Recu 12/ - MEK

INCLUDES TEST ON PERLITE

PARTICULATE EMISSION SAMPLING AND ANALYSIS UNITED STATES GYPSUM COMPANY EAST CHICAGO, INDIANA

Reference 2

JULY - 1973

SUBMITTED BY:
ENVIRONMENTAL INSTRUMENT SYSTEMS, INC.
116 NORTH HILL STREET
SOUTH BEND, INDIANA 46617

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I INTRODUCTION

Stack emissions testing was conducted by Environmental Instrument Systems, Inc. at the U.S. Gypsum Company, East Chicago plant to determine particulate loading and emission rates from selected process ducts and control systems. The specific process ducts sampled were the #1 and #2 Raymonds, #1 and #3 Kettles and the Dryer. Inlet and exhaust particulate sampling was also conducted on the #2 and #3 Cottrell control systems and the Perlite Ore process dust collection system to determine the operational efficiency of the individual units and the degree of compliance with applicable air pollution control regulations. Sampling was conducted during the period of 6-18-73 to 6-22-73 and related process weight data was obtained from U.S. Gypsum personnel.

II PROCEDURE

Sampling Method

Sampling for particulates utilized the standard U.S. Environmental Protection Agency (EPA) train (Figure 1). The EPA train allows samples to be collected under isokinetic conditions. In those instances deemed necessary a cyclone assembly was placed ahead of the filter to collect particles greater than 10 microns in diameter. For the performance evaluations two complete sampling trains were used, one on the inlet to the control and the other on the outlet of the control.

Analytical Procedure

Pre-dried (at 105°C) and pre-weighed glass fiber filters were used for the collection of particulate matter. Following the isokinetic sampling run, the filters were placed in aluminum dishes for transport back to the

EIS laboratory for analysis. In addition, the interior of the probe and nozzle was washed with acetone to remove any entrained particulate matter. The cyclone assembly was also washed with acetone. These washings were collected in clean, dry polyethylene bottles. Any adhered particles which were not removed with the acetone were loosened by means of a "rubber policeman" and placed in the nozzle wash bottles.

In the laboratory, the filter and nozzle washings were transferred to separate tared weighing dishes, then oven dried and desiccated to a constant weight. Results were recorded to 0.1 mg using a single pan balance. Total particulate weight then was determined as a sum of the filter weights and probe, nozzle and cyclone washing weights.

III PROCESS & SAMPLING INFORMATION

The specific processes sampled from 6-18-73 to 6-22-73 are listed below.

- Inlet to and outlet from the #2 Cottrell Electrostatic Precipitator
- Inlet to and outlet from the #3 Cottrell Electrostatic Precipitator
- Inlet to and outlet from the Perlite Ore Expansion process multiclone system
- #1 and #2 Raymond Mill ducts
- #1 and #3 Kettle Calcining ducts
- Rock Dryer duct

Simultaneous inlet and outlet sampling was coordinated by means of hand carried walkie-talkies. This method of sampling ensured that one sampling crew would not be operational while the other crew was shut down during change of sampling ports. Total sampling time for the evaluation of control equipment efficiency was thus the same for both inlet and outlet samples, in addition to being simultaneous.

Coordination of plant process status with the sampling crews from Environmental Instrument Systems, Inc. was performed by U.S. Gypsum personnel. As indicated by the Process Status and Charge Weight Data (Appendix A), a "communications breakdown" occured and the sampling of the #2 Raymond Mill duct, specifically Runs #2 and #3 on 6-21-73, was conducted during a process interruption. Run #1 was completed in its entirety while the process was operational.

Inlet sampling to the #3 Cottrell Electrostatic Precipitator necessitated the use of a standard pitot tube for velocity head determinations. Velocity pressures lower than 0.1 inches of water were experienced in all the sampling ports.

Use of a standard pitot tube in place of the S-type allowed accurate measurement of low velocity pressures to be made.

Some difficulty was initially experienced in the sampling of the Kettle Calcining ducts. Particulate flow rates which induced sampling equipment clogging were encountered. Specifically, the 4" filter, and the probe and the nozzle tended to clog well before the end of the 110 minute sampling period. This problem was overcome by having on hand extra filters, assembled in the filter supports, for a quick change of a clogged filter and the use of exceedingly high probe temperatures to prevent moisture-induced clogging of the probe and nozzle.

IV RESULTS

The following section presents the results of the sampling conducted at the U.S. Gypsum Co., East Chicago, Indiana plant.

Calculations of the Allowable Emission Rate (lbs/hr) were made by using the equations outlined in Appendix D. Combined charge weights of various processes were used in those cases where more than one process was associated with a particular control system.

STACK NO.: #2 COTTRELL ELECTROSTATIC PRECIPITATOR - RUN #1

Date: 6-18-73 Inlet calculations based on velocity pressure data obtained on 7-28-73.
Time: 5:40 PM - 8:00 PM; 120 minutes

	INLET	OUTLET
Stack Cross Sectional Area (sq.ft.)	15.83	6.30
Average Stack Temperature (^{o}F)	205	206
Average Stack Velocity (ft./sec.)	38.75	99.89
Flow Rate, Stack Conditions (cfm)	36,812	37,789
Flow Rate, Standard Conditions (scfm)	28,462	29,198
Total Sampled Volume, Standard Conditions (scf)	48.45	135.28
Percent Moisture	9	8
Barometric Pressure (in.Hg.)	29.04	29.05
Total Particulate Weight (grams)	75.64	9.12
Particulate Concentration, Standard Conditions (grains/scf)	24.11	1.04
Particulate Concentration, Stack Conditions (grains/acf)	20.44	0.88
Particulate Flowrate, Standard Conditions (lbs./hr.)	5877	260
Isokineticity (%)	90	69
Process Rate (tons/hr.)	119	119
Allowable Emission Rate (lbs./hr.)		37.2
Percent Efficiency		95.58

STACK NO.: #2 COTTRELL ELECTROSTATIC PRECIPITATOR - RUN #2

Date: 6-19-73 Inlet calculations based on velocity pressure data obtained on 7-28-73.
Time: 10:38 AM - 1:04 PM; 120 minutes

	INLET	OUTLET
Stack Cross Sectional Area (sq.ft.)	15.83	6.31
Average Stack Temperature (^{o}F)	206	200
Average Stack Velocity (ft./sec.)	38.69	99.00
Flow Rate, Stack Conditions (cfm).	36,755	37,448
Flow Rate, Standard Conditions (scfm)	28,546	29,332
Total Sampled Volume, Standard Conditions (scf)	50.38	140.07
Percent Moisture	9	8
Barometric Pressure (in.Hg.)	29.19	29.19
Total Particulate Weight (grams)	105.48	12.73
Particulate Concentration, Standard Conditions (grains/scf)	32.30	1.40
Particulate Concentration, Stack Conditions (grains/acf)	27.53	1.20
Particulate Flowrate, Standard Conditions (lbs./hr.)	7904	353
Isokineticity (%)	92	68
Process Rate (tons/hr.)	119	119
Allowable Emission Rate (lbs./hr.)		37.2
Percent Efficiency		95.53

STACK NO.: #2 COTTRELL ELECTROSTATIC PRECIPITATOR - RUN #3

Date: 6-20-73 Inlet calculations based on velocity pressure data obtained on 7-28-73.
Time: 11:01 AM - 1:45 PM; 120 minutes

	INLET	OUTLET
Stack Cross Sectional Area (sq.ft.)	15.83	6.31
Average Stack Temperature (^{o}F)	205	212
Average Stack Velocity (ft./sec.)	38.51	104.32
Flow Rate, Stack Conditions (cfm)	36,584	39,465
Flow Rate, Standard Conditions (scfm)	28,595	30,553
Total Sampled Volume, Standard Conditions (scf)	27.75	49.71
Percent Moisture	9	8
Barometric Pressure (in.Hg.)	29.35	29.35
Total Particulate Weight (grams)	60.30	8.10
Particulate Concentration, Standard Conditions (grains/scf)	33.53	2.51
Particulate Concentration, Stack Conditions (grains/acf)	28.73	2.11
Particulate Flowrate, Standard Conditions (lbs./hr.)	8219	658
Isokineticity (%)	90	92
Process Rate (tons/hr.)	119	119
Allowable Emission Rate (lbs./hr.)		37.2
Percent Efficiency		91.99

STACK NO.: #3 COTTRELL ELECTROSTATIC PRECIPITATOR - RUN #1

	INLET	OUTLET
Date: 6-19-73		
Time: 4:41 - 6:00 PM; 60 minutes		
Stack Cross Sectional Area (sq.ft.)	36.00	6.31
Average Stack Temperature (^{o}F)	104	118
Average Stack Velocity (ft./sec.)	13.72	55.43
Flow Rate, Stack Conditions (cfm)	29,640	20,971
Flow Rate, Standard Conditions (scfm)	27,200	18,776
Total Sampled Volume, Standard Conditions (scf)	21.08	59.41
Percent Moisture	3	3
Barometric Pressure (in.Hg.)	29.20	29.20
Total Particulate Weight (grams)	7.99	0.37
Particulate Concentration, Standard Conditions (grains/scf)	5.85	0.10
Particulate Concentration, Stack Conditions (grains/acf)	5.54	0.09
Particulate Flowrate, Standard Conditions (lbs./hr.)	1364	15
Isokineticity (%)	85	95
Process Rate (tons/hr.)	29	29
Allowable Emission Rate (lbs./hr.)		28.7
Percent Efficiency		98.88

STACK NO.: #3 COTTRELL ELECTROSTATIC PRECIPITATOR - RUN #2

Date: 6-19-73	INLET	OUTLET
Time: 6:28 - 7:37 PM; 60 minutes		
Stack Cross Sectional Area (sq.ft.)	36.00	6.31
Average Stack Temperature (^{o}F)	103	115
Average Stack Velocity (ft./sec.)	12.40	56.40
Flow Rate, Stack Conditions (cfm)	26,754	21,336
Flow Rate, Standard Conditions (scfm)	24,594	19,180
Total Sampled Volume, Standard Conditions (scf)	18.16	60.05
Percent Moisture	3	3
Barometric Pressure (in.Hg.)	29.20	29.19
Total Particulate Weight (grams)	8.34	0.07
Particulate Concentration, Standard Conditions (grains/scf)	7.09	0.02
Particulate Concentration, Stack Conditions (grains/acf)	6.72	0.02
Particulate Flowrate, Standard Conditions (lbs./hr.)	1494	3
Isokineticity (%)	81	94
Process Rate (tons/hr.)	28	28
Allowable Emission Rate (lbs./hr.)		28.4
Percent Efficiency		99.81

STACK NO.: #3 COTTRELL ELECTROSTATIC PRECIPITATOR - RUN #3

	INLET	OUTLET
Date: 6-19-73		
Time: 8:03 - 9:10 PM; 60 minutes		
Stack Cross Sectional Area (sq.ft.)	36.00	6.31
Average Stack Temperature (^{o}F)	102	114
Average Stack Velocity (ft./sec.)	11.50	55.84
Flow Rate, Stack Conditions (cfm)	24,840	21,127
Flow Rate, Standard Conditions (scfm)	22,796	18,990
Total Sampled Volume, Standard Conditions (scf)	16.80	59.68
Percent Moisture	3	3
Barometric Pressure (in.Hg.)	29.10	29.10
Total Particulate Weight (grams)	6.90	0.09
Particulate Concentration, Standard Conditions (grains/scf)	6.34	0.02
Particulate Concentration, Stack Conditions (grains/acf)	6.00	0.02
Particulate Flowrate, Standard Conditions (lbs./hr.)	1238	3.6
Isokineticity (%)	81	94
Process Rate (tons/hr.)	28	28
Allowable Emission Rate (lbs./hr.)		28.4
Percent Efficiency		99.79

STACK NO.: PERLITE - RUN #1

Date: 6-22-73	INLET	OUTLET
Time: 4:25 PM - 4:55 PM; 24 minutes		
Stack Cross Sectional Area (sq.ft.)	1.27	1.36
Average Stack Temperature (^{o}F)	551	371
Average Stack Velocity (ft./sec.)	52.11	32.87
Flow Rate, Stack Conditions (cfm)	3,957	2,684
Flow Rate, Standard Conditions (scfm)	2,032	1,676
Total Sampled Volume, Standard Conditions (scf)	11.50	8.71
Percent Moisture	4	4
Barometric Pressure (in.Hg.)	29.30	29.30
Total Particulate Weight (grams)	0.43	0.27
Particulate Concentration, Standard Conditions (grains/scf)	0.58	0.47
Particulate Concentration, Stack Conditions (grains/acf)	0.31	0.31
Particulate Flowrate, Standard Conditions (lbs./hr.)	10.2	6.8
Isokineticity (%)	84.09	83.01
Process Rate (lbs./hr.)	2,500	2,500
Allowable Emission Rate (lbs./hr.)		4.1
Percent Efficiency		33.33

STACK NO.: PERLITE - RUN #2

Date: 6-22-73	INLET	OUTLET
Time: 5:35 - 6:07 PM; 24 minutes		
Stack Cross Sectional Area (sq.ft.)	1.27	1.36
Average Stack Temperature (^{o}F)	544	411
Average Stack Velocity (ft./sec.)	73.17	33.22
Flow Rate, Stack Conditions (cfm)	5,557	2,713
Flow Rate, Standard Conditions (scfm)	2,868	1,613
Total Sampled Volume, Standard Conditions (scf)	18.92	8.23
Percent Moisture	4	4
Baromatric Pressure (in.Hg.)	29.25	29.25
Total Particulate Weight (grams)	0.28	0.15
Particulate Concentration, Standard Conditions (grains/scf)	0.23	0.28
Particulate Concentration, Stack Conditions (grains/acf)	0.13	0.18
Particulate Flowrate, Standard Conditions (lbs./hr.)	5.7	3.9
Isokineticity (%)	98	82
Process Rate (lbs./hr.)	2500	2500
Allowable Emission Rate (lbs./hr.)		4.1
Percent Efficiency		30.76

STACK NO.: PERLITE - RUN #3

Date: 6-22-73	INLET	OUTLET
Time: 6:35 - 7:05 PM; 24 minutes		
Stack Cross Sectional Area (sq.ft.)	1.27	1.36
Average Stack Temperature (^{o}F)	550	380
Average Stack Velocity (ft./sec.)	76.98	31.78
Flow Rate, Stack Conditions (cfm)	5,846	2,595
Flow Rate, Standard Conditions (scfm)	2,994	1,598
Total Sampled Volume, Standard Conditions (scf)	19.14	7.83
Percent Moisture	4	4
Barometric Pressure (in.Hg.)	29.20	29.20
Total Particulate Weight (grams)	0.29	0.14
Particulate Concentration, Standard Conditions (grains/scf)	0.23	0.28
Particulate Concentration, Stack Conditions (grains/acf)	0.12	0.18
Particulate Flowrate, Standard Conditions (lbs./hr.)	5.9	3.8
Isokineticity (%)	95	78
Process Rate (lbs./hr.)	2500	2500
Allowable Emission Rate (lbs./hr.)		4.1
Percent Efficiency		35.25

STACK NO.: #1 KETTLE	RUN #2	RUN #3
Date:	6-21-73	6-21-73
Time:	3:15-5:05PM; 110 min.	7:10-9:00PM; 110 min.
Stack Cross Sectional Area (sq.ft.)	2.18	2.18
Average Stack Temperature (^{o}F)	235	233
Average Stack Velocity (ft./sec.)	32.44	32.40
Flow Rate, Stack Conditions (cfm)	4,246	4,240
Flow Rate, Standard Conditions (scfm)	3,173	3,177
Total Sampled Volume, Standard Conditions (scf)	74.89	70.08
Percent Moisture	46	47
Barometric Pressure (in.Hg.)	29.30	29.30
Total Particulate Weight (grams)	220.96	208.53
Particulate Concentration, Standard Conditions (grains/scf)	47.09	46.41
Particulate Concentration, Stack Conditions (grains/acf)	65.29	66.02
Particulate Flowrate, Standard Conditions (lbs./hr.)	1281	1263
Isokineticity (%)	133	127
Process Rate (tons/hr.)	19	19
Allowable Emission Rate (lbs./hr.)		

STACK NO.: #3 KETTLE	RUN #1	RUN #2	RUN #3
Date:	6-21-73	6-22-73	6-22-73
Time:	6:40-8:40PM; 110 min.	9:14-11:14AM; 110 min.	11:45AM-1:45PM; 110 min
Stack Cross Sectional Area (sq.ft.)	2.18	2.18	2.18
Average Stack Temperature (^{o}F)	202	206	191
Average Stack Velocity (ft./sec.)	31.68	32.34	34.34
Flow Rate, Stack Conditions (cfm)	4,146	4,234	4,495
Flow Rate, Standard Conditions (scfm)	3,248	3,309	3,596
Total Sampled Volume, Standard Conditions (scf)	69.85	79.32	83.04
Percent Moisture	39	37	35
Barometric Pressure (in.Hg.)	29.30	29.40	29.40
Total Particulate Weight (grams)	83.90	128.13	139.50
Particulate Concentration, Standard Conditions (grains/scf)	21.52	29.83	32.10
Particulate Concentration, Stack Conditions (grains/acf)	27.87	37.40	39.80
Particulate Flowrate, Standard Conditions (lbs./hr.)	599	846	990
Isokineticity (%)	108	116	108
Process Rate (tons/hr.)	19	19	19

STACK NO.: #1 RAYMOND	RUN #1	RUN #2	RUN #3
Date:	6-21-73	6-21-73	6-21-73
Time:	1:45-2:00PM; 15 min.	2:27-2:37PM; 10 min.	2:55-3:13PM; 18 min.
Stack Cross Sectional Area (sq.ft.)	0.40	0.40	0.40
Average Stack Temperature (^{o}F)	136	136	158
Average Stack Velocity (ft./sec.)	73.60	82.86	84.22
Flow Rate, Stack Conditions (cfm)	1,740	1,959	1,991
Flow Rate, Standard Conditions (scfm)	1,515	1,705	1,671
Total Sampled Volume, Standard Conditions (scf)	16.31	10.73	4.16
Percent Moisture	4	4	4
Barometric Pressure (in.Hg.)	29.30	29.30	29.30
Total Particulate Weight (grams)	3.85	0.88	0.43
Particulate Concentration, Standard Conditions (grains/scf)	3.64	1.26	1.59
Particulate Concentration, Stack Conditions (grains/acf)	3.36	1.17	1.39
Particulate Flowrate, Standard Conditions (lbs./hr.)	47.3	18.5	22.8
Isokineticity (%)	80	70	61
Process Rate (tons/hr.)	19	INTERRUPTED PROCESS	INTERRUPTED PROCESS

STACK NO.: #2 RAYMOND	RUN #1	RUN #2	RUN #3
Date:	6-21-73	6-21-73	6-21-73
Time:	3:40-3:58PM; 18 min.	4:37-4:55PM; 18 min.	5:28-5:46PM: 18 min.
Stack Cross Sectional Area (sq.ft.)	0.39	0.39	0.39
Average Stack Temperature (^{o}F)	133	154	160
Average Stack Velocity (ft./sec.)	75.26	80.65	81.06
Flow Rate, Stack Conditions (cfm)	1,779	1,907	1,916
Flow Rate, Standard Conditions (scfm)	1,557	1,612	1,604
Total Sampled Volume, Standard Conditions (scf)	5.45	5.53	5.97
Percent Moisture	5	5	5
Barometric Pressure (in.Hg.)	29.30	29.30	29.30
Total Particulate Weight (grams)	1.44	1.27	1.46
Particulate Concentration, Standard Conditions (grains/scf)	4.09	3.55	3.78
Particulate Concentration, Stack Conditions (grains/acf)	3.76	3.15	3.33
Particulate Flowrate, Standard Conditions (lbs./hr.)	54.5	49.0	52.0
Isokineticity (%)	86	84	91
Process Rate (tons/hr.)	19	19	19

STACK NO.: DRYER	RUN #1	RUN #2	RUN #3
Date:	6-20-73	6-21-73	6-21-73
Time:	5:55-6:30PM; 30 min.	8:30-9:00AM; 30 min.	9:50-10:20AM; 30 min.
Stack Cross Sectional Area (sq.ft.)	3.83	3.83	3.83
Average Stack Temperature (^{o}F)	145	148	146
Average Stack Velocity (ft./sec.)	38.86	45.90	47.76
Flow Rate, Stack Conditions (cfm)	8,930	10,548	10,976
Flow Rate, Standard Conditions (scfm)	7,640	9,030	9,435
Total Sampled Volume, Standard Conditions (scf)	27.59	23.57	23.23
Percent Moisture	6	6	6
Barometric Pressure (in.Hg.)	29.20	29.40	29.40
Total Particulate Weight (grams)	27.45	27.83	26.17
Particulate Concentration, Standard Conditions (grains/scf)	15.35	18.22	17.38
Particulate Concentration, Stack Conditions (grains/acf)	14.14	16.70	16.00
Particulate Flowrate, Standard Conditions (lbs./hr.)	1005	1410	1406
Isokineticity (%)	81	92	87
Process Rate (tons/hr.)	43	43	43

V DISCUSSION

Sampling of the #2 and #3 Cottrell Electrostatic Precipitators and the Perlite Ore Expansion process multiclone system allowed the determination of two important parameters. These parameters are the particulate emission rates and the percent efficiency of the existing control systems.

Table 1 summarizes the emission rates determined in the field and the applicable allowable emission rates as calculated from the "Municipal Code of East Chicago, Indiana Relating to Air Quality Control" (Appendix D). Table 2 presents the percent efficiency of the existing control systems.

TABLE 1. EMISSION RATES / ALLOWABLE EMISSION RATES

Stack Description	Emission Rates (lbs/hr)			Allowable Emission Rate (lbs/hr)
	Run 1	Run 2	Run 3	
#2 Cottrell	260	353	658	37.2
#3 Cottrell	15	3.0	3.6	28.4 (Run 1 - 28.7)
Perlite Multiclone	6.8	3.9	3.8	4.1

TABLE 2. PERCENT EFFICIENCY CONTROL EQUIPMENT

Stack Description	% Efficiency		
	Run 1	Run 2	Run 3
#2 Cottrell	95.58	95.53	91.99
#3 Cottrell	98.88	99.81	99.79
Perlite Multiclone	33.33	30.76	35.25

Table 1 indicates that the particulate emission rates from the #2 Cottrell Electrostatic Precipitator increased substantially from the first sampling run on 6-18-73 (Monday) to the third sampling run on 6-20-73 (Wednesday). The process rates remained the same during the three sampling runs. Taking into consideration the particulate weight loading to the precipitator, Table 2 shows that the percent efficiency of the system remained essentially constant at about 95.5% on Monday and Tuesday, then decreased to 92% on Wednesday. It is realized that the first two sampling runs (Monday and Tuesday) on the outlet side of the precipitator were performed at lower isokinetic conditions than the final run on 6-20-73 (Wednesday). The lower isokineticity factor indicates that the particulate flow rate thru the probe nozzle, at the time of sampling, was biased toward a higher mass concentration than was actually present in the stack gas stream. This would indicate that the percent efficiency on Monday and Tuesday was probably slightly higher than the 95.5% observed. All three sampling runs indicate that the particulate emission rate from the #2 Cottrell exceeded the allowable emission rate as set forth by the "Municipal Code of East Chicago, Indiana Relating to Air Quality Control."

The #3 Cottrell Electrostatic Precipitator was found to be in compliance with the applicable air pollution control regulation on all three sampling runs. The precipitator exceeded 99% efficiency on the last two sampling runs, while the first run showed a 98.88% efficiency (see Table 2). The second and third sampling runs were performed with only the Stucco Conveying process in operation. During a portion of the first sampling run, both the Stucco Conveying and the Tube Milling processes were operational (see Table 1 and Appendix A).

Results of emission rate sampling for the Perlite Ore Expansion process multiclone system indicate that the allowable emission rate was exceeded only during the first sampling run (see Table 1). It is felt that the first run is not indicative of normal process operating conditions. On 6-22-73 (Friday), the day of the Perlite multiclone sampling operation, electrical difficulties were being experienced by U.S. Gypsum personnel in the operation of the Perlite system. Following resolution of the problems, and when informed that the Perlite system was again "operational," Environmental Instrument Systems, Inc. performed the first of the three sampling runs. The raw field data then obtained from the next two runs, when compared with the first, indicated that the Perlite process might not have been completely "operational" during the first run. Specifically, pitot tube velocity pressure readings for the Inlet duct to the Perlite multiclone system were substantially lower during the first run than those experienced on the final two runs. All three runs showed that the multiclone system was operating at a 30-35% efficiency (Table 2).

APPENDIX

MEMORANDUM

WAYNE COUNTY DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL DIVISION

DATE: June 6, 1975

Rec'd Nov. 13, 1979 by PJM from Wayne County Dept. of Health

TO: Technical Services File

FROM: Michael Maillard, P.E.

SUBJECT: Source Testing Conducted at U.S. Gypsum Co., 10090 W. Jefferson, River Rouge

Particulate tests were conducted on May 14, 1975, at the above location on the gas-fired chemical kiln-kettle system controlled by a Flex-Kleen bag house. The tests were conducted by the Technical Services section of the Wayne County Air Pollution Control Division. Monitoring of the processes was conducted by Mr. Boyd with stack opacity evaluation performed by Mr. Muldoon - both of the Enforcement section.

The emission tests average 0.16 lbs/1000 lbs exhaust gas. The allowable emission is 0.20 lbs/1000 lbs exhaust gas.

Preliminary data were obtained on May 6, 1975. This involved velocity head ranges, stack temperatures, flue gas analyses, and moisture content determination. Three particulate samples were obtained on May 14, 1975, from the 36" I.D. stack by sampling at 8 points across each of two perpendicular diameters in the sampling plane, at 4 minutes per point. The sampling train used (see attached sketch was sequentially: nozzle for appropriate isokinetic sampling rates; stainless steel filter holder with a meshed glass thimble (sample #1), or a 47 mm glass fiber filter (samples #2 and #3); two standard impingers in parallel with initial 100 ml distilled water per impinger; condenser; 1-1/2 cfm leakless pump; and dry gas meter with orifice meter. Velocity traverses were taken prior to each sample with the probe washes obtained in the field.

The processing during the sampling was 55 tons/hr of gypsum rock to the kiln, 4 tons/hr of this product was siphoned off for soil conditioner use and the balance sent into three 19 ton/hr capacity kettles.

The opacity evaluations are listed in Table I. It should be noted that the 2-minute violation was caused by agglomerated material in the stack breaking off. The uninsulated stack coupled by the hygroscopic nature of the material will cause build-ups and incidents of this kind.

The sampling rate was found to be 107%, 104%, and 97% of proper isokinetic flows for the three samples, respectively. The following data summary sheet contains sampling parameters and the resultant emissions.

Michael Maibach

MM/vl

att. - 3

copies: Messrs. C. Andrus (Mr. McLin)
B. Baskin

Source Sampling -
U. S. Gypsum Co.
June 6, 1975

TABLE I

Sampling Time Interval	Type Sampling	Observation Time Interval	OPACITY %					
			0	10	20	30	40	50
4-75 :05-10:15	Particulate	9:30-10:18		48				
4-75 0:53-12:10	Particulate	11:30-12:15	15	28				2
4-75 :00-3:20	Particulate	2:05-3:40	28	68				

Total observed minutes in violation = 2
Minutes in violation during testing = 2

WAYNE COUNTY DEPARTMENT OF HEALTH, AIR POLLUTION CONTROL DIVISION

SUMMARY OF STACK SAMPLING DATA AND TEST RESULTS

EQUIPMENT AND CONTROLS: Chemical Kiln & Kettles Controlled by Flex-Kleen Bag House

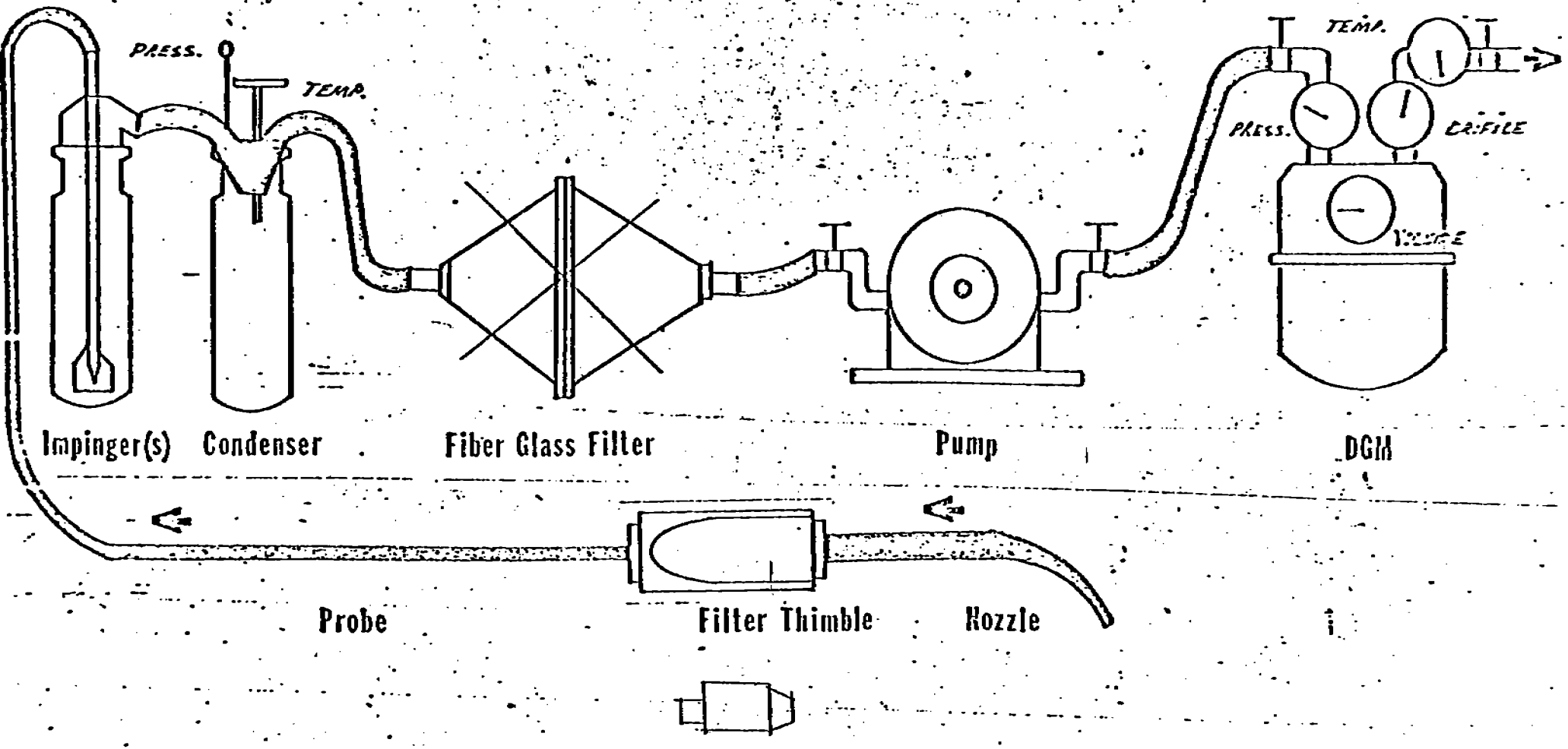
LOCATION: 10090 W. Jefferson, River Rouge - U. S. Gypsum Co. TEST DATE: May 14, 1975

STACK DIMENSION: 36" I.D. STACK AREA: 7.069 Sq. Ft. PERMIT NO. 3188

	Sample Number		
	1	2	3
Recorded sample volume at meter conditions, ft^3	45.152	42.232	38.490
Meter temperature, average °R	530.8	537.0	543.6
Meter pressure, average "Hg abs	29.29	29.28	29.22
Stack temperature, average °F	196.1	207.9	211.5
Stack pressure, average "Hg abs	29.26	29.26	29.19
Total sample volume corrected to meter conditions, ft^3	59.609	54.827	52.582
Percent CO_2 in stack gas, average, dry basis	1.4	1.0	0.9
Percent O_2 in flue gas, average, dry basis	19.0	19.0	19.1
Percent N_2 in flue gas, average, dry basis	79.7	80.0	80.0
Percent CO in flue gas, dry basis	-	-	-
Percent moisture in flue gas, average	25.3	24.2	28.3
Ratio actual to theoretical air, R	N.A.	N.A.	N.A.
Specific gravity flue gas at stack conditions	0.908	0.910	0.892
Weight particulate collected, grams	0.3670	0.2490	0.1944
Weight gas sample, lbs	3.95	3.60	3.33
Average velocity stack gas, fpm	5309	5242	5191
Volume flow rate stack gas, acfm	37527	37056	36693
Lbs particulate/1000 lbs flue gas	0.205	0.153	0.129
Lbs particulate/1000 lbs flue gas corrected to 50% excess air	N.A.	N.A.	N.A.
Lbs particulate/hr	24.7	17.9	14.6

Average emission	0.16	lbs particulate/1000 lbs exhaust gas
Average emission	19.1	lbs particulate/hr
Allowable emission	0.20	lbs particulate/1000 lbs exhaust gas
Allowable emission	N.A.	lbs particulate/hr

SAMPLING TRAIN



U.S. Gypsum Company
10090 W. Jefferson, River Rouge
Sampling Date: May 14, 1975

UNITED STATES GYPSUM COMPANY

EMPIRE NEVADA 89405

March 24, 1977

Rec'd 11:15?

Mr. Don Henry, Esquire
U. S. Environmental Protection Agency, Region IX
100 California Street
San Francisco, California 94111

Your Code: ENT-242-18

Dear Mr. Henry:

This is to advise that the completion date for dust collecting equipment now being installed on our #3 kettle is March 30th.

Copies of Source Test plan covering the installation particulars and test procedures have been completed and submitted with this letter and to the Washoe County District Health Department.

In order to finalize testing and bring this kettle on stream at the earliest possible date we would like to proceed with testing immediately after the installation is completed or around Aprin 4th.

I sincerely hope that this will meet with your approval.

Very truly yours,

UNITED STATES GYPSUM COMPANY

L. A. Ziech
Works Manager

LAZ:ss

UNITED STATES GYPSUM COMPANY

EMPIRE NEVADA 89405

March 24, 1977

Washoe County District Health Department
Division of Environmental Services
P. O. Box 11130
Reno, Nevada 89510

Attention: Mr. Charles R. Breese Jr., Director

Dear Mr. Breese:

Please find the enclosed source test plan to cover the re-activation of #3 and #4 gypsum kettles which were shut down under your direction on May 31, 1976 because of the lack of emission control devices. As you know we are presently operating #1 and #2 kettles with adequately designed baghouses which effectively remove particulate emission from the stack effluent. Effective particulate removal was demonstrated by source sampling performed under the direction of observers from your department.

Present market demand for gypsum products necessitates activating a third kettle and a stand-by kettle in order to prevent loss of business due to mechanical breakdown. In order to accomplish this our engineering department has designed a dust collection system that will utilize a single baghouse collector shared by both #3 and #4 kettles. The baghouse itself is very similar to the one now operating on #2 kettle. The capacity of the new baghouse collector is adequate for one kettle only and the electrical control circuitry for the new collector effectively prevents #3 and #4 kettles from operating at the same time. A set of prints for the installation is enclosed for your review.

The Source Test Plan included with this report follows the outline you submitted to us with your letter dated 3-4-77.

It is noted that in the period during which we are mobilized with equipment and technical help to do source sampling we intend to retest the clean air effluent from the expanded perlite collector. You will recall that source sampling conducted during December 1975 revealed excessive particulate emission from this stack. A new cloth specification was developed immediately for this collector, new bags were installed and particulate emission was effectively reduced.

Due to the lack of trained manpower, however, this source has not yet been retested.

It is also noted that the same people who conducted the source sampling during prior testing are available to us again so that we can assure an adequate degree of technical competence during the present program.

If you have questions or need further information do not hesitate to call upon us.

Very sincerely yours,

UNITED STATES GYPSUM COMPANY

L. A. Ziech
Works Manager

LAZ:lt

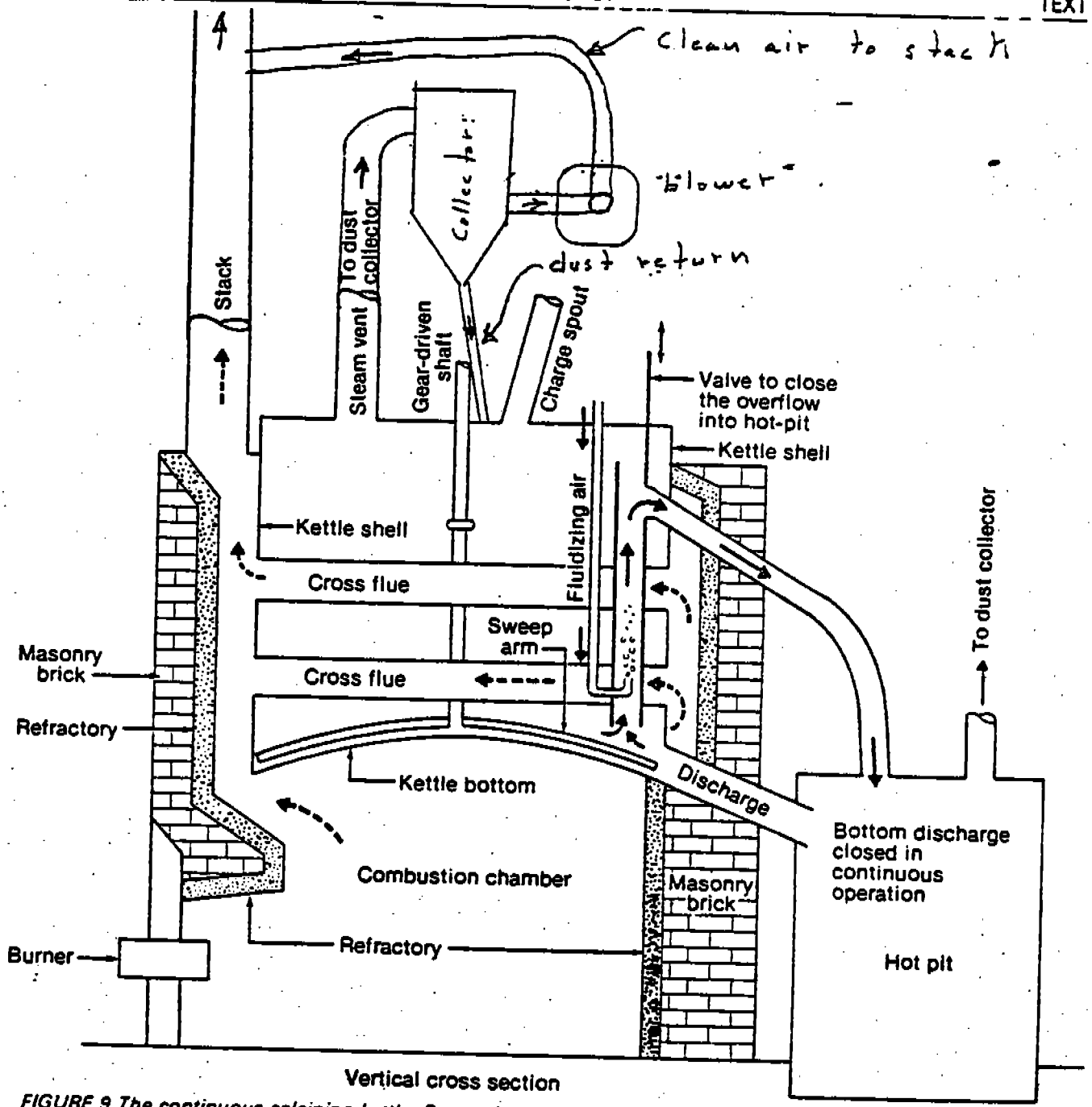
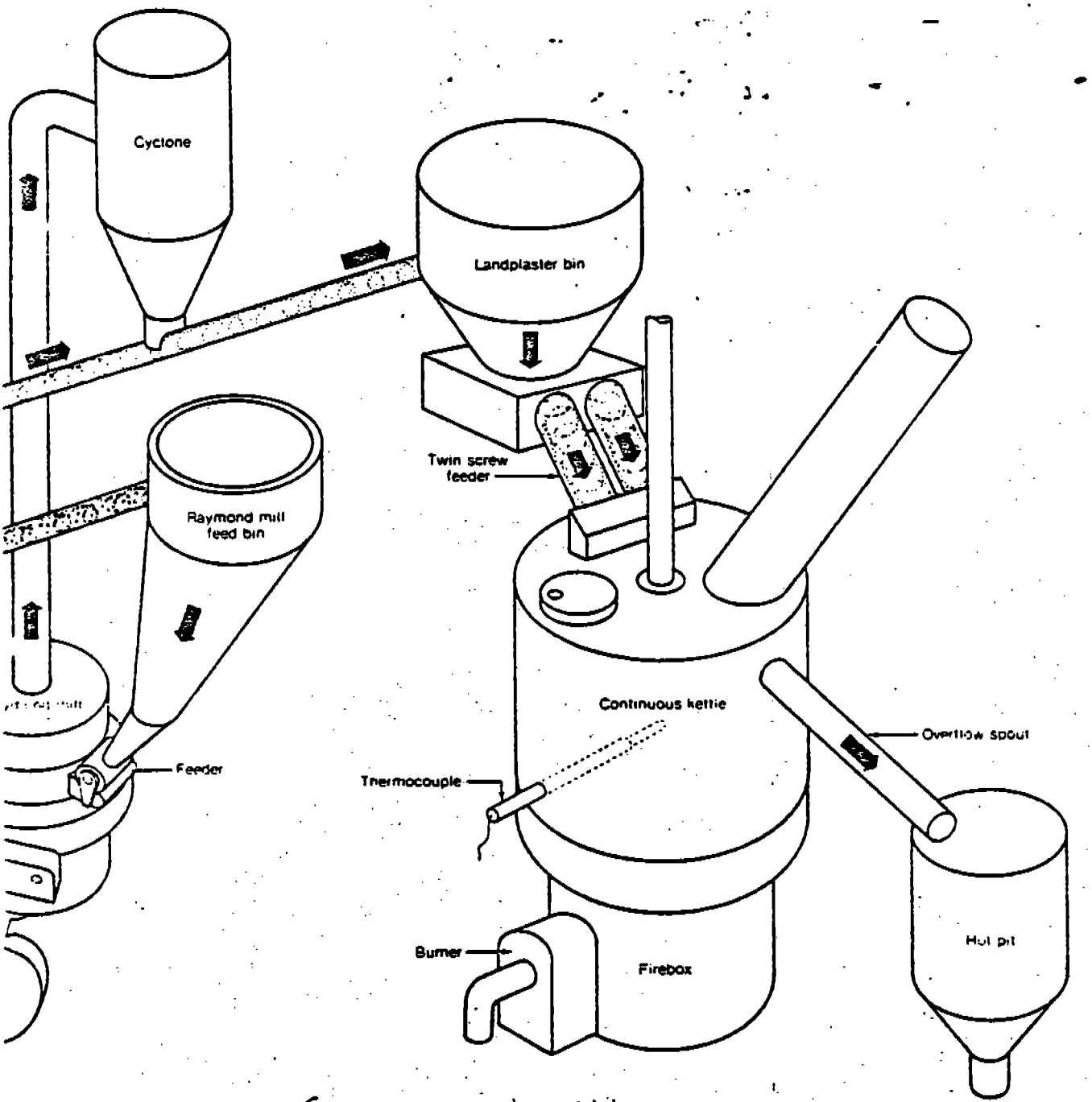


FIGURE 9 The continuous calcining kettle. Stucco is discharged continuously by introducing compressed air into an overflow channel inside (solid arrows).
Heat flows from the firebox, around baffles, through the flues and out the stack (broken arrows).

Typical Gypsum Kettle



Gypsum Kettle

Typical Process Flow

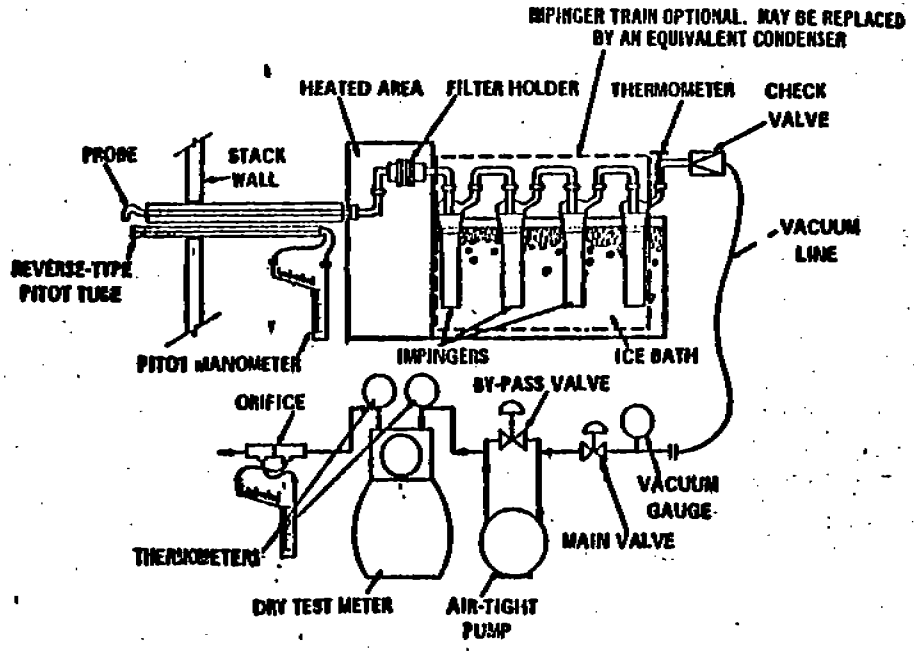


Figure 5-1. Particulate-sampling train.

5.3.2 Desiccant—Drierite,[1] indicating.

4. *Procedure.*

4.1 Sampling

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture,[2] and range of velocity head.

4.1.2 Preparation of collection train. Weigh to the nearest gram approximately 200 g. of silica gel. Label a filter of proper diameter, desiccate[2] for at least 24 hours and weigh to the nearest 0.5 mg. in a room where the relative humidity is less than 50%. Place 100 ml. of water in each of the first two impingers, leave the third impinger empty, and place approximately 200 g. of preweighed silica gel in the fourth impinger. Set up the train without the probe as in Figure 5-1. Leak check the sampling train at the sampling site by plugging up the inlet to the filter holder and pulling a 15 in. Hg vacuum. A leakage rate not in excess of 0.02 c.f.m. at a vacuum of 15 in. Hg is acceptable. Attach the probe and adjust the heater to provide a gas temperature of about 250° F. at the probe outlet. Turn on the filter heating system. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger as low as possible and preferably at 70° F. or less. Temperatures above 70° F. may result in damage to the dry gas meter from either moisture condensation or excessive heat.

[1] Trade name.

[2] Dry using Drierite[1] at 70° F.±10° F.

[illegible] operation. For each [illegible] the example [illegible] Figure 5-2. Take readings at [illegible] at least every 5 minutes, [illegible] significant changes in stack conditions necessitate additional adjustments [illegible] to begin sampling, position the [illegible] at the first traverse point with the [illegible] pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least 6 minutes at each traverse point; sampling time must be the same for each point. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. Turn off the pump at the conclusion of each run and record the final readings. Remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in section 4.2.

PLANT _____
LOCATION _____
OPERATOR _____
DATE _____
RUN NO. _____
SAMPLE BOX NO. _____
METER BOX NO. _____
METER $\Delta H_@$ _____
C FACTOR _____

SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE _____
BAROMETRIC PRESSURE _____
ASSUMED MOISTURE, % _____
HEATER BOX SETTING _____
PROBE LENGTH, in. _____
NOZZLE DIAMETER, in. _____
PROBE HEATER SETTING _____

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (P_g), in. Hg	STACK TEMPERATURE (T_s), °F	VELOCITY HEAD ($\sqrt{P_g}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER, in. H_2O	GAS SAMPLE VOLUME, cu ft	GAS SAMPLE TEMPERATURE AT DRY GAS METER: INLET, °F	GAS SAMPLE TEMPERATURE AT DRY GAS METER: OUTLET, °F	SAMPLE BOX TEMPERATURE, °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °F
TOTAL							Avg	Avg		
AVERAGE							Avg			

Figure 5-2. Particulate field data.

4.2 Sample recovery. Exercise care in moving the collection train from the test site to the sample recovery area to minimize the loss of collected sample or the gain of extraneous particulate matter. Set aside a portion of the acetone used in the sample recovery as a blank for analysis. Measure the volume of water from the first three impingers, then discard. Place the samples in containers as follows:

Container No. 1. Remove the filter from its holder, place in this container, and seal.

Container No. 2. Place loose particulate matter and acetone washings from all sample-exposed surfaces prior to the filter in this container and seal. Use a razor blade, brush, or rubber policeman to lose adhering particles.

Container No. 3. Transfer the silica gel from the fourth impinger to the original container and seal. Use a rubber policeman as an aid in removing silica gel from the impinger.

Report No. 23074
File No. 1-0015
1/28/76

UNITED STATES GYPSUM COMPANY

RESEARCH CENTER

REPORT

Isokinetic Source Sampling: Empire Gypsum Mill

Per Mr. G. W. Kellogg's request, isokinetic tests were performed on all eleven stack emission sources at the Empire gypsum mill in accordance with the guidelines specified by the District Board of Health of Washoe County, Nevada.

County observers were present for the initial testing to judge whether we were qualified to perform the tests ourselves. The observers were satisfied with our performance and were willing to accept our data without an observer present.

The results are:

Process	Pollution Mass Rate, lbs/hr	Concentration, grains/SCF
Raymond Mill No. 4	0.110	0.0020
Raymond Mill No. 3	0.194	0.0031
Kettle No. 2	2.99	0.053
Kettle No. 1	3.43	0.116
Rock Screen Dust Collector	0.062	0.0030
Packer No. 1 and 2	0.14	0.015
Packer No. 3	0.106	0.0060
End Finishing Saw	0.075	0.0048
Tube Mill	0.0009	0.0003
Stucco Screen	0.0154	0.0025
Perlite	13.55	1.28

All emission sources were well within the compliance levels, except for the perlite. A hole was found in a collection bag, which should account for the high amount of particulate collected. A particle size analysis was performed on the sample collected by the filter.

The results are:

625 Mesh	20 Microns	91.74%	Finer than
425	33	99.12	
325	45	99.99	
200	75	100.00	

which indicate that perhaps a change in bag material is required. Further testing, however, will be necessary to verify it.

Test No. 3
Date 12/2/75
Process Kettle No. 2

Data Summary

Schematic of Stack

Sampling Points, Inches

2.75	
4.39	
6.21	
8.31	
10.91	
14.66	
25.00	
28.74	
31.34	
33.44	
35.26	
36.90	

Diameter of Stack - - - 35.65 inches
No. Dia above const. -- 10
No. Dia below const. - 8

Area Nozzle	0.0007658 ft.^{2}
Area Stack	6.932 ft.^{2}
Static Pressure	±0.70
Stack Pressure	26.81
Baromatric Pressure	26.11
Cp	0.85
Average ΔP	0.157
Average $(\Delta P)^{\frac{1}{2}}$	0.391
Average ΔM	1.75
Average tm	1.111
Average ts	283
Number Traverse Points	24
Vm (S+D)	34.96 ft.^{3}
Total Mass, gms	0.1210 gms
V (std)	28.53 fps
Q (std) - SCFM	6533
C (std)	.053 gr/SCF
PMR	2.99 lbs/hr
% I	100.9

March 25, 1977

Source Test Plan

1. Source Information:

   A. Name, address, and location of the facility being tested:

      United States Gypsum Company
      Empire, Nevada 89405

      The Empire facility is located on State Highway 34, approx. 100 miles north of Reno, Nevada.

   B. Responsible persons at the facility, and telephone number:

      Mr. L. A. Ziech, Works Manager, (702) 557-2341
      Mr. D. L. Mustard, Personnel Supt., " Ext. 25
      Mr. K. V. Kraft, Engr. Supt., " Est. 36
      Mr. E. D. Heiss, Project Engr., " Ext. 36

      Mr. E. C. Dessain, Chemical Analyst and graduate of the E.P.A. course in Source Sampling will be assigned to Empire during source testing from the U.S. Gypsum Co. Research Center, 1000 E. Northwest Highway, Des Plaines, Ill. 60016, phone (312) 299-3381.

2. Testing Firm Information:

   A. Name and address of the firm conducting the testing.

      Due to the prohibitive expense of hiring an outside consultant for work at this isolated location, no testing firm will be involved in this Source Test Plan. All work will be performed by U.A. Gypsum Co. employees under the supervision of E.P.A. field observers.

   B. Responsible person at the testing firm, and telephone number.

      Not applicable to this Source Test Plan.

3. Sampling Equipment:

   A. A description of the emission sampling equipment including a schematic diagram of the sampling train.

      Iso Kinetic stack sampling test will be performed by Mr. Dessain and Mr. Heiss on #3 Kettle, #4 Kettle and on the perlite expander. The Research Appliance Corporation sampler will be employed - the schematic diagram of the sampling train for this device is shown on p. 581, Chapter 1 - E.P.A., app. A. A copy of this page is attached for your review.

4. Procedures:

   A. Types of pollutants to be sampled:

      Particulate emissions will be measured and the PMR (Pollution Mass Rate in lbs./hr.) and the C (Concentration in grains/SCF) will be determined. Stack moisture will also be determined.

   B. A description of the sampling analysis procedures:

      A preliminary survey of each stack will be made in order to determine cross-sectional area, gas velocity, temperature, etc. so that the R.A.C. can be fitted with the proper nozzle before it is transported to the sampling site. The stack will be traversed in the manner set out in Chapter 1 - E.P.A. and field notes and calculations will be submitted to your office on the same forms as the data and report of 1-28-76, report #23074, file no. 1-0015.

   C. Documentation for any proposed variations from the specified procedures:

      There will be no variation from specified procedures during this source test.

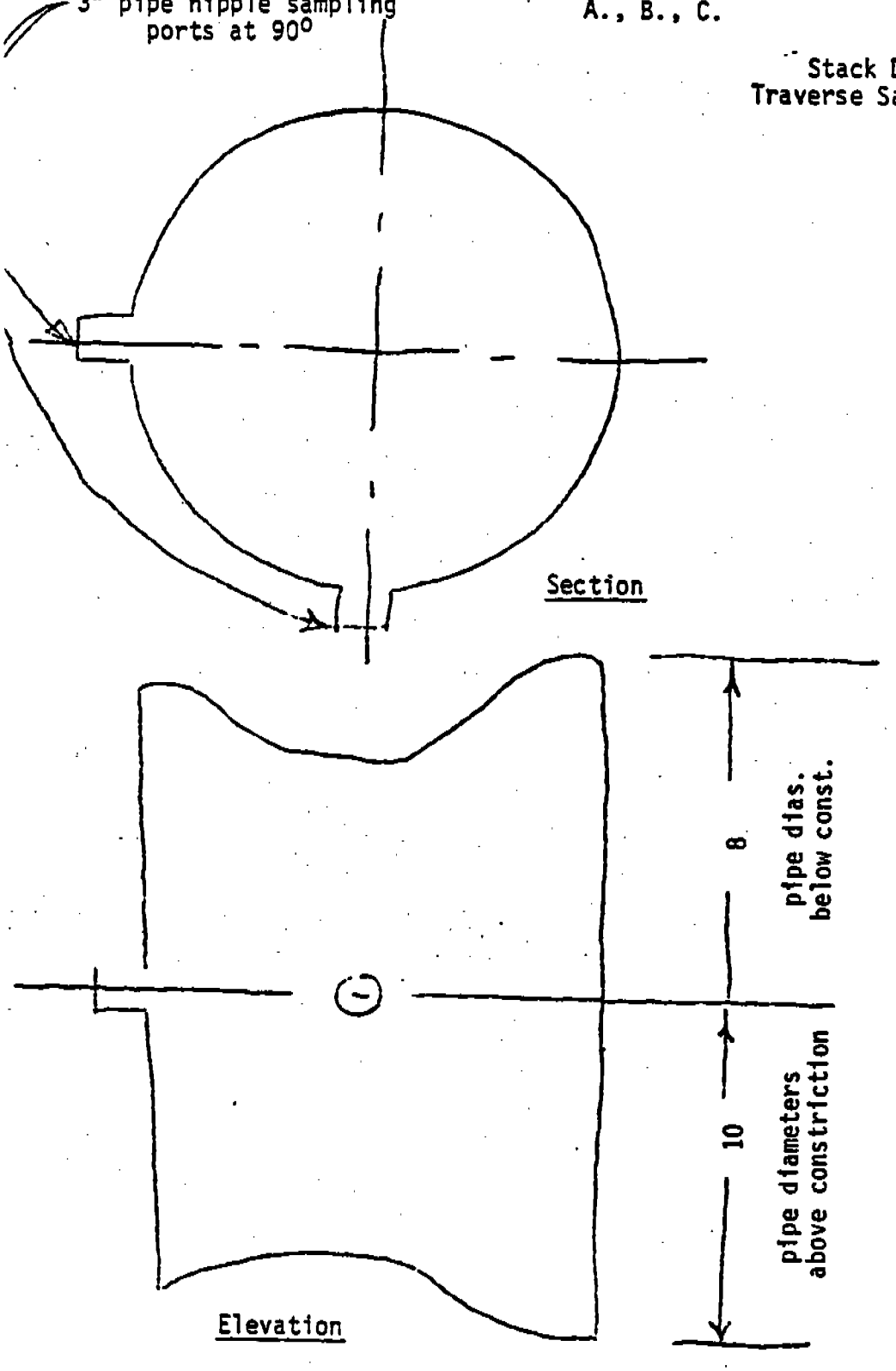
5. Emission Point Information:

   A. A sketch with dimensions indicating the flow of exhaust gases from the process through the control equipment and associated duct work to the stack.

      A complete set of prints of the new installation has been provided for your review - these will provide sufficient dimensional information In order to provide better visulization of the exhaust gas and dust flow, a small schematic sketch has also been included for your review.

Sketch for Source Test Plan

#5. Emission Point Information
A., B., C.



Stack Diameter 35.65 inches
Traverse Sampling points, inches

2.75
4.39
6.21
8.31
10.91
14.66
25.00
28.74
31.34
33.44
35.26
36.90

5. Continued,

   B. A diagram of the stack showing the dimensions and the configuration of the sampling, and the distances to the nearest up stream and down stream flow interferences.

      (Sketch included with this report)

   C. A cross sectional sketch of the stack at the sampling location, showing sampling point locations.

      (Sketch included with this report)

   D. Estimated flue gas conditions at the sampling location, including temperature, moisture content and velocity.

      Avg. stack temperature, 300° F., moisture content varies between 7 to 10%, avg. gas velocity (Std.) 29 F.P.S.

6. Process Equipment:

   A. A description of the process operation, including a process flow sheet.

      Ground raw gypsum is fed into the Kettle which is heated by fuel oil. The heated gases from the furnace pass around the suspended shell and through heat exchanger flues that pass through the agitated ground gypsum. The combustion gases pass into the main stack. As combined moisture is removed from the gypsum, it passes through the steam stack into the dust collector which returns the dust to the Kettle. The clean effluent from the collector passes to the main stack.

      (Typical Kettle cross section attached to this report.)

   B. Type and quanity of raw materials, catalysts and products being used or produced in the process.

      Approximately 20 tons of raw ground gypsum are charged into the Kettle. When the batch is completed approx. 16 tons of calcined gypsum is produced that will be used in making plaster products. If the batch Kettle is used to produce calcined gypsum for wall board products a small amount (10 to 20 lbs.) of dry calcium chloride is added to speed up the removal of combined moisture.

   C. Maximum rated capacity of the process.

      #3 Kettle capable of producing 7.0 tons per hour. #4 Kettle 7.0 tons per hour.

D. Actual maximum operating capacity of the process.

During 1977, either #3 or #4 Kettles will produce approx. 6.5 tons per hour. These two Kettles cannot operate at the same time.

E. Operating capacity during the previous six month period.

Zero. Both #3 and #4 Kettles have been shut down since 5-31-76.

F. Process data to be monitored to insure representitive operation during the test.

All data shown on the attached data summary sheet will be monitored to insure representative sampling.

G. Normal maintenance schedule for this process.

Kettles are usually shut down Sunday and Monday for maintenance.

I. Type of feed stock or fuel that causes the greatist individual emissions and the percent of annual production for which these materials are used.

Ground gypsum is the primary source of particulate emissions and moisture and accounts for 90% of the total annual production. Combustion products are also released but concentrations are low due to the large dilution by secondary air. Very little combustion smoke is produced. The major visible emission from the Kettle stacks is moisture (steam) which is visible during cold weather.

7. Control Equipment:

A. Description of emission control system including the types of control equipment, manufacturer, rated capacity.

A complete set of prints and a Bill of Material is included which describes the Flex-Kleen baghouse collector in detail.

B. Data to be monitored and recorded to insure representive operation of the control equipment during testing.

The Kettle operator will monitor critical data during the test as he does during normal operation. The following data can be taken from the automatic recorder charts: stucco temperature, stack temperature, time and curve of the Kettle "cook off" cycle.

C. Minimum acceptable values of all control divice parameters, such as flow rates, pressure drops, temperature, and voltage of electrical input.

A final batch dump temperature of 270° F. to 300° F. and a cycle time between 1 hr. 45 mins. to 2 hrs. will be required to duplicate normal operation.

D. Description of any conditioning of gases prior to the control device.

A mixture of air, gypsum particles and steam passes into the bag-house collector. No gases are produced during calcination and no gas conditioning is required.

E. Normal maintenance schedule on control equipment for previous year.

This is new equipment and has not been previously maintained. Based on the maintenance history of #2 Kettle dust collector, the following schedule will be applicable: 1. Visually inspect stack effluent daily. 2. Inspect interior of collector weekly or bi-weekly for torn or loose bags. 3. Purchase and install new bags as necessary.

8. Data Sheets:

A. Copies of field data sheets to be used during the test.

(copies enclosed.)

9. Chain of Custody:

A. A description of the procedures that will be followed to maintain the integrity of the samples collected.

There are only two collector boxes for the R.A.C. sampler. At the completion of the test run, the box will be labeled and transported to the plant laboratory for sample weighing and calculations. Ordinarily the final data and calculations will be completed on the day following the test.

B. Copies of chain of custody seals and data sheets:

Custody seals have not been used during previous testing. If necessary, however, we will set up a custody seal system according to your recommendations.

10. Quality Control:

The following items should be available to the observer prior to the start of the test.

A. Calibration sheets for dry gas meter, pitot tube, nozzle and other equipment that requires calibration.

B. Quality assurance control charts for the analytical procedures to be used in the analysis of test samples.

C. A list of preweighed filters to be used during particulate emission testing.