some of the other brominated compounds. This trend is somewhat more pronounced than for bromoform as discussed above. Again, the thermal degradation of the analyte in the injector or on the metal column is suspected of being the cause of this trend and use of a glass column or a fused silica capillary column is expected to provide better method performance for this compound. However, since bromomethane is a priority pollutant, it was included in the next step of this evaluation.

For 12 of the 14 remaining compounds included in these evaluations, Method 8010 performed as it had for the priority pollutant reference compounds. For these analytes, at least two calibration models were accepted over a concentration range of two-and-a-half or three-orders of magnitude. As shown in Table 10, these compounds include allyl chloride, benzyl chloride, bromobenzene, 1-chlorohexane, chloroprene, 4-chlorotoluene, dibromomethane, 1,4-dichloro-2-butene, dichlorodifluoromethane, ethylene dibromide, 1,1,1,2-tetrachloroethane, and 1,2,3-trichloropropane. All three calibration models were accepted for 1,2-dibromo-3-chloropropane after the two lowest

concentrations were eliminated from the concentration range being evaluated. As shown in Table 8, the response factors determined for this analyte for the two lowest levels were substantially higher than those determined for this compound at higher concentrations. Again, this trend was observed for other brominated compounds included in this study and may be due to the use of the metal chromatographic column. None of the calibration models were accepted for methyl iodide over any portion of the concentration range tested. Examination of the response factors presented in Table 10 for this compound indicated substantial variability between concentrations as well as substantial variability in the response factors determined at any single concentration. Contact with the metal chromatographic column and the relative thermal lability of these compounds are probably the causes of this imprecision. For both of these compounds use of a glass column or a fused silica capillary column is expected to improve the performance of Method 8010.

Based on the results of the Instrumentation Range Determination, 39 of the 40 analytes used in these experiments were included in the Preliminary Method Evaluation of Method 8010 suitability testing. Only methyl iodide was excluded from this next set of experiments because an appropriate calibration model could not be found for this analyte over any portion of the concen tration range tested.

DLI Studies--

The results of the Instrumentation Range Determination for the 46 compounds used in evaluating Method 8010 using the DLI sample introduction technique are summarized in Table 17 which presents the concentration range over which each calibration model was accepted for each analyte. For 16 of the 27 priority pollutant compounds, at least two calibration models were accepted over a concentration range of two, two-and-a-half, or three orders of magnitude. The lowest or the two lowest concentrations were eliminated

from the range being evaluated for those compounds for which calibration models were accepted over less than three orders of magnitude. For these compounds including, bromomethane, 2-chloroethyl vinyl ether, the three dichlorobenzene isomers, trichlorofluoromethane, and vinyl chloride, the analyte concentrations used at these lower levels may have been selected under ideal conditions when the GC system was performing optimally and may be too low for consistent instrument operation. For the remaining 11 priority pollutants, only the quadratic calibration model was accepted over the concentration range of two, two-and-a-half, or three orders of magnitude. The reasons for the observed relatively poorer performance of Method 8010 for these compounds are not well understood. Examination of the response factors determined for these analytes, shown in Table 11, does not reveal any consistent trend. In some cases, substantial differences exist among the response factors for all of the concentrations tested. For other compounds, the response factors determined at the intermediate concentrations are relatively consistent, but those determined for the highest and the lowest concentrations are substantially different. Eight of these 11 compounds were included in Solution Sets 1 or 6 for the DLI portion of the Method 8010. Perhaps some unidentified error in the preparation of the stock solution or the dilutions is the cause of these anomalous results. In any event, since acceptable performance of Method 8010 for priority pollutants has been demonstrated and well documented, the conclusion must be drawn that the Instrumentation Range Determination data for these compounds are the result of some laboratory anomaly or error and not due to performance of Method 8010 for these analytes.

Of the remaining 19 compounds included in the DLI portion of the step of the Method 8010 evaluation, at least two calibration models were accepted for 14 analytes over a concentration range of two, two-and-a-half, or three orders of magnitude. For these compounds, the performance of Method 8010 was equivalent to that observed for the priority pollutants used as reference

compounds. Therefore, Method 8010 is considered suitable for these compounds at this stage of the evaluations. For the other five compounds, which include bromobenzene, chloromethyl methyl ether, 1,2-dibromo-3-chloropropane, dibromomethane, and dichlorodifluoromethane, either only the quadratic model was accepted over a concentration range of two-and-a-half or three orders of magnitude or the two or three calibration models accepted were found to suitable over a concentration range of only one-and-a-half orders of magnitude. Four of these five compounds were included in Solution Sets 1 or 6 during this portion of the study and, as discussed above, some laboratory error may be the cause of these anomalous data. Since data obtained for these analytes are equivalent to that generated for priority pollutant compounds, Method 8010 was considered to have performed acceptably for all of the analytes included in the DLI portion of the Instrumentation Range Determination.

Method 8015

PTD Studies--

The results obtained for the Instrumentation Range Determination for Method 8015 using the PTD sample introduction technique are summarized in Table 18. Only six analytes were included in this portion of the method evaluation and none of these compounds are priority pollutants. For five compounds, at least two calibration models were accepted over a concentration range of two, two-and-a-half, or three orders of magnitude. This method performance is equivalent to that obtained for the priority pollutant reference compounds in the PTD portion of Method 8010 testing. These compounds include diethyl ether, ethyl methacrylate, methacrylonitrile, methyl ethyl ketone, and methyl methacrylate. None of the calibration models were accepted over any portion of the concentration range tested for methyl isobutyl ketone. Examination of the response factors determined for this

compound and presented in Table 12 reveal substantial variability between concentrations. This variability may be associated with the low purging efficiency of this compound.

DLI Studies--

Table 19 presents a summary of the results obtained for the Instrumentation Range Determination of Method 8015 using the DLI sample introduction technique. A total of nineteen compounds, none of which are priority pollutants, were included in these evaluations. For 13 of these analytes, at least two calibration models were accepted over a two, two-and-a-half, or three orders of magnitude concentration range. Again, the performance of Method 8015 for these compounds is equivalent to that observed for Method 8010 priority pollutant reference compounds. For three compounds including 1,2,3,4-diepoxybutane, methyl mercaptan, and β-propiolactone, only the quadratic calibration model was accepted over a concentration range of two, two-and-a-half, or three orders of magnitude. As shown in Table 13, the response factors determined for these compounds are very consistent at each concentration but are more variable between concentrations. Again, these results are similar to those obtained for some of the priority pollutant compounds in the DLI portion of Method 8010 testing. Consequently, Method 8015 is assumed to be performing suitably for these compounds in this portion of the study. For the remaining three compounds used in the Method 8015 testing, none of the calibration models were accepted over any portion of the concentration range evaluated. As shown in Table 13, response factors determined for carbon disulfide and malononitrile were quite low which suggests that the FID detector used in Method 8015 is not very sensitive for the detection of these compounds. In fact, such a large amount of malononitrile was required to obtain a reliable response that solubility difficulties were encountered at the higher concentration levels and the two highest concentration standards could not be prepared in the solvents used in this

study. The response factors determined for β-propiolactone are quite consistent at each concentration but appear to increase with increasing concentration. Consequently, Method 8015 appears to be unsuitable for the determination of carbon disulfide, malononitrile, and β-propiolactone. However, based on the Instrumentation Range Determination, Method 8015 appears to be suitable for the determination of the other 16 compounds in nonaqueous samples using the DLI sample introduction technique.

Method 8020

PTD Studies--

The results obtained for the Instrumentation Range Determination for Method 8020 using the PTD sample introduction technique are summarized in Table 20. Seven of the 11 compounds used in this portion of the method evaluation are priority pollutants. For five of these compounds, only the quadratic model was accepted over a concentration range of two-and-a-half or three orders of magnitude. These analytes included chlorobenzene, 1,2- and 1,4-dichlorobenzene, ethyl benzene, and toluene. Two calibration models were accepted for benzene and for 1,3-dichlorobenzene over a one-and-a-half order of magnitude concentration range. For each of these compounds, the concentration selected for lowest level standards was equivalent to or, for some analytes such as chlorobenzene and ethyl benzene, substantially less than the estimated method detection limit previously reported. To characterize the performance of Method 8020 fully for these compounds, higher concentration ranges may have been more useful. However, these analytes can still be used as reference compounds, and the performance of the Method for other compounds will be discussed in terms of the results obtained for these priority pollutant compounds.

For the other four compounds used in this evaluation including, styrene and the three xylene isomers, the performance of Method 8020 was essentially equivalent to that obtained for the priority pollutant reference compounds.

The quadratic calibration model was accepted for styrene and for p-xylene over a three order of magnitude concentration range and for o- and m-xylene over a concentration range of two orders of magnitude. As for the priority pollutant compounds, use of higher concentration ranges to test the calibration models may have provided a fuller evaluation of the Method performance for these compounds. Based on these data, Method 8020 performed suitable for all of the analytes used in these experiments and all of these analytes were included in the Preliminary Method Evaluation step of the Method 8015 testing.

DLI Studies--

Table 21 presents a summary of the results obtained for the Instrumentation Range Determination for Method 8020 using the DLI sample introduction technique. A total of 12 compounds were used in this portion of the testing. Again the seven priority pollutant compounds will serve as reference compounds and the performance of the Method for the other analytes will be discussed in terms of results obtained for these compounds. Over a concentration range of two-and-a-half or three orders of magnitude, only the quadratic calibration model was accepted for six of the priority pollutant compounds. For the remaining reference analyte, 1,3-dichlorobenzene, both the linear and the quadratic models were accepted over a three order of magnitude concentration range. For three of the remaining compounds including 2-picoline, styrene, and m-xylene, the quadratic calibration model was accepted over a concentration range of two-and-a-half or three orders of magnitude. For these compounds, the performance of Method 8020 was equivalent to that obtained for the priority pollutant compounds. For o-xylene, two calibration models were accepted only after the concentration range being tested had been reduced to one-and-a-half orders of magnitude. None of the calibration models were accepted for p-xylene over any portion of the concentration range tested. Results obtained for these two compounds must be

considered anomalous. Since the Method performed suitable for m-xylene, there is no reason that it should not be suitable for the ortho and para isomers of this compound. The cause of these anomalous data is not known but may be some error in preparation of the stock solutions or in acquisition of the data. Consequently, Method 8020 is assumed to perform suitably for these two compounds and for the other 10 analytes in this step of the evaluation.

PRELIMINARY METHOD EVALUATION

As discussed in detail previously, the Preliminary Method Evaluation phase of the testing of each of these Methods was conducted using the PTD sample introduction technique only. In these experiments, replicate reagent water and synthetic solid matrix samples were prepared by spiking with solutions containing the test analytes at levels within the concentration range over which the calibration models had been accepted in the Instrumentation Range Determination phase of these studies. These samples were then stored at 4°C overnight and analyzed the following day using the appropriate Method and the PTD sample introduction techniques as described in Method 5030. The criteria used in evaluating method performance in this phase of the testing were the recovery of each analyte, expressed as a percent of the amount of material spiked into the replicate samples, and the precision of the measurement of the compound recovered, expressed as the relative standard deviation of the measurement.

The SLMVP specifies 70 to 130 percent as the range for acceptable recoveries and 15 percent as the maximum RSD value for acceptable method precision. For many of the analytes included in this step of the method suitability testing, this performance was not obtained. These Methods failed to achieve the specified performance even for some of the Priority Pollutant compounds for which these Methods have previously been demonstrated to be suitable in these sample types. The cause of these anomalous results must be variable analyte losses in the spiking, handling, and/or storage of the

aqueous and solid samples used in these experiments. For the aqueous samples, a single 500 mL sample was spiked with the solution set being used in the testing. This large sample was then mixed by repeated inversions of the sample container and portions were then poured into 40 mL containers. These containers were filled to overflowing, sealed with a Teflon-lined septum screw cap and stored inverted until analysis on the following day. Variable analyte losses could have easily occurred during the inversion mixing of the large sample and/or during transfer of the sample to smaller bottles for storage. For the solid samples, individual 2 g aliquots were spiked with 20 uL of the solution set being tested. Each aliquot was then stirred with a vortex mixer in a attempt to disperse the test compounds evenly through out the sample. Each sample was then sealed using a Teflon-lined septum screw cap and stored until analysis the next day. Variable analyte losses could have occurred during the sample mixing. Variability could also be due to heterogeneous distribution of the spike through out the sample.

Because of these difficulties, evaluation of the performance of these Methods using the criteria specified in the SLMVP is not reasonable. Instead, the priority pollutant compounds will be considered reference analytes and method performance will be discussed in terms of the results obtained for these compounds.

Method 8010

A summary of the results of the Preliminary Method Evaluation for Method 8010 is presented in Table 22 for aqueous sample and in Table 23 for solid samples. A total of 39 compounds, including 26 priority pollutants, were used in this phase of the method testing.

Aqueous Samples--

In experiments involving the aqueous samples, recoveries for the priority pollutants ranged from 21.8 to 112 percent. With the exception of

three analytes, recoveries for these reference compounds exceeded 50 percent. Recoveries for trichlorofluoromethane, vinyl chloride, and 1,1,1-trichloroethane were determined to be 21.8, 45.1, and 48.2 percent, respectively. These compounds are among the more volatile analytes included in this testing. Therefore, somewhat higher losses during sample preparation are not surprising. The precision of the determination of the priority pollutant compounds was generally good. RSD values for the measurement of these compounds were all less than 22 percent and many were less than 10 percent. Based on the performance of Method 8010 for these reference compounds, the criteria used in evaluating the suitability of this Method for the non-priority pollutant compounds were recoveries in the range of 45 to 1201 percent and variability, as evidenced by RSD values, of less than 25 percent.

Method 8010 achieved these performance criteria for 10 of the remaining 13 compounds used in these evaluations. These compounds for which Method 8010 was determined to be suitable include allyl chloride, bromobenzene, 1-chlorohexane, chloroprene, 1,2-dibromo-3-chloropropane, dibromomethane, 1,4-dichloro-2-butene, ethylene dibromide, 1,1,1,2-tetrachloroethane, and 1,2,3-trichloropropane.

For the three remaining compounds the following results were obtained. Reproducibility of the Method was poor for benzyl chloride and 4-chlorotoluene for which RSD values of 46 and 40 percent, respectively were determined. Poor performance of Method 8010 is not unexpected for benzyl chloride since, as the purging efficiency experiments indicated, this compound is somewhat water soluble. Poor performance of the Method for 4-chlorotoluene is somewhat surprising, however. As the purging efficiency experiments demonstrate, chlorotoluene is efficiently recovered from aqueous samples by purging. This compound is somewhat less volatile than other analytes included in this testing, consequently, it should be somewhat less prone to variable losses due to sample preparation techniques. However, as discussed

below, an unacceptably high variability was also observed for this compound in the solid sample experiments. Perhaps the boiling point and/or molecular weight of chlorotoluene exceed the range that can be consistently determined using ambient temperature PTD sample introduction techniques. A poor recovery of 4.74 percent and an unacceptably high RSD value of 37 percent were determined for dichlorodifluoromethane. This result is not surprising, since this compound is very volatile and, therefore, might be expected to be especially sensitive to vigorous mixing techniques during sample preparation.

Based on these results, Method 8010 is suitable for the determination of all but three of the test compounds in aqueous samples. The three compounds which can not be included in the scope of this Method include benzyl chloride, 4-chlorotoluene, and dichlorodifluoromethane.

Solid Samples--

In experiments involving solid samples, recoveries of the priority pollutant compounds ranged from 6.32 to 76.6 percent. Only two of these reference compounds were determined to have recoveries of less than 25 percent. Recoveries of 6.32 and 10.0 percent were determined for chloromethane and chloroethane, respectively. These compounds are among the most volatile analytes included in this study and, therefore, are more likely to be lost during sample preparation operations. RSD values for the determination of the priority pollutants in solid samples were generally less than 40 percent and less than 20 percent for many of these analytes. For two compounds, vinyl chloride and 1,1,1-trichloroethane, RSD values of 43 and 77 percent, respectively were determined. Since vinyl chloride is relatively volatile, it may be expected to be more susceptible to variable losses during sample preparation. No explanation is apparent for the high degree of variability associated with the determination of 1,1,1-trichloroethane. Results for this compound must be considered anomalous. Based on the performance of Method 8010 for these reference analytes, the criteria used to

evaluate the suitability of this Method for the determination of the other test compounds were recoveries of greater than 25 percent and RSD values of less than 40 percent.

Method 8010 achieved these performance criteria for 11 of the remaining 13 compounds. Compounds for which the Method performed successfully in solid samples included the 10 non-priority pollutants for which the Method was determined to be suitable in aqueous samples plus dichlorodifluoromethane. The 25.1 percent recovery determined for dichlorodifluoromethane was just barely in the acceptable range indicating that this volatile compound is very susceptible to losses during sample handling.

As with the aqueous samples, the variability of the Method for the determination of benzyl chloride and 4-chlorotoluene in solids exceeded the performance criteria. RSD values of 54 and 50 percent, respectively, were determined for these compounds. Discussions of these results are identical to those provided for the determination of these analytes in aqueous samples provided above.

Evaluation of the results of Method 8010 using solid samples indicate that this Method is suitable for the determination of 36 of the 39 test analytes. The three compounds excluded on the basis of these experiments are the same ones eliminated on the basis of the results obtained from the analysis of aqueous samples. The performance of this Method for dichlorodifluoromethane is marginal and performance for benzyl chloride and 4-chlorotoluene is unacceptable.

Method 8015

A summary of the results of the Preliminary Method Evaluation for Method 8015 is presented in Table 24 for aqueous samples and in Table 25 for solid samples. Method 8015 was determined to perform acceptably for five compounds in the Instrumentation Range Determination step. None of these compounds are priority pollutants. Therefore, the performance of Method 8010 for the

priority pollutant compounds used in evaluating the suitability of that Method will be applied in discussing the performance of Method 8015. For aqueous samples, these criteria include a recovery in the range of 45 to 120 percent and variability, as evidenced by the RSD value, of less than 25 percent. The criteria applied in evaluating method performance for solid samples includes a recovery of greater than 25 percent and RSD value of less than 40 percent.

Aqueous Samples--

In experiments involving aqueous samples, the performance of Method 8015 achieved the established criteria for all five of the compounds used in this testing. Recoveries for these compounds ranged from 70.0 to 98.3 percent and RSD values ranged from 2.8 to 20 percent. For these compounds, the performance of Method 8015 was well within the established criteria.

Solid Samples--

For four of the five analytes included in the solid sample experiments, Method 8015 exceeded the criteria established for determining suitability. These compounds included diethyl ether, methacrylonitrile, methyl ethyl ketone, and methyl methacrylate. The recovery of the fifth compound, ethyl methacrylate was very poor. This compound is not expected to be particularly susceptible to loss during sample preparation, so the cause of this low recovery is not well understood. Since the recovery of this compound in the aqueous sample experiments was quite good and no explanation is available for poor recovery from the solid samples, these results may be due to an error in preparation or dilution of the standards. Consequently, Method 8015 is considered to be suitable for the determination of all five of the analytes included in this portion of the testing.

Method 8020

Table 26 provides a summary of the results of the Preliminary Method Evaluation for Method 8020 for aqueous samples and Table 27 presents this information for the solid sample experiments. Eleven compounds, including seven priority pollutants were included in this step of the method performance testing. In the discussions presented below, the priority pollutants will be considered reference compounds and the performance of the Method for other analytes will be discussed in terms of the results obtained for these analytes.

Aqueous Samples--

For the experiments involving aqueous samples, the recoveries for the seven reference compounds ranged from 61.9 to 98.2 percent and the RSD values associated with these determinations were all less than 22 percent. Using a 60 percent minimum recovery and a 20 percent RSD value as the criteria for evaluating method performance for the other four compounds, Method 8020 was determined to be suitable for the determination of these compounds in aqueous samples.

Solid Samples--

Recoveries of the seven priority pollutants from the solid samples ranged from 15.4 to 59.0 percent. For five of these compounds, recoveries exceeded 35 percent. For 1,3-dichlorobenzene and toluene, recoveries of 15.4 and 21.4, respectively, were determined. The cause of these very low recoveries is not known. These compounds are not expected to be particularly susceptible to losses during sample preparation. Since recoveries of these compounds from aqueous samples were acceptable and no rationale is available for poor recovery of these compounds from solids, the assumption will be made that Method 8020 is suitable for the determination of these reference compounds and that these data are anomalous. RSD values associated with the

determination of the seven reference compounds in solids ranged from 13 to 71 percent. For most of these compounds, RSD values of less than 35 percent were determined. The relatively high variability in the determination of benzene can be attributed to the chromatographic interference presented by the methanol used as the extracting solvent. The spiking concentration for benzene had to be increased substantially to ensure a reliable signal for this compound. However, even at a concentration of 300 ug/g, consistent integration of this peak in the presence of a large amount of methanol was very difficult. Use of the alternate extracting solvent, PEG, was precluded by the presence of a number of impurities which were detected by the PID and which interfered with the determination of some of the later eluting compounds, such as the xylene isomers. The reason for the high RSD value associated with the determination of 1,2-dichlorobenzene is not known. Possibly this observed variability is due to incomplete mixing of the solid sample following spiking. Based on the performance of Method 8020 for the reference compounds, the criteria that will be used in discussing the suitability of the Method for the remaining four compounds include a recovery minimum of 40 percent and an RSD maximum of 35 percent.

For the remaining four compounds, the performance of Method 8020 was well within the acceptance established based on results obtained for the reference compounds. Consequently, Method 8020 was determined to be suitable for the determination in solids of all eleven analytes used in this portion of the testing.

6.0 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, 19868.

3. "GM-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, EPA Contract Number 68-03-3224, Work Assignment 1-01.

TABLE 1. 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

TABLE 1. (Continued)

Compound	List[a]	Sample Matrix for Which Method Was Found to Be Suitable: Aqueous/Solids Sample Matrices[b]	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

TABLE 1. (Continued)

Compound	List[a]	Sample Matrix for Which Method Was Found to Be Suitable: Aqueous/Solids Sample Matrices[b]	Nonaqueous Sample Matrices[c]
METHOD 8020 (Continued)			
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 2. 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]	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

TABLE 2. (Continued)

Compound	List[a]	Sample Matrix for Method was Found to be Unsuitable: Aqueous Solid[b]	Nonaqueous Liquid[c]	Comments
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 3. 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
Bromodichlomethane	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

TABLE 3. (Continued)

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency (percent)	Estimated Detection Limit (µg/L)
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

TABLE 4. 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

TABLE 4. (Continued)

Compound	CAS Number	List[a]	Source
METHOD 8010 (Continued)			
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
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

TABLE 4. (Continued)

Compound	CAS Number	List[a]	Source
METHOD 8015 (Continued)			
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 5. INSTRUMENT CONDITIONS SPECIFIED IN METHODS 8010, 8015, AND 8020 AND USED IN THESE METHOD EVALUATIONS

Parameter	Method 8010	Method 8015	Method 8020
Purge gas	Helium	Helium	Helium
Purge gas flow rate ml/min	30 ml/min	30 ml/min	30 ml/min
Purge time (min)	15 min	15 min	15 min
Purge temperature (°C)	Ambient	Ambient	Ambient
Desorb time (min)	1.5 min	1.5 min	1.5 min
Desorb temperature (°C)	180°C	180°C	180°C
Trap material	1 cm 3% SP2100 60/80 mesh 7.7 cm Tenax, 60/80 mesh 7.7 cm Silica gel 15, 60/80 mesh 7.7 cm Charcoal, 6/10 mesh	1 cm 3% SP2100 60/80 mesh 23 cm Tenax, 60/80 mesh	1 cm 3% SP2100 60/80 mesh 23 cm Tenax, 60/80 mesh
GC system	Tracor Model 5830 with Hall Detector	Hewlett-Packard Model 5890 with FID Detector	Tracor Model 560 with PID Detector
GC column	8 ft x 0.1 in. I.D. stainless steel 1% SP-1000 on 60/80 mesh Carbo Pack B	8 ft x 0.1 in. I.D. stainless steel 1% SP-1000 on 60/80 mesh Carbo Pack B	6 ft x 0.082 in. I.D. stainless steel 5% SP-1200/1.75% Bentone 34 on 100/120 mesh Supelcoport
Carrier gas	Helium at 40 ml/min	Helium at 40 ml/min	Helium at 30 ml/min
Oven program	45°C (3 min), 8°C/min, 220°C (15 min)	45°C (3 min), 8°C/min 200°C (15 min)	50°C (2 min), 3°C/min 110°C (15 min)
Injector temperature	200°C	220°C	200°C
Detector temperature	200°C	250°C	200°C

TABLE 6. RETENTION TIMES, PURGING EFFICIENCIES, AND ESTIMATED DETECTION LIMITS DETERMINED FOR METHOD 8010 ANALYTES

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency: Test Concentration (µg/L)	Purging Efficiency: Recovery (RSD)	PTD[a]: 5 S/N	PTD[a]: Estimated Detection Limit (µg/L)	DLI[b]: 5 S/N	DLI[b]: Method Detection Limit (mg/L)
Allyl chloride	107-05-1	10.17	40	88 (2.1)	0.400	0.272	0.400	0.400
Benzyl chloride	100-44-7	30.29	800	25 (6.0)	10.0	3.05	1.50	1.27
Bis(2-chloroethoxy)methane	111-91-1	38.60	400	ND	(c)	--	2.00	0.310
Bis(2-chloroisopropyl)ether	108-60-1	34.79	400	ND	(c)	--	0.25	0.088
Bromoacetone	598-31-2	18.92	400	ND	(c)	--	6.00	2.66
Bromobenzene	108-86-1	29.05	100	81 (4.3)	0.850	0.278	1.50	0.376
Bromodichloromethane	75-27-4	15.44	200	107 (0.8)	0.800	0.138	0.400	0.246
Bromoform	75-25-2	21.12	200	65 (12)	1.45	0.951	1.50	1.03
Bromomethane	74-83-9	2.90	100	77 (12)	0.850	0.850	1.00	0.500
Carbon tetrachloride	56-23-5	14.58	100	81 (5.9)	0.155	0.111	0.300	0.150
Chlorobenzene	106-90-7	25.49	100	51 (20)	0.625	0.701	0.750	0.596
Chloroethane	75-00-3	5.18	100	85 (13)	0.015	0.755	0.600	1.07
2-Chloroethanol	107-07-3	15.18	400	ND	(c)	--	1.50	1.47
Chloroform	67-66-3	12.62	100	88 (18)	0.210	0.123	0.300	0.181
1-Chlorohexane	544-10-5	26.26	80	76 (3)	1.20	0.283	0.750	0.358
2-Chloroethyl vinyl ether	100-75-8	19.23	160	ND	(c)	--	1.50	5.98
Chloromethane	74-87-3	1.40	100	73 (18)	0.500	0.258	1.00	0.314
Chloromethyl methyl ether	107-30-2	8.88	400	ND	(c)	--	4.00	40.0
Chloroprene	126-99-8	15.60	400	90 (3.6)	2.50	2.50	2.50	(d)
4-Chlorotoluene	106-43-4	34.46	80	83 (3.2)	1.95	0.671	1.50	0.928
Dibromochloromethane	124-48-1	18.22	80	109 (5.1)	0.120	0.488	1.00	0.887
1,2-Dibromo-3-chloropropane	96-12-8	28.09	160	14 (8.1)	5.35	1.66	2.00	0.387
Dibromomethane	74-95-3	13.83	40	78 (4.0)	0.800	0.900	1.50	1.17
1,2-Dichlorobenzene	95-50-1	37.96	160	83 (0.4	1.40	1.59	1.00	2.20
1,3-Dichlorobenzene	541-73-1	36.88	80	82 (1.7)	0.400	0.274	0.750	0.375

TABLE 6. (Continued)

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency: Test Concentration (μg/L)	Purging Efficiency: Recovery (RSD)	PTD[a]: 5 S/N	PTD[a]: Estimated Detection Limit (μg/L)	DLI[b]: 5 S/N	DLI[b]: Method Detection Limit (mg/L)
1,4-Dichlorobenzene	106-46-7	38.64	160	80 (2.1)	1.25	0.362	0.750	0.483
1,4-Dichloro-2-butene	764-41-0	23.45	160	30 (6.7)	2.78	0.488	0.600	0.244
Dichlorodifluoromethane	75-71-8	3.68	80	109 (0.8)	0.500	0.130	0.200	0.236
1,1-Dichloroethane	75-34-3	11.21	100	86 (16)	0.300	0.164	0.200	0.235
1,2-Dichloroethane	107-06-2	13.14	200	103 (0.8)	0.300	0.129	0.750	0.221
1,1-Dichloroethylene	75-35-4	10.04	100	78 (3.1)	0.550	0.180	0.200	0.234
Trans-1,2-Dichloroethylene	156-60-5	11.97	200	107 (3.2)	0.400	0.897	1.20	1.60
Dichloromethane	75-09-2	7.56	100	86 (14)	0.210	2.93	0.200	4.20
1,2-Dichloropropane	78-87-5	16.69	100	90 (18)	0.455	0.300	0.750	0.451
1,3-Dichloro-2-propanol	96-23-1	24.28	400	ND	(c)	--	0.500	0.884
Cis-1,3-dichloropropylene	10061-01-5	17.00	400	100 (1.4)	0.550	0.317	0.750	0.528
Epichlorohydrin	106-89-8	13.65	400	ND	(c)	--	0.900	0.495
Ethylene dibromide	106-93-4	19.59	80	71 (5.7)	1.55	0.645	1.00	0.763
Methyl iodide	74-88-4	7.57	80	87 (2.7)	2.00	2.52	4.00	3.65
1,1,2,2,-Tetrachloroethane	79-34-5	23.12	200	102 (2.1)	0.010	0.140	0.450	0.239
1,1,1,2-Tetrachloroethane	630-20-6	21.10	160	85 (6.8)	0.400	0.117	0.750	0.166
Tetrachloroethylene	127-18-4	23.05	100	51 (17)	0.200	0.402	0.400	0.342
1,1,1-Trichloroethane	71-55-6	14.48	200	97 (3.5)	0.050	0.082	0.200	0.133
1,1,2-Trichloroethane	79-00-5	18.27	40	83 (5.1)	0.250	0.049	0.200	0.068
Trichloroethylene	79-01-6	17.40	100	85 (15)	0.180	0.124	0.450	0.175
Trichlorofluoromethane	75-69-4	9.26	100	82 (13)	0.420	0.191	0.300	0.261

TABLE 6. (Continued)

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency: Test Concentration (µg/L)	Purging Efficiency: Recovery (RSD)	PTD[a]: 5 S/N	PTD[a]: Estimated Detection Limit (µg/L)	DLI[b]: 5 S/N	DLI[b]: Method Detection Limit (mg/L)
1,2,3-Trichloropropane	96-18-4	22.95	40	50 (6.6)	0.360	0.346	0.200	0.288
Vinyl chloride	75-01-4	3.25	100	81 (16)	0.400	0.733	0.700	0.989

(a) PTD Estimated Detection Limits calculated as follows:

$$EDL = \frac{\text{DLI Method Detection Limit (mg/L) x Injection Volume (3 µl)}}{\text{Purging Efficiency x Sample Volume (5 ml)}}.$$

(b) DLI Method Detection Limits calculated as follows:

$MDL = t_{n-1}$ (SD)

where t_{n-1} = student t value for n-1 degree of freedom

n = number of replicate analyzed

SD = standard deviation associated with analysis of n replicates.

(c) Compound not included in this portion of study due to poor purging efficiency.

(d) Compound not included in this portion of study due to poor chromatographic behavior. See text.

TABLE 7. RETENTION TIMES, PURGING EFFICIENCIES, AND ESTIMATED DETECTION LIMITS DETERMINED FOR METHOD 8015 ANALYTES

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency		PTD[a]		DLI[b]	
			Test Concentration (µg/L)	Recovery (RSD)	5 S/N	Estimated Detection Limit (µg/L)	5 S/N	Method Detection Limit (mg/L)
Acetonitrile	75-05-8	3.78	800	ND	(c)	--	1.02	1.32
Allyl alcohol	107-18-6	9.60	800	ND	(c)	--	1.20	0.879
Carbon disulfide	75-15-0	8.59	200	ND	(c)	--	3.40	0.310
1,2,3,4-Diepoxybutane	1464-53-5	15.37	800	ND	(c)	--	0.400	0.037
Diethyl ether	60-29-7	11.24	200	90 (11)	0.075	0.013	0.250	0.019
1,4-Dioxane	123-91-1	14.44	800	ND	(c)	--	0.250	0.022
Ethylene oxide	75-21-8	1.96	800	ND	(c)	--	0.260	0.293
Ethyl methacrylate	97-63-2	23.98	200	55 (14)	0.0200	0.389	0.300	0.357
Isobutanol	78-83-1	14.30	800	2 (0)	(c)	--	0.140	0.029
Malononitrile	109-77-3	19.80	800	ND	(c)	--	2.00	1.56
Methacrylonitrile	126-98-7	13.09	800	37 (5)	0.150	2.53	0.250	0.019
Methyl ethyl ketone	78-93-1	12.93	200	14 (12)	1.50	0.189	0.170	0.044
Methyl isobutyl ketone	108-10-1	20.92	200	20 (34)	0.250	0.051	0.150	0.017
Methyl mercaptan	74-93-1	2.16	800	ND	(c)	--	0.850	0.399
Methyl methacrylate	80-62-6	20.22	200	55 (11)	0.200	0.064	0.140	0.059
Paraldehyde	123-63-7	21.37	800	ND	(c)	--	0.320	0.071
Propargyl alcohol	107-19-7	10.68	800	ND	(c)	--	1.19	1.82

TABLE 7. (Continued)

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency: Test Concentration (μg/L)	Purging Efficiency: Recovery (RSD)	PTD[a]: 5 S/N	PTD[a]: Estimated Detection Limit (μg/L)	DLI[b]: 5 S/N	DLI[b]: Method Detection Limit (mg/L)
β-Propiolactone	57-57-8	13.83	800	1 (32)	(c)	--	1.50	0.242
Propionitrile	107-12-0	8.48	800	7 (22)	(c)	--	0.700	0.231

(a) PTD Estimated Detection Limits calculated as follows:

$$EDL = \frac{\text{DLI Method Detection Limit (mg/L)} \times \text{Injection Volume (3 μl)}}{\text{Purging Efficiency} \times \text{Sample Volume (5 ml)}}.$$

(b) DLI Method Detection Limits calculated as follows:

$MDL = t_{n-1}$ (SD)

where t_{n-1} = student t value for n-1 degree of freedom

n = number of replicate analyzed

SD = standard deviation associated with analysis of n replicates.

(c) Compound not included in this portion of study due to poor purging efficiency.

TABLE 8. RETENTION TIMES, PURGING EFFICIENCIES, AND ESTIMATED DETECTION LIMITS DETERMINED FOR METHOD 8020 ANALYTES

Compound	CAS Number	Retention Time (minutes)	Purging Efficiency: Test Concentration (µg/L)	Purging Efficiency: Recovery (RSD)	PTD[a]: 5 S/N	PTD[a]: Estimated Detection Limit (µg/L)	DLI[b]: 5 S/N	DLI[b]: Method Detection Limit (mg/L)
Benzene	73-41-2	2.59	200	77 (8)	0.036	0.0554	0.250	0.0712
Chlorobenzene	106-90-7	9.38	100	51 (20)	0.028	0.134	0.250	0.114
1,2-Dichlorobenzene	95-50-1	20.60	160	83 (0.4)	0.064	0.124	0.300	0.172
1,3-Dichlorobenzene	541-73-1	17.54	80	82 (2)	0.025	0.395	0.500	0.540
1,4-Dichlorobenzene	106-46-7	16.42	160	80 (2)	0.048	0.110	0.300	0.146
Ethyl benzene	100-41-4	8.12	200	94 (0.4)	0.016	0.0957	0.500	0.150
2-Picoline	109-06-8	9.18	800	ND	(c)	--	1.50	0.424
Styrene	100-42-5	11.60	200	86 (7)	0.036	0.118	0.500	0.169
Toluene	108-88-3	5.14	200	99 (2)	0.012	0.0867	0.400	0.143
o-Xylene	95-47-6	10.54	200	92 (8)	0.035	0.0326	0.300	0.050
m-Xylene	1477-55-0	9.77	200	99 (1)	0.025	0.125	0.500	0.206
p-Xylene	106-42-3	9.18	200	98 (1)	0.061	0.0759	0.500	0.124

(a) PTD Estimated Detection Limits calculated as follows:

$$EDL = \frac{\text{DLI Method Detection Limit (mg/L)} \times \text{Injection Volume (3 µl)}}{\text{Purging Efficiency} \times \text{Sample Volume (5 ml)}}.$$

(b) DLI Method Detection Limits calculated as follows:

$$MDL = t_{n-1}\ (SD)$$

where t_{n-1} = student t value for n-1 degree of freedom

n = number of replicate analyzed

SD = standard deviation associated with analysis of n replicates.

(c) Compound not included in this portion of study due to poor purging efficiency.

TABLE 9. 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 10. RESPONSE FACTORS DETERMINED FOR METHOD 8010 ANALYTES USING PTD

Compound	Solution Set	S/N Concentration, µg/L	Response Factor (Relative Standard Deviation)						
			5 S/N	15 S/N	50 S/N	150 S/N	500 S/N	1500 S/N	5000 S/N
Allyl chloride	3	0.080	8.23 (24)	6.74 (6.2)	5.73 (7.0)	6.20 (6.9)	6.47 (1.6)	6.53 (6.5)	6.84 (3.9)
Benzyl chloride	1	2.0	0.885 (28)	0.489 (60)	0.647 (13.0)	0.650 (16)	1.08 (6.9)	0.953 (19)	0.848 (7.9)
Bis(2-chloroisopropyl)ether	1	1.2	0.913 (91)	0.280 (0.74)	0.199 (11.0)	0.192 (21)	0.262 (13)	0.208 (1.9)	0.202 (3.9)
Bromobenzene	3	0.17	1.01 (21)	1.31 (11)	1.46 (2.6)	1.65 (6.7)	1.85 (6.7)	1.87 (5.9)	1.99 (2.2)
Bromodichloromethane	3	0.16	5.97 (10)	7.13 (3.1)	8.10 (1.2)	9.02 (4.8)	9.33 (1.3)	9.14 (2.0)	8.35 (1.7)
Bromoform	3	0.29	0.377 (25)	0.940 (10)	1.64 (4.8)	2.22 (5.6)	2.59 (5.6)	2.59 (3.2)	2.80 (2.2)
Bromomethane	3	0.17	0.846 (44)	1.39 (6.8)	2.14 (9.1)	3.26 (13)	4.13 (3.1)	3.92 (7.5)	4.33 (5.1)
Carbon tetrachloride	1	0.031	8.76 (17)	8.23 (4.5)	8.51 (8.1)	8.86 (8.0)	13.5 (4.2)	10.6 (5.7)	11.2 (4.1)
Chlorobenzene	2	0.12	2.85 (29)	2.94 (20)	2.82 (7.4)	3.11 (2.2)	3.09 (6.4)	3.05 (3.0)	2.90 (13)
Chloroethane	3	0.003	48.0 (53)	26.7 (19)	9.71 (3.8)	7.74 (2.4)	7.85 (6.0)	6.92 (2.3)	10.0 (0.12)
Chloroform	1	0.070	17.4 (2.0)	12.5 (4.0)	11.8 (4.2)	12.0 (5.7)	16.7 (6.0)	13.4 (2.5)	12.8 (4.0)
1-Chlorohexane	1	0.24	3.68 (23)	2.68 (16)	2.79 (1.5)	2.81 (6.1)	3.91 (5.6)	2.80 (4.0)	2.93 (5.4)
Chloromethane	1	0.10	4.53 (4.0)	4.87 (20)	4.81 (11)	5.28 (14)	7.61 (14)	6.49 (0.79)	6.63 (6.3)
Chloroprene	2	0.50	0.721 (16)	0.697 (11)	0.729 (7.8)	0.778 (3.7)	0.807 (4.0)	0.838 (4.6)	0.787 (5.6)
4-Chlorotoluene	2	0.39	0.995 (24)	0.778 (8.8)	0.804 (8.2)	0.870 (0.59)	0.828 (5.3)	0.788 (5.2)	0.751 (16)
Dibromochloromethane	3	0.024	10.7 (16)	12.4 (13)	16.1 (1.1)	18.2 (6.4)	18.3 (7.3)	21.1 (0.63)	20.7 (5.1)
1,2-Dibromo-3-chloropropane	2	1.07	0.942 (45)	0.950 (36)	0.622 (17)	0.645 (14)	0.738 (6.1)	0.699 (5.4)	0.705 (5.8)
Dibromomethane	3	0.16	1.91 (16)	2.68 (12)	4.00 (1.7)	4.99 (5.3)	5.34 (1.4)	5.41 (0.54)	5.55 (1.7)
1,2-Dichlorobenzene	1	0.28	2.49 (24)	1.81 (0.24)	1.69 (4.7)	1.67 (6.4)	2.20 (3.7)	1.61 (3.4)	1.67 (3.7)
1,3-Dichlorobenzene	3	0.080	1.94 (6.9)	2.77 (33)	1.99 (4.7)	1.82 (8.0)	1.99 (2.2)	1.87 (10)	2.20 (3.5)
1,4-Dichlorobenzene	2	0.25	1.45 (31)	1.24 (19)	1.08 (4.9)	1.20 (3.7)	1.13 (2.6)	1.11 (6.1)	1.54 (2.5)
1,4-Dichloro-2-butene	2	0.55	1.40 (11)	1.52 (14)	1.47 (11)	0.963 (70)	1.72 (30)	2.07 (3.8)	1.95 (8.5)
Dichlorodifluoromethane	2	0.10	15.0 (7.4)	7.17 (7.1)	3.88 (6.9)	3.29 (11)	3.04 (16)	2.98 (14)	3.51 (3.4)
1,1-Dichloroethane	2	0.060	5.88 (16)	5.50 (8.1)	6.31 (5.8)	6.66 (3.6)	6.99 (5.9)	7.04 (6.7)	5.26 (5.7)
1,2-Dichloroethane	2	0.060	6.87 (30)	5.76 (5.3)	6.62 (7.0)	6.92 (5.8)	7.38 (3.1)	7.52 (3.5)	5.34 (4.8)
1,1-Dichloroethylene	1	0.11	6.98 (13)	6.67 (6.0)	6.67 (3.7)	6.95 (8.7)	9.64 (9.9)	7.90 (5.1)	7.64 (5.1)
Trans-1,2-Dichloroethylene	3	0.080	5.74 (23)	8.26 (4.1)	8.11 (5.7)	9.63 (7.1)	10.1 (0.55)	9.91 (6.2)	10.4 (3.2)
Dichloromethane	1	0.042	35.9 (59)	17.0 (18.0)	13.8 (17)	11.2 (6.3)	14.7 (9.3)	11.9 (2.7)	11.7 (3.9)
1,2-Dichloropropane	1	0.091	6.91 (12)	7.27 (3.0)	7.99 (3.7)	8.42 (5.3)	11.3 (4.7)	9.02 (2.0)	8.40 (3.7)
Cis-1,3-dichloropropylene	3	0.11	2.15 (23)	3.00 (6.4)	3.34 (1.8)	3.79 (9.8)	3.96 (1.4)	4.10 (2.2)	4.16 (2.7)
Ethylene dibromide	1	0.31	2.50 (8.6)	2.79 (5.7)	3.40 (6.1)	3.76 (7.6)	5.09 (3.8)	4.01 (3.9)	3.87 (3.8)
Methyl iodide	2	0.40	3.20 (61)	1.04 (33)	0.397 (8.3)	0.296 (22)	0.127 (59)	0.0901 (62)	0.172 (56)
1,1,2,2-Tetrachloroethane	3	0.002	48.7 (38)	101.0 (83)	11.3 (26)	10.8 (20)	7.79 (1.9)	8.14 (5.3)	8.83 (0.40)
1,1,1,2-Tetrachloroethane	1	0.080	7.58 (10)	7.75 (0.47)	8.40 (2.4)	8.97 (7.8)	12.7 (4.0)	9.75 (3.2)	9.62 (1.9)
Tetrachloroethylene	1	0.040	15.2 (8.7)	11.6 (25)	10.2 (2.0)	9.98 (8.1)	14.2 (3.0)	10.4 (1.3)	11.0 (5.6)
1,1,1-Trichloroethane	2	0.010	75.5 (0.83)	26.8 (10)	13.2 (8.9)	8.85 (6.1)	7.47 (5.3)	7.52 (4.9)	7.26 (9.9)
1,1,2-Trichloroethane	2	0.050	6.92 (10)	6.50 (16)	6.81 (3.4)	7.25 (4.9)	7.56 (5.0)	7.53 (3.5)	4.86 (13)
Trichloroethylene	2	0.036	10.6 (19)	8.21 (19)	7.26 (5.8)	7.58 (2.9)	7.73 (5.1)	7.74 (4.0)	7.43 (12)
Trichlorofluoromethane	2	0.084	51.6 (12)	19.5 (7.3)	11.3 (8.8)	8.69 (4.6)	7.78 (6.2)	7.87 (5.8)	7.19 (6.4)
1,2,3-Trichloropropane	2	0.072	4.01 (11)	4.37 (10)	4.34 (6.4)	4.60 (6.0)	4.95 (4.1)	4.84 (4.1)	4.87 (1.2)
Vinyl chloride	1	0.080	7.17 (24)	6.96 (6.6)	6.91 (2.4)	7.03 (10)	10.4 (16)	8.88 (7.5)	9.22 (3.7)

TABLE 11. RESPONSE FACTORS DETERMINED FOR METHOD 8010 ANALYTES USING DLI

Compound	Solution Set	S/N Concentration, mg/L	Response Factor (Relative Standard Deviation)						
			5 S/N	15 S/N	50 S/N	150 S/N	500 S/N	1500 S/N	5000 S/N
Allyl chloride	5	0.080	1.77 (98)	0.98 (3.3)	1.43 (3.3)	1.45 (4.0)	1.39 (0.1)	1.42 (2.7)	1.30 (2.3)
Benzyl chloride	2	0.30	2.71 (26)	2.48 (5.5)	2.75 (1.7)	3.40 (11)	3.18 (0.37)	3.53 (2.3)	3.52 (2.1)
Bis(2-chloroethoxy)methane	1	0.40	0.706 (73)	1.12 (14)	1.37 (11)	1.64 (6.7)	1.74 (4.5)	0.872 (4.1)	0.877 (1.2)
Bis(2-chloroisopropyl)ether	1	0.050	12.7 (28)	17.2 (30)	15.3 (11)	17.0 (3.9)	17.1 (1.4)	16.0 (3.2)	11.6 (8.5)
Bromoacetone	3	1.2	1.49 (14)	2.09 (4.2)	2.87 (5.7)	3.24 (1.4)	3.39 (4.0)	2.93 (4.0)	1.38 (30)
Bromobenzene	1	0.30	1.64 (13)	2.22 (3.8)	2.21 (1.2)	4.91 (1.7)	2.77 (0.74)	2.58 (2.2)	1.88 (7.1)
Bromodichloromethane	2	0.10	3.95 (19)	6.67 (3.6)	9.26 (3.4)	10.8 (8.3)	10.9 (1.4)	11.5 (1.6)	10.9 (2.3)
Bromoform	1	0.30	0.698 (21)	1.22 (16)	1.72 (7.5)	2.18 (4.2)	2.37 (1.8)	2.23 (3.1)	1.69 (6.3)
Bromomethane	6	0.60	0.833 (17)	2.27 (9.5)	2.71 (1.6)	4.02 (11)	3.36 (3.1)	0.467 (0.65)	-- --
Carbon tetrachloride	4	0.20	2.13 (5.2)	2.65 (2.1)	2.48 (6.1)	2.46 (1.1)	2.31 (4.1)	2.20 (1.9)	1.81 (2.2)
Chlorobenzene	3	0.15	6.41 (25)	6.28 (10)	6.04 (7.3)	5.68 (2.7)	5.58 (2.4)	5.20 (7.1)	4.27 (6.9)
Chloroethane	5	0.12	0.491 (8.5)	0.970 (16)	1.36 (6.7)	1.50 (3.1)	1.55 (2.2)	1.57 (1.5)	1.32 (4.2)
2-Chloroethanol	5	0.30	0.179 (27)	0.574 (15)	0.752 (8.4)	1.05 (2.8)	1.15 (0.99)	1.16 (0.91)	1.04 (2.9)
Chloroform	4	0.20	1.44 (8.2)	2.07 (3.5)	2.14 (2.7)	2.24 (0.95)	2.25 (2.4)	2.18 (2.3)	1.79 (2.9)
1-Chlorohexane	2	0.15	3.77 (14)	4.61 (7.0)	4.75 (2.4)	5.52 (9.8)	5.24 (2.2)	5.50 (2.5)	5.02 (1.5)
2-Chloroethyl vinyl ether	1	0.30	ND --	0.319 (24)	0.411 (15)	0.582 (7.0)	0.584 (8.8)	0.597 (16)	0.399 (8.5)
Chloromethane	5	0.20	0.762 (8.5)	1.03 (8.9)	1.41 (3.6)	1.54 (2.2)	1.57 (2.2)	1.56 (0.69)	1.15 (5.0)
Chloromethyl methyl ether	6	0.80	ND --	ND --	0.179 (4.8)	0.673 (5.0)	1.36 (6.7)	1.34 (6.2)	1.57 (0.51)
4-Chlorotoluene	3	0.30	5.59 (19)	5.60 (12)	5.36 (5.1)	5.01 (1.2)	4.82 (3.2)	4.43 (7.1)	3.77 (6.7)
Dibromochloromethane	1	0.20	1.10 (28)	1.97 (11)	2.49 (6.2)	3.13 (1.5)	3.28 (1.4)	3.11 (2.5)	2.21 (3.3)
1,2-Dibromo-3-chloropropane	3	0.40	3.19 (6.0)	3.47 (8.3)	4.05 (5.4)	3.88 (0.88)	4.04 (2.8)	4.21 (4.3)	4.18 (4.9)
Dibromomethane	1	0.30	0.558 (24)	1.28 (4.9)	1.82 (8.9)	2.41 (5.9)	2.57 (2.1)	2.42 (1.1)	1.71 (8.3)
1,2-Dichlorobenzene	3	0.20	5.72 (79)	7.57 (39)	7.99 (14)	7.85 (2.4)	7.61 (5.4)	7.13 (7.4)	6.10 (5.5)
1,3-Dichlorobenzene	2	0.15	7.30 (16)	6.86 (2.6)	7.64 (3.7)	9.72 (11)	8.85 (1.6)	9.22 (3.0)	8.58 (1.5)
1,4-Dichlorobenzene	2	0.15	5.29 (20)	6.26 (6.2)	6.94 (3.7)	9.84 (12)	8.97 (1.7)	9.26 (3.1)	8.55 (1.2)
1,4-Dichloro-2-butene	4	0.40	0.957 (10)	1.05 (1.5)	1.01 (1.6)	1.06 (0.73)	1.08 (0.91)	1.05 (1.8)	0.911 (1.3)
Dichlorodifluoromethane	6	0.040	ND --	3.03 (11)	6.99 (8.4)	6.94 (7.6)	7.38 (8.9)	5.60 (2.9)	3.75 (2.3)
1,1-Dichloroethane	6	0.040	ND --	3.24 (14)	7.11 (6.5)	7.29 (6.9)	9.28 (7.9)	7.76 (3.5)	6.15 (6.8)
1,2-Dichloroethane	3	0.15	4.32 (28)	8.85 (6.6)	10.8 (5.4)	11.9 (1.5)	12.1 (2.9)	11.1 (6.3)	8.81 (4.1)
Trans-1,2-Dichloroethylene	1	0.24	0.814 (42)	1.62 (12)	2.11 (6.3)	2.62 (1.9)	2.81 (3.3)	2.66 (2.4)	1.89 (7.8)
Dichloromethane	6	0.040	ND --	4.20 (10)	7.17 (8.8)	7.43 (5.1)	10.7 (11)	8.87 (3.7)	7.41 (1.7)
1,1-Dichloroethylene	6	0.040	ND --	3.73 (10)	9.79 (4.5)	9.89 (2.7)	12.0 (8.8)	9.23 (0.83)	7.03 (5.9)
1,2-Dichloropropane	1	0.15	1.88 (19)	2.92 (6.9)	3.74 (5.9)	4.11 (2.2)	4.05 (1.4)	3.76 (1.0)	2.63 (5.9)
1,3-Dichloro-2-propanol	2	0.10	4.49 (55)	4.19 (14)	6.24 (5.1)	8.58 (11)	8.41 (2.2)	9.34 (2.8)	8.99 (1.7)
Cis-1,3-dichloropropylene	2	0.15	2.04 (22)	3.81 (5.0)	5.06 (3.2)	6.06 (6.5)	5.89 (2.3)	6.13 (2.4)	5.77 (2.3)
Epichlorohydrin	4	0.60	0.451 (9.8)	0.696 (2.4)	0.786 (1.2)	0.867 (4.6)	0.908 (0.68)	0.884 (1.6)	0.692 (1.7)
Ethylene dibromide	2	0.20	3.17 (24)	4.73 (2.8)	5.91 (2.0)	7.51 (10)	7.23 (1.8)	7.53 (2.8)	6.99 (2.2)
Methyl iodide	5	0.80	0.077 (20)	0.180 (4.7)	0.448 (9.0)	0.62 (1.4)	0.703 (2.7)	0.717 (1.1)	0.615 (1.5)
1,1,2,2-Tetrachloroethane	1	0.090	2.66 (16)	4.18 (7.3)	4.56 (5.0)	5.03 (1.7)	4.91 (1.7)	4.58 (2.2)	3.32 (8.2)
1,1,1,2-Tetrachloroethane	3	0.15	3.15 (21)	4.78 (4.7)	4.79 (7.7)	5.98 (1.6)	5.22 (14)	6.42 (3.4)	5.94 (3.8)
Tetrachloroethylene	3	0.080	11.5 (27)	15.2 (4.6)	15.5 (5.6)	15.1 (1.4)	14.4 (1.2)	13.5 (5.8)	10.3 (6.2)
1,1,1-Trichloroethane	2	0.040	6.08 (21)	8.59 (7.0)	12.1 (2.1)	12.4 (9.9)	14.1 (1.3)	14.9 (1.9)	13.8 (2.6)
1,1,2-Trichloroethane	2	0.040	15.6 (11)	23.8 (2.8)	28.9 (1.9)	34.0 (10)	31.4 (2.1)	32.6 (2.4)	30.1 (1.8)
Trichloroethylene	4	0.30	1.43 (10)	1.66 (0.84)	1.57 (3.0)	1.62 (0.77)	1.58 (2.7)	1.56 (1.3)	1.30 (0.88)
Trichlorofluoromethane	5	0.060	0.737 (21)	1.27 (12)	1.98 (8.2)	2.18 (1.8)	2.17 (1.3)	2.17 (1.8)	1.92 (1.9)
1,2,3-Trichloropropane	2	0.040	15.3 (45)	17.6 (7.7)	16.3 (9.0)	18.4 (16)	15.7 (2.2)	15.7 (2.8)	13.9 (2.0)
Vinyl chloride	5	0.14	0.222 (30)	0.544 (23)	0.953 (8.0)	1.16 (2.0)	1.24 (1.7)	1.29 (0.83)	1.06 (5.9)

TABLE 12. RESPONSE FACTORS DETERMINED FOR METHOD 8015 ANALYTES USING PTD

Compound	Solution Set	S/N Concentration, g/L	Response Factor (Relative Standard Deviation)													
			5 S/N		15 S/N		50 S/N		150 S/N		500 S/N		1500 S/N		5000 S/N	
Diethyl ether	2	0.015	20.6	(75)	11.0	(2.2)	14.9	(23)	12.5	(8.6)	12.5	(12)	12.7	(2.1)	12.2	(5.3)
Ethyl methacrylate	2	0.040	14.3	(140)	5.98	(73)	7.35	(27)	7.30	(12)	6.89	(35)	7.17	(18)	7.21	(7.2)
Methacrylonitrile	1	0.030	1.15	(62)	0.356	(9.3)	0.316	(4.2)	0.281	(14)	0.273	(6.5)	0.288	(3.6)	0.290	(4.6)
Methyl ethyl ketone	2	0.30	1.86	(48)	1.74	(15)	1.96	(48)	1.87	(3.3)	2.10	(5.0)	2.15	(2.2)	2.23	(1.0)
Methyl isobutyl ketone	2	0.050	8.59	(17)	9.75	(17)	6.25	(52)	5.53	(2.0)	5.64	(6.3)	5.61	(4.1)	5.73	(2.4)
Methyl methacrylate	2	0.040	6.84	(82)	5.07	(46)	6.16	(70)	6.56	(23)	6.08	(25)	6.64	(8.8)	6.47	(6.4)

TABLE 13. RESPONSE FACTORS DETERMINED FOR METHOD 8015 ANALYTES USING DLI

Compound	Solution Set	S/N Concentration, mg/L	Response Factor (Relative Standard Deviation)						
			5 S/N	15 S/N	50 S/N	150 S/N	500 S/N	1500 S/N	5000 S/N
Acetonitrile	1	0.21	2.09 (14)	3.40 (12)	5.11 (0.80)	5.93 (1.4)	6.45 (2.2)	6.54 (1.9)	6.63 (0.91)
Allyl alcohol	2	0.24	4.59 (5.7)	6.56 (1.3)	8.04 (1.0)	8.65 (1.0)	9.01 (1.1)	9.42 (1.4)	9.46 (1.0)
Carbon disulfide	1	0.78	0.539 (6.7)	0.644 (5.2)	0.493 (1.2)	0.480 (0.50)	0.389 (1.1)	0.282 (5.5)	0.187 (0.82)
1,2,3,4-Diepoxybutane	1	0.080	6.90 (2.9)	7.37 (1.3)	5.68 (0.33)	7.71 (0.01)	7.80 (0.15)	7.89 (1.2)	6.01 (1.3)
Diethyl ether	2	0.050	8.13 (2.5)	8.53 (1.3)	8.48 (1.1)	8.36 (1.0)	8.23 (1.1)	8.36 (1.2)	8.26 (1.3)
1,4-Dioxane	2	0.050	11.9 (3.0)	10.0 (1.4)	8.56 (5.1)	7.73 (1.8)	7.08 (1.0)	6.81 (1.1)	6.42 (1.0)
Ethylene oxide	1	0.052	4.11 (36)	3.88 (5.8)	4.58 (3.3)	4.32 (1.8)	4.53 (0.91)	4.61 (4.5)	4.77 (1.6)
Ethyl methacrylate	3	0.060	9.70 (11)	10.5 (13)	10.6 (2.6)	10.1 (1.5)	9.59 (1.0)	9.69 (1.0)	9.19 (2.0)
Isobutanol	1	0.028	17.6 (6.5)	14.8 (4.7)	12.0 (0.86)	13.2 (0.46)	13.1 (0.43)	12.7 (5.5)	12.8 (6.0)
Malononitrile	3	0.40	0.122 (33)	0.351 (8.1)	0.868 (1.3)	1.02 (1.6)	2.15 (7.1)	-- --	-- --
Methacrylonitrile	2	0.050	10.7 (2.5)	11.1 (1.5)	11.1 (1.7)	11.0 (1.0)	10.9 (1.5)	11.0 (1.4)	10.8 (1.1)
Methyl ethyl ketone	1	0.034	11.5 (8.1)	8.53 (7.5)	9.62 (0.67)	9.73 (0.82)	9.97 (1.4)	9.96 (1.1)	9.94 (0.95)
Methyl isobutyl ketone	2	0.030	12.0 (3.7)	12.1 (1.9)	12.5 (1.0)	11.8 (1.2)	11.5 (1.2)	11.5 (1.0)	11.2 (1.0)
Methyl mercaptan	2	0.170	1.54 (16)	2.57 (7.3)	2.67 (1.0)	3.38 (1.3)	4.50 (1.0)	3.88 (1.0)	3.95 (1.7)
Methyl methacrylate	1	0.028	14.6 (13)	12.0 (1.9)	9.8 (7.4)	10.6 (0.21)	10.4 (0.34)	10.1 (4.1)	10.0 (0.62)
Paraldehyde	1	0.064	4.28 (7.1)	5.61 (0.80)	6.40 (0.37)	6.29 (0.11)	6.24 (0.29)	6.22 (1.2)	6.08 (1.4)
Propargyl alcohol	1	0.24	3.09 (10)	4.68 (2.9)	6.27 (1.4)	8.26 (0.97)	9.30 (0.49)	9.84 (2.4)	9.69 (0.83)
β-Propiolactone	2	0.30	1.31 (5.4)	2.21 (5.3)	3.11 (1.5)	3.64 (1.0)	4.05 (1.1)	4.42 (1.1)	4.55 (1.0)
Propionitrile	2	0.14	4.81 (11)	6.93 (3.9)	8.24 (1.0)	8.39 (1.0)	8.52 (1.1)	8.73 (1.3)	8.60 (1.0)

TABLE 14. RESPONSE FACTORS DETERMINED FOR METHOD 8020 ANALYTES USING PTD

Compound	Solution Set	S/N Concentration, g/L	Response Factor (Relative Standard Deviation)						
			5 S/N	15 S/N	50 S/N	150 S/N	500 S/N	1500 S/N	5000 S/N
Benzene	2	0.0072	198.0 (4.7)	65.6 (5.2)	23.4 (4.1)	12.3 (6.2)	11.8 (8.0)	13.2 (5.6)	15.0 (2.4)
Chlorobenzene	1	0.0056	2.82 (11)	1.98 (9.2)	1.48 (7.5)	1.42 (7.0)	1.42 (4.8)	1.78 (12)	2.11 (11)
1,2-Dichlorobenzene	1	0.013	1.36 (28)	0.929 (24)	0.712 (8.6)	0.705 (8.0)	0.729 (5.1)	0.952 (11)	1.08 (9.5)
1,3-Dichlorobenzene	2	0.005	17.6 (38)	7.42 (37)	5.43 (13)	4.07 (19)	3.81 (16)	4.80 (2.1)	5.34 (1.4)
1,4-Dichlorobenzene	1	0.0096	1.79 (30)	1.13 (19)	0.908 (4.6)	0.883 (6.5)	0.917 (4.4)	0.182 (13)	4.37 (11)
Ethyl benzene	2	0.0032	57.8 (38)	15.2 (13)	7.98 (22)	4.79 (13)	4.11 (11)	4.70 (8.5)	5.93 (3.5)
Styrene	2	0.0072	6.87 (19)	4.54 (44)	5.58 (12)	4.99 (8.8)	5.21 (12)	7.19 (1.9)	7.86 (2.2)
Toluene	2	0.0024	51.3 (16)	20.5 (6.0)	11.4 (8.4)	7.72 (9.5)	6.[illegible] (12)	7.39 (7.6)	8.99 (2.3)
o-Xylene	1	0.0070	4.59 (7.1)	3.08 (11)	1.56 (11)	1.30 (15)	1.10 (3.3)	1.36 (11)	1.62 (9.5)
m-Xylene	2	0.0050	13.3 (36)	9.10 (13)	6.99 (7.5)	6.59 (12)	6.31 (15)	7.76 (9.8)	8.45 (2.9)
p-Xylene	2	0.012	4.89 (69)	5.00 (21)	4.92 (11)	4.78 (13)	5.19 (14)	6.99 (1.8)	8.10 (3.2)

TABLE 15. RESPONSE FACTORS DETERMINED FOR METHOD 8020 ANALYTES USING DLI

Compound	Solution Set	S/N Concentration, mg/L	Response Factor (Relative Standard Deviation)													
			5 S/N		15 S/N		50 S/N		150 S/N		500 S/N		1500 S/N		5000 S/N	
Benzene	1	0.050	1.58	(9.5)	1.70	(5.3)	1.80	(6.4)	1.83	(1.1)	2.17	(1.0)	2.49	(1.0)	2.74	(2.6)
Chlorobenzene	1	0.050	1.31	(15)	1.93	(5.6)	1.80	(9.2)	1.77	(1.4)	2.23	(11)	2.37	(1.0)	3.03	(3.4)
1,2-Dichlorobenzene	1	0.060	2.08	(19)	2.06	(7.8)	2.22	(8.7)	2.18	(1.0)	2.68	(2.2)	3.05	(1.2)	3.56	(3.2)
1,3-Dichlorobenzene	2	0.100	1.38	(26)	2.4	(7.8)	1.85	(12)	1.48	(28)	2.02	(9.5)	2.36	(10)	2.57	(8.4)
1,4-Dichlorobenzene	1	0.060	1.27	(16)	1.40	(4.5)	1.39	(1.0)	1.43	(1.5)	1.72	(3.0)	1.93	(1.0)	2.22	(3.1)
Ethyl benzene	2	0.100	0.920	(10)	1.03	(5.3)	1.12	(8.0)	1.14	(5.2)	1.42	(6.1)	1.70	(3.7)	1.87	(7.4)
2-Picoline	3	0.30	0.715	(9.4)	0.816	(5.7)	1.02	(2.3)	0.927	(2.6)	1.10	(2.0)	1.24	(1.2)	1.40	(3.0)
Styrene	2	0.100	1.14	(11)	1.49	(4.7)	1.77	(13)	1.71	(6.9)	2.17	(7.8)	2.62	(5.1)	2.76	(7.1)
Toluene	2	0.080	1.40	(12)	1.55	(10)	1.65	(6.0)	1.66	(6.7)	1.98	(5.7)	2.25	(4.3)	2.37	(6.3)
o-Xylene	1	0.060	2.45	(5.6)	2.30	(4.0)	1.86	(10)	1.56	(1.3)	2.36	(1.9)	1.89	(1.0)	2.35	(2.9)
m-Xylene	2	0.010	1.51	(13)	1.85	(9.9)	2.00	(12)	2.09	(6.4)	2.50	(7.8)	2.77	(4.9)	2.71	(7.2)
p-Xylene	2	0.010	1.20	(8.3)	1.40	(5.3)	1.55	(9.1)	1.59	(5.8)	2.06	(6.2)	2.52	(3.4)	2.71	(7.4)

TABLE 16. RESULTS OF INSTRUMENT RANGE DETERMINATION FOR METHOD 8010 USING PTD SAMPLE INTRODUCTION

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (µg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Allyl chloride	8,9,M	0.400-400	0.400-400	0.400-400	3
Benzyl chloride	8	10-10,000	10-10,000	10-10,000	3
Bromobenzene	--	(b)	0.850-850	0.850-850	3
Bromodichloromethane	PP,8,9	(b)	0.800-800	0.800-800	3
Bromoform	PP,8,9	(b)	(b)	4.35-1,450	2.5
Bromomethane	PP,8,9	(c)	(c)	(c)	(c)
Carbon tetrachloride	PP,8,9	(b)	0.155-155	0.155-155	3
Chlorobenzene	PP,8,9	0.625-625	0.625-625	0.625-625	3
Chloroethane	PP,9	(b)	0.150-15.0	0.150-15.0	2
Chloroform	PP,8,9	0.630-210	0.630-210	0.630-210	2.5
1-Chlorohexane	--	3.60-1,200	3.60-1,200	3.60-1,200	2.5
Chloromethane	PP,8,9	0.500-500	0.500-500	0.500-500	3
Chloroprene	8,9,M	2.50-2,500	2.50-2,500	2.50-2,500	3
4-Chlorotoluene	--	1.95-1,950	1.95-1,950	1.95-1,950	3
Dibromochloromethane	PP,9	(b)	0.120-120	0.120-120	3
1,2-Dibromo-3-chloropropane	8,9	53.5-5,350	53.5-5,350	53.5-5,350	2
Dibromomethane	8	(b)	2.40-800	2.40-800	2.5
1,2-Dichlorobenzene	PP,8,9	1.40-1,400	1.40-1,400	1.40-1,400	3
1,3-Dichlorobenzene	PP,8,9	0.400-400	0.400-400	0.400-400	3
1,4-Dichlorobenzene	PP,8,9	1.25-1,250	1.25-1,250	1.25-1,250	3
1,4-Dichloro-2-butene	8,9	(b)	2.78-2,780	2.78-2,780	3
Dichlorofluoromethane	8,9	(b)	0.500-500	0.500-500	3
1,1-Dichloroethane	PP,8,9	0.300-300	0.300-300	0.300-300	3
1,2-Dichloroethane	PP,8,9	0.300-300	0.300-300	0.300-300	3
1,1-Dichloroethylene	PP,8,9	0.550-550	0.550-550	0.550-550	3
Trans-1,2-Dichloroethylene	PP,8,9	(b)	0.400-400	0.400-400	3

TABLE 16. (Continued)

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (μg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Dichloromethane	PP,8,9	0.630-210	0.630-210	0.630-210	2.5
1,2-Dichloropropane	PP,8,9	(b)	0.455-455	0.455-455	3
Cis-1,3-dichloropropylene	8	(b)	0.550-550	0.550-550	3
Ethylene dibromide	8	(b)	1.55-1,550	1.55-1,550	3
Methyl iodide	8,9	(c)	(c)	(c)	(c)
1,1,2,2-Tetrachloroethane	PP,8,9	0.100-10.0	0.100-10.0	0.100-10.0	2
1,1,1,2-Tetrachloroethane	8,9	(b)	0.400-400	0.400-400	3
Tetrachloroethylene	PP,8,9	0.200-200	0.200-200	0.200-200	3
1,1,1-Trichloroethane	PP	(b)	0.150-50	0.150-50	2.5
1,1,2-Trichloroethane	PP,8,9	0.250-250	0.250-250	0.250-250	3
Trichloroethylene	PP,8,9	0.180-180	0.180-180	0.180-180	3
Trichlorofluoromethane	PP,8,9	(b)	1.26-420	1.26-420	2.5
1,2,3-Trichloropropane	8,9	0.360-360	0.360-360	0.360-360	3
Vinyl chloride	PP,8,9	(b)	0.400-400	0.400-400	3

(a) PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List; -- = not on any list.
(b) Smaller concentration ranges than that accepted by another calibration model were not evaluated.
(c) Instrument range data generated for this compound did not fit any of the three calibration models tested even when the concentration range being considered was reduced to one-and-a-half orders of magnitude.

TABLE 17. RESULTS OF INSTRUMENT RANGE DETERMINATION FOR METHOD 8010 USING DLI SAMPLE INTRODUCTION

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (mg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Allyl chloride	8,9,M	(b)	0.400-400	0.400-400	3
Benzyl chloride	8	(b)	1.50-1,500	1.50-1,500	3
Bis(2-chloroethoxy)methane	8,9	(b)	2.00-2,000	2.00-2,000	3
Bromoacetone	8	(b)	18.0-1,800	18.0-1,800	2
Bromobenzene	--	(b)	(b)	1.50-1,500	3
Bromodichloromethane	PP,8,9	(b)	0.400-400	0.400-400	3
Bromoform	PP,8,9	(b)	(b)	1.50-1,500	3
Bromomethane	PP,8,9	(b)	10.0-1,000	10.0-1,000	2
Carbon tetrachloride	PP,8,9	(b)	0.300-300	0.300-300	3
Chlorobenzene	PP,8,9	0.750-750	0.750-750	0.750-750	3
Chloroethane	PP,9	(b)	0.600-600	0.600-600	3
2-Chloroethanol	M	(b)	15.0-1,500	15.0-1,500	2
Chloroform	PP,8,9	(b)	0.300-300	0.300-300	3
1-Chlorohexane	--	(b)	0.750-75.0	0.750-75.0	3
2-Chloroethyl vinyl ether	PP,8	(b)	4.50-1,500	4.50-1,500	2.5
Chloromethane	PP,8,9	(b)	(b)	1.00-1,000	3
Chloromethyl methyl ether	8	(b)	120-4,000	120-4,000	1.5
4-Chlorotoluene	--	1.50-1,500	1.50-1,500	1.50-1,500	3
Dibromochloromethane	PP,9	(b)	(b)	1.00-1,000	3
1,2-Dibromo-3-chloropropane	8,9	(b)	(b)	2.00-2,000	3
Dibromomethane	8	(b)	(b)	4.50-1,500	2.5
1,2-Dichlorobenzene	PP,8,9	10-1,000	10-1,000	10-1,000	2
1,3-Dichlorobenzene	PP,8,9	(b)	2.25-750	2.25-750	2.5
1,4-Dichlorobenzene	PP,8,9	(b)	(b)	7.50-750	2
1,4-Dichloro-2-butene	8,9	(b)	0.600-600	0.600-600	3

TABLE 17. (Continued)

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (mg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Dichlorodifluoromethane	8,9	2.00-60.0	2.00-60.0	2.00-60.0	1.5
1,1-Dichloroethane	PP,8,9	(b)	(b)	0.600-200	2.5
1,2-Dichloroethane	PP,8,9	(b)	(b)	0.750-750	3
1,1-Dichloroethylene	PP,8,9	(b)	(b)	2.00-200	2
Trans-1,2-Dichloroethylene	PP,8,9	(b)	(b)	1.20-1,200	3
Dichloromethane	PP,8,9	(b)	(b)	2.00-200	2
1,2-Dichloropropane	PP,8,9	(b)	(b)	0.750-750	3
1,3-Dichloro-2-propanol	8	(b)	5.00-500	5.00-500	2
Cis-1,3-dichloropropylene	8	(b)	0.750-750	0.750-750	3
Epichlorohydrin	8	(b)	3.00-900	3.00-900	2.5
Ethylene dibromide	8	(b)	10.0-1,000	10.0-1,000	2
Methyl iodide	8,9	(b)	12.0-4,000	12.0-4,000	2.5
1,1,2,2-Tetrachloroethane	PP,8,9	(b)	(b)	0.450-450	3
1,1,1,2-Tetrachloroethane	8,9	(b)	0.750-750	0.750-750	3
Tetrachloroethylene	PP,8,9	(b)	(b)	0.400-400	3
1,1,1-Trichloroethane	PP	(b)	(b)	0.200-200	3
1,1,2-Trichloroethane	PP,8,9	(b)	0.200-200	0.200-200	3
Trichloroethylene	PP,8,9	0.450-450	0.450-450	0.450-450	3
Trichlorofluoromethane	PP,8,9	3.00-300	3.00-300	3.00-300	3
1,2,3-Trichloropropane	8,9	0.200-200	0.200-200	0.200-200	3
Vinyl chloride	PP,8,9	(b)	2.10-700	2.10-700	2.5

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

(b) Smaller concentration ranges than that accepted by another calibration model were not evaluated.

TABLE 18. RESULTS OF INSTRUMENT RANGE DETERMINATION FOR METHOD 8015 USING PTD SAMPLE INTRODUCTION

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (μg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Diethyl ether	--	0.225-75.0	0.225-75.0	0.225-75.0	2.5
Ethyl methacrylate	8,9	0.600-200	0.600-200	0.600-200	2.5
Methacrylonitrile	8	(b)	0.450-150	0.450-150	2.5
Methyl ethyl ketone	8,9	1.50-1,500	1.50-1,500	1.50-1,500	3
Methyl isobutyl ketone	--	(c)	(c)	(c)	(c)
Methyl methacrylate	8,9	0.200-200	0.200-200	0.200-200	3

(a) 8 = Appendix VIII; 9 = Appendix IX; -- = not on any list.
(b) Smaller concentration ranges than that accepted by another calibration model were not evaluated.
(c) Instrument range data generated for this compound did not fit any of the three calibration models tested even when the concentration range being considered was reduced to one-and-a-half orders of magnitude.

TABLE 19. RESULTS OF INSTRUMENT RANGE DETERMINATION FOR METHOD 8015 USING DLI SAMPLE INTRODUCTION

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (mg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Acetonitrile	8	(b)	1.02-1,020	1.02-1,020	3
Allyl alcohol	8	(b)	1.20-1,200	1.20-1,200	3
Carbon disulfide	8,9	(c)	(c)	(c)	(c)
1,2,3,4-Diepoxybutane	8	(b)	(b)	4.00-400	2
Diethyl ether	--	0.250-250	0.250-250	0.250-250	3
1,4-Dioxane	8	(b)	0.250-250	0.250-250	3
Ethylene oxide	8	0.260-260	0.260-260	0.260-260	3
Ethyl methacrylate	8,9	0.300-300	0.300-300	0.300-300	3
Isobutanol	8	0.140-140	0.140-140	0.140-140	3
Malononitrile	8	(c)	(c)	(c)	(c)
Methacrylonitrile	8	0.250-250	0.250-250	0.250-250	3
Methyl ethyl ketone	8,9	(b)	0.510-170	0.510-170	2.5
Methyl isobutyl ketone	--	0.150-150	0.150-150	0.050-150	3
Methyl mercaptan	8	(b)	(b)	2.55-850	2.5
Methyl methacrylate	8,9	0.140-140	0.140-140	0.140-140	3
Paraldehyde	8	3.20-320	3.20-320	3.20-320	2
Propargyl alcohol	8	(c)	(c)	(c)	(c)
β-propiolactone	M	(b)	(b)	1.50-1,500	3
Propionitrile	8	(b)	0.700-700	0.700-700	3

(a) 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List; -- = not on any list.
(b) Smaller concentration ranges than that accepted by another calibration model were not evaluated.
(c) Instrument range data generated for this compound did not fit any of the three calibration models tested even when the concentration range being considered was reduced to one-and-a-half orders of magnitude.

TABLE 20. RESULTS OF INSTRUMENT RANGE DETERMINATION FOR METHOD 8020 USING PTD SAMPLE INTRODUCTION

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (μg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Benzene	PP,8,9	(b)	1.08-36.0	1.08-36.0	1.5
Chlorobenzene	PP,8,9	(b)	(b)	0.028-28.0	3
1,2-Dichlorobenzene	PP,8,9	(b)	(b)	0.064-64.0	3
1,3-Dichlorobenzene	PP,8,9	(b)	0.250-7.50	0.250-7.50	1.5
1,4-Dichlorobenzene	PP,8,9	(b)	(b)	0.048-48.0	3
Ethyl benzene	PP,9	(b)	(b)	0.048-16.0	2.5
Styrene	9,M	(b)	(b)	0.036-35.5	3
Toluene	PP,8,9	(b)	(b)	0.036-12.0	2.5
o-Xylene	9	(b)	(b)	0.345-34.5	2
m-Xylene	9	(b)	(b)	0.250-25.0	2
p-Xylene	9	(b)	(b)	0.061-61.0	3

(a) PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List.
(b) Smaller concentration ranges than that accepted by another calibration model were not evaluated.

TABLE 21. RESULTS OF INSTRUMENT RANGE DETERMINATION FOR METHOD 8020 USING DLI SAMPLE INTRODUCTION (μg/g)

Compound	List[a]	Concentration Range Over Which Calibration Models Were Accepted (mg/L)			Instrument Range (Orders of Magnitude)
		Response Factor Regression	Linear Regression	Quadratic Regression	
Benzene	PP,8,9	(b)	b	0.250-250	3
Chlorobenzene	PP,8,9	(b)	(b)	0.250-250	3
1,2-Dichlorobenzene	PP,8,9	(b)	(b)	0.300-300	3
1,3-Dichlorobenzene	PP,8,9	(b)	0.500-500	0.500-500	3
1,4-Dichlorobenzene	PP,8,9	(b)	(b)	0.300-300	3
Ethyl benzene	PP,9	(b)	(b)	1.50-500	2.5
2-Picoline	8,9	(b)	(b)	1.50-1500	3
Styrene	9,M	(b)	(b)	1.50-500	2.5
Toluene	PP,8,9	(b)	(b)	0.400-400	3
o-Xylene	9	(b)	(b)	9.00-300	1.5
m-Xylene	9	(b)	(b)	0.500-500	3
p-Xylene	9	(c)	(c)	(c)	(c)

(a) PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List.
(b) Smaller concentration ranges than that accepted by another calibration model were not evaluated.
(c) Instrument range data generated for this compound did not fit any of the three calibration models tested even when the concentration range being considered was reduced to one-and-a-half orders of magnitude.

TABLE 22. RESULTS OF PRELIMINARY METHOD EVALUATION FOR METHOD 8010 USING AQUEOUS SAMPLES

Compounds	List[a]	Number of Replicates	Spike Concentration (µg/L)	Recovery Percent (RSD)	Method Successful
Allyl chloride	8,9,M	8	8.00	70.2 (9.6)	Yes
Benzyl chloride	8	7	200	55.5 (46)	No
Bromobenzene	--	8	17.0	84.7 (7.5)	Yes
Bromodichloromethane	PP,8,9	8	16.0	91.2 (6.8)	Yes
Bromoform	PP,8,9	8	29.0	73.8 (5.6)	Yes
Bromomethane	PP,8,9	8	17.0	74.7 (9.4)	Yes
Carbon tetrachloride	PP,8,9	7	3.10	53.9 (11)	Yes
Chlorobenzene	PP,8,9	9	12.5	87.2 (6.4)	Yes
Chloroethane	PP,9	8	0.300	112 (7.1)	Yes
Chloroform	PP,8,9	7	4.20	61.2 (4.3)	Yes
1-Chlorohexane	--	7	24.0	57.1 (3.6)	Yes
Chloromethane	PP,8,9	7	10.0	52.9 (10)	Yes
Chloroprene	8,9,M	10	50.0	68.4 (12)	Yes
4-Chlorotoluene	--	7	39.0	104 (40)	No
Dibromochloromethane	PP,9	8	2.40	92.9 (6.7)	Yes
1,2-Dibromo-3-chloropropane	8,9	10	107	85.4 (8.1)	Yes
Dibromomethane	8	8	16.0	89.4 (6.3)	Yes
1,2-Dichlorobenzene	PP,8,9	7	28.0	76.8 (3.7)	Yes
1,3-Dichlorobenzene	PP,8,9	8	8.00	87.4 (11)	Yes
1,4-Dichlorobenzene	PP,8,9	9	25.0	68.4 (9.5)	Yes
1,4-Dichloro-2-butene	8,9	7	55.6	81.7 (15)	Yes
Dichlorodifluoromethane	8,9	8	10.0	4.74 (37)	No
1,1-Dichloroethane	PP,8,9	10	6.00	83.3 (8.2)	Yes
1,2-Dichloroethane	PP,8,9	10	6.00	90.7 (8.8)	Yes
1,1-Dichloroethylene	PP,8,9	7	11.0	58.7 (6.2)	Yes
Trans-1,2-Dichloroethylene	PP,8,9	8	8.00	81.0 (8.0)	Yes
Dichloromethane	PP,8,9	7	4.20	70.5 (19)	Yes
1,2-Dichloropropane	PP,8,9	7	9.10	71.8 (4.3)	Yes
Cis-1,3-dichloropropylene	8	8	11.0	84.5 (6.6)	Yes
Ethylene dibromide	8	7	31.0	76.1 (5.9)	Yes
1,1,2,2-Tetrachloroethane	PP,8,9	6	0.300	71.0 (22)	Yes
1,1,1,2-Tetrachloroethane	8,9	7	8.00	68.8 (2.2)	Yes
Tetrachloroethylene	PP,8,9	7	4.00	57.8 (5.2)	Yes
1,1,1-Trichloroethane	PP	6	1.00	48.2 (8.7)	Yes
1,1,2-Trichloroethane	PP,8,9	10	5.00	92.6 (8.0)	Yes
Trichloroethylene	PP,8,9	10	3.60	74.2 (9.4)	Yes
Trichlorofluoromethane	PP,8,9	6	8.40	21.8 (11)	Yes
1,2,3-Trichloropropane	8,9	10	7.20	95.0 (6.1)	Yes
Vinyl chloride	PP,8,9	7	8.00	45.1 (9.3)	Yes

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

TABLE 23. RESULTS OF PRELIMINARY METHOD EVALUATION FOR METHOD 8010 USING SOLID SAMPLES

Compounds	List[a]	Number of Replicates	Spike Concentration (µg/g)	Recovery Percent (RSD)	Method Successfu
Allyl chloride	8,9,M	6	8.00	39.2 (21)	Yes
Benzyl chloride	8	9	200	69.5 (53)	No
Bromobenzene	--	6	17.0	59.4 (14)	Yes
Bromodichloromethane	PP,8,9	6	16.0	56.9 (13)	Yes
Bromoform	PP,8,9	6	29.0	76.6 (5.4)	Yes
Bromomethane	PP,8,9	6	17.5	37.5 (15)	Yes
Carbon tetrachloride	PP,8,9	9	3.1	25.5 (5.5)	Yes
Chlorobenzene	PP,8,9	6	12.5	38.5 (26)	Yes
Chloroethane	PP,9	6	8.00	10.0 (12)	Yes
Chloroform	PP,8,9	8	4.20	45.2 (18)	Yes
1-Chlorohexane	--	9	24.0	41.0 (30)	Yes
Chloromethane	PP,8,9	9	10.0	6.32 (22)	Yes
Chloroprene	8,9,M	6	50.0	34.4 (24)	Yes
4-Chlorotoluene	--	6	39.0	30.3 (50)	No
Dibromochloromethane	PP,9	6	2.40	65.4 (11)	Yes
1,2-Dibromo-3-chloropropane	8,9	6	107	35.8 (30)	Yes
Dibromomethane	8	6	16.0	68.1 (15)	Yes
1,2-Dichlorobenzene	PP,8,9	8	4.00	37.5 (20)	Yes
1,3-Dichlorobenzene	PP,8,9	6	8.00	44.0 (12)	Yes
1,4-Dichlorobenzene	PP,8,9	6	25.0	39.6 (36)	Yes
1,4-Dichloro-2-butene	8,9	6	55.6	49.6 (38)	Yes
Dichlorodifluoromethane	8,9	6	10.0	25.1 (31)	No
1,1-Dichloroethane	PP,8,9	6	6.00	35.0 (23)	Yes
1,2-Dichloroethane	PP,8,9	6	6.00	34.3 (27)	Yes
1,1-Dichloroethylene	PP,8,9	8	11.0	27.8 (36)	Yes
Trans-1,2-Dichloroethylene	PP,8,9	6	8.00	39.2 (18)	Yes
Dichloromethane	PP,8,9	8	4.2	33.8 (14)	Yes
1,2-Dichloropropane	PP,8,9	8	9.1	56.0 (12)	Yes
Cis-1,3-dichloropropylene	PP	6	11.0	59.3 (14)	Yes
Ethylene dibromide	8	8	31.0	72.2 (7.1)	Yes
1,1,2,2-Tetrachloroethane	PP,8,9	5	0.200	27.0 (37)	Yes
1,1,1,2-Tetrachloroethane	8,9	8	4.00	62.5 (12)	Yes
Tetrachloroethylene	PP,8,9	9	4.00	40.0 (28)	Yes
1,1,1-Trichloroethane	PP	6	1.00	48.5 (77)	Yes
1,1,2-Trichloroethane	PP,8,9	6	5.00	27.0 (15)	Yes
Trichloroethylene	PP,8,9	6	3.60	30.3 (19)	Yes
Trichlorofluoromethane	PP,8,9	6	8.40	39.4 (25)	Yes
1,2,3-Trichloropropane	8,9	6	7.20	37.1 (30)	Yes
Vinyl chloride	PP,8,9	9	8.00	4.38 (43)	Yes

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

TABLE 24. RESULTS OF PRELIMINARY METHOD EVALUATION FOR METHOD 8015 USING AQUEOUS SAMPLES

Compounds	List[a]	Number of Replicates	Spike Concentration (µg/L)	Recovery Percent (RSD)	Method Successful
Diethyl ether	--	6	1.50	82.3 (2.8)	Yes
Ethyl methacrylate	8,9	6	4.00	70.0 (16)	Yes
Methacrylonitrile	8	8	3.00	98.3 (11)	Yes
Methyl ethyl ketone	8,9	6	30.0	74.0 (3.8)	Yes
Methyl methacrylate	8,9	6	4.00	70.2 (20)	Yes

(a) 8 = Appendix VIII; 9 = Appendix IX; -- = not on any list.

TABLE 25. RESULTS OF PRELIMINARY METHOD EVALUATION FOR METHOD 8015 USING SOLID SAMPLES

Compounds	List[a]	Number of Replicates	Spike Concentration (µg/g)	Recovery Percent (RSD)	Method Successfu
Diethyl ether	--	7	1.50	35.1 (40)	Yes
Ethyl methacrylate	8,9	6	4.00	2.30 (18)	Yes
Methacrylonitrile	8	8	0.030	66.7 (9.8)	Yes
Methyl ethyl ketone	8,9	7	30.0	82.0 (7.6)	Yes
Methyl methacrylate	8,9	7	4.00	100 (23)	Yes

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

TABLE 26. RESULTS OF PRELIMINARY METHOD EVALUATION FOR METHOD 8020 USING AQUEOUS SAMPLES

Compounds	List[a]	Number of Replicates	Spike Concentration (µg/L)	Recovery Percent (RSD)	Method Successful
Benzene	PP,8,9	8	0.720	98.2 (4.2)	Yes
Chlorobenzene	PP,8,9	9	0.560	79.6 (7.6)	Yes
1,2-Dichlorobenzene	PP,8,9	9	1.28	79.7 (4.9)	Yes
1,3-Dichlorobenzene	PP,8,9	8	0.500	73.4 (22)	Yes
1,4-Dichlorobenzene	PP,8,9	9	0.960	78.6 (7.0)	Yes
Ethyl benzene	PP,9	6	0.320	61.9 (14)	Yes
Styrene	9,M	8	0.710	83.8 (19)	Yes
Toluene	PP,8,9	8	0.240	78.3 (19)	Yes
o-Xylene	9	9	0.690	85.4 (21)	Yes
m-Xylene	9	8	0.500	84.6 (15)	Yes
p-Xylene	9	8	1.22	79.5 (13)	Yes

(a) PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List.

TABLE 27. RESULTS OF PRELIMINARY METHOD EVALUATION FOR METHOD 8020 USING SOLID SAMPLES

Compounds	List[a]	Number of Replicates	Spike Concentration (µg/g)	Recovery Percent (RSD)	Method Successful
Benzene	PP,8,9	8	300	36.3 (45)	Yes
Chlorobenzene	PP,8,9	8	2.40	47.1 (22)	Yes
1,2-Dichlorobenzene	PP,8,9	7	1.28	47.7 (71)	Yes
1,3-Dichlorobenzene	PP,8,9	8	40.0	15.4 (13)	Yes
1,4-Dichlorobenzene	PP,8,9	8	0.960	54.3 (21)	Yes
Ethyl benzene	PP,9	8	50.0	59.0 (23)	Yes
Styrene	9,M	8	7.00	70.3 (20)	Yes
Toluene	PP,8,9	8	50.0	21.4 (35)	Yes
o-Xylene	9	7	4.00	48.0 (17)	Yes
m-Xylene	9	8	12.0	61.6 (27)	Yes
p-Xylene	9	8	12.0	52.0 (25)	Yes

(a) PP = Priority Pollutant; 8 = Appendix VIII; 9 = Appendix IX; M = Michigan List.

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