PHOSPHORUS EMISSIONS FROM THE INCINERATION OF CHEMICAL SLUDGE

OCTOBER, 1976

Ministry of the Environment

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The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

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PHOSPHORUS EMISSIONS FROM THE INCINERATION OF CHEMICAL SLUDGE

Prepared by
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Municipal Sewage Unit
Municipal & Private Section
Pollution Control Branch

October, 1976

ACKNOWLEDGEMENTS

The Ministry of the Environment would like to thank the Metropolitan Toronto Works Department for allowing the Main Sewage Treatment Plant Incinerator to be used for this study. Special appreciation is extended to Mr. W. A. Salib, P. Eng., Plant Manager at the Main Plant, and his staff for the assistance received in carrying out this study. Appreciation is also extended to Environment Canada, Ontario Region, Environmental Control Division for funding the stack sampling program carried out by the Ontario Research Foundation in conjunction with this study.

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NOMENCLATURE

mg - milligram

kg - kilogram

mg/1 - milligram per litre

mg/g - milligram per gram

ml - millilitre

mIgd - million Imperial gallons per day

PROVINCE OF ONTARIO

MINISTRY OF THE ENVIRONMENT

PHOSPHORUS SAMPLING PROGRAM AT THE MAIN SEWAGE TREATMENT PLANT

ABSTRACT

In an effort to reduce phosphorus inputs to our waterways, the Province of Ontario spent some $1.5 million on related phosphorus removal treatability studies. Municipalities in the Province have spent an estimated $15 million on capital works necessary to implement the Phosphorus Removal Program. The phosphorus that is removed from the wastewater remains in the sludge.

A study to determine the emission of phosphorus compounds when sewage sludge is incinerated in a multiple hearth furnace was carried out at the Main Sewage Treatment Plant in Toronto. The wastewater treatment plant along with the incinerators are operated by the Metropolitan Toronto Works Department.

A phosphorus mass balance on the digested sludge fed into the incinerator and all the effluent leaving the incinerator was undertaken on March 22, 1976. All sampling with exception of the stack gases was done by Ministry of the Environment personnel. Ontario Research Foundation carried out the stack sampling. Samples of the digested sludge, incinerator ash, scrubber water, slurry feed and stack gases were taken and analysed at the Ministry of the Environment Laboratories in Toronto.

It was shown that on the day of sampling more than 99% of the total phosphorus contained in the digested sewage sludge remained in the incinerator ash. The phosphorus in the ash is in an insoluble form.

CONCLUSIONS

1. On the day of sampling *more than 99% of the total phosphorus contained in the digested sludge remained in the ash after incineration.*

2. Phosphorus present in the ash is in an *insoluble form.*

3. On the day of sampling *less than 0.04% of the total phosphorus contained in the digested sludge was discharged to the environment from the incinerator stack.*

4. Less than 1% of the phosphorus contained in the sludge being incinerated enters the stack in the exhaust gases. Ninety-six percent (96%) of the phosphorus contained in the exhaust gases is removed by the Wet Gas Scrubber System.

5. *Incineration can be an effective means for disposal of chemically treated sludges with minimum phosphorus emissions.*

INTRODUCTION

The Municipality of Metropolitan Toronto was required to have phosphorus removal facilities installed and operational by December 31, 1975 at all of their wastewater treatment plants. Total phosphorus concentrations in the effluent were required to be 1 mg/l or less. Prior to the phosphorus removal requirement, the phosphorus concentration in the effluent of the main sewage treatment plant was approximately 4 mg/l.

When phosphorus is removed from the liquid portion of the sewage it ultimately ends up in the sewage sludge. Sludge is disposed of by three basic methods; spreading on agricultural lands, disposal at a land fill site, and incineration. In the first two methods the phosphorus is adsorbed by the soil. When the sludge is incinerated, however, the phosphorus portion may be retained in the ash or go up the stack with the gases. The purpose of this study was therefore to obtain the information necessary to compute a phosphorus loading balance during sewage sludge incineration. This would enable us to determine whether a major portion the phosphorus was remaining in the ash or being discharged to the atmosphere during the incineration process. Since approximately 40% of the sludge produced in Ontario is incinerated the results of this study on phosphorus emissions was of major concern.

In order to determine a phosphorus balance throughout the incineration process at the Main Plant a sampling program was carried out on March 22, 1976.

SAMPLING PROGRAM

The Main Treatment Plant is located in Metropolitan Toronto just east of Leslie Street, on the shoreline of Lake Ontario. This plant serves the central area of Toronto and has a capacity of 180 mIgd for which it provides secondary type treatment. Incineration has been used as a means of sludge disposal at the Main Sewage Treatment Plant for the past 22 years. Approximately 125 tons (dry weight) of sludge per day are incinerated at this plant.

Digested sludge is treated with a polymer and vacuum filtered before being transported to the five, multi-hearth furnaces of the incineration system. Three of the furnaces are 12 hearth units while the two remaining have only 8 hearths. The sampling program was carried out on the #3 furnace which is a 12 hearth unit.

In order to complete a mass balance of the incinerator system, samples of the below listed influent and effluent streams were taken.

1) Digested sludge (incineration input)
2) Scrubber influent
3) Scrubber effluent
4) Ash
5) Scrubber effluent and Slurry feed
6) Stack gases

The sampling program was carried out using 1½ hour sampling intervals with a break in between to allow for equipment cleaning and changeover. Four such sampling periods were conducted between 10 a.m. and 7:00 p.m., March 22, 1976. Composite samples for all liquid and solid waste streams were made up of two equally portioned, blended grab samples taken at the beginning and end of each of the

sampling periods. Stack gas samples were single samples taken over the 1½ hour time period. Stack gas sampling was done by the Ontario Research Foundation while all other sampling was done by Ministry staff. A summary of analytical results is attached as Appendix A while laboratory analyses are shown in Appendix B.

Digested sludge, as it comes from the vacuum filter, is a black homogeneous material. Solids content was approximately 14.4% on the day of sampling.

An intricate system of conveyor belts carries the sludge from the first floor of the building to the fifth floor where it enters the furnaces. The quantity of wet sludge entering each furnace is recorded by means of a totalizer. Each furnace has a nominal capacity of approximately 12 tons of set sludge per hour.

Digested sludge samples were taken directly from the conveyor belt on the fifth floor immediately prior to entering the first hearth of the #3 furnace. A 16 ounce wide mouth jar was used to store and transport the digested sludge to the MOE Laboratory for analysis.

Analyses requested on the four sludge samples were ignited solids (total, ashed, loss) and phosphorus (total and total soluble).

The furnace (figure 1) consists of a refractory-lined steel shell containing a series of horizontal hearths. Sludge alternates from in-feed to out-feed as it is moved downward by rabble arms through the furnace. The furnace is divided into three distinct operating zones. The first is the "Drying Zone", where most of the moisture is driven off, the second "Incineration Zone", where organics are combusted and the third "Cooling Zone", where the ash is cooled prior to discharge into the ash hopper. The continuously discharging ash is screened to prevent clinkers

MULTIPLE-HEARTH FURNACE FLOW SHEET

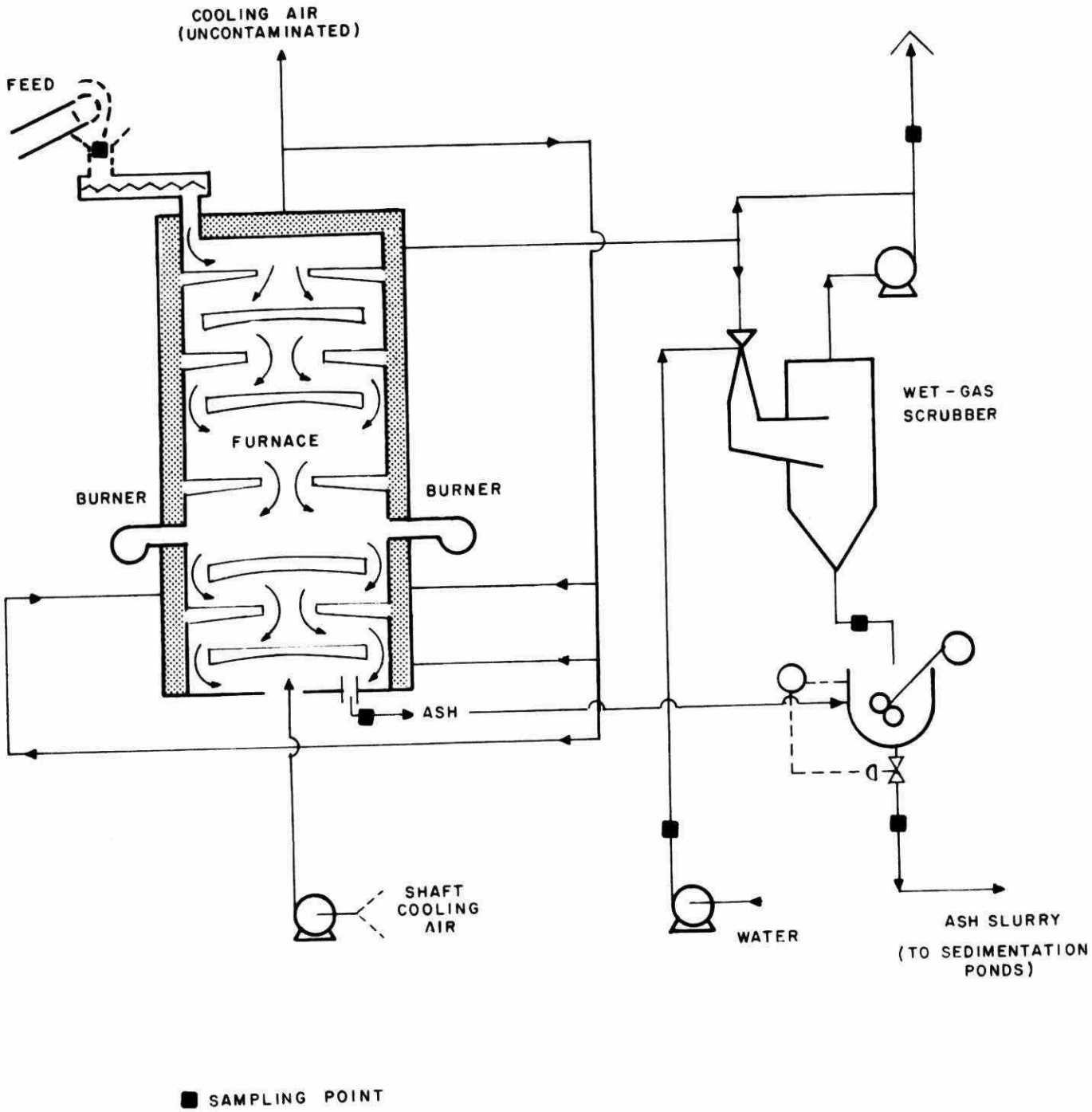

FIGURE I

from entering the ash hopper. Samples of the ash were obtained using a shovel. Ash samples were stored and transported in 16 ounce wide mouth jars. Analyses to determine Total and Total Soluble Phosphorus were performed on the four ash samples. The ash is ultimately mixed with the wet gas scrubber effluent and discharged to sedimentation ponds. The decant from these ponds is discharged to Lake Ontario.

A Potential Leaching Capacity Test was also carried out on the ash to see if the phosphorus would dissolve in lake water. This test indicated that all of the phosphorus in the ash was in an insoluble form when Lake Ontario water was used as the leaching medium.

Particulate matter and gaseous materials produced during sludge incineration are removed in a wet-gas scrubber located on the exhaust flue of each furnace. In order to determine what effect the wet-gas scrubber has on phosphorus emissions, samples of scrubber influent and effluent were obtained for analyses. Scrubber influent water is the effluent from the sewage treatment plant. A sampling station for the scrubber influent was available in the basement of the incinerator building. Caution was used to ensure that representative samples were obtained. Taps were thoroughly flushed and the sampling apparatus was rinsed with the sample liquid before each grab.

Sampling stations for scrubber effluent and the ash slurry were also located in the basement section of the incinerator building. Analyses for these samples consisted of total, suspended and dissolved solids, as well as total and soluble phosphorus (soluble phosphorus is measured as filtered reactive orthophosphate).

Gaseous and particulate matter which remains in suspension after being drawn through the wet-gas scrubber is free to move up the stack and enter the atmosphere. Stack sampling during this

program was performed by Ontario Research Foundation using a Particulate Matter Sampling Train (figure 2).

Single point samples of the stack gases were taken using procedures which comply with both the Environmental Protection Service and Ministry of the Environment Source Testing Code recommendations. Stack gas sampling was done isokinetically (air sample withdrawal rate is equal to the stack gas emission rate). Reeve Angel 900 AF Fiberglass filters were used in order to minimize chemical interference. Impinger solutions and probe wash solutions were preserved after each test for chemical analysis by MOE. Volumes of impinger and probe wash solutions recorded before and after testing are shown in Appendix A.

Analytical data for all sampling operations are summarized in Appendix A. Stack gas volumes are also shown in Appendix A. Actual analysis sheets are attached as Appendix B.

Grab samples of the settling pond effluent and lake water were taken. Analyses for total and soluble phosphorus as well as dissolved and suspended solids were performed.

LOADING INFORMATION

In order to determine where and in what quantities the phosphorus is located after incineration, loadings were calculated for all inputs and discharges in the incineration system (Table I). Using the average of the four sampling runs more than 99% of the total phosphorus contained in the digested sludge entering the incinerator is retained in the ash in an insoluble form. Since, however, the ash volume or quantities could not be measured directly, loadings were computed using the ignited solids analysis done on

PARTICULATE MATTER SAMPLING TRAIN

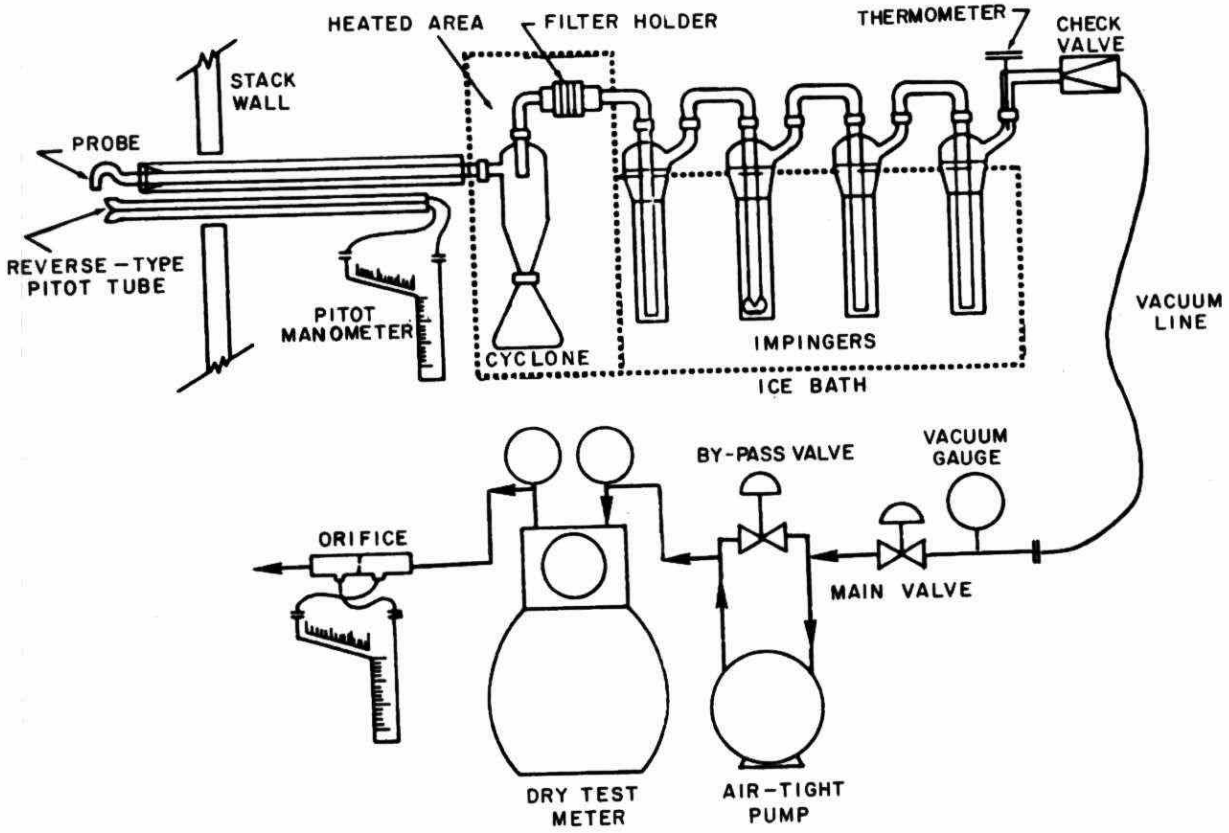

FIGURE II

PHOSPHORUS EMISSIONS FROM THE INCINERATION

OF CHEMICAL SLUDGE

TABLE I

PHOSPHORUS LOADING SUMMARY

	DIGESTED SLUDGE	ASH*	SCRUBBER WATER	STACK		
TIME	PHOSPHORUS LOADING (kg/day)	PHOSPHORUS LOADING (kg/day)	PHOSPHORUS REMOVED FROM STACK GASES BY SCRUBBER (kg/day)	IMPINGER PHOSPHORUS LOADING (kg/day)	FILTER PAD PHOSPHORUS LOADING (kg/day)	TOTAL PHOSPHORUS LOADING TO ATMOSPHERE (kg/day)
10:30-12:00	1002.8	985.0	12.2	.008	.407	.415
1:00-2:30	896.3	899.4	9.07	.004	.354	.358
3:00-4:30	865.6	892.2	11.2	.026	.277	.303
5:00-6:30	948.9	925.8	3.24	.008	.355	.363
Average	928.4	925.6	8.9	.012	.348	.360

* Ash loading valves were calculated from ignited solids tests done on digested sludge samples.

the digested sludge. Variations in the moisture content of the wet digested sludge resulted in slight inconsistencies found in the ash phosphorus loadings during the 1:00 - 2:30 and 3:00 - 4:30 time intervals. The amount of phosphorus removed by the scrubber waters accounted, on the average, for approximately 0.9% of the total phosphorus loading to the system. The small amount of phosphorus found on the stack gas sampling filter indicates that little of the ashed material is carried up the stack.

In conclusion more than 99% of the total phosphorus in the digested sludge remains, upon incineration, in the ash. Of the remaining phosphorus which goes up the stack, 96% is removed by the gas scrubber system. Therefore only 0.04% (0.36 kg/day) of the total phosphorus input to the incinerator is discharged to the atmosphere.

COMPARISON OF PHOSPHORUS DATA BEFORE AND AFTER CHEMICAL ADDITION

During the period between December 17th and December 21st, 1975 a special phosphorus survey was carried out by the Main Sewage Treatment Plant personnel. This program was conducted before chemical addition for purposes of phosphorus removal was implemented at the Main Plant.

As was stated earlier, any phosphorus removed from the liquid waste stream ultimately ends up in the sludge. For comparative purposes only, data from the December and March studies are presented in Table II. It must be pointed out that the two studies were done for different purposes, however, since common sampling points were used an attempt has been made to compare the data.

As can be seen by the results in Table II the percentage

PHOSPHORUS EMISSIONS FROM THE INCINERATION

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TABLE II

AND AFTER CHEMICAL ADDITIONS

	December 1975 Sampling Program	March 1976 Sampling Program
% P in Wet Filter Cake (average)	0.14	0.41
% P in Dry Ash (average)	1.8	5.8
Raw Water to Scrubber mg/l	2.8	0.69
Scrubber Effluent mg/l	4.5	3.4
P Removed from Stack Gases by Scrubber mg/l	1.7	2.7

phosphorus in the wet filter cake and the dry ash increased after phosphorus removal was implemented. A decrease in the phosphorus concentration of the raw water to scrubbers (sewage effluent) is evident since the purpose of phosphorus removal is to reduce phosphorus concentrations in the treatment plant effluent to 1 mg/l or less. The removal of phosphorus from the stack gases by the wet-gas scrubber is also shown.

APPENDIX

A

SUMMARY OF ANALYTICAL RESULTS

- Sludge Totalizer Readings
- Stack Gas Sampling Summary
- Summary of Analysis

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SLUDGE TOTALIZER READINGS

TIME INTERVAL	START	FINISH
10:30 - 12:00	174154	174314
1:00 - 2:30	174448	174602
3:00 - 4:30	174664	174814
5:00 - 6:30	174906	175057

- Totalizer readings are to the nearest tenth of a ton.

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STACK GAS SAMPLING SUMMARY

SAMPLING PERIOD	GAS FLOW IN STACK DURING SAMPLING PERIOD (Dry standard cubic feet/minute)	GAS COLLECTED FOR ANALYSIS DURING SAMPLING PERIOD (Dry standard cubic feet)
10:30 to 12:00	16,900	59.285
1:00 to 2:30	15,700	56.687
3:00 to 4:30	16,100	54.949
5:00 to 6:30	14,800	53.223
AVERAGE	15,875	56.036

Stack Gas Sampling done by Ontario Research Foundation

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STACK GAS SAMPLING SUMMARY

TIME INTERVAL	WEIGHT OF SOLIDS FROM PROBE RINSE (mg)	WEIGHT OF SOLIDS FROM FILTER MEDIUM (mg)	TOTAL WEIGHT GAIN (mg)	VOLUME OF WATER USED FOR PROBE RINSE (ml)	FINAL VOLUME OF WATER IN IMPINGER* (ml)
10:30 - 12:00	2.2	139.4	141.6	181	512
1:00 - 2:30	0.4	106.7	107.1	150	528
3:00 - 4:30	0.5	60.2	60.7	266	434
5:00 - 6:30	0.4	97.1	97.5	211	502
	.875	100.85	101.7	202	494

* Volume at start was 250 ml

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SUMMARY OF ANALYTICAL RESULTS

TIME INTERVAL	IMPINGER SOLN. (mg/l) SOLIDS TOTAL	SUSP.	DISS.	PHOSPHORUS as P TOTAL	SOLUBLE (1)	PROBE WASH (mg/l) PHOSPHORUS as P TOTAL	SOLUBLE	PROBE WASH FILTER (mg/l) PHOSPHORUS as P TOTAL	SOLUBLE (2)	STACK EMISSIONS SAMPLE (mg/g) PHOSPHORUS as P TOTAL	SOLUBLE
10:30-12:00	-	5	190	0.04	0.10	0.24	0.08	Trace		7.0	-
1:00- 2:30	-	5	220	0.02	0.08	0.12	xx	Trace		8.3	-
3:00- 4:30	205	5	200	0.14	0.12	0.16	0.08	Trace		10.8	-
5:00- 6:30	211	6	205	0.04	xx	0.08	0.04	Trace		9.1	-
Average	208	5	204	0.06	0.1	0.15	0.07	-		8.8	-

(1) Soluble phosphorus as filtered reactive orthophosphate
(2) Soluble phosphorus as total dissolved phosphorus
xx Sample exhausted

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OF CHEMICAL SLUDGE

SUMMARY OF ANALYTICAL RESULTS

	DIGESTED SLUDGE					ASH	
	TOTAL SOLIDS mg/l			PHOSPHORUS as P mg/g		PHOSPHORUS as P mg/g	
TIME INTERVAL	DRIED	ASHED	LOSS	TOTAL	SOLUBLE*	TOTAL	SOLUBLE*
10:30-12:00	148900	71900	77000	29	0.16	59	0.0087
1:00- 2:30	143200	68200	75000	28	0.15	59	0.0048
3:00-4:30	142000	68300	73700	28	0.14	60	0.0029
5:00-6:30	14900	71600	77700	29	0.12	59	0.0042
Average	145850	70000	75850	28.5	0.14	59.3	0.0052

* Soluble phosphorus as total dissolved phosphorus

PHOSPHORUS EMISSIONS FROM THE INCINERATION

OF CHEMICAL SLUDGE

SUMMARY OF ANALYTICAL RESULTS

TIME INTERVAL	SCRUBBER INFLUENT mg/l					SCRUBBER EFFLUENT mg/l					SCRUBBER & SLURRY FEED mg/l				
	SOLIDS			PHOSPHORUS as P		SOLIDS			PHOSPHORUS as P		SOLIDS			PHOSPHORUS as P	
	TOTAL	SUSP.	DISS.	TOTAL	SOLUBLE	TOTAL	SUSP.	DISS.	TOTAL	SOLUBLE	TOTAL	SUSP.	DISS	TOTAL	SOLUBLE
10:30-12:00	710	15	695	0.56	0.18	890	80	810	4.4	0.58	860	55	805	3.2	0.40
1:00- 2:30	803	13	790	0.62	0.18	940	70	870	3.0	0.58	975	105	870	6.4	0.32
3:00- 4:30	813	13	800	0.78	0.28	940	70	870	4.3	0.46	1060	200	860	13.0	0.48
5:00- 6:30	790	15	775	0.78	0.32	915	50	865	1.8	0.56	1115	235	880	12.0	0.60
Average	779	14	765	0.69	0.24	921	68	854	3.4	0.55	1003	149	854	8.7	0.45

Note: Soluble phosphorus as filtered reactive orthophosphate

APPENDIX

B

LABORATORY ANALYSES

- ORF Laboratory Results
- MOE Laboratory Results

PHOSPHORUS EMISSIONS FROM THE INCINERATION

OF CHEMICAL SLUDGE

SAMPLING PROGRAM

ORF LABORATORY RESULTS

TIME INTERVAL	WEIGHT OF SOLIDS FROM PROBE RINSE (mg)	WEIGHT OF SOLIDS FROM FILTER MEDIUM (mg)	TOTAL WEIGHT GAIN (mg)	VOLUME OF WATER USED FOR PROBE RINSE (ml)	FINAL VOLUME OF WATER IN IMPINGER* (ml)
10:30 - 12:00	2.2	139.4	141.6	181	512
1:00 - 2:30	0.4	106.7	107.1	150	528
3:00 - 4:30	0.5	60.2	60.7	266	434
5:00 - 6:30	0.4	97.1	97.5	211	502

* Volume at start was 250 ml

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto

Report to: J. Archer, Pollution Control
6th - 135 St.Clair

c.c. Regional Files
Lab.

Source: Main W.P.C.P.
Incinerator Study

Date Sampled: Mar.22/76 **by:** J.Archer

p

Lab. No.	5-Day B.O.D.	SOLIDS			NITROGEN AS N				PHOSPHORUS AS P				
		Tot. Solids	Susp.	Diss.	Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.			
12-27		710	15	695					.56	.18			
12-28		890	80	810					4.4	.58			
12-29		860	55	805					3.2	.40			
12-30		-	<5	190					.04	.08			

12-27	1A	Scrubber Influent	10.30 a.m. - 12.00 Noon
12-28	1B	Scrubber Eff.	"
12-29	1C	Scrubber & Slurry Feed	"
12-30	1D	Impinger Soln.	

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J. Archer **c.c.** Regional Files, Lab.

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	NITROGEN AS N – Free Ammonia	NITROGEN AS N – Total Kjeldahl	NITROGEN AS N – Nitrite	NITROGEN AS N – Nitrate	PHOSPHORUS AS P Tot.	PHOSPHORUS AS P Sol.			
12-31		803	13.	790					.62	.18			
12-32		940	70.	870					3.0	.58			
12-33		975	105	870					6.4	.48			
12-34		-	<5.	220					.02	.10			

12-31	2A	Scrubber Influent	1.00 p.m. - 2.30 p.m.
12-32	2B	Scrubber Eff.	"
12-33	2C	Scrubber & Slurry Feed	"
12-34	2D	Impinger Soln.	"

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J.Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	SOLIDS			NITROGEN AS N –				PHOSPHORUS AS P				
		Solids Tot.	Susp.	Diss.	Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.			
12-35		813	13.	800					.78	.28			
12-36		940	70	870					4.3	.46			
12-37		1060	200	860					13.	.48			
12-38		205.	5.	200					.14	.12			

12-35	3A	Scrubber Influent	3.00 p.m. - 4.30 p.m.
12-36	3B	Scrubber Eff.	"
12-37	3C	Scrubber & Slurry Feed	"
12-38	3D	Impinger Soln.	"

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J.Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	SOLIDS Tot. Solids	SOLIDS Susp.	SOLIDS Diss.	NITROGEN AS N - Free Ammonia	NITROGEN AS N - Total Kjeldahl	NITROGEN AS N - Nitrite	NITROGEN AS N - Nitrate	PHOSPHORUS AS P Tot.	PHOSPHORUS AS P Sol.			
12-39		790	15	775					.78	.32			
12-40		915	50	865					1.8	.56			
12-41		1115	235	880					12.	.60			
12-42		211	6.	205					.04	**			

**sample exhausted

12-39	4A Scrubber Influent	5.00 p.m. - 6.30 p.m.
12-40	4B Scrubber Eff.	"
12-41	4C Scrubber & Slurry Feed	"
12-42	4D Impinger Soln.	"

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J.Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	SOLIDS			NITROGEN AS N –				PHOSPHORUS AS P				
		Tot.	Susp.	Diss.	Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.			
12-43		335	20	315					.17	.035			
12-44		945	30	915					1.4	.52			

12-43 1Y Lake water 6.30 p.m.

12-44 1Z Lagoon Eff.

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J. Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	Susp. Solids			NITROGEN AS N - Free Ammonia	NITROGEN AS N - Total Kjeldahl	NITROGEN AS N - Nitrite	NITROGEN AS N - Nitrate	PHOSPHORUS AS P Tot.*	PHOSPHORUS AS P Diss. Total			
12-239									7.0	-			
12-240									8.3	-			
12-241									10.8	-			
12-242									9.1	-			

*Results in mg/gm dry wt.

12-239	P-1 Stack Emmission Sample
12-240	P-2 " " "
12-241	P-3 " " "
12-242	P-4 " " "

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J. Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	Susp. Solids			NITROGEN AS N - Free Ammonia	NITROGEN AS N - Total Kjeldahl	NITROGEN AS N - Nitrite	NITROGEN AS N - Nitrate	PHOSPHORUS AS P * Tot.	PHOSPHORUS AS P * ~~Diss.~~ Total	% Moisture		
12-45									59.	.0087	trace		
12-46									59.	.0048	trace		
12-47									60.	.0029	trace		
12-48									59.	.0042	trace		

*mg/gm dry wt.

12-45	1F	Ash	10.30 a.m. - 12.00 Noon
12-46	2F	Ash	1.00 p.m. - 2.30 p.m.
12-47	3F	Ash	3.00 p.m. - 4.30 p.m.
12-48	4F	Ash	5.00 p.m. - 6.30 p.m.

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J.Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	TOTAL SOLIDS			NITROGEN AS N –				PHOSPHORUS AS P				
		Solids Dried	Ashed	Loss	Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	* Tot.	* Diss. Total			
12-49		148900	71900	77000					29	.16			
12-50		143200	68200	75000					28	.15			
12-51		142000	68300	73700					28	.14			
12-52		149300	71600	77700					29	.12			

*mg/gm dry wt.

12-49	1S	Digested sludge	10.30 a.m. - 12.00 noon
12-50	2S	Digested sludge	1.00 p.m. - 2.30 p.m.
12-51	3S	Digested sludge	3.00 p.m. - 4.30 p.m.
12-52	4S	Digested sludge	5.00 p.m. - 6.30 p.m.

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J.Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	Susp. Solids			NITROGEN AS N - Free Ammonia	NITROGEN AS N - Total Kjeldahl	NITROGEN AS N - Nitrite	NITROGEN AS N - Nitrate	PHOSPHORUS AS P - Tot.	PHOSPHORUS AS P - Diss. ~~xxx~~ Total			
12-247									.24	.08			
12-248									.12	**			
12-249									.16	.08			
12-250									.08	.04			

**sample exhausted

12-247	1E Probe wash water
12-248	2E Probe wash water
12-249	3E Probe wash water
12-250	4E Probe wash water

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All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Toronto **Report to:** J. Archer **c.c.** Regional Files

Source:

Date Sampled: **by:**

Lab. No.	5-Day B.O.D.	Susp. Solids			NITROGEN AS N -				PHOSPHORUS AS P				
					Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.			
12-243									trace	-			
12-244									trace	-			
12-245									trace	-			
12-246									trace	-			
					Results too low to give accurate analysis								

12-243	Q-1 Probe wash Filter
12-244	Q-2 " " "
12-245	Q-3 " " "
12-246	Q-4 " " "

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