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**RESULTS FOR THE OCTOBER 21, 1988
SCRUBBER PERFORMANCE TEST AT THE
ST. CROIX WASTE TO ENERGY INCINERATION
FACILITY IN NEW RICHMOND, WISCONSIN**

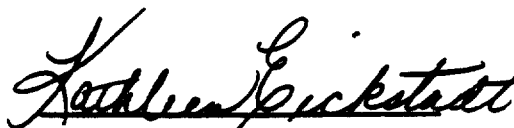
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**Report Number 8-2648
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KE/klq**


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1 INTRODUCTION

On October 21, 1988, Interpoll Laboratories personnel conducted simultaneous hydrogen chloride and sulfur dioxide determinations on the Incineration System at the St. Croix Waste To Energy Facility in New Richmond, Wisconsin. On-site testing was performed by E. Trowbridge, C. Mosser, R. Rosenthal and D. Smith.

The gas samples were collected at the inlet to the dry scrubber, the North and South heat exchanger outlets and the stack using standard EPA Method 5 trains, except that 1 N NaOH was used in the first two impingers instead of distilled water. Both acidic gases, hydrogen chloride and sulfur dioxide, were collected simultaneously using identical sampling trains. The collected samples were analyzed by ion chromatography. Volumetric flow rate determinations were conducted at both the scrubber inlet and stack locations in order to calculate SO_2 and HCl mass rates.

A three-point traverse was used at each test site to collect representative gas samples. Each traverse point was sampled seven minutes to give a total sampling time of 21 minutes per run. A 12-point traverse was used in the volumetric flow rate determination at each test site.

The important results of the HCl and SO_2 test are summarized in Section 2. Detailed computer results are presented in Section 3. Field data, laboratory results and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The important results of the acid gas determinations are summarized in Table 1.

The average removal efficiency of the Interel dry scrubbing system for hydrogen chloride was greater than 99.997%. As will be noted, the hydrogen chloride concentrations in exhaust gas from the scrubber were below detection limits. Sulfur dioxide removal rates averaged greater than 83.2%. The sulfur dioxide concentrations observed in the exhaust were extremely low for MSW-fired combustors averaging less than 6.5 ppm.

Sulfur dioxide concentrations averaged 20 ppm,w at the North heat exchanger outlet and 3.0 ppm,w at the south heat exchanger outlet. Hydrogen chloride concentrations at the north and south heat exchanger outlets averaged 15 ppm,w and 27 ppm,w respectively.

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of this fact and a complete review of the entire data and results, it is our opinion that the concentrations and mass rates reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

Table 1. Results of the October 21, 1988 Acid Gas Determinations on the Incineration System at the St. Croix Waste to Energy Facility in New Richmond, Wisconsin.

<u>Concentration (ppm.v)</u>			<u>Mass Rate (LB/HR)</u>		<u>Removal Efficiency (% w/w)</u>
<u>Inlet</u>	<u>Heat Exchanger Outlet</u>	<u>Stack</u>	<u>Inlet</u>	<u>Stack</u>	
<u>(North)</u>					
<u>(South)</u>					
<u>(Sulfur Dioxide)</u>					
37	17	4.0	0.50 <	7.3	0.096 < 98.7 >
35	38	3.0	8.0	7.2	1.8 75.0
51	5.0	3.0	11	10	2.4 76.0
Avg	41	20	3.0	8.2	1.4 < 83.2 >
<u>(Hydrogen Chloride)</u>					
301	15	29	0.0071 <	34	0.00088 < 99.997 >
354	14	7.0	0.0071 <	41	0.00088 < 99.998 >
292	16	44	0.0071 <	33	0.00088 < 99.997 >
Avg	316	15	27	36	0.00088 < 99.997 >

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition (Orsat and moisture) are presented first followed by the computer printout of the sulfur dioxide and hydrogen chloride results.

The results have been calculated on an IBM Computer using programs written in Extended BASIC specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs.

Interpoll Report No. 8-2648
 Interel Corporation
 New Richmond, Wisconsin

Test No. 3
 MSW Incinerator Baghouse Inlet

Results of Orsat & Moisture Analyses——Methods 3 & 4(%v/v)

Date of run	Run 1 10-21-88	Run 2 10-21-88	Run 3 10-21-88
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Dry basis (orsat)

carbon dioxide.....	5.62	6.04	5.70
oxygen.....	14.18	13.88	13.93
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.20	80.08	80.37

Wet basis (orsat)

carbon dioxide.....	4.96	5.19	4.96
oxygen.....	12.51	11.92	12.12
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	70.74	68.78	69.91
water vapor.....	11.79	14.11	13.01
Dry molecular weight.....	29.47	29.52	29.47
Wet molecular weight.....	28.11	27.90	27.98
Specific gravity.....	0.971	0.964	0.966

Test No. 2
 North Heat Exchanger Outlet

Results of Orsat & Moisture Analyses——Methods 3 & 4(%v/v)

Date of run	Run 1 10-21-88	Run 2 10-21-88	Run 3 10-21-88
Dry basis (orsat)			
carbon dioxide.....	4.78	5.98	4.98
oxygen.....	15.27	14.44	15.45
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.95	79.58	79.57
Wet basis (orsat)			
carbon dioxide.....	4.39	5.49	4.52
oxygen.....	14.01	13.26	14.03
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	73.37	73.09	72.28
water vapor.....	8.23	8.15	9.16
Dry molecular weight.....	29.38	29.53	29.41
Wet molecular weight.....	28.44	28.59	28.37
Specific gravity.....	0.982	0.988	0.980

Test No. 2
 South Heat Exchanger Outlet

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

Date of run	Run 1 10-21-88	Run 2 10-21-88	Run 3 10-21-88
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Dry basis (orsat)

carbon dioxide.....	4.50	5.41	5.30
oxygen.....	15.71	15.18	15.07
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	79.79	79.41	79.63

Wet basis (orsat)

carbon dioxide.....	4.05	4.83	4.72
oxygen.....	14.15	13.56	13.43
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	71.88	70.93	70.95
water vapor.....	9.91	10.68	10.90
Dry molecular weight.....	29.35	29.47	29.45
Wet molecular weight.....	28.22	28.25	28.20
Specific gravity.....	0.975	0.976	0.974

Test No. 3
 MSW Incinerator Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88

Dry basis (orsat)

carbon dioxide.....	4.10	4.85	4.20
oxygen.....	15.86	15.54	15.90
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	80.04	79.61	79.90

Wet basis (orsat)

carbon dioxide.....	3.72	4.40	3.83
oxygen.....	14.41	14.08	14.49
carbon monoxide.....	0.00	0.00	0.00
nitrogen.....	72.72	72.15	72.80
water vapor.....	9.15	9.37	8.89
Dry molecular weight.....	29.29	29.40	29.31
Wet molecular weight.....	28.26	28.33	28.30
Specific gravity.....	0.976	0.979	0.978

Test No. 3
 MSW Incinerator Baghouse Inlet

Results of Sulfur Dioxide Determinations-----Method 6

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	1300/1322	1350/1412	1422/1442
Barometric pressure...(IN.HG)	28.91	28.91	28.91
Meter temperature....(DEG-F)	59.75	74.33	79.16
Meter correction coefficient	0.9953	0.9533	0.9953
Volume through gas meter....			
at meter conditions...(CF)	15.460	16.330	16.000
standard conditions...(SCF)	15.170	14.928	15.134
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	11.79	14.11	13.01
Milliequivalents of SO4 in..			
gas sample.....	1.50	1.45	2.07
<u>Sulfur dioxide concentration</u>			
(GR/DSCF).....	0.0489	0.0480	0.0676
(MG/DSCM).....	112	110	155
(PPM-DRY).....	42	41	58
(PPM-WET).....	37	35	51
SO2 Emission rate....(LB/HR)	7.33	7.20	10.14

Test No. 2
 North Heat Exchanger Outlet

Results of Sulfur Dioxide Determinations-----Method 6

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	930/ 951	1003/1024	1032/1053
Barometric pressure...(IN.HG)	28.91	28.91	28.91
Meter temperature....(DEG-F)	49.80	47.40	47.20
Meter correction coefficient	0.9953	0.9953	0.9953
Volume through gas meter....			
at meter conditions...(CF)	15.770	15.870	15.820
standard conditions..(SCF)	15.776	15.951	15.907
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	8.23	8.15	9.16
Milliequivalents of SO4 in..			
gas sample.....	0.71	1.56	0.20
<u>Sulfur dioxide concentration</u>			
(GR/DSCF).....	0.0221	0.0483	0.0062
(MG/DSCM).....	51	111	14
(PPM-DRY).....	19	42	5
(PPM-WET).....	17	38	5

0.19 41.5 5.32

Test No. 2
 South Heat Exchanger Outlet

Results of Sulfur Dioxide Determinations-----Method 6

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	1108/1129	1140/1201	1208/1229
Barometric pressure..(IN.HG)	28.91	28.91	28.91
Meter temperature....(DEG-F)	45.75	47.70	47.50
Meter correction coefficient	0.9953	0.9953	0.9953
Volume through gas meter....			
at meter conditions...(CF)	15.730	15.700	15.720
standard conditions..(SCF)	15.862	15.771	15.797
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	9.91	10.68	10.90
Milliequivalents of SO4 in..			
gas sample.....	0.16	0.12	0.12
<u>Sulfur dioxide concentration</u>			
(GR/DSCF).....	0.0048	0.0039	0.0038
(MG/DSCM).....	11	9	9
(PPM-DRY).....	4 4.12	3 3.35	3 3.26
(PPM-WET).....	4	3	3

Test No. 3
 MSW Incinerator Stack

Results of Sulfur Dioxide Determinations-----Method 6

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	1300/1321	1350/1411	1422/1445
Barometric pressure..(IN.HG)	28.92	28.92	28.92
Meter temperature....(DEG-F)	63.30	63.30	64.00
Meter correction coefficient	1.0025	1.0025	1.0025
Volume through gas meter....			
at meter conditions...(CF)	15.730	16.260	15.770
standard conditions...(SCF)	15.447	15.967	15.465
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	9.15	9.37	8.89
Milliequivalents of SO4 in..			
gas sample.....	0.00	0.33	0.43
<u>Sulfur dioxide concentration</u>			
(GR/DSCF).....	0.0000	0.0103	0.0138
(MG/DSCM).....	0	24	32
(PPM-DRY).....	0.55	9(8.84)	12 (11.8)
(PPM-WET).....	0.5	8	11
SO2 Emission rate....(LB/HR)	0.00	1.76	2.36

Test No. 3
 MSW Incinerator Baghouse Inlet

Results of HCl Determinations

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	1300/1322	1350/1412	1422/1442
Barometric pressure..(IN.HG)	28.91	28.91	28.91
Meter temperature....(DEG-F)	59.75	74.33	79.16
Meter correction coefficient	0.9953	0.9953	0.9953
Volume through gas meter.... at meter conditions...(CF)	15.460	16.330	16.000
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	11.79	14.11	13.01
Volumetric flow rate (DSCFM)	17497	17497	17497
HCl in sample.....(MG)	222.14	275.62	218.03
HCl concentration.....			
(GR/DSCF).....	0.2259	0.2728	0.2222
(MG/DSCM).....	517.31	624.69	508.91
(PPM-DRY).....	341.22	412.05	335.68
(PPM-WET).....	300.99	353.91	292.01
HCl emission rate....(LB/HR)	33.872	40.904	33.322

HCl = Hydrogen chloride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 2
 North Heat Exchanger Outlet

Results of HCl Determinations

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	0930/0951	1003/1024	1032/1053
Barometric pressure..(IN.HG)	28.91	28.91	28.91
Meter temperature....(DEG-F)	49.80	47.40	47.20
Meter correction coefficient	0.9953	0.9953	0.9953
Volume through gas meter.... at meter conditions...(CF)	15.770	15.870	15.820
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	8.23	8.15	9.16
Volumetric flow rate (DSCFM)			
HCl in sample.....(MG)	11.11	10.80	11.93
HCl concentration.....			
(GR/DSCF).....	0.0109	0.0104	0.0116
(MG/DSCM).....	24.87	23.92	26.49
(PPM-DRY).....	16.41	15.77	17.48
(PPM-WET).....	15.06	14.49	15.87

HCl = Hydrogen chloride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 2
 South Heat Exchanger Outlet

Results of HCl Determinations

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	1108/1129	1140/1201	1208/1229
Barometric pressure...(IN.HG)	28.91	28.91	28.91
Meter temperature....(DEG-F)	45.75	47.70	47.50
Meter correction coefficient	0.9953	0.9953	0.9953
Volume through gas meter.... at meter conditions...(CF)	15.730	15.700	15.720
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	9.91	10.68	10.90
Volumetric flow rate (DSCFM)			
HCl in sample.....(MG)	22.21	5.30	33.73
HCl concentration.....			
(GR/DSCF).....	0.0216	0.0052	0.0329
(MG/DSCM).....	49.47	11.86	75.43
(PPM-DRY).....	32.63	7.83	49.76
(PPM-WET).....	29.40	6.99	44.33

HCl = Hydrogen chloride

A trailing '<' symbol indicates that the true value
 is less than or equal to the reported value

Test No. 3
 MSW Incinerator Stack

Results of HCl Determinations

	Run 1	Run 2	Run 3
Date of run	10-21-88	10-21-88	10-21-88
Time run start/end.....(HRS)	1300/1321	1350/1411	1422/1443
Barometric pressure...(IN.HG)	28.92	28.92	28.92
Meter temperature....(DEG-F)	63.30	63.30	64.00
Meter correction coefficient	0.9953	0.9953	0.9953
Volume through gas meter.... at meter conditions...(CF)	15.730	15.760	15.770
Total sampling time....(MIN)	21.0	21.0	21.0
Moisture content.....(%V/V)	9.15	9.37	8.89
Volumetric flow rate (DSCFM)	19945	19945	19945
HCl in sample.....(uG)	5.14<	5.14<	5.14<
HCl concentration..... (GR/10 ³ DSCF).....	0.0052<	0.0052<	0.0052<
(uG/DSCM).....	11.85<	11.82<	11.83<
(PPB-DRY).....	7.81<	7.80<	7.80<
(PPB-WET).....	7.10<	7.07<	7.11<
HCl emis. rate...(10 ⁻³ LB/HR)	0.88<	0.88<	0.88<

HCl = Hydrogen chloride

A trailing '<' symbol indicates that the true value is less than or equal to the reported value

Test No. 3
MSW Incinerator Baghouse Inlet

Results of Volumetric Flow Rate Determination ~~Method 1~~ Method 2

Date of Determination.....	10-21-88
Time of Determination.....(HRS)	1445
Barometric pressure.....(IN.HG)	28.91
Pitot tube coefficient.....	.84
Number of sampling ports.....	1
Total number of points.....	12
Shape of duct.....	Round
Stack diameter.....(IN)	47.5
Duct area.....(SQ.FT)	12.31
Direction of flow.....	UP
Static pressure.....(IN.WC)	-5.5
Avg. gas temp.....(DEG-F)	477
Moisture content.....(% V/V)	11.79
Avg. linear velocity.....(FT/SEC)	50.0
Gas density.....(LB/ACF)	.03920
Molecular weight.....(LB/LBMOLE)	29.47
Mass flow of gas.....(LB/HR)	86894
Volumetric flow rate.....	
actual.....(ACFM)	36948
dry standard.....(DSCFM)	17497

Test No. 3
 MSW Incinerator Stack

Results of Volumetric Flow Rate Determination-----Method 2

Date of Determination.....	10-21-88
Time of Determination.....(HRS)	1445
Barometric pressure.....(IN.HG)	28.92
Pitot tube coefficient.....	.84
Number of sampling ports.....	2
Total number of points.....	12
Shape of duct.....	Round
Stack diameter.....(IN)	34
Duct area.....(SQ.FT)	6.30
Direction of flow.....	UP
Static pressure.....(IN.WC)	-.4
Avg. gas temp.....(DEG-F)	216
Moisture content.....(% V/V)	9.15
Avg. linear velocity.....(FT/SEC)	76.9
Gas density.....(LB/ACF)	.05535
Molecular weight.....(LB/LBMOLE)	29.29
Mass flow of gas.....(LB/HR)	96658
Volumetric flow rate.....	
actual.....(ACFM)	29105
dry standard.....(DSCFM)	19945