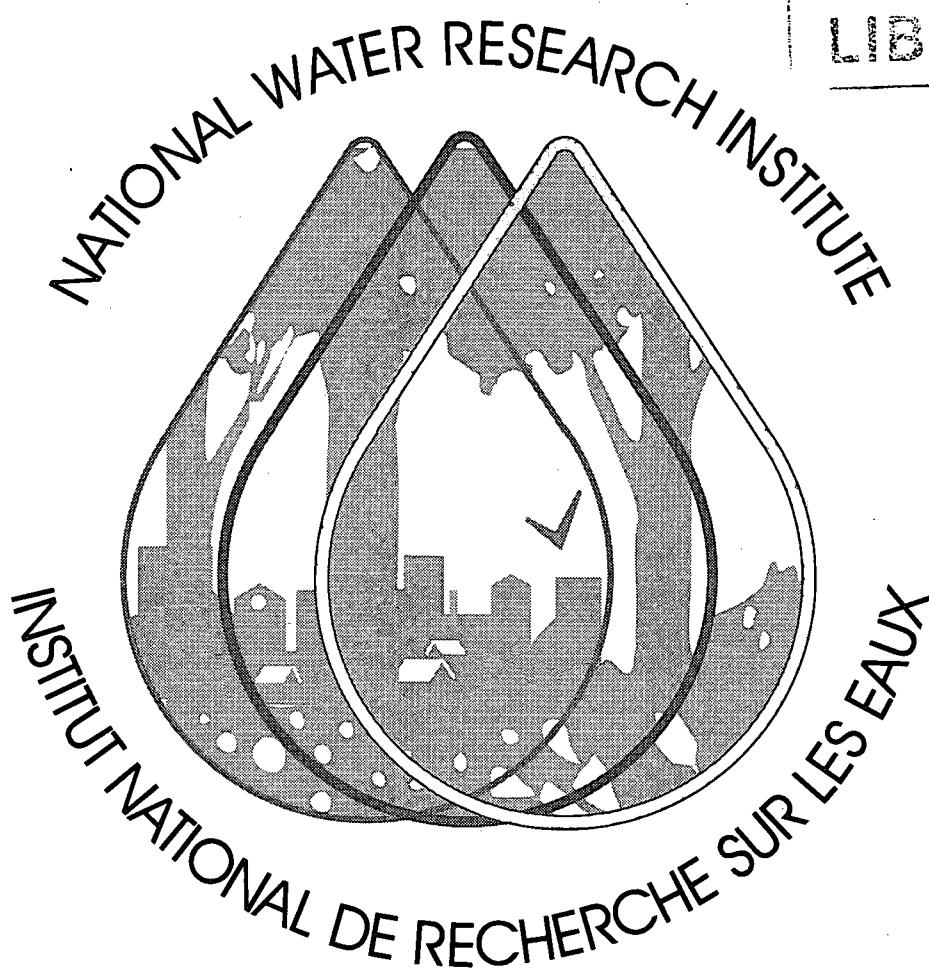


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**MERCURY: DETERMINATION OF THE
APPROPRIATE CONTAINER FOR
SAMPLING AND INTERLABORATORY QA
STUDIES**

H. Alkema and J. Simser

NWRI Contribution No. 97-170

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**MERCURY: DETERMINATION OF THE APPROPRIATE CONTAINER
FOR SAMPLING AND INTERLABORATORY QUALITY ASSURANCE STUDIES**

H. Alkema and J. Simser

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NWRI Contribution No. 97-170

MANAGEMENT PERSPECTIVE

As first step in successful environmental analyses, sample preservation particulars for trace elements at ambient concentrations must be known. At this time, the preservation of Mercury, at natural concentrations of 0.4 micrograms per liter or less, needed investigation. Reliable preservation is required for the various Canadian ecosystem programs as well as for the Institute Ecosystem Quality Assurance Interlaboratory program. The latter checks and verifies the accuracy and comparability of the laboratories performance for this important priority toxicant.

This report presents the results of an evaluation of four types of sample container which are commonly used for mercury samples. The evaluation was performed to determine which type would be most suitable for maintaining the integrity of low level mercury concentrations over time. It was determined that Pyrex® and Teflon® were suitable for preservation at concentration levels of 0.005 to 0.4 µg/L Hg. Bottle preparation was found to be critically important.

An additional finding was that the presence of an ionic background matrix was shown to aid in maintaining the concentration of mercury in low level samples. A caution was noted for the preservation of Mercury in very soft waters. The results from the study also suggest that for very low levels repeated use of sample containers increases their reliability.

SOMMAIRE À L'INTENTION DE LA DIRECTION

Dans toute analyse environnementale valable, il faut au départ connaître les caractéristiques de préservation des échantillons pour les éléments traces présents aux concentrations ambiantes. Pour l'instant, c'est la préservation du mercure, aux concentrations naturelles de 0,4 microgramme ou moins par litre, qui nécessite des recherches. Une préservation fiable est requise pour les divers programmes canadiens relatifs à l'écosystème, ainsi que pour le programme interlaboratoires d'assurance de la qualité de l'écosystème à l'INRE. Ce dernier contrôle et vérifie la justesse et la comparabilité du rendement des laboratoires dans le cas de cet important toxique prioritaire.

Le rapport présente les résultats d'une évaluation de quatre types de contenants à échantillons couramment utilisés pour le mercure. L'évaluation a été effectuée pour déterminer quel type de contenant serait le plus approprié pour conserver intégralement de faibles concentrations de mercure au cours du temps. On a constaté que le Pyrex^{MD} et le Téflon^{MD} convenaient bien pour la préservation à des concentrations de 0,005 à 0,4 µg/L de Hg. La préparation de l'échantillon s'est révélée d'une importance critique.

On a également observé que la présence d'une matrice ionique naturelle aidait à maintenir la concentration de mercure dans les échantillons peu concentrés. Une mise en garde s'appliquait pour la préservation du mercure dans des eaux très douces. De plus, les résultats de l'étude montraient que, pour de très faibles concentrations, l'emploi répété des contenants à échantillons en augmentait la fiabilité.

ABSTRACT

This study was performed to determine which container type would be most suitable for maintaining the integrity of water samples containing mercury at very low concentrations. Historically, various types of containers have been used for mercury sampling and interlaboratory studies conducted by Environment Canada. The container types investigated included flintglass, Pyrex®, polyethylene, and Teflon®. Mercury concentration levels in the water samples ranged from 0.005 to 0.4 µg/L Hg. It was determined that polyethylene bottles were unsuitable as containers for Hg samples. Pyrex® bottles were superior to flintglass due to decreased variability of results in interlab studies. Teflon® bottles were equivalent to Pyrex® in the time study but have not been evaluated for variability of results in interlab studies. Pyrex® bottles proved to be the most reliable container for mercury samples. They are recommended for use in the department, both for sample storage and for interlaboratory QA studies.

RÉSUMÉ

La présente étude a été effectuée pour déterminer quel type de contenant serait le plus approprié pour conserver intégralement des échantillons d'eau renfermant de très faibles concentrations de mercure. Dans le passé, divers types de contenants ont été utilisés pour l'échantillonnage du mercure et les études interlaboratoires effectués par Environnement Canada. Parmi les divers types de contenants étudiés, il y en avait en verre à silex, en Pyrex^{MD}, en polyéthylène et en Téflon^{MD}. Les concentrations de mercure des échantillons d'eau variaient de 0,005 à 0,4 µg/L de Hg. On a déterminé que les bouteilles en polyéthylène ne convenaient pas comme contenants pour les échantillons de Hg. Les bouteilles en Pyrex^{MD} étaient supérieures à celles en verre à silex, comme en fait foi la variabilité moindre des résultats dans les études interlaboratoires. Les bouteilles en Téflon^{MD} étaient équivalentes à celles en Pyrex^{MD} dans l'étude relative au temps, mais elles n'ont pas été évaluées en fonction de la variabilité des résultats dans les études interlaboratoires. Les bouteilles en Pyrex^{MD} étaient les contenants les plus fiables pour les échantillons de mercure. Leur emploi est recommandé dans le Ministère, aussi bien pour le stockage des échantillons que pour les études d'AQ interlaboratoires.

1.0 Introduction

Mercury is recognized as a toxic element and has been used as a potent pesticide, fungicide, and bactericide in agriculture. Industrially, mercury has had many applications, including catalysis and the electrolytic production of chlorine and caustic soda. In 1969, an estimated 62 percent of the annual mercury consumption (110 000 kg) by chlor-alkali plants in Canada, was discharged directly into rivers and streams (Environment Canada, 1983). The remaining 38 percent was lost to the atmosphere, to products and to solid wastes.

Once released into the environment, mercury can be methylated by the action of microbial organisms in aquatic sediments. This methylation increases its mobility in the environment. Methylmercury is accumulated by organisms, unlike inorganic Hg(II), and undergoes biomagnification up food chains. Methylmercury is the most toxic of all mercury species (OECD, 1974). The water quality guideline for total mercury in Canada is 0.1 µg/L (Gaudet *et al.*, 1995). Values for methylmercury in water should not exceed 0.01 µg/L. Above this level, the accumulation of methylmercury in fish has been shown to exceed the 0.5 mg/kg limit set for human fish consumption (Olson *et al.*, 1975).

Environmental problems can arise even from low levels of mercury. To measure these low levels accurately and reliably, it is essential that mercury samples be stored and preserved appropriately. This study was undertaken to determine whether the type of sample container has any influence on the measurable concentration of mercury in low level samples over time. The containers under investigation here were: Teflon®, Pyrex®, flintglass, and polyethylene.

2.0 Experimental

2.1 Materials and Reagents

Sample bottle types and brands are listed below:

Teflon®-	Nalgene PFA and Nalgene FEP
Pyrex®-	Wheaton brand
flintglass -	standard borosilicate glass
polyethylene	- Nalgene HDPE

Bulk solutions were prepared with a SPEX Plasma Standard of elemental mercury dissolved in 10% nitric acid. The standard concentration was 1000 µg/L Hg.

Sulfuric acid used for sample preservation was manufactured by Mallinckrodt and was rated as Analytical Reagent grade. The potassium dichromate was a Baker Analyzed® Primary Standard reagent.

2.2 Bulk Mercury Solutions

Pyrex® glass vessels for bulk mercury solutions were rinsed with 1% (v/v) H₂SO₄ and then deionized water. The vessels were soaked for a month with a solution of 1% (v/v) H₂SO₄ and 0.05% (w/v) K₂Cr₂O₇, followed by three rinses with deionized water. This level of cleanliness is appropriate for the intended use of the vessels.

A 100 µg/L mercury stock solution was prepared by a 10:1 dilution of the 1000 µg/L mercury standard and used for the preparation of bulk solutions. Four bulk mercury solutions were prepared with a deionized water matrix in the clean Pyrex® vessels. Bulk solutions were preserved with 1% (v/v) H₂SO₄ and 0.05% (w/v) K₂Cr₂O₇. This preservation method is required by the NLET Sample Collection Summary 1996-97 and recommended by an exhaustive study of mercury sample preservation (Carron and Agemian, 1977).

Five bulk mercury solutions were similarly prepared in a matrix of 75% filtered Lake Ontario water and 25% deionized water .

Bulk solutions were divided into aliquots and submitted to the reference laboratory for analysis. Testing of the bulk solutions was repeated until concentrations stabilized.

2.3 Containers

Equal numbers of each type of container (Teflon®, Pyrex®, flintglass, and polyethylene) were rinsed with 1% (v/v) H₂SO₄ and then deionized water. They were soaked for one month in a solution of 1% (v/v) H₂SO₄ and 0.05% (w/v) K₂Cr₂O₇, followed by three rinses with deionized water. Five bottles of each type were randomly selected and submitted to the reference laboratory for bottle blank analysis. Bottle blanks were prepared with 1% (v/v) H₂SO₄ and 0.05% (w/v) K₂Cr₂O₇ in the applicable background matrix. A value of <0.005 µg/L Hg for each blank confirmed the efficacy of the cleaning procedure. After the bulk solutions had stabilized, they were subsampled into the 125 mL containers. Procedures were identical for the deionized matrix and the Lake Ontario matrix. Two bottles of each container type were submitted for mercury analysis on a regular basis. Results reported are an average of these two values, as presented in Appendix A, Individual Sample Analyses.

2.4 Interlaboratory Mercury Studies

Serial dilutions of the stabilized bulk solutions produced new mercury samples for the NWRI Ecosystem Interlaboratory Mercury Studies. In Study FP65, 25 participating laboratories analyzed samples prepared with the deionized matrix and contained in 125 mL Pyrex® bottles. The samples prepared with the Lake Ontario matrix were also contained in Pyrex® bottles. These were analyzed by 19 participating laboratories in Study FP67.

For comparison, data are available from Study FP63. These mercury samples were prepared in a deionized matrix and contained in 125 mL flintglass bottles. Twenty-two laboratories provided analyses.

3.0 Results and Discussion

3.1 Bulk Mercury Solutions

In the preparation of the bulk solutions for this study, a period of one month was required for stabilization of the deionized matrix solutions. At the end of that period, a decrease of approximately 13% in the mercury concentration was observed. Conversely, the bulk solutions prepared with the Lake Ontario matrix (specific conductance = $252 \mu\text{Scm}^{-1}$) maintained their initial concentration over the same time period. Figure 1 depicts the mercury concentrations over time for both matrices.

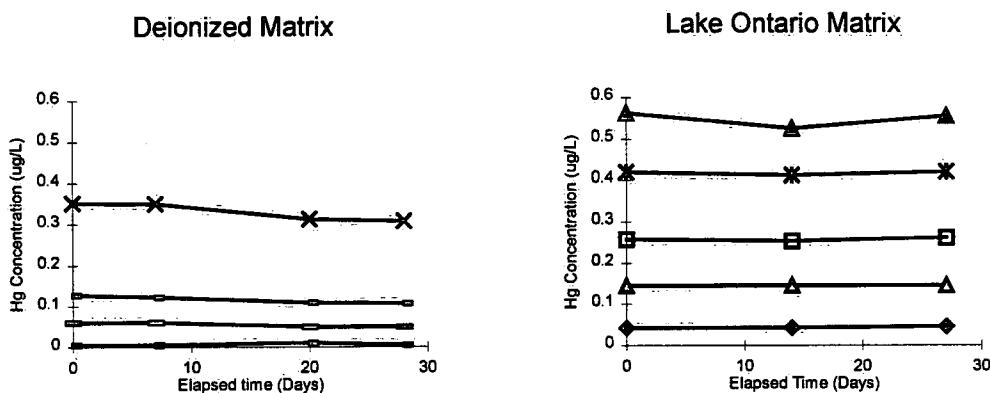


Figure 1: Bulk Solution Stabilization. Initial concentrations are represented by the values at Day 0.

The improved stability of the Lake Ontario matrix supports the conclusion that ionic strength aids in preventing mercury losses (Carron and Agemian, 1977). Further study is warranted to determine which ions and concentrations from this matrix are responsible for the improvement (Jackson, 1996).

3.2 Containers

Results of the time study for each container type have been plotted for both the deionized and Lake Ontario matrices. Linear regression lines have been applied to each concentration level. The results for the deionized matrix are depicted in Figure 2.

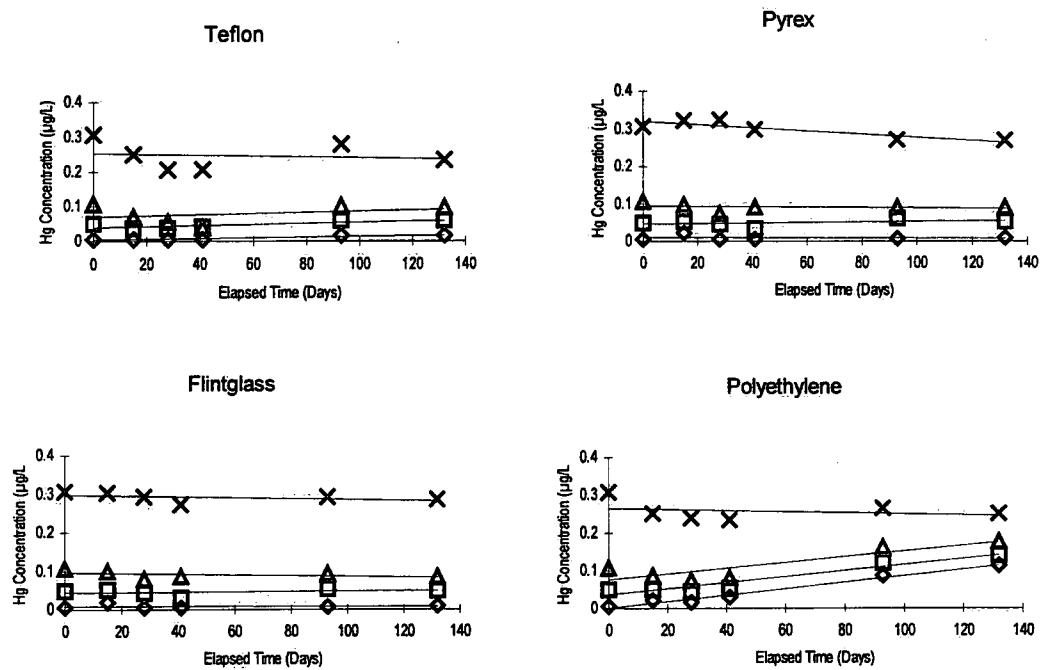


Figure 2: Stability of Hg in deionized water in 4 container types. Initial concentrations are represented by values at Day 0.

Table 1 summarizes the initial and final concentrations and the percentage of change which each represents for the deionized matrix.

Table 1. Change in Hg concentration over 132 days in a deionized matrix.

Initial Conc'n (ug/L Hg)	Teflon®		Polyethylene		Pyrex®		Flintglass	
	Final Conc'n	% Change						
<0.005	0.016	+220	0.113	+2160	0.009	+80	0.009	+80
0.049	0.059	+20.4	0.14	+185	0.053	+8.2	0.048	-2
0.1065	0.097	-8.9	0.177	+66	0.09	-15	0.084	-21
0.3065	0.234	-23.6	0.251	-18	0.268	-12.6	0.284	-7.3
Avg. Change (Absolute Value)	68		607		29		27	

The samples prepared in the deionized matrix show differences over time in the same order of magnitude as seen in the bulk solution preparation. The exception was the polyethylene bottles in which the Hg concentration changes over 600% on average over 132 days.

The results of the time study for the samples prepared with the Lake Ontario background are illustrated in Figure 3.

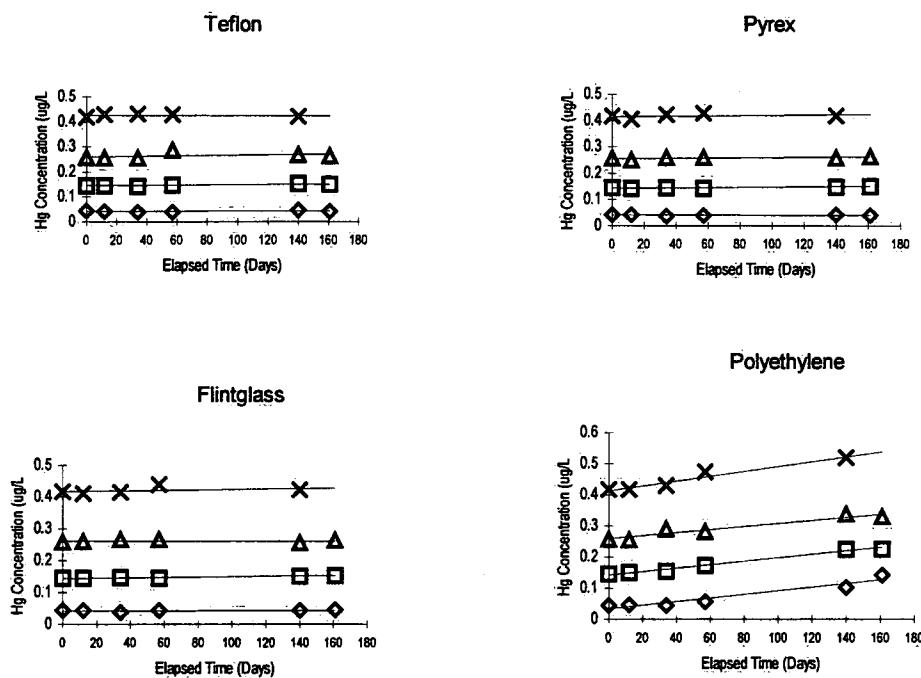


Figure 3: Stability of Hg in Lake Ontario water in 4 container types. Initial concentrations are represented by values at Day 0.

Table 2 summarizes the initial and final concentrations and the percentage of change which each represents for the Lake Ontario matrix.

Table 2. Change in Hg concentration over 161 days in a Lake Ontario matrix.

Initial Conc'n (ug/L Hg)	Teflon®		Polyethylene		Pyrex®		Flintglass	
	Final Conc'n	% Change						
0.043	0.041	-4.6	0.142	+230	0.040	-7.0	0.044	+2.3
0.145	0.150	+3.4	0.226	+56	0.151	+4.1	0.154	+6.2
0.257	0.262	+1.9	0.329	+28	0.262	+1.9	0.264	+2.7
0.417	0.420	-0.7	0.519	+24	0.417	0.0	0.422	+1.2
Avg. Change (Absolute Value)	2.6		84.5		3.2		3.1	

It is evident from these data that the stability of samples has greatly improved in a matrix with ionic strength as opposed to the deionized matrix. Polyethylene bottles are unsuitable as containers for mercury samples over time. There is no apparent difference in the performances of Teflon®, Pyrex® and flintglass bottles. The flintglass bottles, however, exhibit shortcomings which are discussed in the following section.

3.3 Interlaboratory Mercury Studies

Data summaries for the three interlaboratory studies are presented in Appendix B, Results of Interlaboratory Studies. The precision function reveals how the standard deviation varies with the interlaboratory mean. The precision function for each study is illustrated in Figure 4.

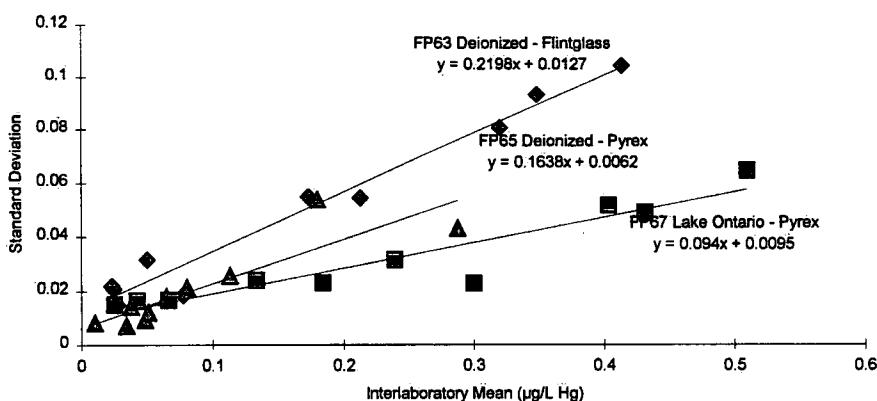


Figure 4: Precision Functions for Interlaboratory Mercury Studies

Higher sample concentrations show increased variability of results. The slope of this variability (precision function) describes the proportion of that increase. The flintglass bottles with mercury samples prepared in deionized water (FP63) have the highest standard deviation for any given mercury concentration. The FP65 mercury samples were also prepared with a deionized background. The Pyrex® bottles used in FP65 show a decrease in the slope of the precision function from that of the flintglass bottles. When the Lake Ontario background is used with Pyrex® bottles in FP67, the lowest standard deviations of the three studies are observed, resulting in the lowest precision function slope.

In the interlaboratory studies, the Pyrex® bottles were more reliable than the flintglass bottles. The Lake Ontario background resulted in an improved precision function over that of the deionized matrix.

No data are available to evaluate the precision function for Teflon® bottles. Table 1 suggests that the Teflon® bottles were inferior to the Pyrex® and flintglass bottles. Table 2, on the other hand, indicates that Teflon®, Pyrex®, and flintglass bottles are equivalent. The Teflon® bottles used in the Lake Ontario background portion of the study had been previously used for mercury sample analysis. The Teflon® bottles were new when the deionized background portion of the study was undertaken. Perhaps this repeated use of bottles results in decreased adsorption on the bottle walls and improves the stability of samples. If this were so, this "conditioning" could also be a contributing factor in the improvement seen in the precision function of the Pyrex® bottles between FP65 and FP67. The change in background matrix from deionized to Lake Ontario water may not be solely responsible for the observed improvement in precision function from FP65 to FP67.

All analyses for the time study were performed by the National Laboratory for Environmental Testing at NWRI. The individual NLET results have been plotted against interlaboratory mean values in Figure 5. The excellent performance in these plots establishes firm confidence in the data supplied for this evaluation.

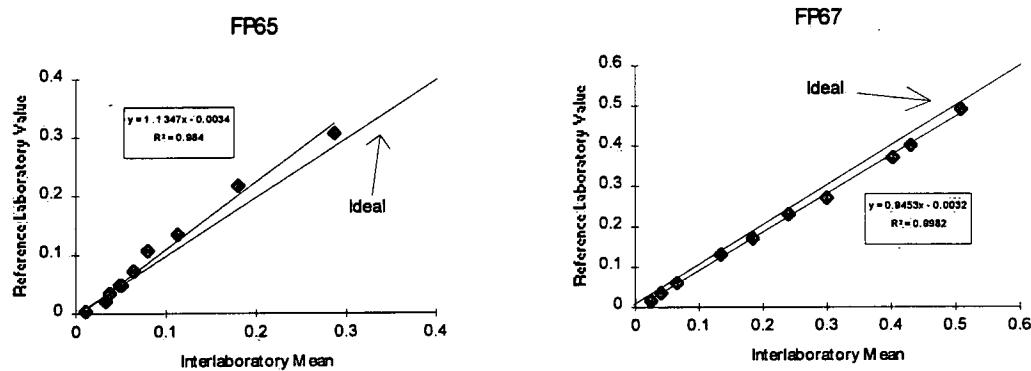


Figure 5: NLET Performance in Interlaboratory Mercury Studies, FP65 and FP67

4.0 Conclusions and Recommendations

The results of this study confirm that Pyrex® and Teflon® sample bottles should be the containers of choice for collecting water samples containing low concentrations of mercury.

Pyrex® glass has been shown to be superior to flintglass for Interlaboratory Mercury Studies. Teflon® bottles may also be acceptable, but their precision function has not been evaluated.

It is recommended that sample bottles be conditioned prior to use.

Laboratories that perform mercury analyses on soft water samples must be cautioned about the instability of samples in such waters even when using accepted preservation methods.

Further study is warranted to determine which ions in the Lake Ontario matrix are responsible for the improved stability of mercury samples over deionized water.

5.0 References

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APPENDIX A

Individual Sample Analyses

Mercury Study - Deionized Water Matrix

First Batch

Average Values after Bulk Stabilization	Elapsed Time 15 days - Analyzed July 21, 1994			
(ppb)	Teflon	Polyethylene	Flintglass	Pyrex
<0.005	<0.005	0.020	0.0185	0.022
0.049	0.0365	0.0505	0.0515	0.0535
0.1065	0.070	0.0865	0.0985	0.098
0.3065	0.250	0.250	0.3025	0.322

Second Batch

Average Values after Bulk Stabilization	Elapsed Time 28 days - Analyzed August 3, 1994			
(ppb) July 5, 1994	Teflon	Polyethylene	Flintglass	Pyrex
<0.005	<0.005	0.015	<0.005	<0.005
0.049	0.0375	0.045	0.043	0.047
0.1065	0.0555	0.0735	0.0795	0.074
0.3065	0.2055	0.238	0.292	0.3225

Third Batch

Average Values after Bulk Stabilization	Elapsed Time 41 days - Analyzed August 16, 1994			
(ppb) July 5, 1994	Teflon	Polyethylene	Flintglass	Pyrex
<0.005	0.005	0.029	<0.005	<0.005
0.049	0.041	0.054	0.030	0.035
0.1065	0.039	0.080	0.086	0.091
0.3065	0.206	0.233	0.273	0.297

Fourth Batch

Average Values after Bulk Stabilization	Elapsed Time 93 days - Analyzed October 7, 1994			
(ppb) July 5, 1994	Teflon	Polyethylene	Flintglass	Pyrex
<0.005	0.016	0.086	0.0065	0.005
0.049	0.059	0.121	0.054	0.061
0.1065	0.101	0.161	0.092	0.091
0.3065	0.279	0.265	0.291	0.270

Fifth Batch

Average Values after Bulk Stabilization	Elapsed Time 132 days - Analyzed November 15, 1994			
(ppb) July 5, 1994	Teflon	Polyethylene	Flintglass	Pyrex
<0.005	0.016	0.086	0.0065	0.005
0.049	0.059	0.121	0.054	0.061
0.1065	0.101	0.161	0.092	0.091
0.3065	0.279	0.265	0.291	0.270

Mercury Study - Lake Ontario Matrix

First Batch

Average Values after Bulk Stabilization	Elapsed Time 12 days - Analyzed June 27, 1995			
(ppb)	Teflon	Polyethylene	Flintglass	Pyrex
0.043	0.041	0.046	0.043	0.043
0.145	0.144	0.150	0.144	0.144
0.257	0.254	0.254	0.259	0.250
0.417	0.427	0.417	0.410	0.404

Second Batch

Average Values after Bulk Stabilization	Elapsed Time 34days - Analyzed July 19, 1995			
(ppb)	Teflon	Polyethylene	Flintglass	Pyrex
0.043	0.039	0.044	0.036	0.037
0.145	0.143	0.155	0.147	0.146
0.257	0.255	0.289	0.265	0.258
0.417	0.430	0.430	0.414	0.421

Third Batch

Average Values after Bulk Stabilization	Elapsed Time 57 days - Analyzed August 11,1995			
(ppb)	Teflon	Polyethylene	Flintglass	Pyrex
0.043	0.038	0.057	0.042	0.040
0.145	0.148	0.173	0.144	0.144
0.257	0.285	0.282	0.265	0.259
0.417	0.428	0.472	0.439	0.425

Fourth Batch

Average Values after Bulk Stabilization	Elapsed Time 140 days - Analyzed November 2, 1995			
(ppb)	Teflon	Polyethylene	Flintglass	Pyrex
0.043	0.047	0.103	0.042	0.041
0.145	0.152	0.226	0.152	0.147
0.257	0.268	0.337	0.256	0.257
0.417	0.420	0.519	0.422	0.417

Fifth Batch

Average Values after Bulk Stabilization	Elapsed Time 161days - Analyzed November 23, 1995			
(ppb)	Teflon	Polyethylene	Flintglass	Pyrex
0.043	0.041	0.142	0.044	0.040
0.145	0.150	0.226	0.154	0.151
0.257	0.262	0.329	0.264	0.262
0.417	0.394	0.450	0.381	0.378

APPENDIX B

Results of Interlaboratory Studies

- a. Study FP63 (Deionized Background, Flintglass Containers)
- b. Study FP 65 (Deionized Background, Pyrex Containers)
- c. Study FP67 (Lake Ontario Background, Pyrex Containers)

FPHG STUDY 0063

DATA SUMMARY

PAGE 1

FP/GLAP INTERLAB STUDY 63 - Mercury

PRINTOUT PREPARED: 1996-03-27

PARAMETER: 80095 Mercury ug Hg/L

SAMPLE RESULTS

	1	2	3	4	5	6	7	8	9	10	BIAS
LAB	HG-1	HG-2	HG-4	HG-3	HG-6	HG-5	HG-7	HG-9	HG-8	HG-10	
F001	<	0.05	<	0.05	<	0.05	0.16	0.05	H	0.25	VH
F002						0.17	0.07	0.22		0.27	0.30
F003	<	0.005		0.005		0.024	0.016	0.165		0.078	0.332
F008	0.05		0.05	0.05		0.05	0.18	0.08		0.14	0.29
F010	<	0.1	<	0.1	<	0.1	0.2	0.1		0.2	0.3
F011	0.05		0.05	0.06		0.05	0.20	0.11		0.24	H
F016	<	0.03	<	0.03	<	0.03	H	0.23		0.08	VH
F020	VH	0.36	EH	0.12	H	0.10	<	0.05	VH	0.29	0.33
F023	VH	0.123		0.038	VH	0.123	VH	0.292		0.038	VH
F024		0.02	<	0.02		0.03	0.03	0.14		0.08	VH
F032		0.01		0.01		0.03	0.02	0.16		0.07	0.18
F033	W	0.01	W	0.01	T	0.03	T	0.02		0.16	0.34
F035	<	0.02	<	0.02	<	0.02	L	0.10		0.05	0.30
F036		0.0009		0.0068		0.0222	0.0134	0.153		0.073	EL
F037	<	0.1	<	0.1	<	0.1	<	0.1		0.10	0.16
F038	<	0.05	<	0.05		0.05	<	0.05		0.09	0.17
F044		0.007		0.013		0.033	0.020	0.175		0.083	H
F046	<	0.05	<	0.05	<	0.05	<	0.05		0.07	0.17
F047	<	0.05	<	0.05		0.05	<	0.05		0.07	0.18
F055	<	1.0	<	1.0	<	1.0	<	1.0	EH	1.0	<
F059	<	0.1	<	0.1	<	0.1	VH	0.3	L	0.1	0.2
F062	EH	0.5	<	0.5	EH	0.9	EH	1.0	<	0.5	<
TOTAL LABS REPORTING	21	21	21	21	22	22	22	22	22	22	22
SUMMARY OF ALL DATA EXCLUDING '<' AND 'W' CODED RESULTS											
# LABS	9	8	13	11	21	20	20	21	21	21	21
MEAN	.12454	.03660	.11555	.14022	.21262	.12360	.20435	.36090	.33343	.39819	
STD DEV	.18051	.03867	.23761	.26578	.18815	.20706	.06424	.16419	.09944	.12351	
MEDIAN	.05000	.02550	.05000	.03000	.16500	.08000	.19000	.31000	.30000	.37000	
SUMMARY OF DATA EXCLUDING '<', 'W', 'EL' AND 'EH' CODED OR FLAGGED RESULTS											
# LABS	8	7	12	10	20	19	19	19	20	20	20
MEAN	.07761	.02469	.05018	.06424	.17325	.07747	.21253	.34832	.32010	.41350	
STD DEV	.12076	.02049	.03143	.08907	.05478	.01842	.05427	.09297	.08051	.10430	
MEDIAN	.03500	.01300	.04150	.02500	.16250	.08000	.20000	.31000	.30000	.37500	
% ASSIGNED FLAGS	30.0	11.1	23.1	27.3	33.3	5.0	35.0	42.9	33.3	33.3	

FPHG STUDY 0065

DATA SUMMARY

PAGE 1

NWRI Ecosystem Interlab QA for Mercury

PRINTOUT PREPARED: 1996-09-04

PARAMETER: 80095 Mercury

ug Hg/L

SAMPLE RESULTS

LAB	HG-11	HG-12	HG-13	HG-14	HG-15	HG-16	HG-17	HG-18	HG-19	HG-20	BIAS
	1	2	3	4	5	6	7	8	9	10	
F001	0.005	0.047	0.085	0.300	0.036	0.072	0.218	0.031	0.050	0.136	
F002		0.041	0.068	0.279	0.028	0.048	0.157	0.024	0.037	L	0.082
F003	0.005	0.043	0.091	0.289	0.028	0.055	0.212	0.028	0.054		0.138
F006	< 0.02	0.05	0.09	0.30	0.04	0.07	0.20	0.03	0.06		0.13
F010	VH	0.1	EH	0.1	T	0.1	VH	0.1	EH	0.1	EH
F011	0.02	0.04	0.10	H	0.36	0.05	0.07	0.21	0.04		0.14
F015	< 0.05	0.05	0.08	0.29	< 0.05	0.06	0.18	< 0.05	0.05		0.10
F020	< 0.05	< 0.05	0.08	0.278	< 0.05	0.055	0.193	< 0.05	< 0.05		0.092
F025	< 0.05	0.06	0.10	0.34	< 0.05	0.07	H	0.24	< 0.05		0.13
F032	0.006	0.041	0.077	0.276	0.035	0.060	0.184	0.026	0.046		0.114
F033	< 0.02	0.05	0.09	0.30	0.05	0.07	0.20	0.04	0.05		0.13
F035	< 0.01	0.04	0.07	0.29	0.03	0.05	0.21	0.03	0.04		0.13
F036	0.005	0.045	L	0.052	0.262	0.022	L	0.036	VL	0.067	0.034
F037	< 0.005	EL	0.02	0.07	0.28	0.02	0.04	0.19	EL	0.005	0.04
F038	< 0.05	< 0.05	0.07	EL	0.14	< 0.05	< 0.05	L	0.14	< 0.05	< 0.05
F046	< 0.05	< 0.05	L	0.05	VL	0.17	< 0.05	< 0.05	VL	0.10	< 0.05
F050	0.024	0.043		0.093	0.29	0.034	0.058	0.172	0.039	0.043	0.118
F052	< 0.05	H	0.07	EH	0.14	H	0.35	VH	0.07	EH	0.12
F062	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
F066	< 0.1	< 0.1	0.1	0.1	0.3	< 0.1	< 0.1	VH	0.3	EH	0.1
F069	< 0.1	< 0.1	< 0.1	< 0.1	0.24	< 0.1	< 0.1	0.16	< 0.1	< 0.1	0.1
F072	W	0.2	W	0.2	VL	0.03	0.26	W	0.2	VL	0.08
F078	< 0.11	< 0.11	< 0.11	EL	0.14	< 0.11	< 0.11	VL	0.11	< 0.11	< 0.11
F080	EH	0.125	< 0.050	0.065	L	0.225	< 0.050	H	0.095	L	0.138
F086	0.0078	0.0622	H	0.123	H	0.352	0.0506	0.0879	VH	0.287	0.0473
											0.0673 VH 0.171

TOTAL LABS
REPORTING

24 25 25 25 25 25 25 25 25 25 25

SUMMARY OF ALL DATA EXCLUDING '<' AND 'W' CODED RESULTS

# LABS	9	16	22	24	14	18	23	14	16	22
MEAN	.03309	.05014	.08291	.27546	.04240	.06761	.19035	.04352	.05389	.11673
STD DEV	.04599	.01740	.02414	.05847	.02134	.02167	.06174	.02480	.01680	.02981
MEDIAN	.00780	.04600	.08250	.28950	.03550	.06500	.19300	.03650	.05000	.11600

SUMMARY OF DATA EXCLUDING '<', 'W', 'EL' AND 'EH' CODED OR FLAGGED RESULTS

# LABS	8	14	21	22	13	17	23	12	15	21
MEAN	.02160	.04873	.08019	.28777	.03797	.06452	.19035	.03411	.05082	.11324
STD DEV	.03255	.00928	.02101	.04288	.01399	.01781	.06174	.00708	.01184	.02553
MEDIAN	.00690	.04600	.08000	.29000	.03500	.06000	.19300	.03250	.05000	.11400

%ASSIGNED FLAGS 20.0 17.6 22.7 29.2 13.3 21.1 47.8 21.4 11.8 21.7

FPHG STUDY 0067

DATA SUMMARY

PAGE 1

NWRI Ecosystem Interlab QA for Mercury

PRINTOUT PREPARED: 1996-04-26

PARAMETER: 80095 Mercury

ug Hg/L

SAMPLE RESULTS

	1	2	3	4	5	6	7	8	9	10	BIAS
LAB	HG-26	HG-27	HG-28	HG-29	HG-30	HG-21	HG-22	HG-23	HG-24	HG-25	
F001	<	0.02	0.054	0.19	0.30	0.47	L	0.02	0.14	0.28	0.43
F002		0.015	0.058	0.160	0.270	0.410		0.028	0.123	0.210	0.358
F003		0.019	0.063	0.187	0.314	0.451		0.036	0.139	0.254	0.419
F006		0.03	0.08	0.22	0.35	H	0.52	0.05	0.17	0.29	0.47
F007		0.013	0.048	L	0.130	VL	0.320	0.029	L	0.100	VH
F010	<	0.1	EH	0.2	EL	0.1	0.3	0.4	<	0.1	L
F011		0.02	0.06	0.18	0.30	0.43		0.05	0.14	0.24	0.37
F015	<	0.05	0.074	0.198	0.316	0.434		0.054	0.172	0.267	0.395
F020	<	0.05	H	0.10	0.21	0.30	0.44	<	0.05	0.13	0.25
F030	<	0.2	<	0.2	EL	0.2	EH	1.4	<	0.2	L
F032		0.021	0.065	0.174	0.288	0.417		0.038	0.134	0.237	0.374
F033		0.02	0.07	0.18	0.28	0.42		0.05	0.15	0.25	0.40
F035	H	0.04	0.08	0.19	0.3	0.4		0.05	0.14	0.24	0.38
F037		0.01	0.06	0.15	0.25	0.37	L	0.02	0.11	0.20	0.34
F038	EH	0.07	0.07	0.18	0.3	0.43	<	0.05	0.14	0.25	0.43
F046	<	0.05	0.06	0.18	0.32	0.50	EH	0.14	0.13	0.25	0.43
F051	VH	0.06	0.09	0.20	0.32	0.50	H	0.08	0.22	0.38	0.52
F080	<	0.02	L	0.029	EL	0.037	EL	0.129	EL	0.042	VL
F095	<	0.1	<	0.1	0.21	0.29	0.42	<	0.1	0.16	0.27

TOTAL LABS REPORTING	19	19	19	18	19	19	19	19	19	19
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SUMMARY OF ALL DATA EXCLUDING '<' AND 'W' CODED RESULTS

# LABS	11	17	17	18	19	14	18	18	19	19
MEAN	.02891	.07418	.17506	.28483	.46926	.04907	.13800	.24694	.39016	.49742
STD DEV	.01976	.03628	.04201	.05023	.23693	.03055	.03096	.04520	.07642	.08320

MEDIAN	.02000	.06500	.18000	.30000	.43000	.04600	.13950	.25000	.40000	.51000
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SUMMARY OF DATA EXCLUDING '<', 'W', 'EL' AND 'EH' CODED OR FLAGGED RESULTS

# LABS	10	16	16	16	17	13	17	17	18	18
MEAN	.02480	.06631	.18369	.29987	.43129	.04208	.13318	.23912	.40339	.51000
STD DEV	.01508	.01681	.02308	.02280	.04892	.01640	.02395	.03161	.05159	.06439
MEDIAN	.02000	.06400	.18350	.30000	.43000	.04200	.13900	.25000	.40000	.51000

%ASSIGNED FLAGS	27.3	17.6	17.6	11.1	21.1	28.6	22.2	33.3	26.3	26.3
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