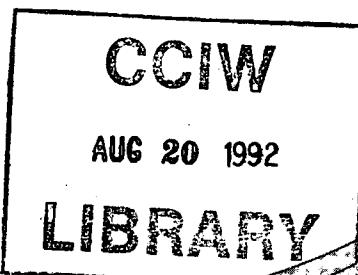
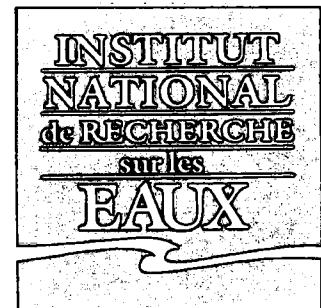
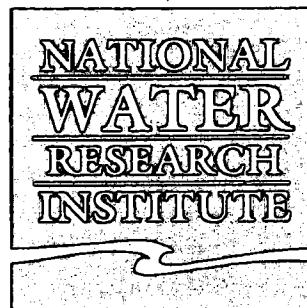


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EVALUATION OF THE METHOD FOR THE
DETERMINATION OF DIOXINS AND
FURANS IN PULP AND PAPER INDUSTRY
RELATED MATRICES

R.J. Wilkinson, B.K. Afghan and I. Sekerka

NWRI CONTRIBUTION NO. 92-10

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DIOXINS AND FURANS IN PULP AND PAPER INDUSTRY RELATED
MATRICES**

R.J. Wilkinson, B.K. Afghan and I. Sekerka

**Research and Applications Branch
National Water Research Institute
867 Lakeshore Rd., P.O. Box 5050
Burlington, Ontario
L7R 4A6**

NWRI Contribution No. 92-10

MANAGEMENT PERSPECTIVE

The results of environmental studies have pushed the ecotoxicological effects of the pulp and paper industry to the forefront of national interest. The Canadian Environmental Protection Act recognizes effluents from pulp mills as substances requiring formal assessment and possible regulatory control. In 1987, Environment Canada initiated a major program to determine and monitor the level of chlorinated dioxins and furans in products and wastes produced by the paper industry. The Research and Applications Branch laboratory contributed to the research by developing analytical methods and by providing analytical data. The performance of previously developed methodology was validated using less complex samples such as fish, sediment and water.

The effort to apply this methodology to the pulp and paper related samples showed that modifications were necessary. Also, the requirement of the determination of dioxins and furan homologues was tested and validated. This report documents the performance of the modified method and instrumentation in terms of precision, recoveries and reproducibility.

The analytical results generated by this methodology are found to be valid and reliable. They fall well within the criteria for accurate determination of dioxins and furans.

The report also indicates that the variability of the analytical procedures is lower than the variability of sampling and sample processing. Over 400 analyses were carried out during 1987-90.

Interlaboratory studies incorporating different samples, methods and standards confirmed an acceptable performance of the methodology described in this report.

SOMMAIRE À L'INTENTION DE LA DIRECTION

Les résultats d'études environnementales ont placé les effets écotoxicologiques des activités de l'industrie des pâtes et papiers au premier rang des intérêts nationaux. La Loi canadienne sur la protection de l'environnement reconnaît que les effluents des usines de pâte sont des substances qui doivent être l'objet d'une évaluation officielle et peut-être de mesures de réglementation. En 1987, Environnement Canada a mis en application un important programme visant à déterminer et à surveiller la concentration de dioxines et de furanes chlorés dans des produits et des déchets de l'industrie papetière. Le laboratoire de la Direction de la recherche pure et appliquée a participé aux recherches par la mise au point de méthodes d'analyse et la production de données analytiques. L'efficacité de la méthode mise au point antérieurement a été validée au moyen d'échantillons moins complexes comme des échantillons de poisson, de sédiments et d'eau.

L'effort en vue d'appliquer cette méthode à des échantillons reliés aux activités de l'industrie des pâtes et papiers a montré que des modifications étaient nécessaires. On a également déterminé les besoins relatifs au dosage des homologues des dioxines et des furanes et validé la méthode. Le présent rapport étaye l'efficacité de la méthode modifiée et des instruments en fonction de la précision, des récupérations et de la reproductibilité.

Les résultats analytiques obtenus par cette méthode sont valables et fiables. Ils respectent les critères de dosage précis des dioxines et des furanes. Le rapport montre également que la variabilité des techniques d'analyse est moindre que la variabilité due à l'échantillonnage et au traitement des échantillons. Plus de 400 analyses ont été effectuées entre 1987 et 1990. Des études interlaboratoires portant sur différents échantillons, méthodes et étalons ont confirmé qu'un niveau acceptable d'efficacité peut être obtenu avec la méthode décrite dans le présent rapport.

ABSTRACT

Interest in the determination of the content of PCDD's and PCDF's in pulp and paper industry products and wastes has dramatically increased with their detection in the aquatic environment, including fish in the immediate vicinity of these mills. Concentrations of 2,3,7,8-TCDD have been determined to be in the parts per trillion range in water and fish. In some instances, the concentration has exceeded the guidelines of various government agencies. In 1988, the Canadian Government in co-operation with the pulp and paper industry, conducted a national survey, to assess the environmental impact by initiating operational and research programs to monitor and determine the fate and effects of these compounds on the aquatic environment at and near all pulp mills. Multi-media, ultra trace analyses of dioxins and furans have been carried out in the Clean and Hazardous Chemicals Laboratory (CHCL) of RAB/NWRI. This laboratory has provided analytical data to researchers involved in monitoring and impact assessments.

This report describes the method suitable for analysis of samples associated with the pulp and paper mill industry for PCDD's and PCDF's. It summarizes the data generated during the period 1987-90, that the analysis at ppt and ppq levels is highly difficult and the reliable determination at these levels presents many problems. These problems include sample heterogeneity, cross-contamination during sample processing, handling of standards and extracts, selection and availability of standards, extraction, cleanup, qualitation and quantitation of isomers and confirmation of results. The analytical results have been found to be valid and reliable for 2,3,7,8-TCDD as well as total Cl₄ - Cl₈ PCDD's and PCDF's according to the criteria stated within this report. Interlaboratory validation studies have indicated the performance of the described analytical method, with respect to precision and spike recovery, to be uniform throughout the entire period. These interlaboratory studies, incorporating different samples, laboratories methods and standards confirmed an acceptable performance of the methodology used.

RÉSUMÉ

L'importance de mesurer la concentration des PCDD et des PCDF dans les produits et les déchets de l'industrie des pâtes et papiers a augmenté de façon spectaculaire avec leur dépistage dans le milieu aquatique, notamment chez les poissons au voisinage immédiat de ces usines. Les teneurs en 2,3,7,8-TCDD, dans l'eau et chez le poisson, atteignaient des valeurs de l'ordre de la partie par 10^{12} . Dans certains cas, la teneur était supérieure aux recommandations de différents organismes gouvernementaux. En 1988, le gouvernement canadien, en collaboration avec l'industrie des pâtes et papiers, a effectué une enquête nationale en vue d'évaluer les incidences environnementales. À cette fin, on a entrepris des programmes opérationnels et de recherche pour surveiller et déterminer le devenir de ces composés et leurs effets dans le milieu aquatique dans le voisinage immédiat ou plus éloigné de toutes les usines de pâtes. Des analyses au niveau d'ultra traces des dioxines et des furanes dans plusieurs milieux ont été effectuées dans le Laboratoire ultra-propre pour les produits chimiques dangereux de la Direction de la recherche pure et appliquée de l'INRE. Ce laboratoire a fourni des données analytiques aux chercheurs chargés de la surveillance et de l'évaluation des incidences.

Le présent rapport décrit la méthode qui s'applique à l'analyse d'échantillons associés à l'industrie des pâtes et papiers en ce qui concerne le dosage des PCDD et des PCDF. Il résume les données produites entre 1987 et 1990, et les auteurs signalent que l'analyse de teneurs de l'ordre de la partie par 10^{12} et de la partie par 10^{15} est très difficile et que le dosage fiable de teneurs de cet ordre pose de nombreux problèmes. Par exemple, l'hétérogénéité de l'échantillon, la contamination des échantillons les uns par les autres pendant leur traitement, la manipulation des étalons et des extraits, la sélection et la disponibilité des étalons, l'extraction, la purification, la mesure qualitative et quantitative des isomères et la confirmation des résultats. On a constaté que les résultats analytiques étaient valables et fiables en ce qui concerne le 2,3,7,8-TCDD aussi bien que pour l'ensemble des PCDD et PCDF tétrachlorés à octachlorés ($\text{Cl}_4 - \text{Cl}_8$) conformément

aux critères énoncés dans le présent rapport. Des études interlaboratoires de validation ont montré que l'efficacité de la méthode d'analyse décrite, sur le plan de la précision et celui de la récupération à partir d'échantillons enrichis, est constante pendant toute la période visée. Ces études interlaboratoires, portant sur différents échantillons, méthodes de laboratoire et étalons ont confirmé que l'efficacité de la méthode était acceptable.

INTRODUCTION

Several highly publicized environmental "catastrophes", such as an explosion in Seveso, Italy, of an industrial plant producing 2,3,5-trichlorophenol and the resulting contamination of the environment's with dioxins, the spraying of agent orange containing dioxins in Vietnam and the spraying of contaminated waste oil in Missouri, have focused scientific attention on this class of compounds. Environmental effects of these compounds were reported as early as the 60's when millions of broiler chickens in the U.S.A. died from feed fats contaminated with PCDD impurities. It was not until the 70's that 2,3,7,8-TCDD was found in fish in New York State, resulting in stringent regulations to control the commercial fishery⁽¹⁾. The results of scientific studies and investigations during the late 80's, indicated that the pulp & paper industry was a major source - entry of dioxins and furans into the environment⁽²⁾. The Canadian government embarked on a program of intensified research and monitoring of these compounds to assess their impact on the ecosystem.

This report documents the work undertaken by the Clean and Hazardous Chemicals Laboratory, RAB/NWRI during the period of 1987-1990, generating analytical data for PCDDs and PCDFs in pulp and paper related samples and the aquatic environmental media in the vicinity of these mills. The report includes the rationale for the cleanup scheme and provides statistical evaluation of the data to verify and validate the analytical methodology⁽³⁾. The results indicate the variability of the analytical procedure to be less than the variability of sampling and compositing, especially in the case of sediments and solid materials. Replicate analysis of samples from the same location, indicate a good degree of reproducibility of the analytical methodology, however, the variability of results for targeted compounds indicate poor homogeneity.

METHODOLOGY

The analytical schematic was evolved from an earlier procedure designed to analyze relatively simple fish tissue matrices⁽⁴⁻⁶⁾. This procedure consists of A - Extraction, B - Cleanup/Isolation, and C - Analytical Confirmation and Quantitation. The use of this schematic assumes familiarity with the general aspects of dioxin and furan analysis. Because sludge, pulp, effluents and sediments, may contain many organic compounds in addition to those normally found in an environmental sample, the size of the sample aliquots taken for analysis were kept to 5-10 g for solids and 1-4 L for effluents, except for special projects such as RAB Study No. 84-012, designed to determine the applicability of the large sample extractor to the preconcentration of organics for ultra-trace analysis.

The method of extraction of a sample is dictated by it's type, composition, moisture content and sample history such as sampling site, etc. All samples are spiked prior to extraction with a ¹³C labelled, 2,3,7,8 substituted (one from each homologous series) cocktail of surrogates. Most solid samples require exhaustive soxhlet-toluene extraction to quantitatively extract the dioxins and furans from the bulk of the organic matrix. Some samples, depending on their type and condition, require acid digestion with 6N HCl followed by filtration prior to the Soxhlet extraction and liquid/liquid extraction of the filtrate with toluene. Effluents or aqueous samples are usually liquid/liquid extracted with methylene chloride. Fish tissues, require a gel permeation chromatographic separation of the lipids, following initial digestion prior to the clean/up isolation procedures. All samples are treated with a basic wash (0.05M trisodium phosphate) to remove phenolic and other acidic type compounds followed by an acidic wash (6N sulfuric acid) to remove basic and biogenic components. If the extract is suspected of containing sulfur (usually accompanied by an intense yellow colouring of the organic solvent) the sample is shaken vigorously with mercury until formation of black mercurous sulfite ceases. After filtration, the extract is then applied to a basic

alumina column to separate aliphatic compounds from the aromatic or targeted compounds. It has also been determined, that the "cleanup and isolation" and hence the qualitation/quantitation of the dioxins and furans can be further enhanced by the use of a 40% sulfuric acid on silica gel chromatographic column for extract conditioning prior to the final "polishing" of the extract on a carbon impregnated glass fibre/serial solvent elution liquid chromatographic system. The block scheme of the procedure is given in Figure 7.

Prior to HRGC/LRMS analysis, the sample extract was spiked with a "performance" standard enabling the analyst to calculate Internal Standard recoveries and eliminate variation in operator and instrumental performance. Some contaminated samples require additional cleanup, as evidenced by an excessive instrumental background, which must be reduced and/or removed before actual qualitation and quantitation was possible. This was accomplished using a micro alumina column. Other techniques are being investigated to further improve the condition of the final solution to remove ambiguities such as PNAs & PCBs, etc.

Analytical Protocols

Ions monitored:

	Tetra	Penta	Hexa	Hepta	Octa
Native Furan M-COCl	242.9	278.9	310.9	344.8	378.8
Native Dioxin M-COCl	258.9	294.9	326.9	360.8	396.8
Native Furan Confirmation Ion	303.9	337.9	375.8	409.8	441.7
Native Furan Quantitation Ion	305.9	339.9	373.8	407.8	443.7
¹³ C labelled Furan Confirmation Ion	315.9				
¹³ C labelled Furan Quantitation Ion	317.9				
Native Dioxin Confirmation Ion	319.9	353.9	391.8	425.8	457.7
Native Dioxin Quantitation Ion	321.9	355.9	389.8	423.8	459.7
¹³ C labelled Dioxin Confirmation Ion	331.9	365.9	403.9	437.8	469.8
¹³ C labelled Dioxin Quantitation Ion	333.9	367.9	401.9	435.8	471.8
TOTAL NO. OF IONS	10	8	8	8	8

Isotopic Mass Ratios

<u>Dioxins</u>	<u>Acceptable Range</u>	<u>Furans</u>
320/322	0.65 - 0.89	304/306
354/356	0.51 - 0.71	338/340
392/390	0.69 - 0.93	376/374
426/424	0.83 - 1.12	410/408
458/460	0.75 - 1.01	442/444

Instrumental conditions and parameters for all analyses:

A. GC: Hewlett-Packard 5880
 MODE: Split/Splitless; 0.75 min. splitless
 COLUMN: Hewlett-Packard ULTRA-2
 column length: 25m
 film thickness: 0.11 micron
 column I.D.: 0.2 mm

INJECTION PORT TEMP.: 250°C
 OVEN TEMP. PROFILE: Initial temp.: 80°C
 Initial time: 3 min.
 Level 1 temp.: 180°C
 program rate: 20°C/min.
 hold time: 0.00 min.
 Level 2 temp.: 260°C
 program rate: 5°C/min.
 hold time: 20 min.

B. MSD: Hewlett-Packard 5970B
 Source temp.: 200°C
 Transfer line: 250°C
 EMV: 70 ev
 Mode: MID
 Resolution: ≈ 600
 Solvent delay: 14 min.
 eM volts: 600 relative

Standards

MSD Std.	¹³ C	1,2,3,4-TCDD	50 pg/ μ L
	¹³ C	2,3,7,8-TCDD	50 pg/ μ L
	¹³ C	1,2,3,7,8-PCDD	100 pg/ μ L
	¹³ C	1,2,3,4,7,8-HCDD	100 pg/ μ L
	¹³ C	1,2,3,4,6,7,8-HPCDD	100 pg/ μ L
	¹³ C	OCDD	150 pg/ μ L

+ Native Dioxins and Furans of the same 2,3,7,8 substituted isomers at identical levels of concentration

Perf. Std.	¹³ C	1,2,3,4-TCDD	50 pg/ μ L
Spk. Std. (Surrogate)	¹³ C	2,3,7,8-TCDD	50 pg/ μ L
	¹³ C	1,2,3,7,8-PCDD	100 pg/ μ L
	¹³ C	1,2,3,4,7,8-HCDD	100 pg/ μ L
	¹³ C	1,2,3,4,6,7,8-HPCDD	100 pg/ μ L
	¹³ C	OCDD	150 pg/ μ L

Surrogate Standard Recovery Criteria

¹³ C Surrogates	Amt Spiked (ng)	Acceptable Recovery (%)
2,3,7,8-TCDD	1.25	40 - 120
1,2,3,7,8-PCDD	2.5	35 - 120
1,2,3,4,7,8-HXCDD	2.5	30 - 120
1,2,3,4,6,7,8-HPCDD	2.5	25 - 120
OCDD	3.75	20 - 120

Obtained data of homologues recoveries and RSD are given in Figures 3 and 4.

Instrument Calibration:

1. Mass selective detector was daily checked for air m/z 28 and water m/z 18 in the system.
2. Mass selective detector was tuned using PFTBA (69;219;502) (perfluorotributylamine) first in the morning and when problems arise to confirm condition of the system.
3. The MSD standard was injected prior to sample injection and after every two samples and/or immediately after tuning.
4. If the response of the performance standard (^{13}C 1,2,3,4-TCDD) varies by more than 15%, the MSD standard was injected after every sample.
5. Retention times for the dioxins and furans must fall within the windows determined using a window defining solution. The results of the calibration are summarized in Figure 1.

Standards Utilization Protocol:

1. MSD std. is the instrument calibration standard injected each morning and after every two samples. It contains the native dioxins and furans as well as the ^{13}C labelled dioxin isomers and the performance standard. Values obtained, are used to determine ^{13}C surrogate recovery and the performance standard characteristics for each sample.
2. Performance standard is the ^{13}C labelled 1,2,3,4-TCDD. It is contained in the MSD or Instrument Standard and is also added to each sample just prior to injection at the same concentration

to determine instrument and operator performance. Values obtained are used to eliminate instrumental and operator variables. The data of performance standard response are summarized in Figure 2.

3. SPK Standard or Surrogate Standard are the same ^{13}C labelled dioxins as those contained in the MSD or Instrument Calibration Standard. They are added to the sample matrix prior to extraction to determine the cleanup efficiency.

Criteria of Positive Identification:

1. Signal to noise ratio must be at least 2.5:1 (manual).
2. Retention times of the confirmation and quantitation ions of the native ions must be the same as those of the spiked ^{13}C labelled ions.
3. Check for the presence and retention times of the M-COCL ions.
4. Isotopic mass ratios must be within the listed range.
5. Recoveries of the ^{13}C spiked surrogates must be within the listed tolerances.

Quantitation:**1. Determine the Response Factor (R.F.):**

$$\text{Dioxin R.F.} = \frac{\text{Area of the native dioxin ion in the external standard (MSD std)}}{\text{Area of the corresponding } ^{13}\text{C dioxin ion in the external standard (MSD std)}}$$

$$\text{Furan R.F.} = \frac{\text{Area of the native furan ion in the external standard (MSD std)}}{\text{Area of the corresponding } ^{13}\text{C dioxin ion in the external standard (MSD std)}}$$

2. then if injection volume is constant and final volume is 25 μL

$$\begin{aligned} \text{Concentration of Native in Sample} &= \frac{\text{Concentration of } ^{13}\text{C Surrogate in Sample (pg)} \times \text{Area}}{\text{R.F.} \times \text{Area of Corresponding } ^{13}\text{C Surrogate in sample}} \times 25 \div \text{wt of sample(g)} \\ &= \text{pg/g} \\ &= \text{ppt} \end{aligned}$$

RESULTS AND DISCUSSION

The tables in this report contain the data obtained and reported during the period 1987-1990, with particular emphasis on Table 6, "The Determination of Anaerobic Dehalogenation of Dioxins and Furans in Homogenized Pulpmill Bottom Sediments, Stored Overtime, Under Deionized Water". This was a multi-operator project, involving 48 samples with accompanying blanks and spikes analyses.

Instrument variability from September 1988 to March 1989, expressed in absolute ion intensities of the performance standard, $^{13}\text{C},1,2,3,4\text{-TCDD}$, calculated from the instrument or calibration standard (MSD STD) injected into the HRGC/LRMS system daily over the six month term gave an RSD of 31.3%. When expressed as the absolute ion intensities of the performance standard $^{13}\text{C},1,2,3,4\text{-TCDD}$, added to the final sample extracts the RSD was 35.4%. This indicates that the instrumentation (HP MSD) was under control and the sample matrix did not significantly increase the variability of instrument performance for this compound. Comparing the ion intensities of $^{13}\text{C},2,3,7,8\text{-TCDD}$ to $^{13}\text{C},1,2,3,4\text{-TCDD}$ both contained in the instrument standard (MSD STD) over the same period gave a RSD of 7.7%, further indicating good instrument performance. Matrix variability over the same period can be evaluated by comparing the ion intensities of $^{13}\text{C},1,2,3,4\text{-TCDD}$ added to the final sample extracts, to the same ion intensities of $^{13}\text{C},1,2,3,4\text{-TCDD}$ in the instrumentation or calibration standard (MSD STD). Obtained RSD of 14.0%, indicates that the matrix effects over the entire period was acceptable.

Additional performance indicators, such as the separation of $^{13}\text{C},1,2,3,4\text{-TCDD}$ from $2,3,7,8\text{-TCDD}$, normally expressed as a percent valley, 10% being acceptable, was $\geq 29\%$. The mean of the difference of the absolute retention times for $^{13}\text{C},1,2,3,4\text{-TCDD}$ and $2,3,7,8\text{-TCDD}$ was 0.1398 ± 0.024 with an RSD of 16.7%. Further, the absolute retention time for $2,3,7,8\text{-TCDD}$, understated conditions, did not vary greater than 2.0% with a mean retention time of 16.93 ± 0.03 .

The precision of the methodology and instrumental protocol may be evaluated from the data presented in "The National Dioxin Interlaboratory QC Studies #1, #2, #3 and #4. In these studies, one sample was run three times, once in each study, while another was run four times, once in Study 1, twice in Study 2 and once in Study 3. Because the studies were conducted over a wide time interval, Study 1 - Apr. 89, Study 2 - Dec.-Jan. 89/90, Study 3 - Sept.-Oct. 90, and Study 4 - Jan. 92, the RSD's of the absolute ion intensities of each ¹³C labelled standard, in the instrumentation standard were determined at the time of each study. Results summarized in Figure 5 indicate that variability of the instrument for all three studies was constant, and certainly within an acceptable range.

The RSD's of the absolute ion intensities for each ¹³C labelled standard in the final sample extracts, were also determined in an effort to establish matrix effect. Results given in Figure 6 point out matrix interference with the late eluting high chlorinated congeners. Study #2 was run at a time of instrumentation problems and column performance deterioration. The RSD values suggest that the problem was constant and influenced the results for all congeners. After resolving the problem, source rehabilitation, and installation of a new column, the RSD values are low and constant across the full analytical spectrum indicating that sample matrix is not a problem. Previous experience indicates some matrix interferences are actually accentuated by column deterioration and/or source deterioration as indicated by the acceptable performance of the calibration standard during the running of Study #2.

All other results and tables are included to indicate the overall constant and satisfactory performance of the methodology with direct reference to the ¹³C,1,2,3,4 performance standard and the constantly good recoveries of the ¹³C labelled spiked surrogates from a variety of complex matrices associated with the pulp and paper industry.

ACKNOWLEDGEMENTS

The authors wish to thank Tina Hooey and Marsha Ferguson, for their tireless technical assistance and Dr. John Carey for valuable expertise given in several private communications.

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LIST OF TABLES

1. DOE, Dioxin Task Force Analytical Working Group, Interlaboratory Studies #1 and #2, to determine effective methodology for the analysis of pulpmill associated samples and the awarding of contractual projects: - 88.
2. The National Dioxin Interlaboratory QC Studies to assess laboratory performance. (Studies #1 to #4).
3. WQ-OR studies #122-86 and #122-88 to determine the distribution of organics in aqueous and sediment samples from the vicinity of a pulpmill on the Rainy River.
4. RAB study 84-012 to determine the applicability of the large sample extractor to the preconcentration of organics for ultra-trace analysis.
5. RAB Study 84-021, Quality Assurance and Reference Material Studies to pre-screen and evaluate a bulk sediment sample to determine its suitability for development into a dioxin reference material.
6. LRB Study 82-069, Study #1 to determine if dehalogenation of dioxins in sediments occurs and to study possible degradation pathways.
7. LRB Study 82-069, Study #4 to determine sediment transport and bioaccumulation of dioxins and furans.

TABLE 1. ANALYSIS OF PULPMILL ASSOCIATED SAMPLES TO DETERMINE THE EFFECTIVENESS OF RAB METHODOLOGY

SAMPLE LD.	Wt g	% RECOVERY										NATIVE COMPOUNDS FOUND (ppm)							
		PERF. STANDARD		¹³ C SURROGATES						DIOXINS				FURANS					
		Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa
Matrix (Pulp) SPIKE	5	93	85	90	85	80	78	-	-	-	-	NOT DETECTED	-	-	-	-	-	-	-
PULP	5	NA	79	100	96	91	88	-	-	-	331	1554	-	-	-	31	59	-	-
PULP	15	96	80	83	78	57	37	20	-	-	-	1623	-	-	-	-	-	-	-
SLUDGE	5	88	66	45	48	49	43	205	-	-	216	1295	958	-	-	-	-	-	-
SLUDGB	5	NA	28	59	80	83	72	263	-	-	335	1938	2777	-	-	-	-	-	49
SLUDGE	5	NA	56	54	56	42	26	280	-	-	628	1998	4731	-	-	-	-	-	90
SLUDGB	5	NA	45	46	48	46	39	294	-	-	2560	13024	5141	-	-	-	-	-	434
EFFLUENT	1L	NA	26	27	25	22	20	114	-	243	1690	1366	1198	-	1308	3652	942	-	-

Statistical Data of the Recovery of ¹³C Surrogates:
n = 8

¹³C Components

	Tetra	Penta	Hexa	Hepta	Octa
\bar{x}	58	63	65	59	50
S.D.	23	25	24	24	25
R.S.D.	40	40	37	41	50

TABLE 3. ANALYSIS OF SUSPENDED SEDIMENTS FROM THE VICINITY OF A PULPMILL ON THE RAINY RIVER

SAMPLE I.D.	Wt g	% RECOVERY PERF. STANDARD	NATIVE COMPOUNDS FOUND (ppb)												
			¹³ C SURROGATES				DIOXINS				FURANS				
			Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa
1	5.023	96	60	82	79	68	60	-	-	93	211	-	-	148	-
2	5.818	109	84	75	41	29	35	58	-	229	868	392	362	274	-
3	8.145	123	87	100	99	66	33	83	-	47	580	1643	839	-	526
4	7.375	102	79	114	118	92	58	72	-	-	488	1864	2220	447	267
5	7.738	54	57	67	63	46	28	269	-	-	467	-	3211	-	-
6	6.728	65	77	103	114	105	54	141	-	-	50	252	1002	-	343
7	5.976	79	94	43	20	41	66	83	-	-	-	876	704	243	-
8	6.489	90	21	82	104	105	105	-	-	70	230	-	-	-	-
9	5.777	93	44	52	56	53	49	-	-	45	270	-	-	-	343
10	5.261	94	79	85	84	59	28	70	-	-	-	3.18	-	-	422
11	5.428	106	83	92	93	76	29	54	-	130	470	-	-	-	156
12	5.623	78	74	87	78	77	69	122	-	-	117	801	-	779	306
13	5.651	95	77	97	126	112	78	114	-	-	173	965	129	30	408

Statistical Data of the Perf. Std. and ¹³C Surrogates

n = 13

Perf. C¹³Tetra Penta Hexa Hepta Octa
Std.

	\bar{x}	91	71	83	83	72	54
S.D.	19	20	20	31	26	23	
R.S.D.	21	28	24	37	36	43	

TABLE 3.(b) ANALYSIS OF FISH FROM THE VICINITY OF A PULPMILL ON THE RAINY RIVER

TABLE 4. LARGE VOLUME AQUEOUS SAMPLES IN THE VICINITY OF A PULPMILL ON THE RAINY RIVER

SAMPLE I.D.	VOL. L.	% RECOVERY PERF. STANDARD	NATIVE COMPOUNDS FOUND (ppb)													
			' ¹³ C SURROGATES			DIOXINS			FURANS			Tetra Penta Hexa Hepta Octa				
			Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa	Hepta	Tetra	Penta	Hexa	Hepta	Octa
1 Control Whole	38	-	104	128	126	127	109	-	-	-	-	-	-	-	-	-
2 Control Centrif.	37	149	97	102	100	105	97	-	-	-	-	-	-	-	-	-
3 Downstream	39	166	87	95	88	124	115	36	-	-	5	9	10	-	32	-
Whole																
4 Downstream	36.2	61	98	110	112	92	102	-	-	-	27	138	-	-	-	-
Centrifuged																
5 Boise Canada	20.6	126	91	102	101	129	137	-	4	-	40	205	-	-	-	13
Plume Centrif.																
6 Boise USA Plume	35.8	94	93	107	96	129	156	13	4	-	-	-	5	-	-	-
Centrifuged																
7 Boise USA Plume	39.5	94	98	103	118	182	192	11	25	-	-	13	22	4	-	-
Whole																
8 Boise Canada	37.5	166	66	64	45	74	65	11	-	44	-	-	-	18	11	-
Effluent Whole																
9 Boise USA	35.6	131	71	67	62	75	60	29	-	2	-	-	26	-	-	-
Effluent																
Centrifuged																

Statistical Data

n = 9

Perf. Std.	Tetra	Penta	Hexa	Hepta	Octa
\bar{x}	123	89	98	94	115
S.D.	38	13	20	26	34
R.S.D.	31	15	20	28	30

Perf. Std.	Tetra	Penta	Hexa	Hepta	Octa
\bar{x}	123	89	98	94	115
S.D.	38	13	20	26	34
R.S.D.	31	15	20	28	30

TABLE 5. ANALYSIS OF A BULK SEDIMENT SAMPLE TO DETERMINE IT'S SUITABILITY FOR DEVELOPMENT INTO A DIOXIN REFERENCE MATERIAL

TABLE 6
DETERMINATION OF ANAEROBIC DEHALOGENATION OF DIOXINS AND FURANS IN HOMOGENIZED PULP MILL
BOTTOM SEDIMENTS, STORED UNDER DIIONIZED WATER

SAMPLE I.D.	RUN No	WT Date	PERC. STD. %	% RECOVERY ¹³ C SURROGATES				DIOXINS				NATIVE COMPOUND FOUND (ppb)							
				Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa	Hepta	Octa	Tetra	Penta	Hexa	Hepta	Octa	
1 CPM	1	Sept	10.242	119	70	68	59	80	78	-	19	697	456	394	115	-	52	-	
2 CPM	88	10.724	126	70	64	61	76	78	-	9	188	203	200	40	6	8	-	-	
1 SOMASS	10.205	121	73	58	50	60	65	50	22	32	291	168	272	23	6	-	36	50	
2 SOMASS	10.148	131	73	58	44	63	50	50	30	44	517	218	258	37	8	-	18	33	
1 PM	15.157	108	69	63	50	68	60	-	-	-	293	55	45	245	8	-	-	-	
2 PM	15.322	103	79	62	44	74	71	-	-	-	184	122	512	123	6	-	-	-	
1 WF	10.003	78	62	77	65	74	54	-	-	-	125	-	-	63	17	-	-	-	
2 WF	10.129	101	78	79	65	88	66	-	-	-	164	-	-	115	-	-	-	-	
1 CPM	2	Oct	10.244	108	66	78	79	78	64	37	20	416	81	174	75	-	-	30	20
2 CPM	88	10.147	99	75	87	92	93	90	42	103	1240	271	480	222	-	-	93	72	
1 SOMASS	8.741	110	78	87	96	86	77	77	108	143	448	750	4460	66	-	20	197	243	
2 SOMASS	5.245	143	81	98	101	97	88	-	53	68	292	161	296	-	-	14	42	75	
1 PM	15.537	97	45	50	54	49	52	-	-	138	-	-	-	115	-	-	-	-	
2 PM	15.118	104	81	89	98	101	85	5	-	176	37	40	135	-	4	7	-	-	
1 WF	10.017	123	69	85	91	95	75	7	24	504	919	2122	208	-	9	27	81	-	
2 WF	10.666	121	76	88	94	95	73	8	-	457	256	987	252	6	-	41	-	-	
1 CPM	3	Nov	10.999	116	81	78	79	71	65	-	-	286	303	435	51	-	-	20	-
2 CPM	88	10.754	106	79	76	74	59	56	-	37	652	889	978	98	-	-	47	52	
1 SOMASS	5.442	111	86	94	107	103	87	-	36	-	351	418	562	22	-	9	48	35	
2 SOMASS	5.028	116	60	54	50	41	35	-	-	112	169	214	-	-	-	-	-	-	
1 PM	15.238	110	19	18	17	15	13	-	-	212	85	62	214	-	-	-	-	-	
2 PM	14.893	115	93	88	90	84	70	-	-	231	258	206	145	-	4	-	-	-	
1 WF	9.980	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2 WF	9.946	137	41	41	48	53	50	-	-	404	679	1306	130	13	10	37	51	-	
1 CPM	4	Jan	5.460	115	75	80	84	83	71	55	102	1597	541	1326	236	-	-	191	115
2 CPM	89	10.972	91	78	91	106	107	93	40	73	1236	610	852	214	-	-	62	80	
1 SOMASS	5.062	103	86	93	99	86	58	56	147	68	474	501	242	47	-	-	-	-	
2 SOMASS	5.085	91	52	55	56	47	-	-	104	105	574	397	553	60	-	-	-	-	
1 PM	15.624	130	73	75	65	52	-	-	6	10	229	56	51	232	-	7	-	-	
2 PM	10.214	83	15	15	16	19	18	-	-	-	237	289	304	108	-	-	-	-	
1 WF	10.001	129	66	69	71	65	52	-	-	55	630	175	139	193	-	22	-	-	
2 WF	9.943	116	80	89	97	90	64	-	-	19	605	139	128	298	-	4	-	-	

1 CPM	5	Feb	9.814	104	80	108	118	97	114	-	319	305	447	67	-	7	-	
2 CPM	89	8.101	117	74	97	111	97	112	107	34	70	1480	1650	7979	192	-	33	53
1 SOMASS	5.146	128	77	95	107	80	107	80	107	138	65	424	201	391	24	-	-	290
2 SOMASS	5.199	132	62	82	87	75	56	126	98	126	98	608	398	556	36	-	-	-
1 PM	14.414	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 PM	10.758	113	41	55	56	52	45	-	-	-	-	-	-	-	-	-	-	-
1 WF	9.97	106	65	75	86	78	67	-	-	-	-	-	-	-	-	-	-	-
2 WF	9.964	94	77	90	96	93	81	-	-	-	-	-	-	-	-	-	-	-
1 CPM	6	Mar	5.697	110	73	85	81	76	87	-	10	784	279	75	136	-	-	-
2 CPM	89	5.094	123	75	86	95	89	81	74	98	1866	770	2602	338	-	42	176	120
1 SOMASS	5.417	87	23	24	26	29	39	-	-	-	234	277	1000	-	-	-	-	-
2 SOMASS	5.225	150	72	88	96	87	89	-	-	114	95	992	267	-	-	-	56	-
1 PM	11.033	102	25	31	33	28	25	-	-	-	245	199	222	216	-	-	-	24
2 PM	14.824	129	75	92	97	95	80	-	-	-	286	40	28	181	-	-	-	-
1 WF	9.992	129	70	92	92	68	53	-	5	-	456	130	-	190	-	-	-	-
2 WF	9.984	148	70	85	86	60	34	-	15	1224	210	163	-	314	-	-	-	-

TABLE 7. ANALYSIS OF SIZED SEDIMENT SAMPLES TO DETERMINE THE TRANSPORT OF DIOXINS AND FURANS IN THE ENVIRONMENT

SAMPLE ID.		Wt	PERF.	% RECOVERY				NATIVE COMPOUNDS FOUND (ppb)																	
Site Type	Part	g	STD	%	¹³ C SURROGATES				DIOXINS			FURANS													
	Size			%	Tetra	Penta	Hexa	Hepa	Octa	Tetra	Penta	Hexa	Hepta	Octa	Penta	Hexa	Hepta	Octa	Octa						
2	Trap	>0.707	8.4050	121	79	82	79	64	50	27	137	546	150	114	299	89	89	89							
		0.707-0.09	7.8631	117	91	111	103	78	56																
		0.09	5.5361	98	54	75	79	67	50																
2	Bottom	>0.707	7.3075	133	62	72	76	65	50	27	137	546	150	140	32	32	32	32							
		0.707-0.09	8.4079	114	51	61	61	47	61																
		0.09	7.1351	114	73	92	72	70	76																
3	Trap	>0.707	8.6336	-	79	82	96	90	108	59	42	115	27	88	98	14	14	14	14						
		0.707-0.09	7.9190	112	71	97	61	80	59	19	93	281	53	98	14	14	14	14	14						
		0.09	8.0311	108	71	78	83	85	94																
3	Bottom	>0.707	9.8733	135	87	90	85	103	92	21	523	150	150	150	150	150	150	150	150						
		0.707-0.09	7.8883	114	71	83	74	83	55																
		0.09	8.3688	138	78	83	85	94	81																
5	Bottom	>0.707	1.2631	115	77	86	85	84	70	21	65	65	65	65	65	65	65	65							
		0.707-0.9	8.0391	116	78	90	90	72	71																
		0.09	8.0369	126	65	78	72	63	86																
Site 2 TRAP		RSD				RSD				RSD				RSD				RSD							
Site 2	n = 3	PerfStd.	112	12	11	RSD				RSD				RSD				RSD							
		¹³ CTetra	75	19	25	RSD				RSD				RSD				RSD							
		Penta	89	19	21	RSD				RSD				RSD				RSD							
Site 3	n = 2	PerfStd.	110	3	3	RSD				RSD				RSD				RSD							
		¹³ CTetra	77	8	10	RSD				RSD				RSD				RSD							
		Penta	97	.7	1	RSD				RSD				RSD				RSD							
Site 3 TRAP	n = 2	PerfStd.	76	21	28	RSD				RSD				RSD				RSD							
		Hepia	94	20	21	RSD				RSD				RSD				RSD							
		Octa	59	0	0	RSD				RSD				RSD				RSD							
Site 2 BOTTOM		RSD				RSD				RSD				RSD				RSD							
Site 2	n = 3	PerfStd.	129	13	109	RSD				RSD				RSD				RSD							
		¹³ CTetra	79	8	10	RSD				RSD				RSD				RSD							
		Penta	85	4	5	RSD				RSD				RSD				RSD							
Site 3 BOTTOM		RSD				RSD				RSD				RSD				RSD							
Site 3	n = 3	PerfStd.	119	11	9	RSD				RSD				RSD				RSD							
		¹³ CTetra	73.3	7.2	9.8	RSD				RSD				RSD				RSD							
		Penta	84.7	6.1	7.2	RSD				RSD				RSD				RSD							
Site 4 BOTTOM		RSD				RSD				RSD				RSD				RSD							
Site 4	n = 3	PerfStd.	113	11	9	RSD				RSD				RSD				RSD							
		¹³ CTetra	74.7	7.2	9.8	RSD				RSD				RSD				RSD							
		Penta	85.7	9.0	11.9	RSD				RSD				RSD				RSD							

TABLE 7.(b) ANALYSIS OF CENTRIFUGED SUSPENDED SEDIMENTS FROM THE VICINITY OF A PULPMILL ON THE ST. MAURICE RIVER
RIVER AT LA TUQUE QUEBEC TO DETERMINE PRESENCE OF DIOXINS AND FURANS

TABLE 2 (1A)

NATIONAL DIOXIN QC STUDY No. 1
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F033	355	443	129	322	1546	3520	5960
F058	270	270	45 L	590	1300	3100	5305
F061	-	293	<67	811	1387	4537	7028
F065	510	720	<570	<1100	2700	4500	7920
F066	<160 L	<1100	<600	<230 L	1500	2000 L	3500
F077	490	540	150	650	1600	4700	7640
F088	396	396	119	740	2240	6690	10185
F089	140 L	330	1100 H	2700 H	3800 H	7300	15230 H
N090	281	353	<61 L	573	1191	4388	6505
N122	500	500	130	590	910	2900	5030
N187*	320	420	156	663	1367	4192	6798
Interlab Mean	362	427	261	849	1776	4348	7373
SD	125	134	372	707	834	1558	3130
Interlab Median	355	408	129	620	1500	4388	6798

* CHML

TABLE 2 (1AA)

NATIONAL DIOXIN QC STUDY No. 1
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
F033	188	1239 H	665	1469	3514	6699	13586
F058	95	95 L	210 L	4000 H	1600 L	7100	13005
F061	-	213	403	1940	3634	8660	14850
F065	140	790 H	2000 H	<1100	11000 H	9600	23390
F066	110	650	770	1500	2200	3400 L	8520
F077	88	150 L	620	3700 H	3000	13000	20470
F088	100	150 L	375	1280	3330	10500	15635
F089	59	390	1000	1200	3500	4100	10190
N090	135	446	700	1805	3511	7604	14066
N122	53	160 L	670	1800	2100	7600	12330
N187*	106	402	529	1090	2553	5940	10514
Interlab Mean	107	426	722	1978	3631	7655	14232
SD	40	350	474	1027	2540	2763	4399
Interlab Median	103	390	665	1650	3330	7600	13586

* CHML

TABLE 2 (1B)

NATIONAL DIOXIN QC STUDY No. 1
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F033	353	481	133	396	2354	4486	7850
F058	310	310	79	140 L	1800	3700	6029
F061	-	179 L	<67	454	877 L	2542	4052
F065	510	620	<1000	<1800	2000	4700	7320
F066	<150 L	<1500	<2200	<340 L	2200	4000	6200
F077	420	420	130	880	2300	6600	10330
F088	259	274	75	733	1950	7620	10652
F089	140 L	400	860 H	3200 H	2700	6200	13360
N090	301	380	<61 L	774	1347	4479	6980
N122	580	580	160	660	1100	3600	6100
N187*	379	551	185	915	1408	4349	7408
Interlab Mean	361	420	232	906	1821	4752	7844
SD	132	141	280	896	573	1481	2629
Interlab Median	332	410	130	733	1950	4479	7320

* CHML

TABLE 2 (1BB)

NATIONAL DIOXIN QC STUDY No. 1
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
F033	171	1294	765	1944	4066	8252	16321
F058	130	203 L	150 L	2400	800 L	7100	10653
F061	-	<115 L	261 L	1116	2224	4498	8099
F065	157	940	1500	<1800	10000 H	9400	21840
F066	170	950	1100	2400	4900	6400	15750
F077	170	920	1100	3800	5300	16000	27120
F088	134	305 L	320 L	1360	3710	14200	19895
F089	93	600	550	1600	3700	6800	13250
N090	184	712	944	2236	3995	8900	16787
N122	82	280 L	830	2000	2700	9700	15510
N187*	169	741	552	1320	3001	8402	14016
Interlab Mean	146	695	734	2018	4036	9059	16295
SD	35	352	414	777	2340	3362	5249
Interlab Median	163	712	765	1972	3995	8402	15750

* CHML

TABLE 2 (2A)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results for Sample 1 (pg/g wet sediment)

Lab No.	% moisture	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
		2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F058	72.5	nd	nd	nd	nd	146	788	934
F065	70.4	170	200	70	60	70	110	510
F066	71.49	25	25	<16	148	174	399	746
F077	72.7	8	8	nd	46	76	273	403
F089	65	<1	12	<1	116	165	<14	293
N122*	63	52	89	6	141	189	962	1387
N187	73	24	24	12	75	221	463	795
N193	75	50	88	35	58	340	1060	1581
Interlab Mean		55	64	31	92	173	579	831
SD		59	69	29	42	86	361	458
Interlab Median		72%	25	25	12	75	170	431
								771

* This laboratory analyzed Sample #1 AFTER drying the sediment. The data provided above were extrapolated from the reported results for the dry sediment using % moisture to give the corresponding value for the original wet sample.

TABLE 2 (2AA)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

FURAN Results for Sample 1 (pg/g wet sediment)

Lab No.	% moisture	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
		2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F058	72.5	13	13	43.9	158	428	480	1123
F065	70.4	19	190	240	190	360	180	1160
F066	71.49	11	66	68	285	684	542	1645
F077	72.7	8	22	27	123	147	292	611
F089	65	<1	63	<1	298	242	<14	603
N122*	63	9	37	122	444	518	2331	3452
N187	73	20	20	31	125	698	996	1870
N193	75	38	140	280	770	2000	1280	4470
Interlab Mean		17	69	116	299	635	872	1867
SD		10	64	104	219	585	751	1392
Interlab Median	72%	12	50	56	238	473	511	1403

* This laboratory analyzed Sample #1 AFTER drying the sediment. The data provided above were extrapolated from the reported results for the dry sediment using % moisture to give the corresponding value for the original wet sample.

TABLE 2 (2Aa)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results for Sample 1 (pg/g dry sediment)

Lab No.	% moisture	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
		2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F058*	72.5	<21.4 L	<21.4 L	<21.3 L	<27.6 L	532	2870	3402
F061	**	30 L	30 L	<67	214	329	973	1546
F065*	70.4	570 H	670 H	240 H	210	240 L	360 L	1720
F066*	71.49	88	88	<57	520	610	1400	2675
F077*	72.7	30 L	30 L	<90	170	280	1000	1480
F088	**	64	126	166 H	718 H	1535 H	4670 H	7215 H
F089*	65	<4 L	33 L	<4 L	330	470	<40 L	833 L
N122	63	140	240 H	17 L	380	510	2600	3747
N187*	73	89	89	44	278	819	1715	2945
N193*	75	200 H	350 H	140	230	1300 H	4200 H	6220 H
N195*	**	86	200 H	115	550	970	12000 H	13835 H
Interlab Mean		144	186	120	360	690	3179	4147
SD		168	200	82	181	424	3405	3777
Interlab Median		72%	86	89	80	278	532	1715
								2945

* These laboratories analyzed Sample #1 as a WET sediment. The data provided above are the wet sample results recalculated to a dry weight basis.

** % moisture unavailable

TABLE 2 (2AAa)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

FURAN Results for Sample 1 (pg/g dry sediment)

Lab No.	% moisture	HOMOLOGUE GROUP CONCENTRATIONS						
		2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	Total PCDD
F058*	72.5	47.3	47.3 L	160	576	1560	1750	4093.3
F061	**	24	24 L	<105 L	436	968	1461	2889
F065*	70.4	64	640 H	810 H	650	1200	620 L	3920
F066*	71.49	40	230	240	1000	2400	1900	5770
F077*	72.7	30	80 L	100 L	450	540 L	1070	2240 L
F088	**	62	315	414	1410	3590 H	6700 H	12429 H
F089*	65	<3 L	180	<4 L	850	690 L	<40 L	1720 L
N122	63	23 L	100	330	1200	1400	6300 H	9330
N187*	73	74	74 L	115 L	463	2565	3689	6926
N193*	75	150 H	570 H	1140 H	3100 H	8200 H	5100 H	15320 H
N195*	**	65	380 H	550 H	1860 H	4380 H	7380 H	14500 H
Interlab Mean		58	240	429	1090	2501	3597	7194
SD		37	213	352	806	2247	2574	4968
Interlab Median		72%	47.3	180	240	850	1560	1900

* These laboratories analyzed Sample #1 as a WET sediment. The data provided above are the wet sample results recalculated to a dry weight basis.

** % moisture unavailable

TABLE 2 (2B)

NATIONAL DIOXIN QC STUDY No. 2
 The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 2

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F058	409	409	<21.3 L	838	1620	4960	7827
F061	206	206	<67	681	1262	3638	5787
F065	260	530	310 H	1300	2700	5900	10740
F066	260	260	120	1300	1500	3200	6380
F077	340	340	<20 L	790	1660	5240	8030
F088	205	261	163	703	1740	6960	9827
F089	110 L	150 L	<4 L	670	720 L	<40 L	1540 L
N122	460	460	58	440	880	3800	5638
N187*	314	314	<15 L	540	1650	4863	7367
N193	570	750 H	280 H	220 L	1700	5200	8150
N195	285	430	180 H	800	1650	20500 H	23560 H
Interlab Mean	311	374	185	753	1553	6426	8622
SD	130	169	95	324	514	5069	5513
Interlab Median	285	340	89	703	1650	4960	7827

* CHML

TABLE 2 (2BB)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 2

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
F058	141	582	945	1550	4080	12600	19757
F061	135	531	512	1390	3054	7460	12947
F065	310 H	2500 H	3300 H	3900 H	11000 H	5900	26600
F066	140	820	940	2000	3900	5400	13060
F077	170	440	930	3540 H	4010	12600	21520
F088	134	686	610	1750	4200	11700	18946
F089	220	820	970	1700	1500 L	8200	13190
N122	67 L	240 L	550	1600	1700 L	11000	15090
N187*	136	316	<15 L	812 L	2332	8352	11812
N193	170	630	1210	2700	7000	7600	19140
N195	140	950	1000	2700	5500	16900 H	27050
Interlab Mean	160	774	1097	2149	4389	9792	18101
SD	62	612	806	949	2718	3474	5415
Interlab Median	140	630	940	1750	4010	8352	18946

* CHML

TABLE 2 (2C)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F058	354	354	<21.3 L	444	805	3670	5273
F061	231	231	<67	795	1502	4335	6863
F065	310	430	430 H	1300 H	2100	4700	8960
F066	330	330	140	600	1300	2800	5170
F077	380	380	<20 L	730	1360	4380	6850
F088	194	253	122	694	1725	7990 H	10784
F089	<4 L	<4 L	<4 L	<4 L	<20 L	<40 L	<40 L
N122	490	490	35 L	370	560 L	2700	4155
N187*	303	303	30 L	508	1567	3311	5719
N193	520	750 H	220 H	210 L	1200	3600	5980
N195	275	430	220 H	630	1220	18000 H	20500 H
Interlab Mean	339	395	171	628	1334	5549	8025
SD	104	149	138	295	439	4626	4796
Interlab Median	310	354	79	600	1300	3670	5980

* CHML

TABLE 2 (2CC)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
F058	<12.5 L	<12.5 L	<17.4 L	1180	3500	8850	13530
F061	<115	<115 L	<105 L	1063	3100	7595	11758
F065	183 H	1800 H	2200 H	3000	8200 H	11000	26200
F066	78	630	640	1600	3400	4900	11170
F077	100	370	830	2200	3390	11100	17890
F088	77	394	481	1620	3590	10675	16760
F089	53	300	<4 L	<6 L	430 L	<40 L	730 L
N122	35 L	160 L	340	1400	1300 L	9100	12300
N187*	91	210	190 L	287 L	1576 L	6474	8737
N193	79	470	1010 H	2100	6500	6600	16680
N195	91	610	770	1880	4250	13500	21010
Interlab Mean	87	549	808	1633	3567	9079	14251
SD	41	496	623	735	2231	2476	6687
Interlab Median	79	370	481	1600	3400	8850	13530

* CHML

TABLE 2 (2D)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
F058	411	411	<21.3 L	477	936	4780	6604
F061	205	205 L	<67 L	874	2134	6087	9300
F065	300	650	200	1300	2600	5600	10350
F066	300	300	160	910	1600	3700	6670
F077	440	440	300	690	1730	5300	8460
F088	221	269	169	676	1430	6480	9024
F089	<4 L	350	140	150 L	53 L	<40 L	693 L
N122	370	440	46 L	450	420 L	3600	4956
N187*	292	292	46 L	688	1529	3853	6408
N193	400	570	170	150 L	1700	4000	6590
N195	265	430	150	705	1440	20000 H	22725 H
Interlab Mean	320	396	153	643	1416	6340	8344
SD	81	132	77	334	723	4909	5430
Interlab Median	300	411	150	688	1529	4780	6670

* CHML

TABLE 2 (2DD)

NATIONAL DIOXIN QC STUDY No. 2
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
F058	192	372	581	1560	3710	9730	15953
F061	157	672	560	1153	4062	9720	16167
F065	330 H	2200 H	3600 H	4100 H	11000 H	12000	32900 H
F066	150	1100	750	2000	4700	5900	14450
F077	180	890	1270 H	3920 H	4260	12900	23240
F088	136	673	585	1770	3900	12100	19028
F089	13 L	510	410	160 L	110 L	<40 L	1190 L
N122	76	330 L	530	1400	1500 L	8800	12560
N187*	137	299 L	205 L	453 L	1544 L	7306	9807
N193	117	620	1090	2200	7600	6300	17810
N195	150	970	940	2350	4750	15400	24410
Interlab Mean	149	785	956	1915	4285	10016	17047
SD	78	537	929	1236	2995	3079	8253
Interlab Median	150	672	585	1770	4062	9720	16167

* CHML

TABLE 2 (3A)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 1

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	521	712 H	205	887	1614	4334	7752
D002	370	370	<75 L	980	2000	5800	9200
D003	250	325	266	801	1110	3100	5602
D004	315	668 H	331	1070	1140	3370	6579
D005	296	296	161	702	1441	2448	5048
D007	258	258	<24.8 L	685	1430	4386	6759
D009	280	330	60 L	660	1490	4360	6900
D010	260	310	170	720	1100	4400	6700
D011*	339	339	197	775	1519	3814	6644
D012	216	292	236	631	892	2680	4731
Interlab Mean	311	390	203	791	1374	3869	6592
SD	87	161	80	145	320	1001	1296
Interlab Median	288	328	184	748	1436	4074	6672

* CHML

TABLE 2 (3AA)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 1

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	171	831	278 L	1303	3138	8760	14310
D002	260 H	660	380	2100	5800	11000	19900
D003	92	472	829	2052	2460	3700	9513
D004	181	1180 H	1530 H	2590	4480	7160	16940
D005	110	565	753	1912	4124	5452	12806
D007	82.2	218 L	353	1528	3453	12963	18515
D009	140	680	630	1880	4650	9170	17010
D010	73	310	550	1800	3200	7000	12860
D011*	118	420	455	1194	3458	7452	12979
D012	93	477	748	1890	5250	4230	12595
Interlab Mean	132	581	651	1825	4001	7689	14743
SD	58	277	361	406	1044	2902	3221
Interlab Median	114	521	590	1885	3791	7306	13645

* CHML

TABLE 2 (3B)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 2

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	264	264	<37 L	1450	1416	5400	8530
D002	360	360	61 L	870	1900	5900	9100
D003	250	350	320	803	1200	3300	5973
D004	328	643	349	1150	708 L	4640	7490
D005	308	308	200	837	1570	2966	5881
D007	268	311	59.5 L	741	1686	4935	7733
D009	300	420	70 L	780	1640	4520	7430
D010	270	310	160	750	1200	4200	6620
D011*	338	400	257	705	1795	4050	7207
D012	231	311	258	625	1020	3160	5374
Interlab Mean	292	368	193	871	1414	4307	7134
SD	42	108	112	246	377	971	1187
Interlab Median	285	331	180	792	1493	4360	7319

* CEML

TABLE 2 (3BB)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 2

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	148	294 L	<37 L	529 L	976 L	7900	9699
D002	240	620	640	2200	5700	10000	19200
D003	130	740	1050	2079	3270	4900	12039
D004	181	1360 H	1600 H	2500	4540	7910	17910
D005	151	760	782	1942	4391	6262	14137
D007	120	342	493	1723	4330	12780	19668
D009	170	970	560	2050	4790	9500	17870
D010	94	320	580	1900	3300	6800	12900
D011*	162	594	478	1370	4251	8272	14965
D012	129	629	865	1960	5750	4840	14044
Interlab Mean	153	663	783	1825	4130	7916	15243
SD	40	327	360	542	1382	2431	3308
Interlab Median	150	625	610	1951	4361	7905	14551

* CHML

TABLE 2 (3C)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	404	551	475 H	629	1413	3645	6713
D002	330	330	52 L	860	1500	5100	7800
D003	220	330	305	857	1350	4300	7142
D004	348	578	288	1080	645	4400	6991
D005	327	327	194	602	1191	2177	4491
D007	265	291	<24.8 L	607	1110	3805	5813
D009	270	410	170	830	1360	4060	6830
D010	250	270	150	680	1000	3900	6000
D011*	326	358	169	664	1405	3487	6083
D012	303	406	343	760	1170	3440	6119
Interlab Mean	304	385	238	757	1214	3831	6398
SD	54	104	126	152	254	764	911
Interlab Median	315	344	182	720	1271	3853	6416

* CHML

TABLE 2 (3CC)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	134	617	732	1100	2985	8193	13627
D002	150	330	300 L	1500	4400	8600	15100
D003	81	551	877	2026	3500	5900	12854
D004	138	1380 H	1430 H	2400	4790	7150	17150
D005	91	697	631	1849	3548	5086	11811
D007	54.9	83.2 L	234 L	1113	2936	10505	14871
D009	120	570	810	1760	4170	8580	15890
D010	50 L	170 L	460	1600	2800	6800	11830
D011 *	109	395	458	1104	3413	6697	12067
D012	96	467	875	2140	6770	5800	16052
Interlab Mean	102	526	681	1659	3931	7331	14125
SD	34	358	350	461	1194	1638	1950
Interlab Median	103	509	682	1680	3524	6980	14276

* CHML

TABLE 2 (3D)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 4

Laboratory No.	2,3,7,8- TCDD	HOMOLOGUE GROUP CONCENTRATIONS					Total PCDD
		T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	283	283	390	H 1002	1738	4096	7508
D002	350	350	48	L 820	1700	5300	8200
D003	250	450	305	744	1150	3600	6249
D004	361	611	300	990	786	4460	7147
D005	313	313	210	760	1318	2593	5194
D007	232	264	109	688	1311	4119	6491
D009	270	390	160	650	1360	4080	6640
D010	270	300	160	670	1000	4100	6230
D011 *	320	383	160	703	1317	3341	5904
D012	286	379	327	759	1180	3890	6535
Interlab Mean	294	372	217	779	1286	3958	6610
SD	42	101	109	125	288	708	845
Interlab Median	285	365	185	752	1314	4088	6513

* CHML

TABLE 2 (3DD)

NATIONAL DIOXIN QC STUDY No. 3
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	138	454	493	1088	3400	7826	13261
D002	190	490	420	1800	5100	9400	17200
D003	120	840	883	1931	3320	5500	12474
D004	164	1230 H	1520 H	2410	4750	7370	17280
D005	118	644	705	2125	3765	5565	12804
D007	82.5	166 L	390	1475	3405	12079	17515
D009	140	770	940	1820	4340	8670	16540
D010	72	250 L	490	1800	3100	6900	12540
D011 *	133	505	442	1376	3546	6147	12016
D012	115	546	963	2290	6840	6080	16719
Interlab Mean	127	590	725	1812	4157	7554	14835
SD	35	306	358	412	1153	2055	2371
Interlab Median	127	526	599	1810	3656	7135	14901

* CHML

TABLE 2 (4A)

NATIONAL DIOXIN QC STUDY No. 4
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 1

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	<25 L	<25 L	<75	100 L	212 L	2826	3138
D002	100	110	<49 L	240	600	1900	2800
D003	130	150	150	490	850	2600	4240
D004	110	110	40 L	330	510	2400	3390
D005	140	160	37 L	320	740	1700	2957
D006	152	204	154	345	801	2147	3651
D008	120	180	130	970 H	1200	3600	6080
D010	120	130	100	306	567	2080	3180
D011*	161	161	74	327	915	2160	3637
D012	150	340 H	78	850 H	990	3000	5258
D013	120	260	180	350	770	2300	3860
D014	142	222	99	379	1000	2538	4238
D015	143	186	152	426	721	2055	3540
Interlab Mean	132	184	109	418	760	2408	3844
SD	19	66	48	238	253	511	936
Interlab Median	130	161	99	345	770	2300	3637

* CHML

TABLE 2 (4AA)

NATIONAL DIOXIN QC STUDY No. 4
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 1

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	55	315	342	1000	1911	7091	10659
D002	70	210	290	730	1700	3500	6400
D003	47	200	540	1220	2090	4200	8250
D004	120	710 H	460	540	110 L	4100	5920
D005	80	350	250	1100	2500	2900	7100
D006	85	437	427	1085	1980	3868	7797
D008	<7.2 L	64 L	270	990	2800	4800	8924
D010	23 L	95 L	380	891	1570	3280	6220
D011 *	88	266	233	537 L	1755	4629	7420
D012	98	640	850 H	1700	3300	4300	10790
D013	78	630	550	1600	3000	3800	9580
D014	94	452	194	1163	2005	3683	7497
D015	104	437	393	1079	1704	3406	7019
Interlab Mean	79	370	398	1049	2033	4120	7967
SD	27	206	177	345	795	1042	1600
Interlab Median	80	350	380	1079	1980	3868	7497

* CHML

TABLE 2 (4B)

NATIONAL DIOXIN QC STUDY No. 4
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 2

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	141	172	<50 L	829	938	4728	6667
D002	160	200	<77 L	400	990	3100	4700
D003	220	290	290	850	1600	4600	7630
D004	14 L	14 L	9 L	910	680 L	5100	6713
D005	300	300	53 L	780	1300	3200	5633
D006	303	417	263	677	1455	4005	6817
D008	230	360	290	1800 H	2400	6900	11750
D010	225	277	143	604	1090	3910	6020
D011 *	379	407	156	672	2016	3839	7090
D012	87 L	170	48 L	370 L	570 L	1600 L	2758 L
D013	250	460	310	560	1500	4300	7130
D014	290	523	382 H	11930 H	16920 H	10570 H	40325 H
D015	263	342	287	860	1446	3668	6603
Interlab Mean	220	302	203	1634	2531	4578	9218
SD	98	139	126	3113	4353	2175	9557
Interlab Median	230	300	156	780	1446	4005	6713

* CHML

TABLE 2 (4BB)

NATIONAL DIOXIN QC STUDY No. 4
 The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 2

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	45 L	200 L	923	2338	2000	12322	17783
D002	120	450	530	1200	3200	7800	13000
D003	110	770	930	2450	4550	9200	17900
D004	170	1200	1200	1700	1600 L	6400	12100
D005	130	750	850	2300	4700	5200	13800
D006	159	823	953	2137	3836	7897	15646
D008	<9.1 L	490	820	2200	5400	10000	18910
D010	79	342 L	750	1820	3480	6880	13300
D011 *	189	510	386 L	1008 L	4045	8626	14575
D012	53 L	360 L	480	1000 L	2100	2800 L	6740 L
D013	140	1100	1300	3000	6700	7500	19600
D014	194	826	388 L	3901	9421 H	9396	23932
D015	169	729	763	2203	3393	6481	13569
Interlab Mean	130	658	790	2097	4187	7731	15450
SD	50	298	287	803	2115	2360	4256
Interlab Median	130	729	820	2200	3836	7800	14575

* CHML

TABLE 2 (4C)

NATIONAL DIOXIN QC STUDY No. 4
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	212	212	138	439	1893	6230	8912
D002	200	240	<76	400	970	3200	4800
D003	260	370	310 H	760	1530	4000	6970
D004	28 L	28 L	15 L	670	940	7400	9053
D005	520 H	520	41 L	760	1300	2900	5521
D006	307	421	274 H	658	1402	3770	6525
D008	<21 L	640	380 H	2900 H	3400 H	7900 H	15220 H
D010	233	245	127	640	931	3360	5300
D011 *	290	290	127	698	1565	4737	7417
D012	140	290	67	800	880	2600	4637
D013	230	430	310 H	510	1200	3600	6050
D014	344	438	<4 L	575	1167	3857	6037
D015	400	498	286 H	469	1260	3340	5853
Interlab Mean	264	356	189	791	1418	4376	7100
SD	125	160	126	647	664	1716	2804
Interlab Median	233	370	127	658	1260	3770	6050

* CHML

TABLE 2 (4CC)

NATIONAL DIOXIN QC STUDY No. 4
 The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 3

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	25 L	108 L	504	1964	4022	14563 H	21161
D002	83	320	480	1200	3100	7000	12000
D003	64	550	830	6500 H	3500	7100	18500
D004	110	840	710	1400	2200	10000	15150
D005	110	550	590	1900	4600	5100	12740
D006	99	640	788	1742	3264	7311	13745
D008	<12 L	170 L	640	1200	4900	9000	15910
D010	17 L	66 L	585	1780	2800	5720	11000
D011 *	<18 L	224 L	282 L	819 L	2966	8714	13005
D012	90	670	750	1500	2800	4000	9720
D013	95	800	1000	2300	4700	6800	15600
D014	84	496	69 L	1789	2545	5508	10407
D015	342 H	581	468	907	2842	5883	10681
Interlab Mean	102	463	592	1923	3403	7438	13817
SD	86	259	243	1441	879	2716	3373
Interlab Median	84	550	590	1742	3100	7000	13005

* CHML

TABLE 2 (4D)

NATIONAL DIOXIN QC STUDY No. 4
The Analysis of Dioxins and Furans in Sediment

DIOXIN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDD
	2,3,7,8- TCDD	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD	
D001	126	150	169	138 L	1122	2193	3772
D002	82	100	<71	250	620	1800	2800
D003	120	160	120	680	780	2300	4040
D004	10 L	10 L	33 L	450	570	2500	3563
D005	220	220	25 L	350	760	1800	3155
D006	156	203	136	342	747	2023	3451
D008	140	140	49	690	1200	3600	5679
D010	117	137	117	394	632	2100	3380
D011 *	179	179	85	356	1010	2730	4360
D012	290 H	560 H	130	1300 H	1600 H	4600 H	8190 H
D013	120	230	160	300	810	2200	3700
D014	121	213	<4 L	392	1004	3094	4703
D015	144	228	98	299	767	1922	3314
Interlab Mean	140	195	102	457	894	2528	4162
SD	66	126	49	296	288	814	1423
Interlab Median	126	179	98	356	780	2200	3700

* CHML

TABLE 2 (4DD)

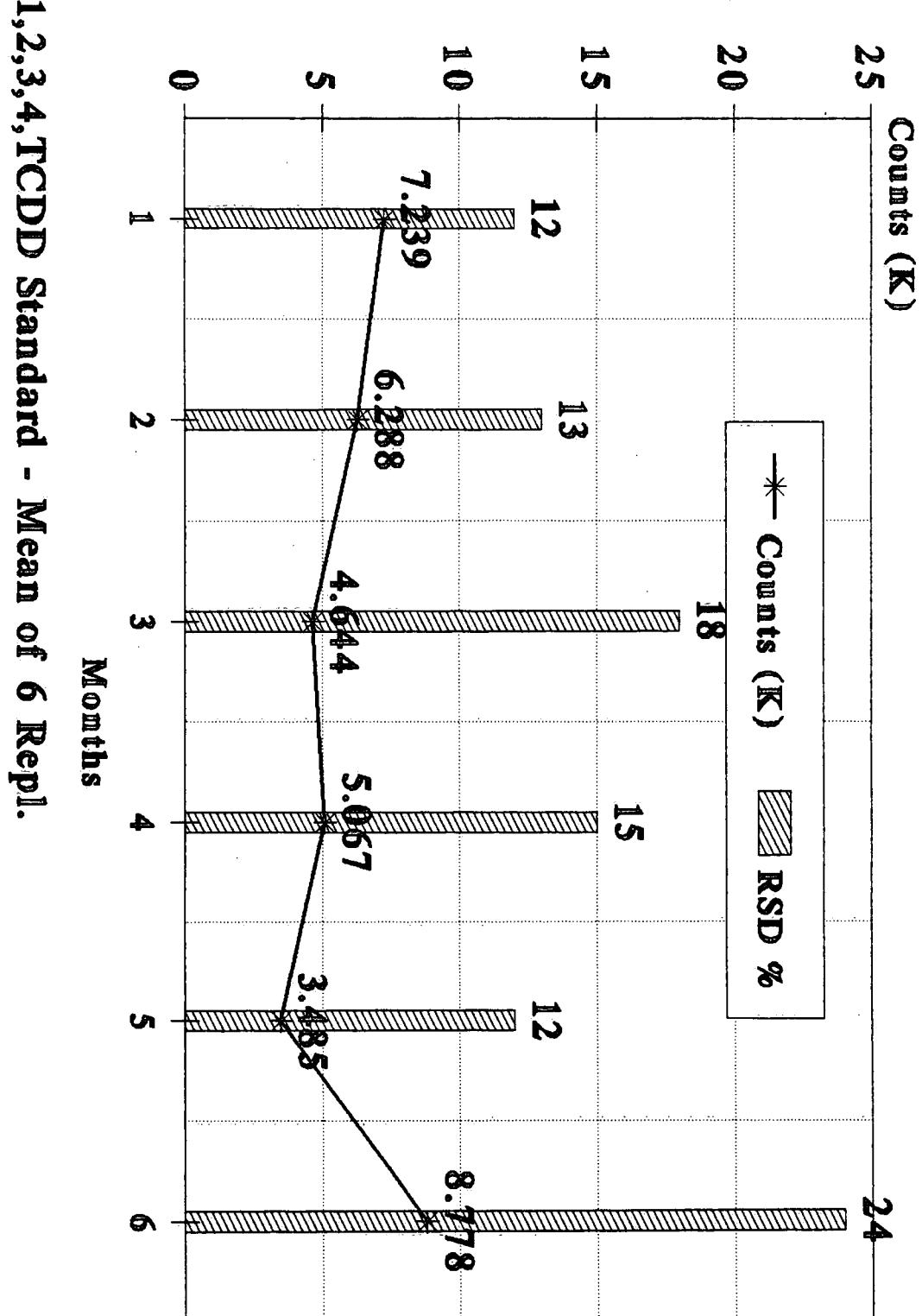
NATIONAL DIOXIN QC STUDY No. 4
The Analysis of Dioxins and Furans in Sediment

FURAN Results (pg/g) for Sample 4

Laboratory No.	HOMOLOGUE GROUP CONCENTRATIONS						Total PCDF
	2,3,7,8- TCDF	T4CDF	P5CDF	H6CDF	H7CDF	O8CDF	
D001	50	283	523	953	1933	6547	10239
D002	67	270	360	700	1800	3400	6500
D003	64	410	500	1080	2000	3800	7790
D004	110	730	520	860	1700	3800	7610
D005	74	320	400	1200	2500	3100	7520
D006	81	395	371	904	2104	3732	7506
D008	<7.2 L	16 L	180 L	640	2200	4500	7536
D010	28 L	125 L	446	1230	2030	3360	7190
D011 *	89	233	191 L	472 L	1803	4700	7399
D012	110	790 H	1300 H	2700 H	5300 H	8300 H	18390 H
D013	76	600	710	1500	3200	3500	9510
D014	77	382	105 L	948	2052	3938	7425
D015	89	385	330	647	1627	2887	5876
Interlab Mean	76	380	457	1064	2327	4274	8499
SD	23	221	302	566	981	1527	3175
Interlab Median	76	382	400	948	2030	3800	7520

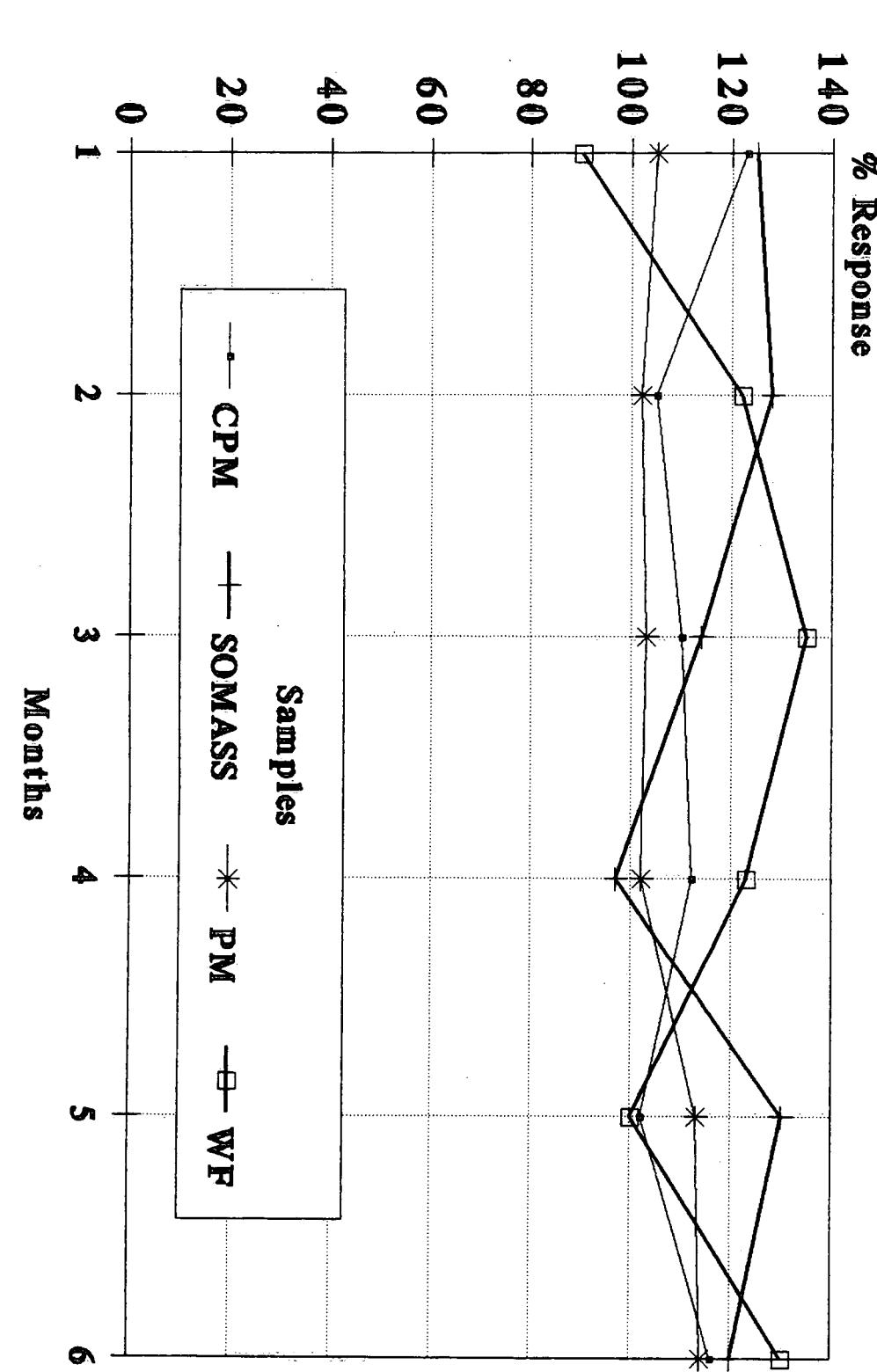
* CHML

FIGURE 1
Instrument Calibration



1,2,3,4,TCDD Standard - Mean of 6 Repl.

FIGURE 2
Performance Standard Response



1,2,3,4, TCDD Standard

Figure 3
Homologues Recoveries

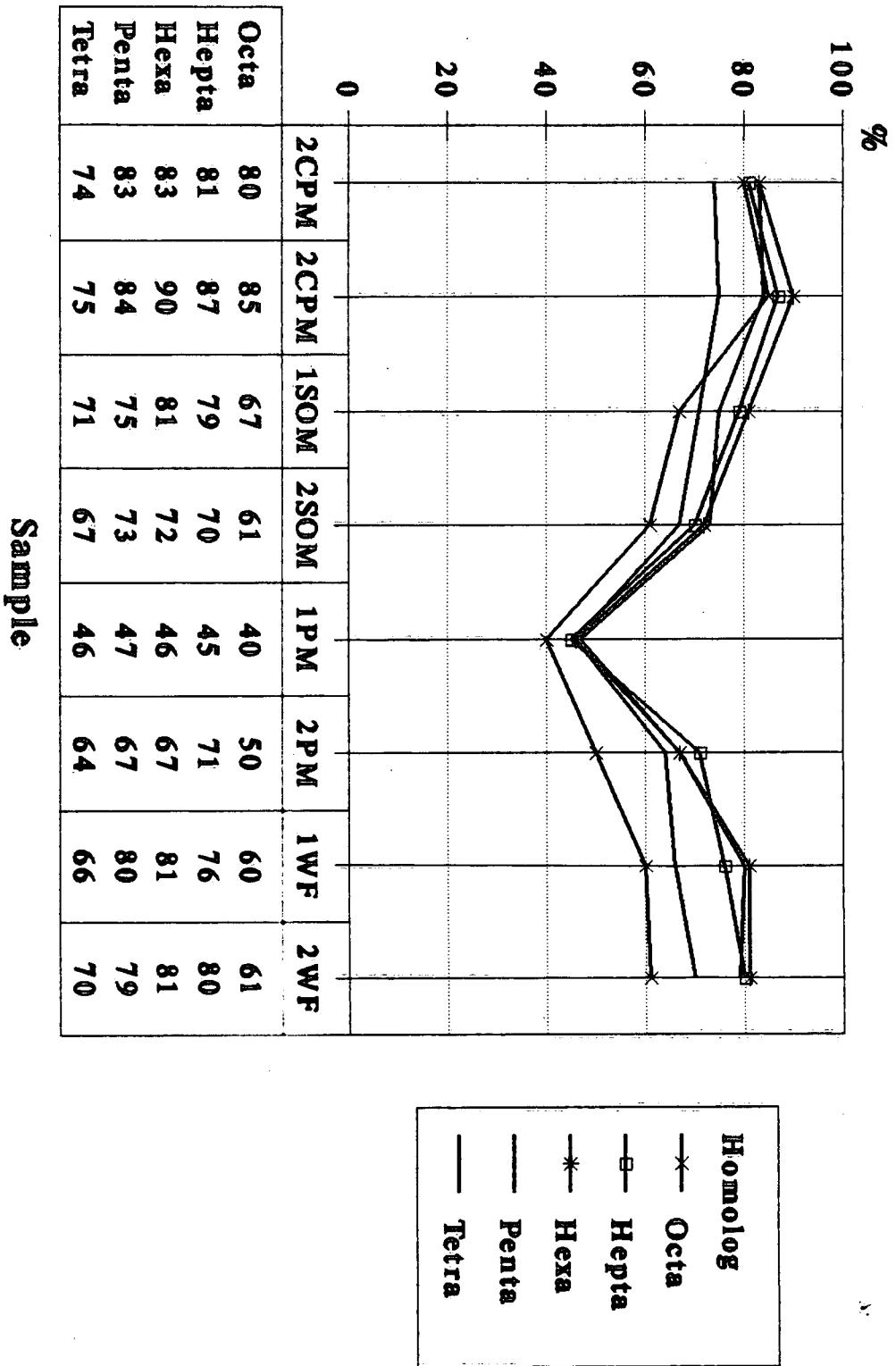
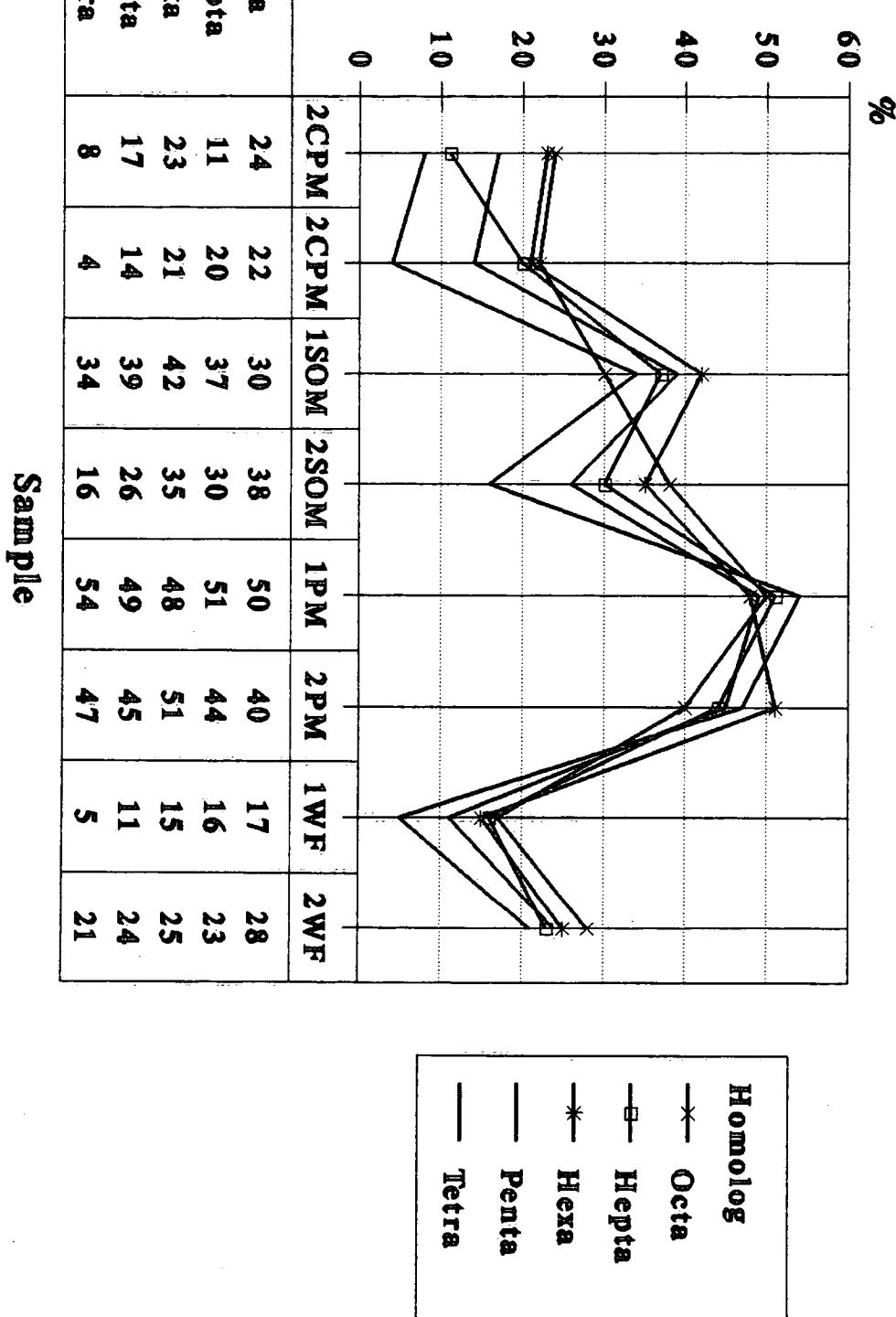
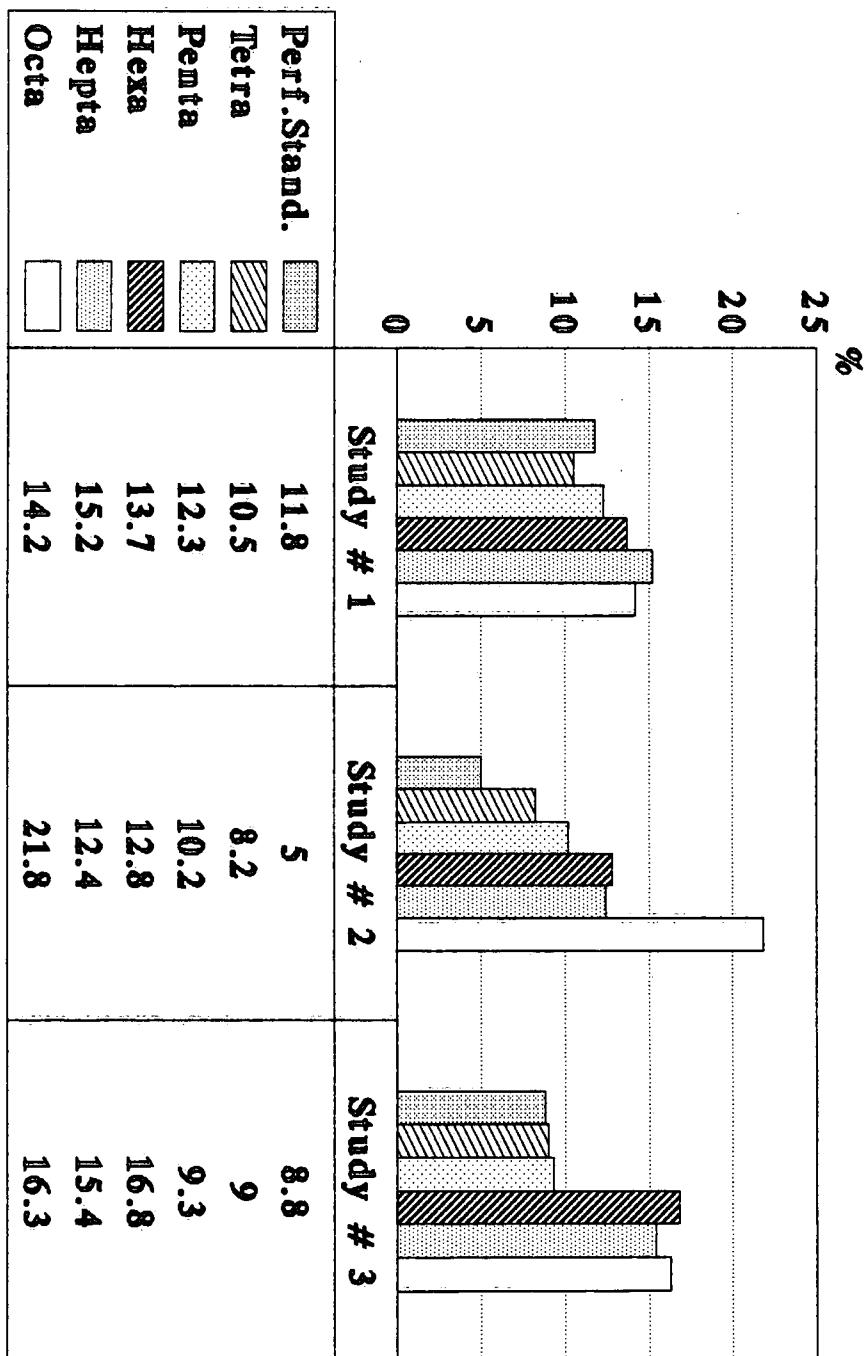


Figure 4
Homologues Recoveries



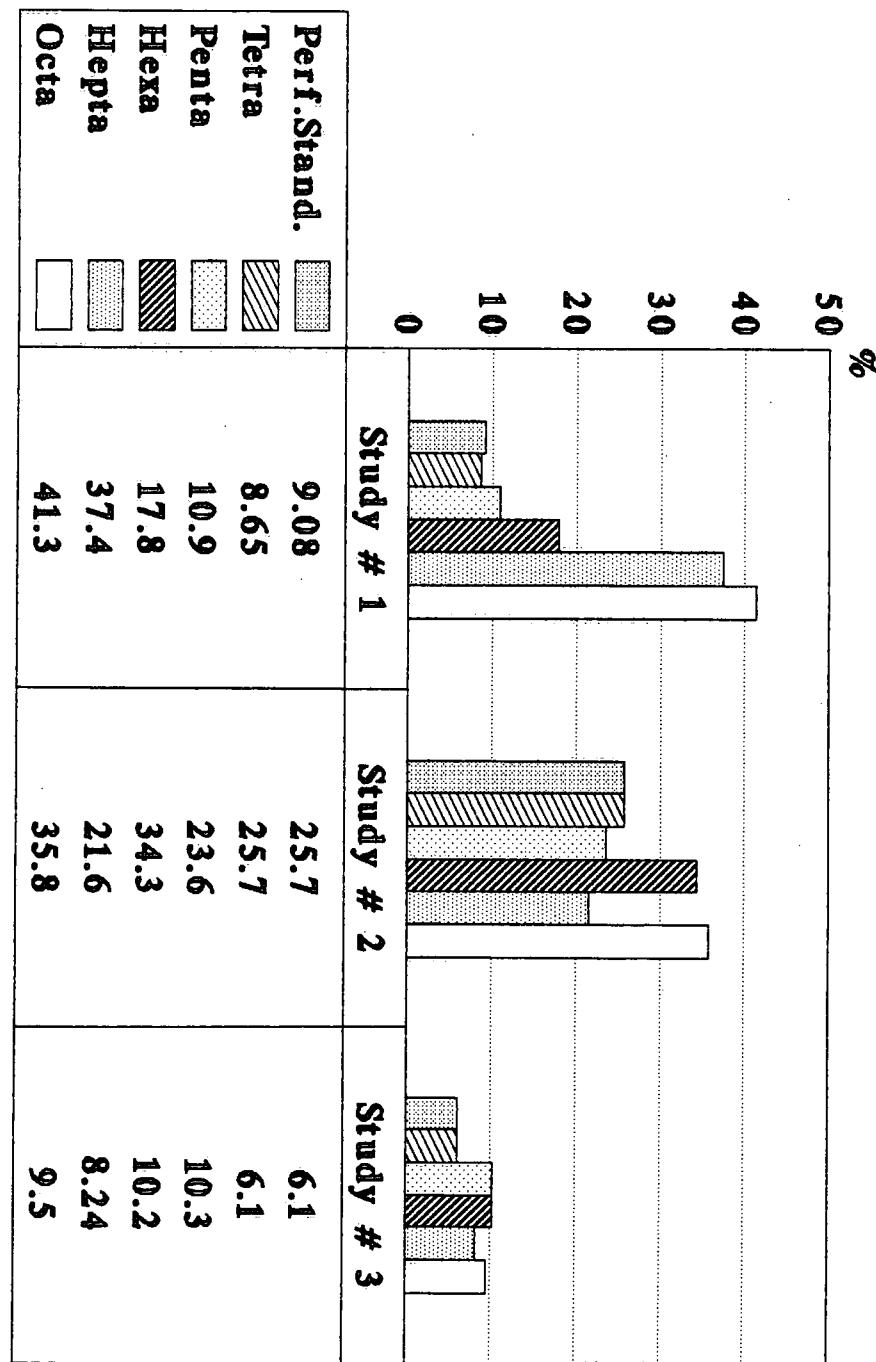
Relative Standard Deviation (%)

FIGURE 5
Reproducibility (RSD %)



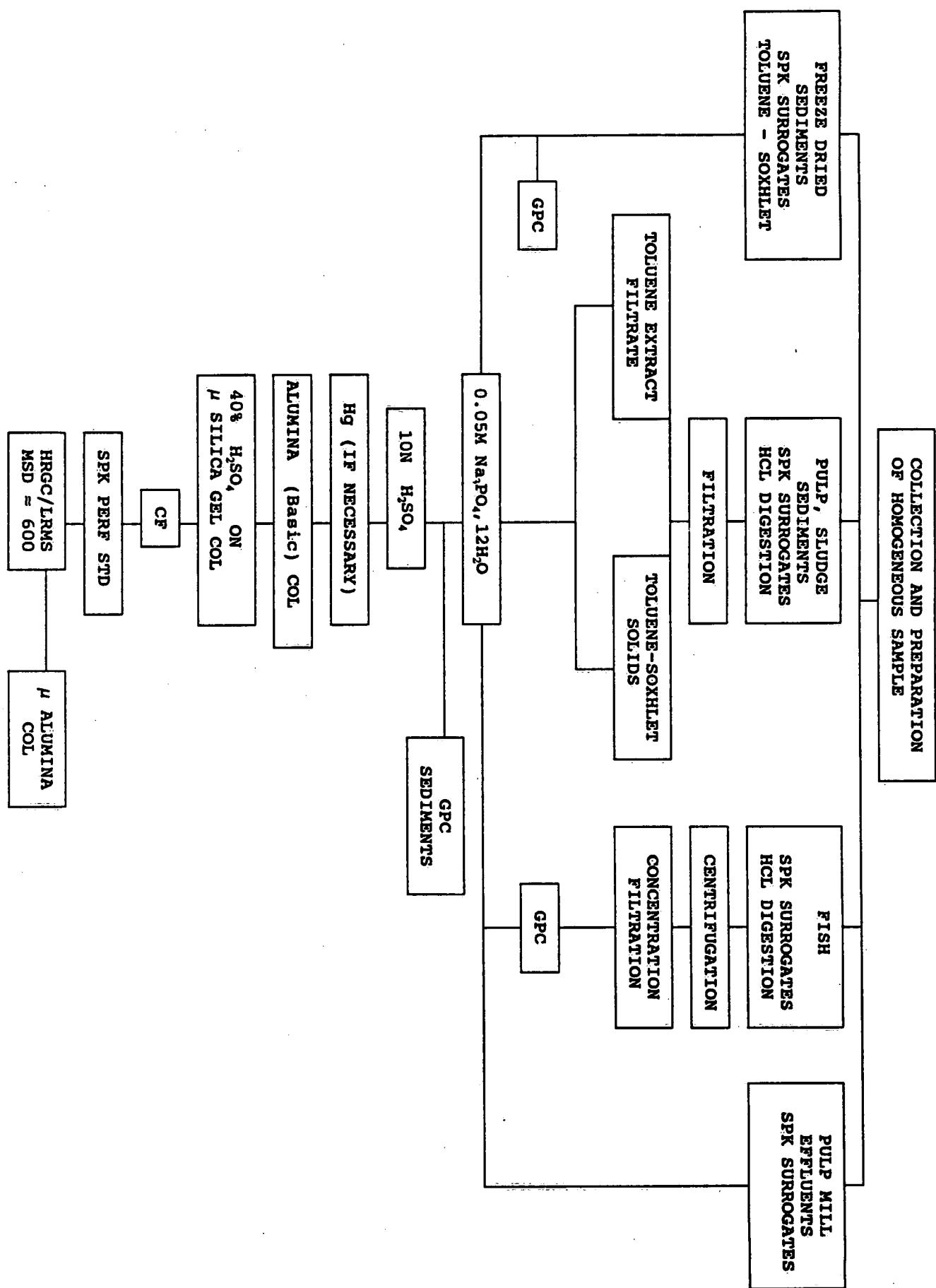
RSD in respect to instrument standard

FIGURE 6
Reproducibility (RSD %)



RSD in respect to final extract

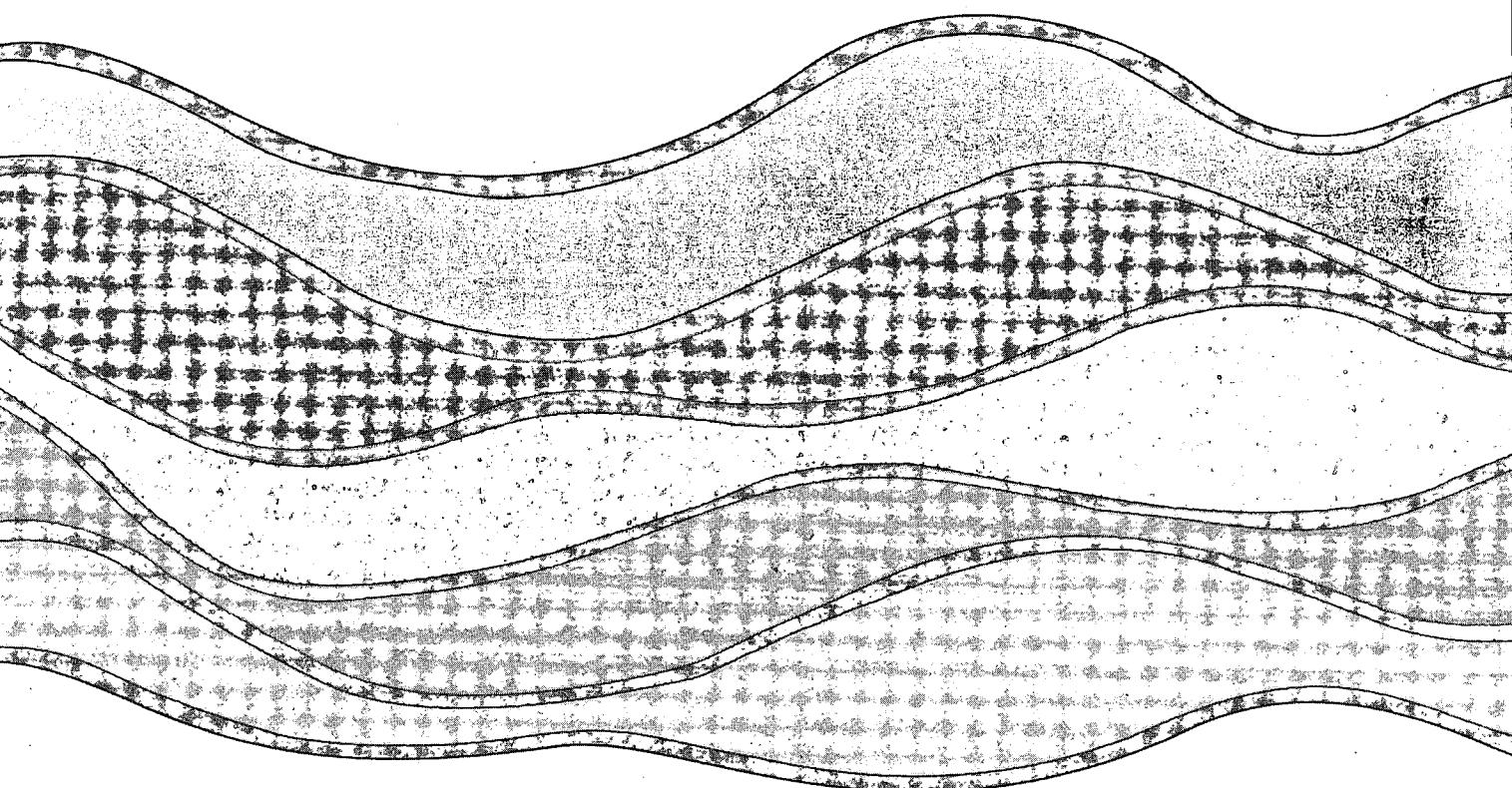
FIGURE 7



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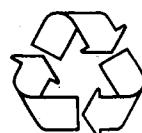


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