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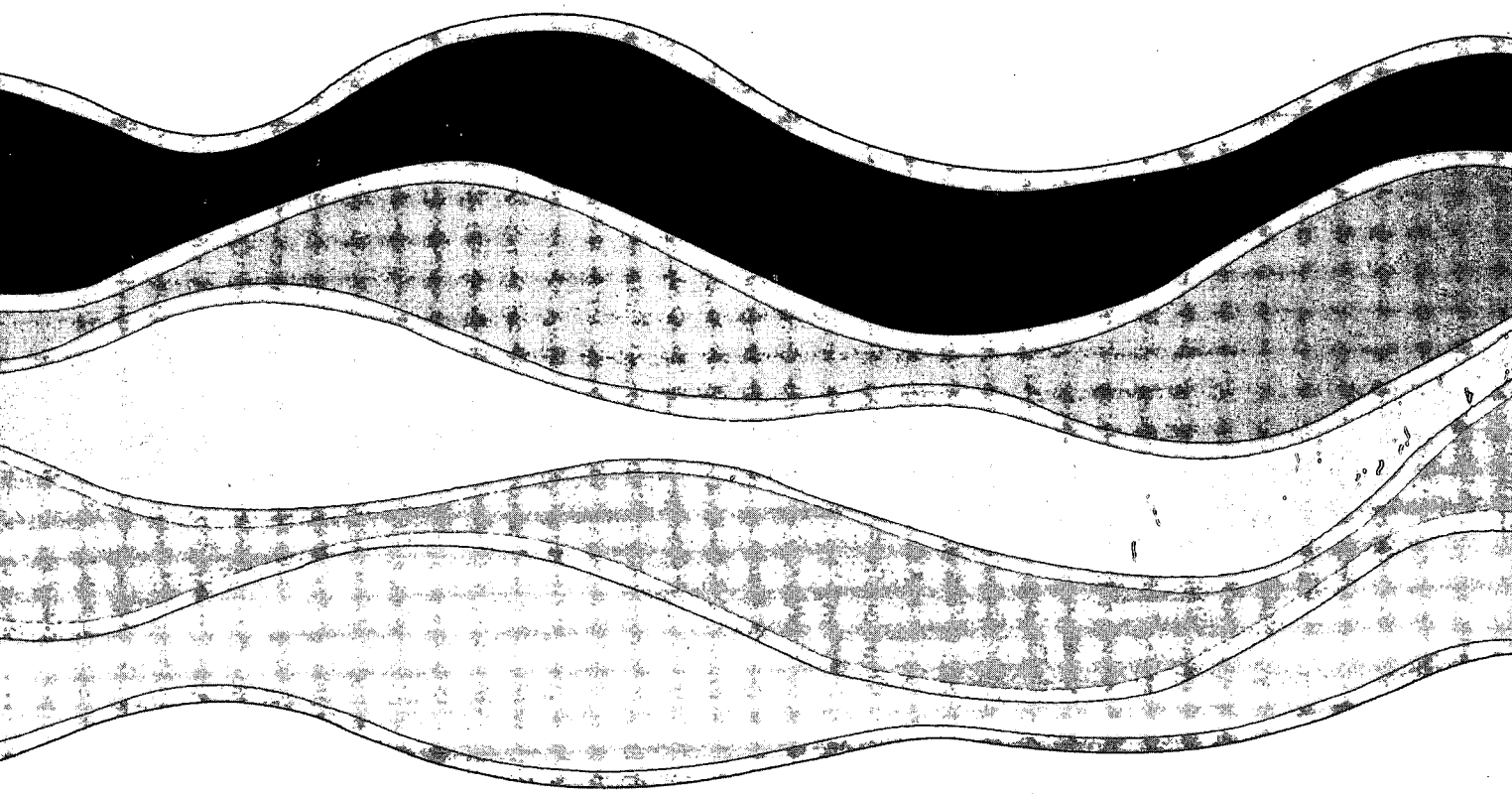

CEPA NATIONAL INTERLABORATORY COMPARISON STUDY (CP-1): ANALYSIS OF CHLOROPHENOLS IN STANDARD SOLUTION AND SEDIMENT EXTRACTS

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MANAGEMENT PERSPECTIVE

Chlorophenols are known environmental contaminants. Residues of these phenols are reported to be present in the environment especially in industrial wastewaters and sludges. Chlorophenols, under the broad heading of "Creosote" and "Effluents from pulp mills using bleaching" are in the CEPA (Canadian Environmental Protection Act) Priority substances List.

The successful implementation of the CEPA is dependent on the availability of reliable scientific data. To assist project mangers and regulating bodies to ensure the validity of analytical data under the Act, an interlaboratory study (CP-1) for the analysis of chlorophenols in standard solution and sediment extracts was designed and conducted. This study will help to establish the degree of comparability of chlorophenol results among participating laboratories.

Dr. J. Lawrence
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PERSPECTIVE GESTION

Les chlorophénols sont des contaminants environnementaux connus. On signale la présence de résidus de ces phénols dans l'environnement, plus particulièrement dans les eaux usées et les boues industrielles. Dans la Loi canadienne sur la protection de l'environnement (LCPE), les chlorophénols sont mentionnés aux rubriques générales "Matières imprégnées de créosote" et "Effluents des usines de pâtes à papier pratiquant le blanchiment" de la Liste des substances prioritaires.

Le succès de l'application de la LCPE dépend de la fiabilité des données scientifiques disponibles. Pour aider les gestionnaires de projets et les organismes de réglementation qui doivent veiller à ce que les données analytiques soient valides conformément à la loi, on a conçu et réalisé une étude interlaboratoire (CP-1) sur l'analyse des chlorophénols dans une solution étalon et des extraits de sédiments. Cette étude facilitera l'évaluation du degré de comparabilité des résultats des analyses de chlorophénol entre les laboratoires participants.

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ABSTRACT

As part of quality assurance program under the auspices of the Canadian Environmental Protection Act (CEPA), an interlaboratory comparison study (CP-1) for the analysis of chlorophenols in standard solution and sediment extracts was designed and conducted by the Quality Assurance Project of the Research and Applications Branch at National Water Research Institute. Thirty-five laboratories were sent five test samples including one standard solution and four sediment extracts. Each laboratory was requested to analyze the six chlorophenols (namely, 3,4- and 2,4-diclorophenols, 2,4,6- and 2,3,6-trichlorophenols, 2,3,4,6-tetrachlorophenol and pentachlorophenol) in all test samples. The response was excellent. Twenty-six out of thirty-five laboratories submitted results. In general, intralaboratory precision was good for most of the participating laboratories and interlaboratory precision was comparable to the previous interlaboratory studies for the analysis of chlorophenols. The agreement of interlaboratory medians and the design values of chlorophenols in all five test samples was satisfactory except for 2,3,4,6-tetrachlorophenol. The reason could be attributed to the calibration standard rather than analytical procedures.

RÉSUMÉ

Dans le cadre du programme d'assurance de la qualité mis en oeuvre en vertu de la Loi canadienne sur la protection de l'environnement (LCPE), l'équipe du projet d'assurance de la qualité de Recherche et applications à l'Institut national de recherche sur les eaux, a conçu et réalisé une étude comparative interlaboratoire (CP-1) sur l'analyse de chlorophénols dans une solution étalon et des extraits de sédiments. On a envoyé à 35 laboratoires 5 échantillons, soit un échantillon de solution étalon et quatre extraits de sédiments. Chaque laboratoire devait analyser 6 chlorophénols (soit les 3,4-dichlorophénol, 2,4-dichlorophénol, 2,4,6-trichlorophénol, 2,3,6-trichlorophénol, 2,3,4,6-tétrachlorophénol et pentachlorophénol) dans chacun des échantillons. La participation a été excellente. Des 35 laboratoires auxquels on s'était adressé, 26 ont présenté des résultats. En général, la précision intralaboratoire était satisfaisante dans la plupart des laboratoires participants; quant à la précision interlaboratoire, elle a été comparable à celle des études interlaboratoires antérieures sur l'analyse des chlorophénols. La concordance entre les médianes interlaboratoires et les concentrations théoriques de chlorophénols dans les 5 échantillons était satisfaisante, sauf dans le cas du 2,3,4,6-tétrachlorophénol. La différence pourrait être imputable à la solution étalon plutôt qu'aux méthodes d'analyse.

1.0 INTRODUCTION

The successful implementation of various aspects of the Canadian Environmental Protection Act (CEPA) is critically dependent on the availability of reliable scientific data. A key component of this new CEPA QA Program is to design and conduct, on a continual basis, a series of interlaboratory QA (Round Robin) studies for CEPA priority substances in a variety of matrices. These interlaboratory QA studies will assist CEPA mangers and regulatory bodies to ensure validity of analytical data. This report describes the first CEPA interlaboratory study (No. CP-1) for the analysis of chlorophenols in a standard solution and in four sediment extracts.

Chlorophenols are environmental contaminants especially in industrial wastewaters and sludges (1). Pentachlorophenol (PCP) has long been used as a wood preservative and other chlorophenols are often used as precursors in the production of many phenoxyalkanoic herbicides and biocides. Although application of PCP as a general wood preservative has now been banned and is limited to special applications such as wood preservatives for hydro-poles, its acute toxicity and the previously wide application will necessitate the continual monitoring of this compound in the environment for some considerable time. In addition, analysis for chlorophenols in sediment samples is particularly important because phenols are retained in large quantities by municipal solid wastes,

landfill leachate and sediments (2-4).

From previous interlaboratory comparison studies, it was noted that many variations in extraction, cleanup and quantification of the toxic organic contaminants existed in sediments. To eliminate the variation of sample extraction procedures, sediment extract samples were used as test samples for the evaluation of performance of participating laboratories in this interlaboratory study.

2.0 STUDY DESIGN

During May 1989, a total of 150 government, industrial and private laboratories in Canada were invited to participate in this study. In September 1989, thirty-five sets of test samples were sent to those who had indicated an interest in participating.

The study consisted of five test samples each containing six chlorophenols; namely 2,4 and 3,4-dichlorophenols (DCP), 2,4,6 and 2,3,6-trichlorophenols (TCP), 2,3,4,6-tetrachlorophenol (TeCP) and pentachlorophenol (PCP). Description of the samples is summarized in Table 1. Sample 1 in sealed glass ampule was a standard solution of the six chlorophenols in acetone. Samples 2 and 5 (SC-1) were blind duplicates of sediment extract in acetone fortified with six chlorophenols. Samples 3 and 4 were another set of blind duplicates of fortified sediment extract (LE-1) with

1/4 concentrations of the same six chlorophenols. The sediments used for samples SC-1 and LE-1 were from Lake St. Claire and Lake Erie, respectively. The sediment extracts were prepared according to the protocol of extraction procedures developed by Chau et al. (5) and, before fortification, they were found to contain undetectable levels of the six chlorophenols in question.

The homogeneity between ampules and stability of chlorophenols were verified in advance by in-house investigation. Samples were found to be stable for the period investigated (three months) and replicate analysis of prepared ampules demonstrated stability and homogeneity.

3.0 RESULTS AND DISCUSSION

The participants were instructed to analyze the test samples using analytical methodology and working standards in current use in their laboratories. A list of participants is provided at the end of this report. Only twelve out of thirty-five participants provided results on schedule. The study was extended to November 30, 1989. Overall, the number of laboratories willing to participate for this study was excellent. Out of the thirty-five laboratories that were willing to participate, twenty-six submitted their results. A preliminary data summary was prepared and distributed to participants on January 16, 1990.

In general, a wide variety of analytical methods and sample cleanup procedures were used by participants. Potassium carbonate (K_2CO_3) or potassium bicarbonate ($KHCO_3$) was generally used for the back extraction of chlorophenols from sediment extracts in organic solvents. Chemical derivatization with either acetic anhydride or diazomethane was carried out. The derivatized extracts were cleanedup with silica gel or florisil. Solid phase extraction was also used by some laboratories for concentration and cleanup during sample preparation. Quantitation of chlorophenols in the final extracts was all done by gas chromatography (GC) with either electron capture detector (ECD) or other types of detectors such as electrolytical conductivity detector (ELCD), mass spectrometry (MS) or mass selective detector (MSD). Some laboratories directly analyzed sediment extracts and the standard solution by GC/MS without any sample preparation. A detailed summary of analytical methodologies used by participants is given in Table 2.

Appendix I presents the raw data submitted by participants as well as the means and standard deviations calculated by us. Means and standard deviations were calculated by using all results reported. Only a few laboratories submitted results for all the six chlorophenols as requested. Pentachlorophenol was the only parameter submitted by all participants since it is the chlorophenol of major concern. To determine accuracy of overall interlaboratory results, median

values instead of mean values were used to compare with the design values since medians were less strongly influenced by outliers. The design values and interlaboratory medians for six chlorophenols in the standard solution and four sediment extract samples are summarized in Tables 3-1 and 3-2, respectively. The degree of agreement between interlaboratory medians and the design values of six chlorophenols was evaluated from the percent recovery of interlaboratory medians. The percent recovery was calculated by dividing the interlaboratory median by the design value and multiplying by 100% as follows.

$$\% \text{ Recovery} = (\text{Interlab. Median} / \text{Design value}) \times 100$$

For the interlaboratory studies of the QA/QC program for CEPA, values determined for test samples in an interlaboratory study, were considered to be satisfactory if they fall within a window of ±25% of the design value. These criteria of ±25% are somewhat arbitrary. For standard solutions without matrix effect and at the higher concentration levels, these criteria are generous whereas at sub-ppb levels and in the presence of large amount of sample co-extractive, these criteria could be a little demanding. However, all the current test samples are at readily detectable levels and contain very little sample matrix interference. Thus, these criteria are considered to be on the generous side. Laboratories that generated results outside this limit would likely be unable to generate acceptable data for most

samples. Those laboratories which generated results within the limits would have a better potential to provide acceptable results for actual samples. However, the capability to analyze the parameters in question at a lower level in the presence of higher amount of sample co-extractive is yet to be confirmed with other future QA studies of more advanced design.

Comparison of the interlaboratory medians with the design values for standard solution (Table 3-1) showed that agreement for five out of six chlorophenols was satisfactory (within ±25% of the design value) and only results for TeCP was more than 25% different from the design value. Similar results were obtained for sediment extract samples as shown in Table 3-2. Based on these results, the difference between the interlaboratory medians and the design values for standard solutions and sediment extracts for TeCp was probably due to the calibration standard rather than analytical procedures.

Interlaboratory precision for chlorophenols, expressed as relative standard deviation (RSD), is given in Tables 4-1 and 4-2. As can be seen from these tables, interlaboratory RSD for all chlorophenols and all test samples are poor with more than ±25% deviations. In general, better precision was obtained for standard solutions than for sediment extracts. However, contrary to expectation, the RSD value of one phenol (2,4,6-TCP) for standard solution is larger than those for sediment extract

samples. Overall, the current results were comparable with the results for chlorophenols in standard solutions observed in previous interlaboratory studies (6-8). As expected, the interlaboratory precision was usually lower (i.e. larger interlaboratory standard deviation) than intralaboratory precision (within-lab precision) since interlaboratory precision involved different laboratories, procedures, instrumentation, and skills of personnel. Intralaboratory precision of chlorophenols for the two pairs of sediment extract samples are summarized in Tables II-1 and II-2 in Appendix II. These tables show a majority of participants had better intralaboratory precision than interlaboratory precision even if their accuracy was poor. However, a few laboratories had poor intralaboratory precision and poor accuracy. It is suggested that these laboratories carefully review their internal QA/QC procedures to pay particularly attention to their calibration standards and analytical procedures.

For detailed data evaluation of each laboratory, submitted results were compared with the design values. The result of each laboratory for a given parameter in a given sample was treated as 'recovery' and the design value for that parameter in the sample was taken as the "true" value. Percent recovery for each parameter in a sample was then calculated. The recoveries were designated as very low, low, satisfactory, high or very high based on the ranges listed in the table below.

Average or Individual % Recovery	Individual Result Designation (Flag)	Multiple Result Designation (Bias)
≥ 150	Very high (VH)	Very High (VH)
149 - 125	High (H)	High (H)
124 - 76	Satisfactory (S)	Satisfactory (S)
75 - 51	Low (L)	Low (L)
≤ 50	Very low (VL)	Very Low (VL)

As described previously, the ± 25% of the design value was set as the satisfactory range. Outside the satisfactory range, the results are flagged high or low accordingly. In addition to the flagging of individual sample results, bias was evaluated for each individual parameter on all test samples. An average recovery for all results in a study for the same parameter regardless of sample concentration and matrix was calculated and the same designation scheme as shown in above table was used to define bias for each individual parameter on all test results. The results for each laboratory's appraisal for flags and bias are given in Appendix III. A summary of flags and bias is given in Table 5. This table was prepared from the detailed evaluation obtained in Appendix III. In the calculation of the number of parameters biased and number of results flagged in Table 5, a very high (VH) or very low (VL) bias was counted as one bias while a high (H) or low (L) bias was counted as half of a bias. Similarly, a VH or VL flag was counted as one flag while H or L flag was counted as half of a flag.

To compare the overall laboratory performance in this study, the key step was the selection of an acceptance criterion. The criterion used for this report was the average of % number of biases and % flags within a study and this criterion was designated as the performance index. This criterion was adopted from that used by the UGLCCS (Upper Great Lakes Connecting Channels Study) QA program for evaluation of the laboratory performance of organic

parameters e.g. chlorinated hydrocarbons (9). It provides a simple way to compare laboratory performance as shown below.

Performance Index	Comment
≤ 25%	Satisfactory
26 - 50%	Moderate
≥ 51%	Poor

Results for chlorophenols in this study are given in Table 5. In conclusion, the majority of participating laboratories demonstrated satisfactory performance. The study indicated that most of the participants had the capability of analyzing sensitive and isomer specific analyses of chlorophenols in sediment extract samples. For those laboratories with poor performance as shown in Table 5, some review and corrective action is deemed to be necessary.

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The following laboratories received samples but did not submit results.

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Table 1. Samples distributed in study CP-1.

Sample No.	Description
1	Standard solution of six chlorophenols in acetone
2	Sediment extract (SC-1) fortified with six chlorophenols
3	Sediment extract (LE-1) fortified with six chlorophenols
4	Duplicate of sample # 3
5	Duplicate of sample # 2

Table 2. Analytical Methodology Used by Participating Laboratories.

Lab	Extraction/Clean-up/Derivatization	Separation/Measurement	
C001	Base partition with 2% $KHCO_3$; Derivatization with acetic anhydride and extracted into petroleum ether simultaneously; Cleanup with 5% deactivated silica gel.	–	GC/MSD
C002	Spiked into water; Derivatization with triple distilled acetic anhydride in 1% KCO_3 and extracted into petroleum ether simultaneously.	30 m x 0.2 mm i.d. x 0.25 µm DB-5 coated column	GC/ECD
C003	Spiked into deionized water; Adjusted to pH ≥ 12 with 5N KOH; Extraction with hexane; Derivatization with acetic anhydride in K_2CO_3 and extracted with hexane.	30 m DB-1701 and DB-5 capillary columns	GC/ECD
C005	Cleanup not applied; Derivatization with CH_2N_2 to methyl esters.	30 m x 0.25 mm i.d. DB-5 and DB-1701 columns	GC/ECD
C008	Spiked into water; Cleanup with solid phase extraction (C_{18} bonded porous silica cartriages); Derivatization with Diazomethane.	30 m x 0.25 mm i.d. x 0.25µm DB-1 and DB-1701 coated columns	GC/ECD
C009	Spiked into Milli-Q water; Adjusted pH to 2 with conc. HCl; Extracted with toluene; Back extracted with 0.1M K_2CO_3; Derivatization with acetic anhydride.	0.20 mm i.d. x 0.33 µm crosslinked 5% phenylmethyl silicone column and 0.20 mm i.d. x 0.17 µm 50% phenymethyl silicone column	GC/ECD

Table 2. Analytical Methodology Used by Participating Laboratories (continued).

Lab	Extraction/Clean-up/Derivatization	Separation/Measurement	
C010	Spiked into reagent water and buffered with $NaHCO_3$; Derivatization with pentaflurobenzyl chloride; Extracted with hexane.	DB-1 column	GC/ECD
C011	Solvent exchange to iso-octane; Derivatization with diazomethane in ether; Cleanup with Florisil.	O.I. Cooperation splitless capillary column 0-32 SPB-1, 30 m long	GC/ELCD
C012	Spiked with a mixture of isotopically ($^{13}C_6$) surrogate; Transfer to 0.1M K_2CO_3 solution; Derivatization with acetic anhydride and extracted into hexane.	30 m x 0.22 mm DB-5 column	GC/MSD
C015	Partitioned with 2% NaCl; Methylated using etheral diazomethane; Cleanup with Florisil, activated copper, conc. H_2SO_4 and Hg.	Packard column 180 cm x 2mm i.d. (a)primary - 4% OV-101/ 6% OV-210 on 80/100 Chromosob W; (b) Secondary - 3% OV-1 on 80/100 Chromosob W	GC/ECD
C016	DCPs analyzed directly; Other CPs by derivatization with diazomethane.	not available	GC/MS
C018	Samples spiked with ^{13}C-PCP and 2,5 - dichloro -4 - bromophenol as surrogate; Extracted with pentane from 1N K_2CO_3; derivatization with acetic anhydride and extracted into pentane; Solent exchange to iso-octane containing d_{10} - anthracene.	30 m PTE-5 (Supelco) with splitless injection	GC/MSD

Table 2. Analytical Methodology Used by Participating Laboratories (continued).

Lab	Extraction/Clean-up/Derivatization	Separation/Measurement	
C019	Samples were analyzed without cleanup or derivitization but added with internal standard d_{10} - anthracene.	15 m DB-5 column	GC/MS
C021	Samples were spiked into organic-free water; Adjusted pH to < 2 with 6N H_2SO_4; Extracted with dichloromethane. Sample #1 (standard) by direct injection without any sample preparation.	30 m x 0.23 mm capillary column	GC/MSD
C023	Derivatization with diazomethane.	30 m x 0.325 mm x 1 µm DB-5 capillary column	GC/ECD
C024	Derivatization with diazomethane.	0.25 mm i.d. x 0.25 µm film thickness HP-5 bonded phase column	GC/MSD
C025	Derivatization with diazomethane.	30 m DB-5 megabore column	GC/ECD
C026	Samples spiked into lab-grade water; Derivatization with acetic anhydride and extracted into petroleum ether; Cleanup with 5% deactivated silica.	30 m SPB-608 and 30 m DB-1 columns	GC/ECD
C027	Not available	15 m DB-Carbowax column	GC/ECD
C028	Derivatization with diazomethane/ether solution; Florisil cleanup and separation; Mercury treatment.	30 m x 0.25 mm i.d. x 0.25 µm DB-1701 and OV-17 capillary columns	GC/ECD
C029	Derivatization with acetic anhydride in iso-octane/buffered water.	not available	GC/ECD

Table 2. Analytical Methodology Used by Participating Laboratories (continued).

Lab	Extraction/Clean-up/Derivatization	Separation/Measurement	
C030	Derivatization with diazomethane using an impinger method; Cleanup with 1% deactivated Florisil.	30 m x 0.25 mm i.d. x 0.25 µm film thickness DB-5 column	GC/ECD
C031	Solvent exchange with diethylether; Derivatization with diazomethane and solvent exchange to hexane; Cleanup with acidic alumina column.	25 m x 0.32 mm fused silica	GC/ECD
C032	No derivatization and cleanup.	Ultra-2 column	GC/MSD
C033	EPA Method 8270 (no correction factors for recoveries have been applied).	Capillary column	GC/MS
C034	Samples spiked with 2,4 - dibromophenol internal standard; Derivatization with acetic anhydride in 0.25M K_2CO_3 and extracted into hexane; Cleanup with 1% deactivated silica gel column; 2,6 - dibromophenol acetate was added as internal standard.	30 m DB-5 column	GC/MS

Table 3-1. Design values and interlaboratory medians for six chlorophenols in standard solution (all values are in µg/mL).

Parameter	Design value	Interlab. Median (sample # 1)
2,4-DCP	10.0	8.43 (84.3)
3,4-DCP	10.0	10.7 (107)
2,4,6-TCP	7.5	6.69 (89.2)
2,3,6-TCP	7.5	6.48 (86.4)
2,3,4,6-TeCP	5.0	3.70 (74.0)
PCP	5.0	5.07 (101)

Note: The numbers in parentheses are the deviations from the design values, expressed as "percent recovery".

Table 3-2. Design values and interlaboratory medians for six chlorophenols in sediment extracts (all values are in µg/mL).

Parameter	Design value	Interlab. Median Sample # 2	5	Design value	Interlab. Median Sampele # 3	4
2,4-DCP	10.0	8.05 (80.5)	7.75 (77.5)	4.0	3.42 (85.5)	3.40 (85.0)
3,4-DCP	10.0	10.2 (102)	9.70 (97.0)	4.0	4.22 (106)	3.90 (97.5)
2,4,6-TCP	7.5	7.58 (101)	6.89 (91.8)	3.0	2.88 (96.0)	2.79 (92.8)
2,3,6-TCP	7.5	7.18 (95.7)	6.79 (90.5)	3.0	3.00 (100)	2.60 (86.7)
2,3,4,6-TeCP	5.0	4.00 (80.0)	4.00 (80.0)	2.0	1.30 (65.0)	1.36 (68.0)
PCP	5.0	4.65 (93.0)	4.46 (89.1)	2.0	1.64 (82.0)	1.94 (97.0)

Note: The numbers in parentheses are the deviations from the d e s i g n values, expressed as "percent recovery".

Table 4-1. Range and average values of percent recoveries of interlaboratory medians for chlorophenols in standard solution and sediment extracts.

Parameter	Standard solution		Sediment extracts	
	Range	Average	Range	Average
2,4-DCP	84.3	84.3 (1)	77.5 - 85.5	82.1 (4)
3,4-DCP	107	107 (1)	97.0 - 106	101 (4)
2,4,6-TCP	89.2	89.2 (1)	91.8 - 101	95.4 (4)
2,3,6-TCP	86.4	86.4 (1)	86.7 - 100	93.2 (4)
2,3,4,6-TeCP	74.0	74.0 (1)	65.0 -80.0	73.3 (4)
PCP	101	101 (1)	82.0 - 97.0	90.3 (4)

Note: The numbers in parentheses are the numbers of samples.

Table 4-2. Range and average values of RSD of chlorophenols in standard solution and sediment extracts.

Parameter	Standard solution		Sediment extracts	
	Range	Average	Range	Average
2,4-DCP	38.0	38.0 (1)	32.7 - 39.9	35.4 (4)
3,4-DCP	40.0	40.0 (1)	34.8 - 46.1	39.4 (4)
2,4,6-TCP	60.2	60.2 (1)	51.3 - 56.6	53.5 (4)
2,3,6-TCP	30.7	30.7 (1)	28.1 - 36.5	31.6 (4)
2,3,4,6-TeCP	36.6	36.6 (1)	43.4 - 49.0	46.6 (4)
PCP	39.3	39.3 (1)	50.7 - 64.6	57.8 (4)

Note: The numbers in parentheses are the numbers of samples.

Table 5. Performance of Individual Laboratory in Study CP-1

Lab. No.	Bias			Flags			Performance Index **	Comment
	No. of Parameters Analyzed	No. of + Parameters Biased	% Bias	No. of Results Reported	No. of * Results Flagged	% Flags		
C001	6	1	16.7	30	6.0	20.0	18.4	Satisfactory
C002	5	1	20.0	25	5.5	22.0	21.0	Satisfactory
C003	6	3	50.0	30	16.0	53.3	51.5	Poor
C005	3	0	0.0	15	2.0	13.3	6.7	Satisfactory
C008	2	0	0.0	10	3.0	30.0	15.0	Satisfactory
C009	6	1	16.7	6	1.0	21.7	19.0	Satisfactory
C010	4	0	0.0	20	1.5	7.5	3.8	Satisfactory
C011	2	0.5	25.0	10	2.5	25.0	25.0	Satisfactory
C012	6	0	0.0	30	0.0	0.0	0.0	Satisfactory
C015	4	3	75.0	20	20.0	100.0	87.5	Poor
C016	3	0	0.0	14	1.5	10.7	5.4	Satisfactory
C018	6	2	33.3	30	11.0	36.7	35.0	Moderate
C019	6	2	33.3	30	15.0	50.0	41.7	Moderate
C021	5	1	20.0	25	5.0	20.0	20.0	Satisfactory
C023	2	0.5	25.0	10	2.5	25.0	25.0	Satisfactory
C024	4	3	75.0	20	16.5	82.5	78.8	Poor
C025	6	1.5	25.0	30	8.0	26.7	25.9	Moderate
C026	5	2.5	50.0	25	14.0	56.0	53.0	Poor
C027	6	1.5	25.0	30	9.5	31.7	28.4	Moderate
C028	2	1.5	75.0	10	9.0	90.0	82.5	Poor
C029	6	0	0.0	30	2.0	6.7	3.4	Satisfactory
C030	3	1.5	50.0	15	7.0	46.7	48.4	Moderate
C031	4	1.0	25.0	20	8.5	42.5	33.8	Moderate
C032	3	0.5	16.7	14	2.5	17.9	17.3	Satisfactory
C033	3	1	33.3	15	8.5	56.7	45.0	Moderate
C034	4	3	75.0	20	15.0	75.0	75.0	Poor

Note:
+ VH or VL bias was counted as one bias, while H or L bias was counted as half of a bias.
* VH or VL flag was counted as one flag, while H or L flag was counted as half of a flag.
** Performance Index = (% Bias + % Flags)/ 2.

APPENDIX I

DATA SUMMARY

Table I-1. Results for 2,4-dichlorophenol.

	Sample Results (µg/mL)					
Lab	1	2	3	4	5	D.L.
C001	7.43	7.31	2.76	2.68	7.54	0.05
C002	6.5	5.9	3.4	2.4	5.9	0.0005
C003	13.5	17.0	5.96	5.64	13.6	0.3
C005	NA	NA	NA	NA	NA	NA
C008	NA	NA	NA	NA	NA	NA
C009	7.9	7.9	3.6	3.4	7.4	0.0005
C010	9.9	11.1	4.1	4.0	11.0	0.025
C011	NA	NA	NA	NA	NA	NA
C012	8.52	8.04	3.98	3.23	7.92	0.02
C015	NA	NA	NA	NA	NA	NA
C016	8.43	8.24	3.08	3.16	7.75	0.05
C018	7.7	11	5.3	5.4	8.5	0.005
C019	13.0	8.05	2.73	2.92	6.70	0.1
C021	8.28	8.01	3.42	3.44	8.82	0.5
C023	NA	NA	NA	NA	NA	NA
C024	4.1	5.6	2.3	2.9	2.9	0.2
C025	10	11	4.3	4.7	11	0.10
C026	3.5	3.8	1.4	1.3	3.4	0.002
C027	9.64	9.55	4.37	5.07	3.36	0.05
C028	NA	NA	NA	NA	NA	NA
C029	9.2	11.1	5.1	4.9	10.0	0.01
C030	NA	NA	NA	NA	NA	NA
C031	NA	NA	NA	NA	NA	NA
C032	8.7	11.8	5.3	4.7	11.9	25.0
C033	1.56	6.16	2.62	2.02	4.77	0.00275
C034	NA	NA	NA	NA	NA	NA
Mean	8.092	8.916	3.748	3.639	7.792	-
S.D.	3.077	3.088	1.225	1.256	3.109	-
Median	8.43	8.05	3.42	3.4	7.75	-
Design	10.0	10.0	4.0	4.0	10.0	-

Table I-2. Results for 3,4-dichlorophenol.

Sample Results (µg/mL)						
Lab	1	2	3	4	5	D.L.
C001	11.10	11.06	4.22	4.12	11.10	0.05
C002	10.8	9.6	4.4	3.0	9.7	0.0005
C003	21.7	25.0	8.39	7.50	19.9	0.5
C005	NA	NA	NA	NA	NA	NA
C008	NA	NA	NA	NA	NA	NA
C009	7.9	7.7	3.6	3.4	7.2	0.0005
C010	NA	NA	NA	NA	NA	NA
C011	NA	NA	NA	NA	NA	NA
C012	10.02	9.03	4.42	3.62	8.88	0.02
C015	NA	NA	NA	NA	NA	NA
C016	NA	NA	NA	NA	NA	NA
C018	5.1	7.5	3.6	3.5	5.6	0.005
C019	6.89	5.74	1.78	1.84	5.01	0.1
C021	NA	NA	NA	NA	NA	NA
C023	NA	NA	NA	NA	NA	NA
C024	NA	NA	NA	NA	NA	NA
C025	13	13	4.8	5.0	13	0.10
C026	9.4	10.6	4.1	3.9	9.7	0.004
C027	10.8	10.2	4.02	4.78	8.97	0.2
C028	NA	NA	NA	NA	NA	NA
C029	10.7	11.9	5.5	4.6	10.9	0.01
C030	NA	NA	NA	NA	NA	NA
C031	NA	NA	NA	NA	NA	NA
C032	NA	NA	NA	NA	NA	NA
C033	NA	NA	NA	NA	NA	NA
C034	NA	NA	NA	NA	NA	NA
Mean	10.674	11.03	4.439	4.115	9.996	-
S.D.	4.27	5.082	1.603	1.432	4.045	-
Median	10.7	10.2	4.22	3.9	9.7	-
Design	10.0	10.0	4.0	4.0	10.0	-

Table I-3. Results for 2,4,6-trichlorophenol.

	Sample Results (µg/mL)					
Lab	1	2	3	4	5	D.L.
C001	7.30	7.75	2.96	2.96	7.74	0.05
C002	7.3	6.8	3.5	2.5	6.8	0.0005
C003	16.0	17.9	5.95	6.08	13.2	0.1
C005	6.98	7.84	3.15	3.68	7.58	0.1
C008	6.40	9.60	2.0	5.120	7.75	20
C009	6.0	6.2	2.6	2.6	5.7	0.0005
C010	7.0	8.0	2.7	2.7	7.6	0.010
C011	NA	NA	NA	NA	NA	NA
C012	7.24	6.87	3.33	2.77	6.79	0.02
C015	1.472	1.050	0.4060	1.006	2.419	0.00001
C016	9.60	9.03	3.25	3.08	7.89	0.05
C018	4.1	5.7	2.8	2.8	4.2	0.005
C019	10.0	7.40	2.34	2.27	5.98	0.1
C021	6.10	5.93	2.54	2.66	6.52	1
C023	NA	NA	NA	NA	NA	NA
C024	3.8	4.9	1.5	1.2	3.6	0.3
C025	7.0	10	3.3	3.2	8.7	0.025
C026	21.0	23.7	9.1	8.8	21.3	0.003
C027	4.43	5.31	2.29	2.16	6.12	0.002
C028	2.8	2.9	1.2	1.2	3.2	0.05
C029	7.2	9.2	3.6	3.3	8.4	0.005
C030	3.1	5.6	2.6	2.6	5.5	0.01
C031	5.4	5.3	2.0	2.3	6.8	0.01
C032	5.4	8.7	4.1	3.2	8.5	25.0
C033	3.15	7.99	3.66	3.42	6.97	0.00224
C034	10	12	4.2	4.7	14	0.01
Mean	7.032	8.152	3.128	3.179	7.636	-
S.D.	4.236	4.616	1.685	1.663	3.917	-
Median	6.69	7.575	2.88	2.785	6.885	-
Design	7.5	7.5	3.0	3.0	7.5	-

Table I-4. Results for 2,3,6-trichlorophenol.

Sample Results (µg/mL)						
Lab	1	2	3	4	5	D.L.
C001	5.30	5.40	1.95	1.92	5.15	0.05
C002	8.1	7.4	3.9	2.7	7.3	0.0005
C003	6.48	8.01	2.48	2.59	6.70	0.1
C005	NA	NA	NA	NA	NA	NA
C008	NA	NA	NA	NA	NA	NA
C009	5.9	6.0	2.5	2.5	5.5	0.0005
C010	NA	NA	NA	NA	NA	NA
C011	NA	NA	NA	NA	NA	NA
C012	7.46	7.00	3.28	2.79	6.79	0.02
C015	1.692	16.40	4.872	1.150	2.568	0.00001
C016	NA	NA	NA	NA	NA	NA
C018	3.5	5.2	2.6	2.6	3.8	0.005
C019	8.69	6.43	2.05	1.91	5.35	0.1
C021	6.29	5.63	2.46	2.51	6.23	1
C023	NA	NA	NA	NA	NA	NA
C024	NA	NA	NA	NA	NA	NA
C025	6.5	9.1	3.0	3.0	7.7	0.025
C026	7.7	8.6	4.1	3.9	7.6	0.001
C027	6.18	7.18	3.04	3.08	8.78	0.003
C028	NA	NA	NA	NA	NA	NA
C029	6.8	8.6	3.8	3.4	7.9	0.005
C030	NA	NA	NA	NA	NA	NA
C031	5.7	5.8	2.2	2.4	7.1	0.01
C032	NA	NA	NA	NA	NA	NA
C033	NA	NA	NA	NA	NA	NA
C034	9.6	11	3.8	4.3	12	0.01
Mean	6.393	7.85	3.069	2.717	6.698	-
S.D.	1.963	2.862	0.863	0.782	2.197	-
Median	6.48	7.18	3.0	2.6	6.79	-
Design	7.5	7.5	3.0	3.0	7.5	-

Table I-5. Results for 2,3,4,6-tetrachlorophenol.

	Sample Results (µg/mL)					
Lab	1	2	3	4	5	D.L.
C001	4.33	4.05	1.93	1.74	4.0	0.05
C002	NA	NA	NA	NA	NA	NA
C003	3.33	3.62	1.30	1.36	2.92	0.03
C005	4.14	4.04	1.27	1.82	3.91	0.05
C008	NA	NA	NA	NA	NA	NA
C009	2.7	2.7	0.8	1.2	2.3	0.0005
C010	4.8	4.6	1.3	1.8	4.5	0.155
C011	2.8	4.0	1.9	1.1	4.0	0.01
C012	4.08	3.86	1.80	1.68	4.02	0.02
C015	1.115	0.9120	0.3020	0.6290	1.463	0.000005
C016	NA	NA	NA	NA	NA	NA
C018	3.6	5.3	2.5	1.4	4.2	0.005
C019	2.06	2.30	0.83	0.50	2.62	0.1
C021	2.92	2.32	1.16	1.30	3.05	1
C023	4.81	8.11	1.95	2.47	8.00	0.10
C024	1.5	1.5	0.41	0.34	1.2	0.3
C025	4.3	5.1	3.0	2.9	7.7	0.025
C026	NA	NA	NA	NA	NA	NA
C027	4.14	3.66	1.00	1.31	4.68	0.004
C028	NA	NA	NA	NA	NA	NA
C029	5.3	4.9	2.7	1.8	4.5	0.003
C030	3.6	4.6	2.1	2.2	4.5	0.01
C031	3.7	3.4	1.3	1.2	3.7	0.005
C032	NA	NA	NA	NA	NA	NA
C033	NA	NA	NA	NA	NA	NA
C034	6.8	7	2.6	2.9	8.7	0.03
Mean	3.686	3.999	1.587	1.56	4.209	-
S.D.	1.348	1.735	0.777	0.715	2.02	-
Median	3.7	4.0	1.3	1.36	4.0	-
Design	5.0	5.0	2.0	2.0	5.0	-

Table I-6. Results for pentachlorophenol.

	Sample Results (µg/mL)					
Lab	1	2	3	4	5	D.L.
C001	4.43	3.65	1.82	1.34	3.42	0.05
C002	6.6	6.7	3.3	2.3	6.7	0.0005
C003	5.22	5.67	1.78	2.11	3.54	0.03
C005	6.29	3.86	0.91	2.1	4.47	0.05
C008	4.700	5.400	1.83	3.05	4.74	10
C009	4.5	4.1	0.3	1.9	3.0	0.0005
C010	6.1	5.1	0.8	2.0	5.5	0.030
C011	4.4	4.6	2.6	0.56	4.6	0.01
C012	6.14	5.43	2.45	2.44	6.16	0.02
C015	1.403	0.9360	0.2860	0.5540	1.203	0.000002
C016	9.09	6.00	ND	1.60	4.76	0.01
C018	1.6	3.3	1.5	0.82	2.2	0.005
C019	2.98	2.51	0.85	<0.1	4.34	0.1
C021	5.25	1.42	1.16	1.59	2.75	1
C023	5.47	5.37	1.06	1.98	4.44	0.10
C024	2.8	3.1	<0.2	0.16	2.0	0.2
C025	6.5	5.8	3.2	2.8	7.8	0.025
C026	6.9	5.4	3.5	3.5	7.1	0.0002
C027	4.92	1.79	0.884	0.888	2.43	0.006
C028	3.0	2.6	1.0	1.0	2.5	0.05
C029	4.9	6.2	2.3	2.1	5.7	0.003
C030	2.4	2.1	0.99	1.17	2.5	0.005
C031	5.4	2.0	0.80	0.60	2.2	0.005
C032	4.9	4.7	4.3	NA	5.5	3
C033	5.65	10.46	3.96	4.3	10.77	0.00463
C034	9.8	9.6	3.7	3.8	13	0.03
Mean	5.052	4.531	1.887	1.861	4.743	-
S.D.	1.984	2.298	1.219	1.083	2.73	-
Median	5.07	4.65	1.64	1.94	4.455	-
Design	5.0	5.0	2.0	2.0	5.0	-

APPENDIX II

INTRALABORATORY PRECISION

(WITHIN-LAB PRECISION)

Table II-1. Results from duplicate analysis of chlorophenols in fortified sediment extract SC-1 (samples 2 and 5).

Lab	Intralaboratory Mean ± S.D. (%RSD)					
	2,4-DCP	3,4-DCP	2,4,6-TCP	2,3,6-TCP	2,3,4,6-TeCP	PCP
	µg/mL					
C001	7.425±0.163(2.20)	11.08±0.028(0.25)	7.745±0.007(0.09)	5.275±0.177(3.36)	4.025±0.035(0.87)	3.535±0.163(4.61)
C002	5.9±0(0)	9.65±0.071(0.74)	6.8±0(0)	7.35±0.071(0.97)	NA	6.7±0(0)
C003	15.3±2.404(15.71)	22.45±3.606(16.06)	15.55±3.323(21.37)	7.355±0.926(12.59)	3.27±0.495(15.14)	4.605±1.506(32.70)
C005	NA	NA	7.71±0.184(2.39)	NA	3.975±0.092(2.31)	4.165±0.431(10.35)
C008	NA	NA	8.675±1.308(15.08)	NA	NA	5.07±0.467(9.21)
C009	7.65±0.354(4.63)	7.45±0.354(4.75)	5.95±0.354(5.95)	5.75±0.354(6.16)	2.5±0.283(11.32)	3.55±0.779(21.94)
C010	11.05±0.071(0.64)	NA	7.8±0.283(3.63)	NA	4.55±0.071(1.56)	5.3±0.283(5.34)
C011	NA	NA	NA	NA	4.0±0(0)	4.6±0(0)
C012	7.98±0.085(1.07)	8.955±0.106(1.18)	6.83±0.057(0.83)	6.895±0.148(2.15)	3.94±0.113(2.87)	5.795±0.516(8.90)
C015	NA	NA	1.735±0.968(55.79)	9.484±9.781(103.13)	1.188±0.390(32.83)	1.0695±0.189(17.67)
C016	7.995±0.346(4.33)	NA	8.46±0.806(9.53)	NA	NA	5.38±0.877(16.30)
C018	9.75±1.768(18.13)	6.55±1.344(20.52)	4.95±1.061(21.4)	4.5±0.990(22.0)	4.75±0.778(16.38)	2.75±0.778(28.29)
C019	7.375±0.955(12.94)	5.375±0.516(9.6)	6.69±1.004(15.01)	5.89±0.764(12.97)	2.46±0.226(9.19)	3.425±1.294(37.78)
C021	8.415±0.573(6.81)	NA	6.225±0.417(6.7)	5.93±0.424(7.15)	2.685±0.516(19.22)	2.085±0.940(45.08)
C023	NA	NA	NA	NA	8.055±0.078(0.97)	4.905±0.658(13.41)
C024	4.25±1.909(44.92)	NA	4.25±0.919(21.62)	NA	1.35±0.212(15.70)	2.55±0.778(30.51)
C025	11±0(0)	13±0(0)	9.35±0.919(9.83)	8.4±0.990(11.79)	6.4±1.838(28.72)	6.8±1.414(20.79)
C026	3.6±0.283(7.86)	10.15±0.636(6.23)	22.50±1.697(7.54)	8.1±0.707(8.73)	NA	6.25±1.202(19.23)
C027	6.455±4.377(67.81)	9.585±0.870(9.08)	5.715±0.573(10.03)	7.980±1.131(14.17)	4.17±0.721(17.29)	2.11±0.453(21.47)
C028	NA	NA	3.05±0.212(6.95)	NA	NA	2.55±0.071(2.78)
C029	10.55±0.778(7.37)	11.4±0.707(6.20)	8.8±0.566(6.43)	8.25±0.495(6.00)	4.7±0.283(6.02)	5.95±0.354(5.95)
C030	NA	NA	5.55±0.071(1.28)	NA	4.55±0.071(1.56)	2.3±0.283(12.30)
C031	NA	NA	6.05±1.061(17.54)	6.45±0.919(14.25)	3.55±0.212(5.97)	2.1±0.141(6.71)
C032	11.85±0.701(5.92)	NA	8.6±0.141(1.64)	NA	NA	5.1±0.566(11.10)
C033	5.465±0.983(17.99)	NA	7.48±0.721(9.64)	NA	NA	10.615±0.219(2.06)
C034	NA	NA	13±1.414(10.88)	11.5±0.707(6.15)	7.85±1.202(15.31)	11.3±2.404(21.27)

Table II-2. Results from duplicate analysis of chlorophenols in fortified sediment extract LE-1 (samples 3 and 4).

Lab	Intralaboratory Mean ± S.D. (%RSD)					
	2,4-DCP	3,4-DCP	2,4,6-TCP	2,3,6-TCP	2,3,4,6-TeCP	PCP
	µg/mL					
C001	2.720±0.057(2.1)	4.17±0.071(1.70)	2.96±0(0)	1.935±0.021(1.09)	1.835±0.134(7.30)	1.58±0.339(21.46)
C002	2.9±0.707(24.4)	3.7±0.990(26.76)	3.0±0.707(23.57)	3.3±0.849(25.73)	NA	2.8±0.707(25.25)
C003	5.8±0.226(3.9)	7.945±0.629(7.92)	6.015±0.092(1.53)	2.535±0.078(3.08)	1.33±0.042(3.16)	1.945±0.233(11.98)
C005	NA	NA	3.415±0.375(10.98)	NA	1.545±0.389(25.18)	1.505±0.841(55.88)
C008	NA	NA	3.56±2.206(61.97)	NA	NA	2.44±0.863(35.37)
C009	3.5±0.141(4.0)	3.5±0.141(4.03)	2.6±0(0)	2.5±0(0)	1.0±0.283(28.30)	1.1±1.13(102.73)
C010	4.05±0.071(1.8)	NA	2.7±0(0)	NA	1.55±0.354(22.84)	1.4±0.849(60.64)
C011	NA	NA	NA	NA	1.5±0.566(37.73)	1.58±1.442(91.27)
C012	3.605±0.530(14.7)	4.02±0.566(14.08)	3.05±0.396(12.98)	3.035±0.346(11.40)	1.74±0.085(4.89)	2.445±0.007(0.29)
C015	NA	NA	0.706±0.424(60.06)	3.011±2.632(87.41)	0.466±0.231(49.57)	0.42±0.190(7.77)
C016	3.12±0.057(1.83)	NA	3.165±0.120(3.79)	NA	NA	0.8±1.13(141.25)
C018	5.35±0.071(1.33)	3.55±0.071(2.0)	2.8±0(0)	2.6±0(0)	1.95±0.778(39.90)	1.16±0.481(41.47)
C019	2.825±0.134(4.74)	1.81±0.042(2.32)	2.305±0.049(2.12)	1.98±0.099(5.00)	0.665±0.233(35.04)	0.425±0.601(141.41)
C021	3.43±0.014(0.41)	NA	2.6±0.085(3.27)	2.485±0.035(1.41)	1.23±0.099(8.05)	1.375±0.304(22.11)
C023	NA	NA	NA	NA	2.21±0.368(16.65)	1.52±0.651(42.83)
C024	2.6±0.424(16.31)	NA	1.35±0.212(15.70)	NA	0.375±0.049(13.07)	0.08±0.113(141.25)
C025	4.5±0.282(6.27)	4.9±0.141(2.88)	3.25±0.071(2.18)	3.0±0(0)	2.95±1.718(58.24)	3.0±0.282(9.40)
C026	1.35±0.071(5.26)	4.0±0.141(3.53)	8.95±0.212(2.37)	4.0±0.141(3.53)	NA	3.5±0(0)
C027	4.72±0.495(10.49)	4.4±0.537(12.20)	2.225±0.092(4.13)	3.06±0.028(0.92)	1.155±0.219(18.96)	0.886±0.0028(3.16)
C028	NA	NA	1.2±0(0)	NA	NA	1.0±0(0)
C029	5.0±0.141(2.82)	5.05±0.636(12.59)	3.45±0.212(6.14)	3.6±0.283(7.86)	2.25±0.636(28.27)	2.2±0.141(6.41)
C030	NA	NA	2.6±0(0)	NA	2.15±0.071(3.30)	1.08±0.127(11.76)
C031	NA	NA	2.15±0.212(9.86)	2.3±0.141(6.13)	1.25±0.071(5.68)	0.7±0.141(20.14)
C032	5.0±0.424(8.48)	NA	3.65±0.636(17.42)	NA	NA	-
C033	2.32±0.424(18.28)	NA	3.54±0.170(4.80)	NA	NA	4.13±0.240(5.81)
C034	NA	NA	4.45±0.354(7.96)	4.05±0.354(8.74)	2.75±0.212(7.71)	3.75±0.071(1.89)

APPENDIX III

LAB-SPECIFIC APPRAISAL FOR BIAS AND FLAG STATEMENTS

GLOSSARY OF TERMS

Codes

NA: not analyzed

ND: not detected

VH: very high

H: high

L: low

VL: very low

S: satisfactory

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C001

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	4 L	71.8	L
3,4-DCP	S	108	S
2,4,6-TCP	S	100	S
2,3,6-TCP	5 L	68.1	L
2,3,4,6-TeCP	S	86.2	S
PCP	3 L	77.6	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C002

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	4 L	65.6	L
3,4-DCP	1 L	97.2	S
2,4,6-TCP	S	95.8	S
2,3,6-TCP	1 H	105	S
2,3,4,6-TeCP	NA	-	-
PCP	1 VH; 3 H	136	H

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C003

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 VH; 4 H	146	H
3,4-DCP	5 VH	213	VH
2,4,6-TCP	5 VH	206	VH
2,3,6-TCP	S	90.3	S
2,3,4,6-TeCP	5 L	66.1	L
PCP	1 L	96.6	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C005

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	S	105	S
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	1 L	79.3	S
PCP	1 H; 1 VL	88.6	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C008

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	1 VH; 1 H; 1 L	111	S
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	NA	-	-
PCP	1 VH	108	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C009

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 L	81.4	S
3,4-DCP	1 L	80.6	S
2,4,6-TCP	S	82.4	S
2,3,6-TCP	1 L	79.7	S
2,3,4,6-TeCP	2 VL; 3 L	50.8	L
PCP	1 VL; 1 L	68.4	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C010

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	S	105	S
3,4-DCP	NA	-	-
2,4,6-TCP	S	96.3	S
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	1 L	86.6	S
PCP	1 VL	94.8	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C011

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	NA	-	-
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	2 L	73.2	L
PCP	1 H; 1 VL	85.4	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C012

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	S	85.0	S
3,4-DCP	S	96.1	S
2,4,6-TCP	S	96.4	S
2,3,6-TCP	S	97.1	S
2,3,4,6-TeCP	S	82.6	S
PCP	S	120	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C015

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	5 VL	22.6	VL
2,3,6-TCP	2 VH; 3 VL	95.0	S
2,3,4,6-TeCP	5 VL	23.3	VL
PCP	5 VL	22.6	VL

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C016

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	S	80.0	S
3,4-DCP	NA	-	-
2,4,6-TCP	1 H	113	S
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	NA	-	-
PCP	1 VH	119	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C018

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	2 H	108	S
3,4-DCP	3 L	71.9	L
2,4,6-TCP	2 L	74.6	L
2,3,6-TCP	1 VL; 2 L	68.0	L
2,3,4,6-TeCP	1 H; 2 L	91.4	S
PCP	3 VL; 2 L	51.6	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C019

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 H; 3 L	83.8	S
3,4-DCP	3 L; 2 VL	53.4	L
2,4,6-TCP	1 H	93.0	S
2,3,6-TCP	3 L	81.0	S
2,3,4,6-TeCP	4 VL; 1 L	41.2	VL
PCP	2 VL; 2 L	59.8	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C021

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	S	84.5	S
3,4-DCP	NA	-	-
2,4,6-TCP	S	84.1	S
2,3,6-TCP	S	81.6	S
2,3,4,6-TeCP	1 VL; 4 L	57.8	L
PCP	1 VL; 2 L	65.2	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C023

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	NA	-	-
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	2 VH	128	H
PCP	1 L	91.4	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C024

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	3 L; 2 VL	51.2	L
3,4-DCP	NA	-	-
2,4,6-TCP	3 VL; 2 L	50.8	L
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	5 VL	24.3	VL
PCP	3 VL; 2 L	41.5	VL

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C025

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	S	109	S
3,4-DCP	4 H	127	H
2,4,6-TCP	1 H	112	S
2,3,6-TCP	S	99.1	S
2,3,4,6-TeCP	2 VH; 1 H	127	H
PCP	2 VH; 2 H	140	H

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C026

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	5 VL	34.9	VL
3,4-DCP	S	99.5	S
2,4,6-TCP	5 VH	295	VH
2,3,6-TCP	2 H	117	S
2,3,4,6-TeCP	NA	-	-
PCP	2 VH; 2 H	149	H

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C027

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 H; 1 VL	92.3	S
3,4-DCP	S	104	S
2,4,6-TCP	3 L	72.0	L
2,3,6-TCP	S	99.8	S
2,3,4,6-TeCP	1 VL; 3 L	73.0	L
PCP	4 VL	54.3	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C028

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	5 VL	39.7	VL
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	NA	-	-
PCP	3 VL; 2 L	52.4	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C029

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 H	111	S
3,4-DCP	1 H	118	S
2,4,6-TCP	S	112	S
2,3,6-TCP	1 H	110	S
2,3,4,6-TeCP	1 H	104	S
PCP	S	111	S

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C030

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	1 VL; 2 L	72.5	L
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	1 L	93.8	S
PCP	4 VL; 1 L	49.6	VL

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C031

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	3 L	75.4	S
2,3,6-TCP	1 L	80.3	S
2,3,4,6-TeCP	5 L	68.2	L
PCP	4 VL	52.4	L

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C032

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 H	115	S
3,4-DCP	NA	-	-
2,4,6-TCP	1 H; 1 L	109	S
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	NA	-	-
PCP	1 VH	129	H

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C033

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	1 VH; 1 VL; 3 L	76.3	S
3,4-DCP	NA	-	-
2,4,6-TCP	1 VL	95.6	S
2,3,6-TCP	NA	-	-
2,3,4,6-TeCP	NA	-	-
PCP	4 VH	190	VH

Lab-Specific Appraisal for Flag and Bias Statements

Lab. Code: C034

Parameter	Flags	Bias	
		Avg. Rec. (%)	Bias
2,4-DCP	NA	-	-
3,4-DCP	NA	-	-
2,4,6-TCP	3 VH; 2 H	155	VH
2,3,6-TCP	1 VH; 4 H	141	H
2,3,4,6-TeCP	1 VH; 4 H	145	H
PCP	5 VH	205	VH

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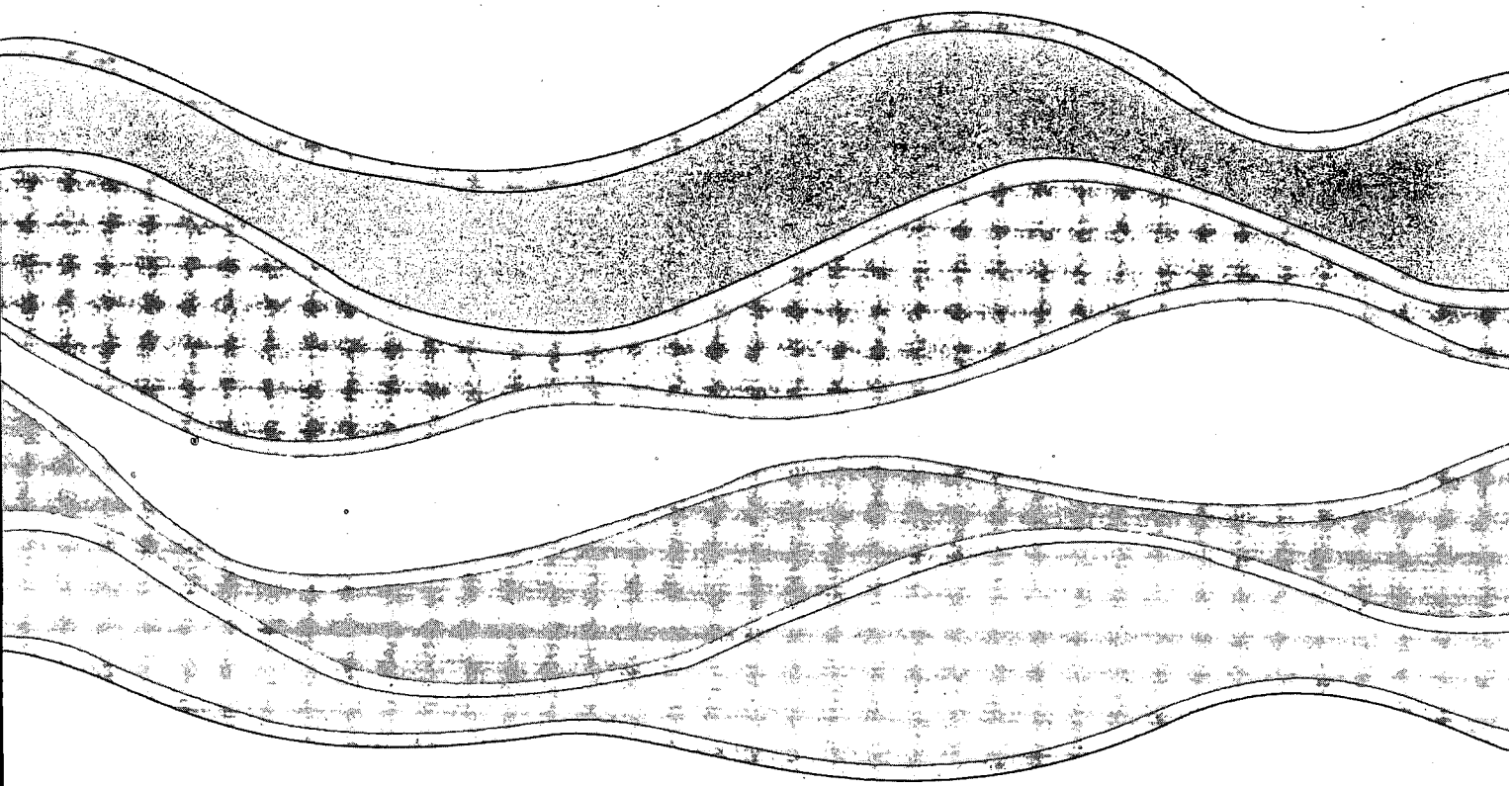

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