

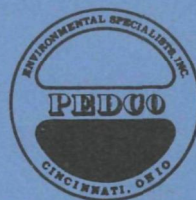
Test Number

72-MM-27

Monsanto Chemical Company

Soda Springs, Idaho

PEDCo ENVIRONMENTAL



Test Number

72-MM-27

Monsanto Chemical Company

Soda Springs, Idaho

Prepared by:

Robert S. Amick

Richard W. Gerstle, P.E.

PEDCo-Environmental Specialists, Inc.

Cincinnati, Ohio

Contract No. 68-02-0237, Task 15

TABLE OF CONTENTS

	<u>Page Number</u>
I. INTRODUCTION	1
II. SUMMARY OF RESULTS	5
III. PROCESS DESCRIPTION	23
IV. LOCATION OF SAMPLING POINTS	27
V. SAMPLING PROCEDURES	29
APPENDIX A - DATA SUMMARY OF SO ₂ /SO ₃ , FLUORIDE, AND P ₂ O ₅ RESULTS, COMPUTER PRINTOUTS, AND EXAMPLE CALCULATIONS	
APPENDIX B - FIELD DATA	
APPENDIX C - LABORATORY REPORT	
APPENDIX D - TEST LOG	
APPENDIX E - PROJECT PARTICIPANTS AND TITLES	

I. INTRODUCTION

Under the Clean Air Act, as amended, the Environmental Protection Agency is charged with the establishment of performance standards for new installations or modifications of existing installations in stationary source categories which may contribute significantly to air pollution. A performance standard is a standard for emissions of air pollutants which reflects the performance of the best emission reduction systems that have been adequately demonstrated (taking into account economic considerations).

Tests Performed

A series of tests were conducted at the elemental phosphorus plant of Monsanto Chemical Company in Soda Springs, Idaho during October 5 - 11, 1972. Fluoride, P_2O_5 , SO_3 and SO_2 concentrations before and after the venturi scrubber serving the slag tapping operation of the No. 8 electric furnace were measured. Stack gas velocities, temperatures, moisture content, and molecular weights were also determined where applicable. Separate sets of three runs were made for fluoride and P_2O_5 determinations. However, each sample was later analyzed by EPA for both fluoride and P_2O_5 , resulting in six determinations for each compound at each sampling site.

Table 1 summarizes the test locations, dates, and other pertinent information pertaining to this test series.

All samples were analyzed by EPA.

Sampling Sites

Stack gases from the furnace slag tapping operation were collected before and after the venturi scrubber, as shown in Figure 1 at points D and E, respectively. Scrubber water samples were taken at a tap in the recycle line a few feet upstream of the scrubber recycle pump, as shown in Figure 1.

TABLE 1. SUMMARY OF EMISSION MEASUREMENTS
MADE AT MONSANTO CHEMICAL COMPANY IN
SODA SPRINGS, IDAHO

Date 1972	Test No.	Test Site	Stack Gas Parameters				Emissions
			Velocity	Temp.	%H ₂ O	Molec. Wt.	
10/5	1 & 2	No. 8 Furnace Slag Tap Scrubber Inlet and Outlet					Fluorides and Visible Emission
10/6	3						"
10/9	1 & 2						P ₂ O ₅ and Visible Emission
10/10	3						"
10/10	1 & 2	↓					SO ₂ & SO ₃
10/11	3		↓	↓	↓	↓	"

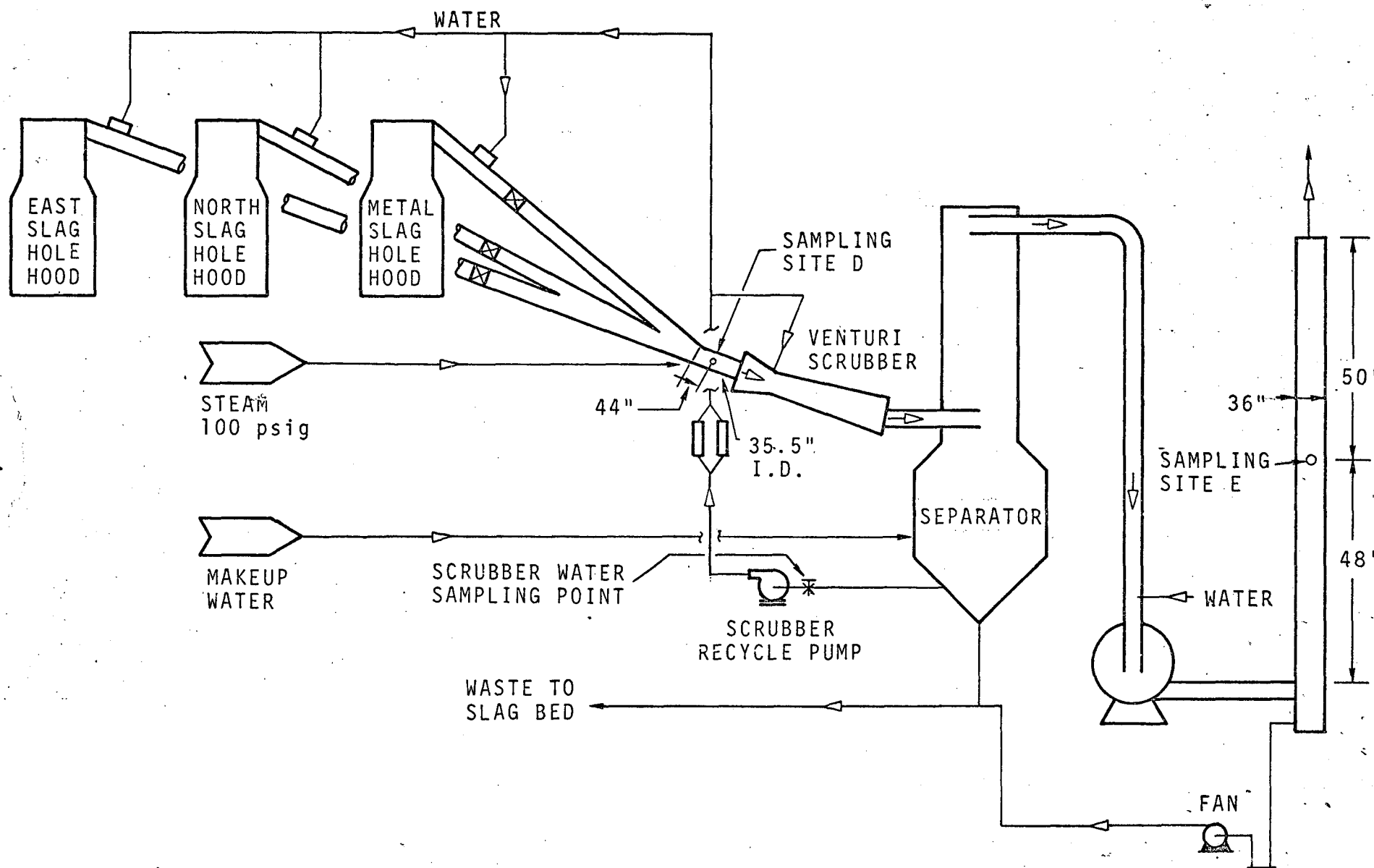


Figure 1. Number 8 phosphorus furnace slag tap scrubber sampling site, Monsanto Chemical Company - Soda Springs, Idaho

II. SUMMARY OF RESULTS

Fluoride, P_2O_5 , and SO_x emission data and associated stack gas flow parameters are presented in Tables 2 through 10. Complete sampling data and calculations are presented in the appendices of this report. Emissions reported in pounds per hour are during tapping only, not continuous clock time.

The average interval between the slag taps during the nine inlet-outlet tests was twenty (20) minutes, while the average slag tap duration was ten (10) minutes, i.e., slag tapping occurred for an average of twenty minutes per hour. Since there were three separate slag-tap holes with separate hoods and aspiration ducts, as illustrated in Figure 1, a wide variation occurred in the emission data, as well as the visible emission observations made during some of the tests.

Tables 11, 12, and 13 summarize the average emission results for the fluoride, P_2O_5 , and SO_x tests, respectively. Tables 14 and 15 summarize the fluoride and P_2O_5 content of the scrubber water and process materials.

Fluoride Tests

The first Greenburg-Smith impinger plugged with particulate matter after five minutes into the first fluoride test;

TABLE 2: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 1 - FLUORIDES

	<u>INLET</u>	<u>OUTLET</u>
Date	10-5-72	10-5-72
Volume of Gas Sampled - DSCF ^a	37.638	24.699
Percent Moisture by Volume	.99	2.09
Average Stack Temperature - °F	125	84
Stack Volumetric Flow Rate - DSCFM ^b	19,825	20,295
Stack Volumetric Flow Rate - ACFM ^c	27,340	26,208
Percent Isokinetic	104.6	73.5
Percent Excess Air	--	--
Percent Capacity	--	--
Feed Rate - ton/hr	--	--
<u>Flourides</u>		
mg	33.74	3.38
gr/DSCF	.01383	.00211
gr/ACF	.01002	.00163
lb/hr ^d	2.350	.367
lb/ton feed	--	--
efficiency, % ^e		84.4
<u>P₂O₅</u>		
mg	509.50	15.90
gr/DSCF	.20890	.00993
gr/ACF	.15141	.00769
lb/hr ^d	35.499	1.728
lb/ton feed	--	--
efficiency, % ^e		95.1

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr.

TABLE 3 : SUMMARY OF EMISSION DATA
 MONSANTO - SODA SPRINGS, IDAHO
 NO. 8 FURNACE INLET AND OUTLET
 RUN NO. 2 - FLUORIDES

	<u>INLET</u>	<u>OUTLET</u>
Date	10-5-72	10-5-72
Volume of Gas Sampled - DSCF ^a	38.107	26.854
Percent Moisture by Volume	.50	3.03
Average Stack Temperature - °F	125	83
Stack Volumetric Flow Rate - DSCFM ^b	21,032	21,134
Stack Volumetric Flow Rate - ACFM ^c	28,867	27,480
Percent Isokinetic	103.9	76.8
Percent Excess Air	--	--
Percent Capacity	--	--
Feed Rate - ton/hr	--	--
 <u>Flourides</u>		
mg	42.73	1.070
gr/DSCF	.01730	.00061
gr/ACF	.01260	.00047
lb/hr ^d	3.119	.111
lb/ton feed	--	--
efficiency, % ^e	96.4	
 <u>P₂O₅</u>		
mg	448.50	11.20
gr/DSCF	.18163	.00643
gr/ACF	.13230	.00494
lb/hr ^d	32.744	1.165
lb/ton feed	--	--
efficiency, % ^e	96.4	

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr.

TABLE 4: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 3 - FLUORIDES

	<u>INLET</u>	<u>OUTLET</u>
Date	10-6-72	10-6-72
Volume of Gas Sampled - DSCF ^a	36.409	32.569
Percent Moisture by Volume	0.00	0.00
Average Stack Temperature - °F	147	77
Stack Volumetric Flow Rate - DSCFM ^b	18,794	21,328
Stack Volumetric Flow Rate - ACFM ^c	26,599	26,547
Percent Isokinetic	108.4	77.8
Percent Excess Air	--	--
Percent Capacity	--	--
Feed Rate - ton/hr	--	--
<u>Flourides</u>		
mg	13.32	1.50
gr/DSCF	.00564	.00084
gr/ACF	.00399	.00067
lb/hr ^d	.909	.154
lb/ton feed	--	--
efficiency, % ^e		83.1
<u>P₂O₅</u>		
mg	174.00	12.60
gr/DSCF	.07375	.00707
gr/ACF	.05213	.00568
lb/hr ^d	11.880	1.295
lb/ton feed	--	--
efficiency, % ^e		89.1

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr.

TABLE 5: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 1 - P₂O₅

	<u>INLET</u>	<u>OUTLET</u>
Date	10-9-72	10-9-72
Volume of Gas Sampled - DSCF ^a	32.689	33.550
Percent Moisture by Volume	0.43	1.90
Average Stack Temperature - °F	137	75
Stack Volumetric Flow Rate - DSCFM ^b	18,197	20,045
Stack Volumetric Flow Rate - ACFM ^c	25,444	25,360
Percent Isokinetic	103.8	101.1
Percent Excess Air	--	--
Percent Capacity	--	--
Feed Rate - ton/hr	--	--
<u>P₂O₅</u>		
mg	226.0	15.2
gr/DSCF	.1067	.00699
gr/ACF	.0748	.00552
lb/hr ^d	16.640	1.201
lb/ton feed	--	--
efficiency, % ^e		92.8
<u>Fluorides</u>		
mg	17.69	.860
gr/DSCF	.00835	.00039
gr/ACF	.00585	.00031
lb/hr ^d	1.302	.067
lb/ton feed	--	--
Percent impinger catch	--	--
efficiency, % ^e		94.9

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr.

TABLE 6: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 2 - P₂O₅

	<u>INLET</u>	<u>OUTLET</u>
Date	10-9-72	10-9-72
Volume of Gas Sampled - DSCF ^a	30.204	32.770
Percent Moisture by Volume	1.27	4.01
Average Stack Temperature - °F	106	83
Stack Volumetric Flow Rate - DSCFM ^b	15,246	19,559
Stack Volumetric Flow Rate - ACFM ^c	20,372	25,657
Percent Isokinetic	118.3	101.2
Percent Excess Air	--	--
Percent Capacity	--	--
Feed Rate - ton/hr	--	--
<u>P₂O₅</u>		
mg	274.20	32.10
gr/DSCF	.14010	.01511
gr/ACF	.10478	.01148
lb/hr ^d	18.308	2.534
lb/ton feed	--	--
efficiency, % ^e		86.2
<u>Fluorides</u>		
mg	97.46	7.29
gr/DSCF	.04979	.00343
gr/ACF	.03724	.00261
lb/hr ^d	6.507	.575
lb/ton feed	--	--
Percent impinger catch	--	--
efficiency, % ^e		91.2

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr.

TABLE 7: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 3 - P₂O₅

	<u>INLET</u>	<u>OUTLET</u>
Date	10-10-72	10-10-72
Volume of Gas Sampled - DSCF ^a	29.668	34.650
Percent Moisture by Volume	.86	3.09
Average Stack Temperature - °F	149	82
Stack Volumetric Flow Rate - DSCFM ^b	18,089	20,005
Stack Volumetric Flow Rate - ACFM ^c	25,939	25,996
Percent Isokinetic	103.8	104.7
Percent Excess Air	--	--
Percent Capacity	--	--
Feed Rate - ton/hr	--	--
 <u>P₂O₅</u>		
mg	231.4	17.9
gr/DSCF	.12036	.00797
gr/ACF	.08394	.00613
lb/hr ^d	18.662	1.367
lb/ton feed	--	--
efficiency, % ^e	92.7	
 <u>Fluorides</u>		
mg	30.7	2.35
gr/DSCF	.01596	.00104
gr/ACF	.01113	.00080
lb/hr ^d	2.475	.179
lb/ton feed	--	--
Percent impinger catch	--	--
efficiency, % ^e	92.8	

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr.

TABLE 8: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 1 - SO_x

	<u>INLET</u>	<u>OUTLET</u>
Date	10-10-72	10-10-72
Volume of Gas Sampled - DSCF ^a	31.752	34.812
Percent Moisture by Volume	2.42	1.75
Average Stack Temperature - °F	143	80
Stack Volumetric Flow Rate - DSCFM ^b	17,811	19,955
Stack Volumetric Flow Rate - ACFM ^c	25,691	25,445
Percent Isokinetic	106.4	105.4
Percent Excess Air	--	--
Percent Opacity	--	--
Feed Rate - ton/hr	--	--
<u>SO₃</u>		
mg	352.50	3.600
gr/DSCF	.17132	.00159
gr/ACF	.11872	.00125
lb/hr ^d	26.155	.27
ppm	125	1.2
lb/ton of feed	--	--
efficiency, % ^f	99.0	
<u>SO₂</u>		
mg	60.20	e
gr/DSCF	.02925	e
gr/ACF	.02027	e
lb/hr ^d	4.5	e
ppm	25	e
lb/ton of feed	--	--
efficiency, % ^e		

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping.

^e SO₂ concentration unavailable - no reproducible value could be obtained due to interferences.

^f Based on emission rate, lb/hr.

TABLE 9: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 2 - SO_x

	INLET 10-10-72	OUTLET 10-10-72
Date		
Volume of Gas Sampled - DSCF ^a	33.453	34.558
Percent Moisture by Volume	3.76	3.15
Average Stack Temperature - °F	144	79
Stack Volumetric Flow Rate - DSCFM ^b	18,587	19,519
Stack Volumetric Flow Rate - ACFM ^c	27,258	25,190
Percent Isokinetic	107.5	107.0
Percent Excess Air	--	--
Percent Opacity	--	--
Feed Rate - ton/hr	--	--
<u>SO₃</u>		
mg	108.50	7.80
gr/DSCF	.05005	.00348
gr/ACF	.03415	.00270
lb/hr ^d	8.0	.58
ppm	36	2.5
lb/ton of feed	--	--
efficiency, % ^e		92.8
<u>SO₂</u>		
mg	37.80	36.40
gr/DSCF	.01743	.01625
gr/ACF	.01189	.01260
lb/hr ^d	2.8	2.7
ppm	15	14
lb/ton of feed	--	--
efficiency, % ^e		

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr

TABLE 10: SUMMARY OF EMISSION DATA
MONSANTO - SODA SPRINGS, IDAHO
NO. 8 FURNACE INLET AND OUTLET
RUN NO. 3 - SO_x

	INLET	OUTLET
Date	10-11-72	10-11-72
Volume of Gas Sampled - DSCF ^a	28.001	30.896
Percent Moisture by Volume	2.86	2.92
Average Stack Temperature - °F	116	83
Stack Volumetric Flow Rate - DSCFM ^b	19,324	18,825
Stack Volumetric Flow Rate - ACFM ^c	26,763	24,385
Percent Isokinetic	102.4	108.4
Percent Excess Air	--	--
Percent Opacity	--	--
Feed Rate - ton/hr	--	--
<u>SO₃</u>		
mg	150.00	10.50
gr/DSCF	.08267	.00524
gr/ACF	.05970	.00404
lb/hr ^d	13.7	.85
ppm	60	3.8
lb/ton of feed	--	--
efficiency, % ^e		
<u>SO₂</u>		
mg	96.60	60.20
gr/DSCF	.05324	.03006
gr/ACF	.03844	.02319
lb/hr ^d	8.8	4.9
ppm	46	26
lb/ton of feed	--	--
efficiency, % ^e		

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on emission rate, lb/hr

TABLE 11. AVERAGE EMISSION RESULTS FOR
FLUORIDE TESTS
1-3

	<u>INLET</u>	<u>OUTLET</u>
Date	---	---
Volume of Gas Sampled - DSCF ^a	---	---
Percent Moisture by Volume	---	---
Average Stack Temperature - °F	132	81
Stack Volumetric Flow Rate - DSCFM ^b	19,884	20,919
Stack Volumetric Flow Rate - ACFM ^c	27,602	26,745
Percent Isokinetic	---	---
Percent Excess Air	N.A.	N.A.
Percent Capacity	N.A.	N.A.
Feed Rate - ton/hr	N.A.	N.A.
<u>Flourides</u>		
mg		
gr/DSCF	.01226	.00119
gr/ACF	.00887	.00092
lb/hr ^d	2.1	.21
lb/ton feed		
efficiency, % ^e	90.0	
<u>P₂O₅</u>		
mg		
gr/DSCF	.15476	.00781
gr/ACF	.11195	.00610
lb/hr ^d	26.708	1.396
lb/ton feed	---	---
efficiency, % ^e	94.8	

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on average emission rate, lb/hr.

TABLE 12. AVERAGE EMISSION RESULTS FOR
P₂O₅ TESTS
1-3

	<u>INLET</u>	<u>OUTLET</u>
Date	---	---
Volume of Gas Sampled - DSCF ^a	---	---
Percent Moisture by Volume	---	---
Average Stack Temperature - °F	131	80
Stack Volumetric Flow Rate - DSCFM ^b	17,177	19,870
Stack Volumetric Flow Rate - ACFM ^c	23,918	25,671
Percent Isokinetic	---	---
Percent Excess Air	N.A.	N.A.
Percent Capacity	N.A.	N.A.
Feed Rate - ton/hr	N.A.	N.A.
<u>P₂O₅</u>		
mg	---	---
gr/DSCF	.12239	.01002
gr/ACF	.08784	.00771
lb/hr ^d	17.87	1.70
lb/ton feed	---	---
efficiency, % ^e	90.4	
<u>Fluorides</u>		
mg	---	---
gr/DSCF	.02470	.00162
gr/ACF	.01807	.00124
lb/hr ^d	3.43	.274
lb/ton feed	---	---
efficiency, % ^e	92.0	

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on average emission rate, lb/hr

TABLE 13. AVERAGE EMISSION RESULTS FOR
SO_x TESTS
1-3

	<u>INLET</u>	<u>OUTLET</u>
Date	---	---
Volume of Gas Sampled - DSCF ^a	---	---
Percent Moisture by Volume	---	---
Average Stack Temperature - °F	134	81
Stack Volumetric Flow Rate - DSCFM ^b	18,574	19,433
Stack Volumetric Flow Rate - ACFM ^c	26,571	25,007
Percent Isokinetic	N.A.	N.A.
Percent Excess Air	N.A.	N.A.
Percent Opacity	N.A.	N.A.
Feed Rate - ton/hr	N.A.	N.A.
<u>SO₃</u>		
mg	---	---
gr/DSCF	.10135	.00344
gr/ACF ^d	.07086	.00266
lb/hr	15.95	.567
ppm	74	2.5
lb/ton of feed	---	---
efficiency, % ^e		96.6
<u>SO₂</u>		
mg	---	---
gr/DSCF	.03331	.02316
gr/ACF ^d	.02353	.01790
lb/hr	5.4	3.8
ppm	28.7	20.0
lb/ton of feed	---	---
efficiency, % ^e		29.6

^a Dry standard cubic feet at 70°F, 29.92 in. Hg.

^b Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.

^c Actual cubic feet per minute

^d Emission rate during tapping

^e Based on average emission rate, lb/hr

TABLE 14. SUMMARY OF SCRUBBER
WATER ANALYSES FOR FLUORIDES AND P_2O_5

TEST	DATE	SCRUBBER WATER FLUORIDES (MG/L)	CONCENTRATIONS P_2O_5 (MG/ML)
1-Fluorides	10/5/72	125.2 ^{a,b} 124.0 (outlet to lake)	3.5 ^{a,b} 1.8 (outlet to lake)
2-Fluorides	10/5/72	168.9 ^{a,b}	3.7 ^{a,b}
3-Fluorides	10/6/72	98.9 ^{a,b}	2.7 ^{a,b}
1- P_2O_5	10/9/72	399.1 ^b	8.8 ^b
2- P_2O_5	10/9/72	1000 ^b	14.3 ^b
3- P_2O_5	10/10/72	268.2 ^b	3.7 ^b

a) Average concentration of 2 samples taken

b) See Figure 1 for scrubber water sample location.

TABLE 15. SUMMARY OF PROCESS
MATERIAL ANALYSES

RAW MATERIAL	DATE	TOTAL FLUORIDES	TOTAL P ₂ O ₅
Silica Sand	10/6/72	< .06 mg/gm	0
Phosphorus Nodules	10/6/72	2.63% (by weight) ^a	27.4% (by weight) ^a
	10/10/72	2.80% (by weight) ^a	28.9% (by weight) ^a
Coke	10/6/72	-	<.1% (by weight)
Precipitator Dust	10/9/72	7.5 mg/gm	26.1%

a) Represents average of 2 samples

consequently, the Greenburg-Smith impinger was replaced with a modified straight tip impinger, which alleviated this plugging for the rest of the test. The modified tip first impinger was used throughout the remaining eight tests at the inlet site.

Particulate concentration at the inlet site was observed to vary widely throughout the nine tests.

The percent isokinetic values for the scrubber outlet fluoride tests were low, averaging 76.03%, because the moisture had been assumed to be approximately 20%, when it was actually less than 2 percent.

A ferrophos tap occurred for 12 minutes during the third fluoride test. This tap yielded visible emissions which were similar to the ordinary slag taps' visible emissions.

The rest of the fluoride tests were run without incident. The average inlet fluoride emission rate was 2.1 lbs/hr and the outlet was .21 lb/hr. The scrubber therefore removed 90.0% of the fluorides on the average.

Opacity readings of visible emissions recorded during the three fluoride tests are included in Appendix A, Field Data. The individual average - weighted opacities for these three

test periods were: Test 1: 14.1%; Test 2: 14.9%; Test 3: 12.0%; the average opacity for the three tests was 13.7%.

P₂O₅ Tests

The relatively low P₂O₅ and fluoride concentrations in Test 1 (when compared with the other P₂O₅ tests) confirmed the following observations made during the first P₂O₅ test:

1. Opacity of the scrubber outlet stack exhaust was considerably less than that observed for the three previous fluoride tests;
2. Dust concentration was about 25% of that observed during the other tests, as evidenced by the lack of appreciable particulate build-up on the fiberglass inlet filter and visual observation of the inlet gas stream.

A ferrophos tap occurred for 18 minutes during P₂O₅ Test No. 2. This tap yielded visible emissions which were similar to the ordinary slag taps' visible emissions.

The third P₂O₅ test was run without incident. The average P₂O₅ emission rate for the three tests was 17.9 lb/hr at the inlet and 1.7 lb/hr at the outlet, yielding an average scrubber efficiency of 90.4%.

SO_x Tests

SO_x tests were made with a single traverse through one port, at both the inlet and outlet, as space restrictions

precluded traversing through both ports with a rigid probe. All tests were made under apparently ordinary conditions.

Average concentrations for SO_3 before and after the scrubber were 74 and 2.6 ppm respectively. The SO_2 average concentrations were 29 and 20 ppm at the inlet and outlet respectively.

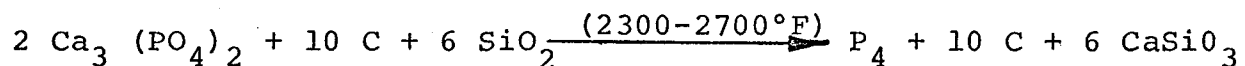
III. PROCESS DESCRIPTION

Elemental phosphorus is produced from phosphate rock by reduction in an electric arc furnace. Typical ores contain 10-13% phosphorus so that about 10 tons of rock must be processed per ton of phosphorus produced. Considerable quantities of coke, silica, and recycled materials are fed to the furnaces with the beneficiated ore.

Prior to being fed to the furnace, the rock is agglomerated and heat-hardened in a kiln. The partially fused product is cooled and crushed to a specified size before being fed to the furnace as shown in Figure 1.

Phosphate feed is carefully proportioned with silica and coke before being transferred to feed bins directly above the furnace. The feed mixture then moves by gravity from the bins down into the furnace as the furnace feed is consumed.

The reaction within the furnace is approximated by the following equation:



Elemental phosphorous and carbon monoxide leave the furnace as gases. Dust is removed from the stream by an electrostatic precipitator and the phosphorous vapor is later condensed out in direct-contact water condensers. Waste CO gas is used as a fuel in the kiln operation.

The molten process by-products and some coke must be periodically removed from the furnace by tapping. This molten material separates into two layers inside the furnace. The lighter top layer is a slag from the ore material. This slag has no economic value except as an aggregate. It is tapped alternately from two tapholes at 15-minute intervals. The slag runs out into water-filled pits behind the furnace building.

The heavier bottom layer is about twice the density of the slag, and is largely a phosphorous-iron mixture known as ferrophos. This metal by-product is tapped from the furnace twice each day. The ferrophos is poured into chills and then shipped to a nearby plant for vanadium recovery.

The tapping of slag and ferrophos results in the evolution of significant amounts of fumes, most of which are P_2O_5 particulates.

The No. 8 furnace at Monsanto's Soda Springs, Idaho plant has been partially controlled since 1971 by a taphole-hooding system vented to a scrubber.

Each of the three tapholes is hooded by a completely enclosed box. Each box is refractory lined with outside dimensions of 8' x 6' x 7'. The refractory lining is necessary

to prevent warping of the metal shell from the intense heat. There are access ports and doors on the hoods which are usually kept closed. However, even when the doors are open, fume pickup is very effective within the hooded area. There is no hooding over the slag runners or at the chill line or metal well.

A three-foot diameter duct directs the fumes from each hood to the control device. Each duct has interior water sprays for cooling purposes and dampers to control draft on each hood. Usually, two ducts are open and one is closed. The intake velocity across the access ports is approximately 700 feet per minute.

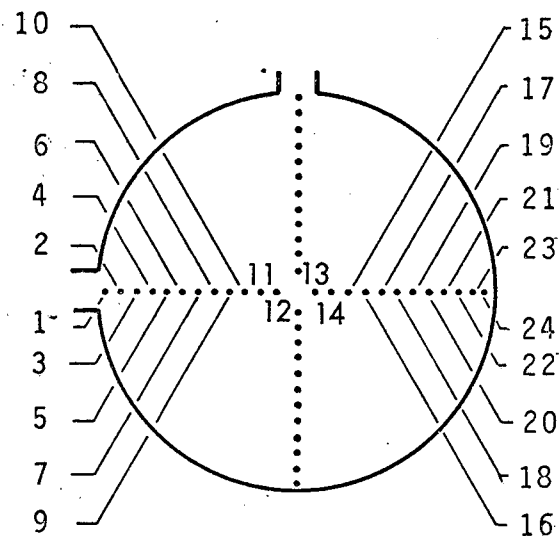
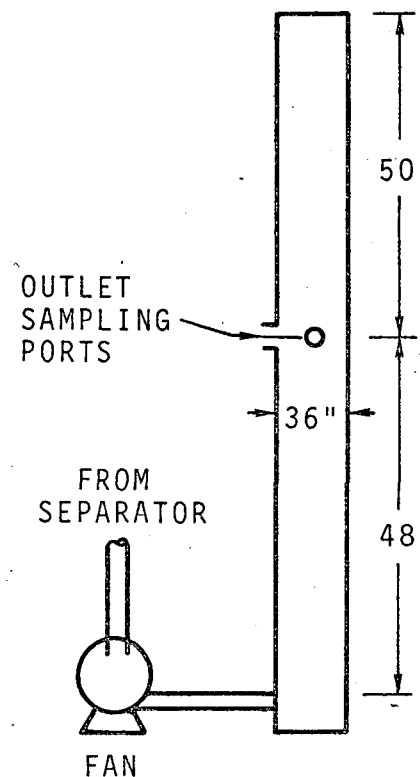
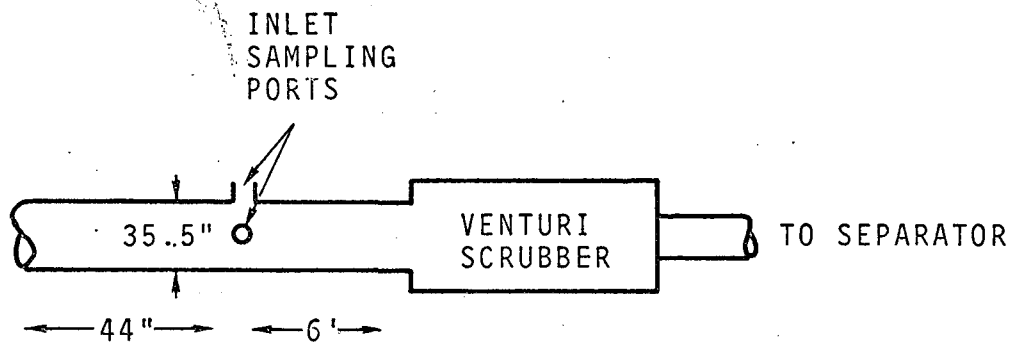
The three ducts join and lead to a high pressure-drop venturi scrubber. Water is sprayed from nozzles on each side of the throat at 370-420 gpm, depending on the amount of water being sprayed into the ductwork prior to the scrubber. The pressure drop across the scrubber is maintained at 48-52 inches of water. From the scrubber the exhaust stream enters a cyclonic separator. The removed water is recirculated from the bottom of the separator back to the venturi throat. Make-up water is added at a rate of 30-40 gallons per minute. From the separator, the cleaned gas is exhausted through an induced draft fan to a 175' fiberglass stack to the atmosphere.

During testing, the furnace and scrubber control system were operating normally and at rated capacity.

IV. LOCATION OF SAMPLING POINTS

Figure 2 shows the sampling ports and the number of sampling points at the inlet and outlet sites used to determine the emissions from the slag tapping process. The inlet site was located in a 35.5-inch round horizontal duct, and samples here were collected at 48 points (24 along each diameter) of a vertical and a horizontal port. This inlet port location (Figures 1 and 2) does not conform to requirements of the Federal Register¹, which specifies a minimum sampling distance from obstructions of two (2) duct diameters and one-half (1/2) duct diameter upstream and downstream of the sampling port respectively. The site was nonetheless used because it was the only available location for sampling. As shown, outlet samples were extracted at 12 points (6 along each diameter) from two ports in a 36-inch round vertical stack 48' above the slag tap scrubber exhaust fan.

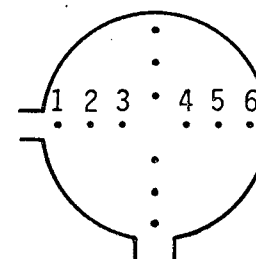
¹ Federal Register, Vol. 36, No. 247, December 23, 1971



TRAVERSE POINT DISTANCES
FROM INSIDE OF STACK, inches

1.	0.4	13.	21.4
2.	1.1	14.	24.0
3.	2.0	15.	25.8
4.	2.8	16.	27.3
5.	3.7	17.	28.6
6.	4.7	18.	29.8
7.	5.7	19.	30.8
8.	6.9	20.	31.8
9.	8.2	21.	32.7
10.	9.7	22.	33.6
11.	11.5	23.	34.4
12.	14.1	24.	35.1

NO. 8 PHOSPHORUS FURNACE
SLAG TAP SCRUBBER INLET



TRAVERSE POINT DISTANCES
FROM INSIDE
OF STACK, inches

1.	1.6	4.	25.4
2.	5.3	5.	30.7
3.	10.6	6.	34.4

NO. 8 PHOSPHORUS FURNACE
SLAG TAP SCRUBBER OUTLET

Figure 2. Slag tap scrubber sampling sites and location of sampling points-Monsanto Chemical Company

V. SAMPLING PROCEDURES

All sampling procedures were selected by EPA prior to field sampling. All analysis of collected samples were also performed by EPA. Field data sheets were submitted to EPA at the test site.

Velocity and Gas Temperature

All gas velocities were measured with a type S pitot tube and inclined draft gage. In all cases velocities were measured at each sampling point across the stack diameter to determine an average value according to procedures described in the Federal Register¹ - Method 1. Temperatures were measured by long stem dial thermometers.

Molecular Weight

An integrated sample of the stack gases was collected during each run by pumping gas into a Mylar plastic bag at the rate of approximately 0.5 liter per minute. This bag sample was then analyzed with an Orsat apparatus for CO₂ and O₂ as described in the Federal Register, December 23, 1971, in Method 3.¹

Fluorides

The basic train for total fluoride samples, as shown in Figure 3, consisted of three standard Greenburg-Smith impingers

¹ Federal Register, Vol. 36, No. 247, December 23, 1971.

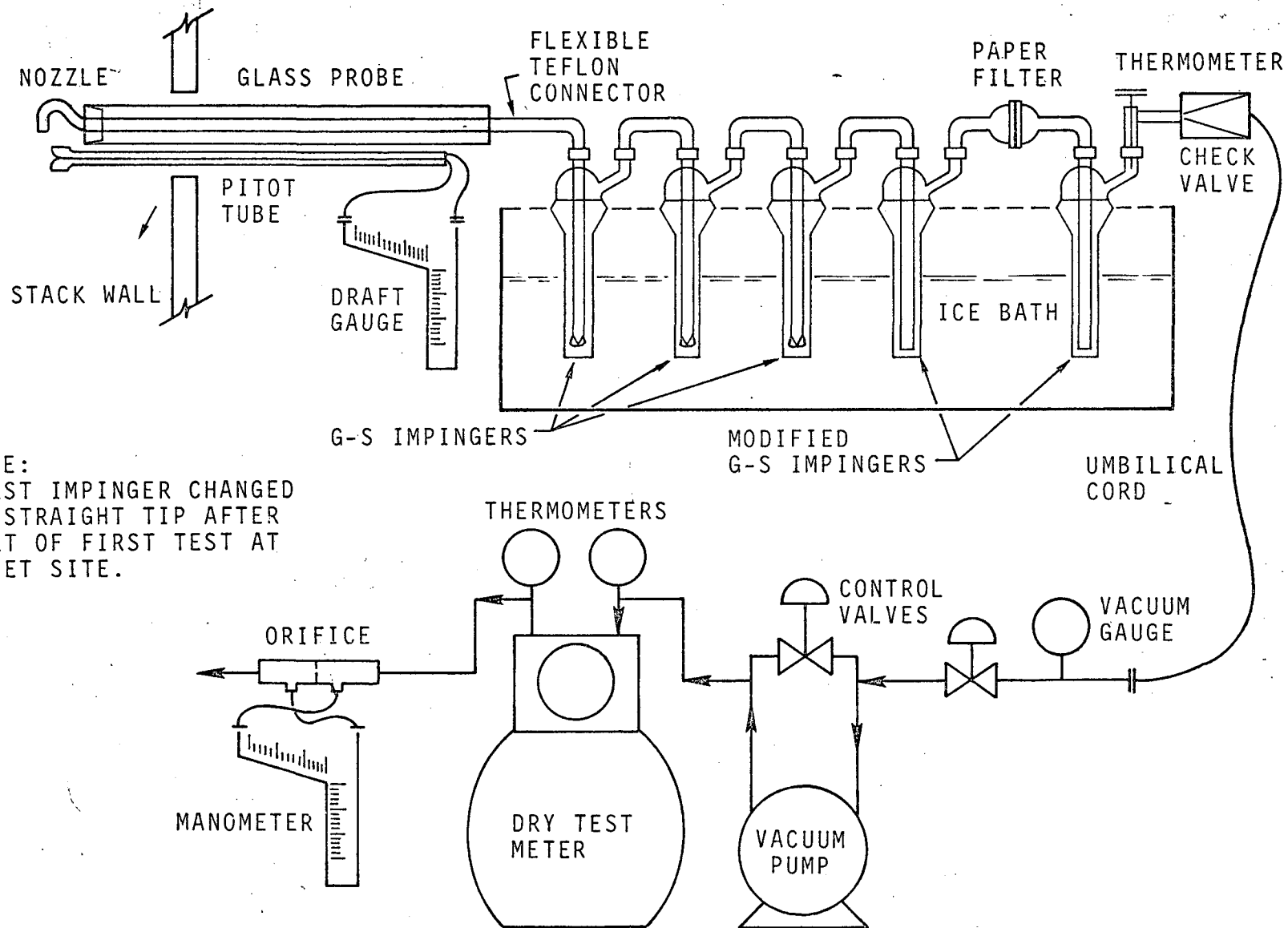


Figure 3. Fluoride and P_2O_5 sampling train.

containing 250 ml each of 2.5% sodium hydroxide^a, one empty straight tip impinger, a 3" or 4" unheated Whatman #1 paper filter, and an impinger containing approximately 200 grams of accurately weighed silica gel. The impingers were contained in an ice-water bath. A stainless steel nozzle and glass lined probe were used in all cases. A flexible Teflon connector (5' long) was used at both test sites to connect the probe to the first impinger, as space limitations precluded the use of a rigid train configuration.

After sampling, the entire train was rinsed with distilled water and combined with the impinger contents and the filter into a single container. An acetone rinse of all components was placed in a second container.

P₂O₅

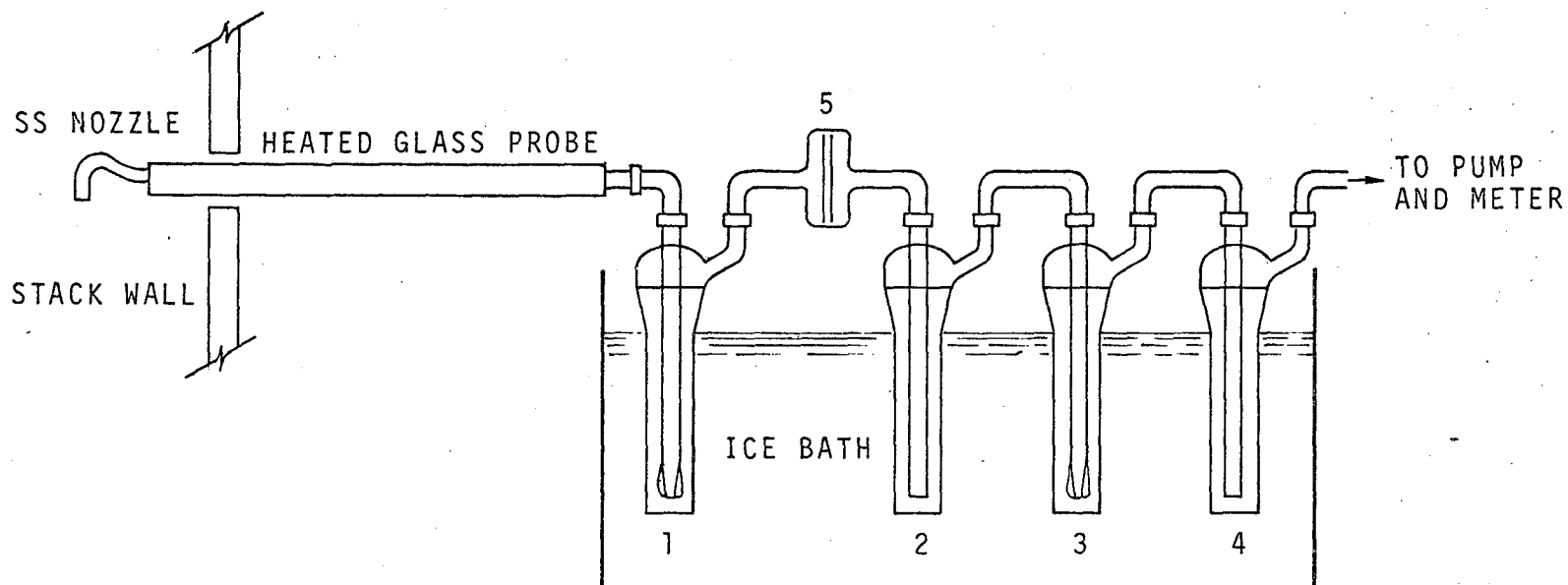
A sampling train identical to that used for fluorides was employed for the collection of P₂O₅ except that only 100 ml of 2.5% sodium hydroxide was used in the first three impingers. Sample recovery was identical to the fluoride procedure.

SO₂ and SO₃

Method 8 as described in the Federal Register¹ was used to measure sulfur oxides as shown in Figure 4. A rigid train

^a Though a 10% NaOH solution was originally planned, this was changed to 2.5% based on tests conducted at another plant during the previous week.

1) Federal Register, Vol. 36, No. 247, December 23, 1971.



1. G-S IMPINGER - 100 ml. 80% ISOPROPANOL
2. MODIFIED G-S IMPINGER - 100 ml. 3% H_2O_2
3. G-S IMPINGER - 100 ml. 3% H_2O_2
4. MODIFIED G-S IMPINGER - 200 g. SILICA GEL
5. FILTER HOLDER w/GLASS FIBER FILTER

Figure 4. SO_2/SO_3 sampling train.

with heated glass lined probe was employed at both the inlet and outlet of the venturi scrubber.

In all cases sampling was conducted under isokinetic conditions by continually monitoring the velocity with a pitot tube and adjusting the sampling rate accordingly. When slag tapping and sampling stopped in the middle of a traverse, that traverse point was completed at the start of the next slag tap before going to the next traverse point.

Sample recovery consisted of rinsing the probe with distilled water and adding the washings to the first impinger along with the filter. The contents of the two impingers after the filter were poured into another container and rinsed with distilled water.