Source category:	Portland Cement	Date:	01/14/93
Plant name :	Lone Star Industries, Inc.	Location:	Bonner Springs, KS
Test date :	9/8 - 10/7/81	Ref. No.:	19
Process :	wet	Basis for process rate :	feed/production
		Ratio:	1.8147536

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. ppm
Rotary kiln (coal-fired) No. 4	ESP	BASED ON FEED RATE							
		filt. PM	2	53	31	0.855	1.710		
		filt. PM	5	19.7	31	0.318	0.635		
		filt. PM	6	21.2	31	0.342	0.684		
		filt. PM	9	18	31.4	0.287	0.573		
		filt. PM	10	21	31.4	0.334	0.669		
		filt. PM	15	25.9	32	0.405	0.809		
		filt. PM	16	4.7	32	0.073	0.147		
					AVERAGE	0.373	0.747	RATING:	B
Rotary kiln (Coal-fired) No.4	none	filt. PM	68	2613	31.3	41.7	83.5		
		filt. PM	74	2391	30.7	38.9	77.9		
		filt. PM	78	1864	30.6	30.5	60.9		
		filt. PM	84	1940	30.1	32.2	64.5		
					AVERAGE	35.8	71.7	RATING:	B
Rotary kiln (coal-fired) No. 4	ESP	filt. PM	67	32.3	31.3	0.516	1.032		
		filt. PM	73	12.5	30.7	0.204	0.407		
		filt. PM	77	5.5	30.6	0.090	0.180		
		filt. PM	83	5.8	30.1	0.096	0.193		
					AVERAGE	0.226	0.453	RATING:	B
Rotary kiln (coal-fired) Nos, 1-3	ESP	filt. PM	21	16.3	35.03	0.233	0.465		
		filt. PM	22	40.6	35.03	0.580	1.159		
		filt. PM	27	11.6	16.72	0.347	0.694		
		filt. PM	28	18.4	16.72	0.550	1.100		
		filt. PM	33	10	32.49	0.154	0.308		
		filt. PM	34	10.7	32.49	0.165	0.329		
		filt. PM	39	20.4	34.05	0.300	0.599		
		filt. PM	40	20.1	34.05	0.295	0.590		
		filt. PM	45	34.4	34.37	0.500	1.001		
		filt. PM	46	21	34.37	0.305	0.611		
		filt. PM	51	13.1	53.47	0.122	0.245		
		filt. PM	52	62.6	53.47	0.585	1.171		
		filt. PM	57	44.8	52.65	0.425	0.851		
		filt. PM	58	29	52.65	0.275	0.551		
					AVERAGE	0.346	0.691	RATING:	B

Rotary kiln (coal-fired) No. 4	ESP	SO2	3	338	31	5.45	10.90		
		SO2	4	333	31	5.37	10.74		
		SO2	7	116	31	1.87	3.74		
		SO2	8	131	31	2.11	4.23		
		SO2	11	185	31.4	2.95	5.89		
		SO2	12	182	31.4	2.90	5.80		
		SO2	17	229	32	3.58	7.16		
		SO2	18	169	32	2.64	5.28		
					AVERAGE	3.36	6.72	RATING:	B
Rotary kiln (coal-fired) No. 1-3	ESP	SO2	23	257	35.03	3.67	7.34		
		SO2	24	283	35.03	4.04	8.08		
		SO2	29	77	16.72	2.30	4.61		
		SO2	30	202	16.72	6.04	12.08		
		SO2	35	112	32.49	1.72	3.45		
		SO2	36	104	32.49	1.60	3.20		
		SO2	41	223	34.05	3.27	6.55		
		SO2	42	245	34.05	3.60	7.20		
		SO2	47	269	34.37	3.91	7.83		
		SO2	48	244	34.37	3.55	7.10		
		SO2	53	355	53.47	3.32	6.64		
		SO2	54	498	53.47	4.66	9.31		
		SO2	59	113	52.65	1.07	2.15		
		SO2	60	205	52.65	1.95	3.89		
		SO2	65	210	49.91	2.10	4.21		
		SO2	66	281	49.91	2.82	5.63		
					AVERAGE	3.10	6.20	RATING:	B
Rotary kiln (coal-fired) No. 4		SO2	69	226	31.3	3.61	7.22		
		SO2	75	68	30.7	1.11	2.21		
		SO2	76	448	30.7	7.30	14.59		
		SO2	79	372	30.6	6.08	12.16		
		SO2	85	505	30.1	8.39	16.78		
		SO2	86	446	30.1	7.41	14.82		
					AVERAGE	5.65	11.30	RATING:	B

Rotary kiln (coal-fired) No. 4		CO2	2-4	48,952	31	790	1,579	2.147	20.0
		CO2	5-8	40,631	31	655	1,311	1.937	18.4
		CO2	9-14	40,425	31.4	644	1,287	1.9065	18.6
		CO2	15-18	37,946	32	593	1,186	1.71575	19.4
					AVERAGE	670	1,341	RATING:	B
Rotary kiln (coal-fired) No. 1-3		CO2	21-24	40,775	35.03	582	1,164	3.72575	9.6
		CO2	27-30	40,479	16.72	1,211	2,421	4.035	8.8
		CO2	33-36	22,835	32.49	351	703	3.852	5.2
		CO2	39-42	36,194	34.05	531	1,063	4.23325	7.5
		CO2	45-48	38,042	34.37	553	1,107	4.0695	8.2
		CO2	51-54	66,792	53.47	625	1,249	4.126	14.2
		CO2	57-60	61,958	52.65	588	1,177	4.246	12.8
		CO2	63-66	46,555	49.91	466	933	3.7125	11.0
					AVERAGE	614	1,227	RATING:	B
Rotary kiln (coal-fired) No. 4		CO2	67,69	51,519	31.3	823	1,646	2.3295	19.4
		CO2	68	86,438	31.3	1,381	2,762	3.355	22.6
		CO2	73,75	56,373	30.7	918	1,836	2.4725	20.0
		CO2	74,76	52,179	30.7	850	1,700	2.0805	22.0
		CO2	77	56,611	30.6	925	1,850	2.178	22.8
		CO2	78	49,415	30.6	807	1,615	1.918	22.6
		CO2	83,85	39,982	30.1	664	1,328	2.192	16.0
		CO2	84,86	52,649	30.1	875	1,749	2.119	21.8
					AVERAGE	905	1,811	RATING:	B
Rotary kiln (coal-fired) No. 4		NOx	1	35	31	0.565	1.129		
		NOx	2	8	31	0.129	0.258		
		NOx	3	16	31.4	0.255	0.510		
		NOx	4	69	31.4	1.099	2.197		
		NOx	5	52	32	0.813	1.625		
		NOx	6	4	32	0.063	0.125		
					AVERAGE	0.487	0.974	RATING:	B
Rotary kiln (coal-fired) No. 1-3		NOx	7	80	34.93	1.15	2.29		
		NOx	8	91	34.93	1.30	2.61		
		NOx	9	61	32.49	0.94	1.88		
		NOx	10	66	32.49	1.02	2.03		
		NOx	11	129	34.05	1.89	3.79		
		NOx	12	114	34.05	1.67	3.35		
		NOx	13	136	34.37	1.98	3.96		
		NOx	14	135	34.37	1.96	3.93		
		NOx	15	194	53.47	1.81	3.63		
		NOx	16	149	53.47	1.39	2.79		
		NOx	17	272	52.65	2.58	5.17		
		NOx	18	256	52.65	2.43	4.86		
					AVERAGE	1.97	3.93	RATING:	B
Rotary kiln (coal-fired) No. 4		NOx	19	82	30.7	1.34	2.67		
		NOx	20	89	30.7	1.45	2.90		
					AVERAGE	1.87	3.73	RATING:	B

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. ppm
Rotary kiln (coal-fired) No. 4	ESP	BASED ON CLINKER PRODUCTION RATE							
		filt. PM	2	53	16.8	1.577	3.15		
		filt. PM	5	19.7	16.9	0.583	1.17		
		filt. PM	6	21.2	16.9	0.627	1.25		
		filt. PM	9	18	17	0.529	1.06		
		filt. PM	10	21	17	0.618	1.24		
		filt. PM	15	25.9	17.4	0.744	1.49		
		filt. PM	16	4.7	17.4	0.135	0.270		
					AVERAGE	0.688	1.38	RATING:	B
Rotary kiln (Coal-fired) No.4	none	filt. PM	68	2613	17	76.9	154		
		filt. PM	74	2391	16.7	71.6	143		
		filt. PM	78	1864	16.6	56.1	112		
		filt. PM	84	1940	16.7	58.1	116		
					AVERAGE	65.7	131	RATING:	B
Rotary kiln (coal-fired) No. 4	ESP	filt. PM	67	32.3	17	0.950	1.900		
		filt. PM	73	12.5	16.7	0.374	0.749		
		filt. PM	77	5.5	16.6	0.166	0.331		
		filt. PM	83	5.8	16.7	0.174	0.347		
					AVERAGE	0.416	0.832	RATING:	B
Rotary kiln (coal-fired) Nos, 1-3	ESP	filt. PM	21	16.3	19.46	0.419	0.838		
		filt. PM	22	40.6	19.86	1.022	2.044		
		filt. PM	27	11.6	9.29	0.624	1.249		
		filt. PM	28	18.4	9.29	0.990	1.981		
		filt. PM	33	10	18.05	0.277	0.554		
		filt. PM	34	10.7	18.05	0.296	0.593		
		filt. PM	39	20.4	18.92	0.539	1.078		
		filt. PM	40	20.1	18.92	0.531	1.062		
		filt. PM	45	34.4	19.09	0.901	1.802		
		filt. PM	46	21	19.09	0.550	1.100		
		filt. PM	51	13.1	29.71	0.220	0.441		
		filt. PM	52	62.6	29.71	1.054	2.107		
		filt. PM	57	44.8	29.25	0.766	1.532		
		filt. PM	58	29	29.25	0.496	0.991		
					AVERAGE	0.620	1.241	RATING:	B

Rotary kiln (coal-fired) No. 4	ESP	SO2	3	338	16.8	10.06	20.12		
		SO2	4	333	16.8	9.91	19.82		
		SO2	7	116	16.9	3.43	6.86		
		SO2	8	131	16.9	3.88	7.75		
		SO2	11	185	17	5.44	10.88		
		SO2	12	182	17	5.35	10.71		
		SO2	17	229	17.4	6.58	13.16		
		SO2	18	169	17.4	4.86	9.71		
					AVERAGE	6.19	12.38	RATING:	B
Rotary kiln (coal-fired) No. 1-3	ESP	SO2	23	257	19.46	6.60	13.21		
		SO2	24	283	19.46	7.27	14.54		
		SO2	29	77	9.29	4.14	8.29		
		SO2	30	202	9.29	10.87	21.74		
		SO2	35	112	18.05	3.10	6.20		
		SO2	36	104	18.05	2.88	5.76		
		SO2	41	223	18.92	5.89	11.79		
		SO2	42	245	18.92	6.47	12.95		
		SO2	47	269	19.09	7.05	14.09		
		SO2	48	244	19.09	6.39	12.78		
		SO2	53	355	29.38	6.04	12.08		
		SO2	54	498	29.38	8.48	16.95		
		SO2	59	113	29.25	1.93	3.86		
		SO2	60	205	29.25	3.50	7.01		
		SO2	65	210	27.71	3.79	7.58		
		SO2	66	281	27.71	5.07	10.14		
					AVERAGE	5.59	11.19	RATING:	B
Rotary kiln (coal-fired) No. 4		SO2	69	226	17	6.65	13.29		
		SO2	75	68	16.7	2.04	4.07		
		SO2	76	448	16.7	13.41	26.83		
		SO2	79	372	16.6	11.20	22.41		
		SO2	85	505	16.7	15.12	30.24		
		SO2	86	446	16.7	13.35	26.71		
					AVERAGE	10.30	20.59	RATING:	B

Rotary kiln (coal-fired) No. 4		CO2	2-4	48,952	16.8	1,457	2,914	2.147	20.0
		CO2	5-8	40,631	16.9	1,202	2,404	1.937	18.4
		CO2	9-14	40,425	17	1,189	2,378	1.9065	18.6
		CO2	15-18	37,946	17.4	1,090	2,181	1.71575	19.4
					AVERAGE	1,235	2,469	RATING:	B
Rotary kiln (coal-fired) No. 1-3		CO2	21-24	40,775	19.46	1,048	2,095	3.72575	9.6
		CO2	27-30	40,479	9.29	2,179	4,357	4.035	8.8
		CO2	33-36	22,835	18.05	633	1,265	3.852	5.2
		CO2	39-42	36,194	18.92	957	1,913	4.23325	7.5
		CO2	45-48	38,042	19.09	996	1,993	4.0695	8.2
		CO2	51-54	66,792	29.71	1,124	2,248	4.126	14.2
		CO2	57-60	61,958	29.68	1,044	2,088	4.246	12.8
		CO2	63-66	46,555	27.71	840	1,680	3.7125	11.0
					AVERAGE	1,102	2,205	RATING:	B
Rotary kiln (coal-fired) No. 4		CO2	67,69	51,519	17	1,515	3,031	2.3295	19.4
		CO2	68	86,438	17	2,542	5,085	3.355	22.6
		CO2	73,75	56,373	16.7	1,688	3,376	2.4725	20.0
		CO2	74,76	52,179	16.7	1,562	3,124	2.0805	22.0
		CO2	77	56,611	16.6	1,705	3,410	2.178	22.8
		CO2	78	49,415	16.6	1,488	2,977	1.918	22.6
		CO2	83,85	39,982	16.7	1,197	2,394	2.192	16.0
		CO2	84,86	52,649	16.7	1,576	3,153	2.119	21.8
					AVERAGE	1,659	3,319	RATING:	B
Rotary kiln (coal-fired) No. 4		NOx	1	35	16.9	1.04	2.07		
		NOx	2	8	16.9	0.237	0.473		
		NOx	3	16	17	0.471	0.941		
		NOx	4	69	17	2.03	4.06		
		NOx	5	52	17.4	1.49	2.99		
		NOx	6	4	17.4	0.115	0.230		
					AVERAGE	0.897	1.794	RATING:	B
Rotary kiln (coal-fired) No. 1-3		NOx	7	80	19.86	2.01	4.03		
		NOx	8	91	19.86	2.29	4.58		
		NOx	9	61	18.05	1.69	3.38		
		NOx	10	66	18.05	1.83	3.66		
		NOx	11	129	18.92	3.41	6.82		
		NOx	12	114	18.92	3.01	6.03		
		NOx	13	136	19.09	3.56	7.12		
		NOx	14	135	19.09	3.54	7.07		
		NOx	15	194	29.71	3.26	6.53		
		NOx	16	149	29.71	2.51	5.02		
		NOx	17	272	29.25	4.65	9.30		
		NOx	18	256	29.25	4.38	8.75		
					AVERAGE	3.01	6.02	ERR	B
Rotary kiln (coal-fired) No. 4		NOx	19	82	16.7	2.46	4.91		
		NOx	20	89	16.7	2.66	5.33		
					AVERAGE	3.31	6.62	RATING:	B

SUMMARY

PLANT: LONE STAR - BONNER SPRINGS

LOCATION: BONNER SPRINGS, KANSAS

TEST/IDENTIFICATION: CTR-8 DATE: NOV. 1981

TESTING BY: LONE STAR MOBILE ENVIRONMENTAL TEST LAB

KILN/COOLER NO. 4

			PERFORMANCE		
Kiln Production	Ton/Hr.	....	16.8	@ 1.827 K.F. Factor	
Kiln Feed Rate	Ton/Hr.	....	30.7		
Fuel Rate (Coal)	Ton/Hr.	....	4.6	@ 12345 BTU/lb.	
" " (Oil)	Gal/Hr.	....	—		
Fuel Ash	%	....	13.2		
Fuel Sulphur	%	....	3.5	@ 0.3 Kiln Feed S.	
KILN (Stack)					ALLOWABLE
Exhaust Gas Flow	DSCFM	....	32477		
Part. Concen.	lb/SCF	....	.00091		
Emission Rate	lb/Ton	....	0.5/14.0		0.3/10.6 #/h 0.3(30.7 + 4.6)
SOX (Kiln) (Concentration)	PPM	....	[illegible]		
Emission Rate	lb/Ton	....	5.9/210 #/h		0.3 10.6 #/h 0.3(30.7 + 4.6)
Emission Rate	lb/MMBTU	....	1.8[illegible]		
NOX (Kiln) (Concentration)	PPM	....	128		
Emission Rate	lb/Ton	....	44		
COOLER (Stack)					
Exhaust Gas Flow	DSCFM	....	22937		
Part. Concen.	lb/SCF	....	0.000013		
Emission Rate	lb/~~Ton~~ hr	....	0.14/2.2		0.1/1.7

REMARKS: Reference 40:

(3) Coal-fired wet process kilns w/ common ESP

(1) Coal-fired wet kiln w/ ESP

(1) Common clinker cooler - no control specified (Delete!)

No raw data!

Data Rating: C

Interoffice Memo

LONE STAR INDUSTRIES, INC.

P. O. Box 2148, Houston, Texas 77001

Originating Office: Central Research Laboratory

Date: November 15, 1981

PERSONAL AND BUSINESS CONFIDENTIAL

TO: C. A. Buckelew

FROM: W. W. Hurst

SUBJECT: Stack Emission Survey and Precipitator Efficiency Testing at Bonner Springs Plant

CC: C. D. Fehnel
R. Click

Stack emission gases were tested on days between September 8 and November 4, to determine current levels of particulate, SO_x and NO_x emissions. Survey included 112 runs on kiln and cooler stacks and precipitator inputs. Testing was conducted in accordance with EPA Methods 1-5 and 7 for Stationary Sources as given in Federal Register, Vol. 35, No. 247 dated December 23, 1971, and amended June 8, 1976. SO_x was tested by Methods promulgated by the Commonwealth of Pennsylvania.

Objectives were:

(1) Determine level of kiln stack emissions on both kiln stacks.

(a) Particulates, Lbs/Hr., Grains/cu.ft.

(b) SO_x as SO_2, Lbs/Hr., ppm

(c) NO_x as NO_2, Lbs/Hr., ppm

(2) Determine particulate loading and current operating efficiency of the electrostatic precipitator used in connection with No. 4 kiln system.

Results Showed:

(1) Stack Emissions Averaged -

	Particulates Lbs/Hr.	Particulates Grains Std.cu.ft.	SO_x Lbs/Hr.	SO_x ppm	NO_x Lbs/Hr.	NO_x ppm
Kiln Stack No. 4	23.4	.081	210	673	31	132
Kiln Stack No. 2	25.2	.042	230	345	140	294
No. 1 and 4 Cooler Stk.	2.2	.006	--	--	--	--

(2) Electrostatic Precipitator Performance -

	Average Particulate Load pptr. Input Lbs/Hr.	Average Particulate Load pptr. Output Lbs/Hr.	Average Precipitator Efficiency $\frac{I-O}{I}$
No. 4 Kiln System Precipitator	2,202	14	99.4

Respectfully Submitted,

W. W. Hurst, P.E.

WWH/po

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I. Introduction

Current Environmental Testing at Bonner Springs resulted from earlier discussion this past spring between George Messinger of Greenwich office and Don Grammas who was Bonner's plant manager at that time. It was agreed environmental testing should be conducted at this time for 3 reasons -

(1) The local Environmental Regulatory Group was seeking current estimates of stack emissions.

(2) No environmental work had been done at Bonner Springs plant since 1974. Accordingly, it was felt up-to-date emission data was needed for present operation and possibly future planning.

(3) We were in the area with the Mobil Laboratory finishing test work at LaCygne, Kansas.

August 9, Victor DeLoach and myself met with the local group at the Bonner plant for an "on site" inspection and further consideration of specific testing goals.

Following these discussions, W. W. Hurst developed a proposed testing plan which was the subject of letter dated August 13 and was distributed to all concerned for comment and/or modification. (Letter included in Appendix).

The plan was to conduct 3 sets of simultaneous test on each kiln stack for each of the emission types of interest (particulates, SO_x, NO_x). Also, perform 3-5 sets of test on No. 4 kiln system precipitators while simultaneously testing at the precipitator Input and Output locations. (The precipitator Output duct had no test ports so that the stack testing location was used. For our purpose the alternate location is considered to yield the same results). We exceeded our quota of tests as a result of delays caused by equipment outage.

The purpose of this report is to present test data and evaluate the results of the Bonner Springs emission survey.

II. Regulations

Source standards for stack particulate emissions applicable to the Bonner Springs plant were covered by Kansas Air Control Regulations promulgated 1-1-74 (see copy of Regulation, in part, included in Appendix).

Section 28-19-20 covered emission standard for particulate matter. The Bonner Springs operation for cement production falls in the general class of processes since it was not explicitly singled out as having certain other processes covered under "Additional Emission Restrictions", Section 28-19-21.

Section 28-19-20B defined process weight rate per hour as the normal operating maximum "feed rate", to the process. Slurry water cannot be included as part of the "Input Material Load" since it does not "constitute, or form, a source of particulate emission". Also, combustion air cannot be included as part of the input load for the same reason. Solid fuels, such as coal, can be included as part of the input load but liquid fuel oil or gaseous natural gas fuel cannot be included.

For Stack No. 4 and Stack No. 2 (with 2 of the small kilns operating) it was appropriate to use formula, $E = (55.0^{0.11} P - 40)$ where $P < 30$ tons/hr. The No. 1 and 4 kiln clinker cooler stack operated at a feed capacity of 26.75 tons/hr. meaning formula, $E = (4.1) P^{0.67}$ would apply where $E < 30$ tons/hr.

E = Maximum Allowable Particulate Emission Rate, Lbs/Hr.

P = Process Weight Rate, Ton/Hr.

Table 4, provided information for the following summary -

	No. 4 Kiln System	No. 2 Kiln System	No. 1 and 4 Clinker Cooler
Coal, Tons/Hr.	4.5	5.0	--
Raw Mix, Tons/Hr.	30.8	33.6	--
Clinker, Ton/Hr.	--	--	26.75
Total Input, T/H	35.3	38.6	26.75

It follows, the allowable particulate emission limit per unit becomes -

(1) No. 4 Kiln Stack - 41.4 Lbs/Hr.
(2) No. 2 Kiln Stack - 42.2 Lbs/Hr.
(3) No. 1 & 4 Cooler Stack - 37.08 Lbs/Hr.

Since actual particulate emissions averaged for Items 1-3 above are 23.4, 25.2 and 2.2 Lbs/Hr., respectively, it becomes obvious stack particulates emitted from Bonner stacks are well within the allowable limits.

III. Operating Equipment and Process Parameters

One medium size and three small, wet process kilns were operated at Bonner. The medium size kiln had its own flue gas transport duct and dust abatement equipment with the cleaned and cooled gas fed to a stack (No. 4) for waste gas dissemination. The three small kilns discharged flue gases to a common electrostatic precipitator for dust abatement with the cleaned gases dissipated through a single stack (No. 2), flue gases leave the kilns at 300°-400°F., traverse a dust chamber and duct system so as to enter the electrostatic precipitators at around 325° and 25-30% water vapor. Gases exiting the precipitators, enter the stacks via induction fans. In all, there are four kilns with two stacks. Kilns 1-3, the small kilns, are associated with kiln stack No. 2 and Kiln No. 4, the medium size unit, has its own stack - kiln stack No. 4. The three small kilns produce clinker at 10 ton/hr. level; whereas, the medium size kiln produces at 18 ton/hr. No. 4 kiln was a Traylor Mfg. and 10' X 340'. No. 1-3 kilns were Worthington Mfg. Kiln No. 1 was 9' for 70' of burning zone tapering to 8' with an overall length of 228'-10". Kilns 2 and 3 were similar at 9' X 8' X 218' with the enlarged section at the burning zone 60'.

Both flue gas processing systems were equipped with Koppers Electrostatic Precipitators. The Koppers unit on No. 2 kiln stack for kilns 1-3 was designed to handle 120,000 ACFM @ 635°F. with an input grain loading of the gases at 52.2 grains/cu.ft. The gases output grain loading should be less than 0.1 grain/cu.ft. - yielding a unit dust removal of 99.8%. No. 4 kiln system was equipped with a Koppers designed to handle 103,000 ACFM gas volume at 650°F. The input grain loading was rated at 73.5 grains/cu.ft. with the output loading less than 0.1 grains/cu.ft. yielding a unit dust removal of 99.8%.

No. 2 stack discharge location was 200' above the foundation. (Foundation was 798' above sea level) Test ports were located on the stack at 123' above foundation where the stack diameter was 7'-9" I.D. The stack had four - 4" dia. pipe ports placed 90° apart and in the same elevation plane. No. 4 stack discharge location was also 200' above the foundation. (Foundation was 800' above sea level) Test ports were located on the stack 96' above foundation where the stack diameter was 9'-7" I.D. This stack also had 4" dia. pipe ports placed at 90° in the same elevation plan - (see Fig. 1 and 2 for details).

A complete listing of process conditions during each source test was tabulated. Note Table T-4 showed raw mix feed rate, flue gas rate, clinker production rate, etc. Also, flue gas characteristics including velocity, pressure, temperature, moisture, density and chemical analysis (CO_2, O_2) were tabulated in Table T-5 through T-8. Additionally, note composite chemical analysis of coal fuel, raw mix and clinker (Table T-10 and Appendix).

IV. Test Equipment and Testing Procedures

The Sampling Train used for source testing was basically a Model AP-5000 "Stac-O-Lator" manufactured by Scientific Glass and Instruments, Inc. of Houston, and has been EPA approved. The impinger type and charge was in accordance with EPA recommendation escept we use somewhat more silica gel than EPA suggests so as to be sure of absorbing all water vapor. The glass fiber filters were 4" Gelman, Type I, with a retention factor of 99.7% @ 0.3 micron particle size.

In general, we used the EPA sampling procedure which is in accord with Kansas State requirements. Each test was 2-3 hours long generally sampling at 0.5 CFM dry gas. Each of the stack tests gathered well over 50 cu.ft. The train was leak checked at the start and end of each run at about 17" Hg. rather than 15" Hg. as required by EPA. Our control valves are at equilibrium with pump at 17" Hg. rather than 15" Hg.

The older but very reliable ASTM test method using Aluminum Oxide Thimbles was used when testing the precipitator input particulate loads since this method lends itself better to heavy particulate loads. Following the Aluminum Oxide Filter Thimbles was the conventional EPA impinger train.

Stainless steel, teflon lined heated probe liners were used for stack testing. Probes were thoroughly washed with Acetone following each test with nozzle removed. Reassembled clean probes were leak checked @ 25" Hg. vacuum with no noticeable leaks tolerated. Probes have been modified for proper spacing of nozzle vs. pitot tube in accordance with EPA's recent change (August, 1977).

We operate out of a 30 ft. mobile laboratory so that all sample recovery, such as weighing, evaporating, and washing, is done within the air conditioned mobile laboratory.

Laboratory analyses are performed strictly in accordance with EPA. Our analytical balance for weighing filters is a Mettler H-6.

Our impinger weighing balance is a Mettler P-1200. We use 4 large desiccators for storing and keeping filters at constant weight. We generally run blanks on each Acetone and distilled water lot but seldom find enough residue for significant modification of results. For the record, our current Acetone residue per 500 ml is 0.6 gm. and our distilled water residue is 1.8 mg. per 500 ml.

We use two Thermo Electric digital thermocouple indicators, Model ELPA with a 1° accuracy. The indicators are electrically connected through switching to a Thermo Electric "Minimite", which is used to calibrate the temperature range of interest per test. The "Minimite" has an accuracy of ± 1/4%. Calibration of thermocouple indicators occurs at the beginning of each plant run and more often if it seems necessary or a significant change occurs in the range of testing interest.

IV. Test Equipment, Cont'd.

Five dry test Rockwell meters are calibrated at the start of each plant test. Part of the mobile laboratory equipment is a Precision Wet Test Meter, Serial No. AA-9, which is used to standardize the dry test meters. The wet test meter is calibrated annually by equipment traceable to the Bureau of Standards.

The orifice used for "ΔH" readings is calibrated at random periods whenever the "ΔH" vs. CFM relationship shows significant variation. The isokinetic equation is combined with the orifice meter equation so as to produce a "$\Delta P = K\Delta H$" relationship with a value of "K" for each D.T.M. vs. orifice meter combination. Accordingly, we use a calculator rather than a nomograph during data collection.

V. Discussion of Results

Generally, results were meaningful and consistently showed Bonner stack emissions were well within emission limits at something less than 50% of the allowable on the kiln stacks and only a fraction of the allowable on the clinker cooler stack.

One exception to an otherwise gratifying testing tour did occur on October 7 as reflected by results - Runs 63 and 64. The reason two runs were involved during a single period in time was due to the fact we make runs simultaneously. Note Table T-1 showed the lb/hr. dust rate emitted during these two runs was about 16 times the average emission determined during the other 14 runs of this series on No. 2 stack. Records showed the No. 2 stack electrostatic precipitator was completely shut down due to an emergency from 10:40 - 13:25 this date. This shutdown period included the last 25-30% of our test run. (Shutdown not known to us at this time so that we finished the runs). Run 63 covered a period from 8:30 - 11:15 and Run 64 covered 8:33 - 11:18. Results of these runs were included in our report since they were, in fact, actually developed. However, results of Runs 63 and 64 were not included in our averages because of their heavy bias that unrealistically and adversely influences the actual emission evaluation at the Bonner plant.

When considering Run 63 and 64 separate from the rest of the testing program, an interesting point developes. Note from Table T-1, Run 63 showed particulate emissions of 531 lbs/hr. as compared to Run 64 at 352 lbs/hr. Based on Run 64 @ 352 Lbs/hr., Run 63 showed 51% more emissions gathered at 531 lbs/hr. This sizable spread in emissions collected occurred for the most part during the last 25% of the run at a time when each of the sampling probes covered only a single segment opposite one another within the stack. The point is, that gases introduced in the bottom of the stack by an induction fan tend to ricochet in an unpredictable pattern as they traverse the stack. We have noticed this phenomenon before, that is, the particulate concentration in stack gases is far from homogeneous in a given plane at any particular time. Accordingly, the 51% discrepancy was real and probably an accurate representation of particulate concentration in two areas under test at the period of sampling.

The precipitator efficiency test showed the electrostatic precipitators were not quite up the optimum efficiency of 99.8%. Test showed the efficiency at 99.4%. Though the current precipitator efficiency was less than the designed level, there is no real need for alarm since stack emissions were well under control. You will recall, the precipitator design grain loading was of the order of 50-75 grains per cu.ft., whereas, the actual input grain loading was considerably less at 5-7 grains/cu.ft. This low input grain loading of only 1/10 rated input loading was undoubtedly the reason the output grain loading remained favorably low even though the precipitator efficiency was under the rated level.

SO_x emissions were not of major concern at this time since the Kansas Regulatory Group have not promulgated a ruling on SO_x emissions applicable to Portland Cement production. Additionally, results seemed favorable

V. Discussion of Results (Continued)

considering the coal used for burning kilns was reasonably high at 3.55% sulfur.

Note Summary Results showed SO_x ppm emissions from Stack No. 4 were higher than SO_x emitted from Stack No. 2; whereas, the lbs/hr. emission from Stack No. 4 were less than the lbs/hr., SO_x emitted from Stack No. 2. This was, in fact, the case which resulted from the fact No. 4 Stack emissions showed very little infiltration of air and thus the SO_x remains concentrated. No. 2 Stack, on the other hand, showed quite a bit of infiltrated air which diluted the SO_x. Remember, ppm is a measure of concentration; whereas, lbs/hr. is not a measure of concentration, but rather, a time rate.

NO_x results were also favorable even though Kansas does not have a NO_x allowable limit. No. 4 Kiln System showed a particularly favorable NO_x level which was undoubtedly due to the low level of excess oxygen. Conversely, No. 2 kiln stack showed twice the concentration in ppm and 4 ½ times the production rate in lbs/hr. The higher value of NO_x in the No. 2 kiln system was primarily due to the occurance of greater quanties of excess oxygen available for NO_x production.

VI. Conclusions

(1) All stack particulate emissions were well within allowable limits.

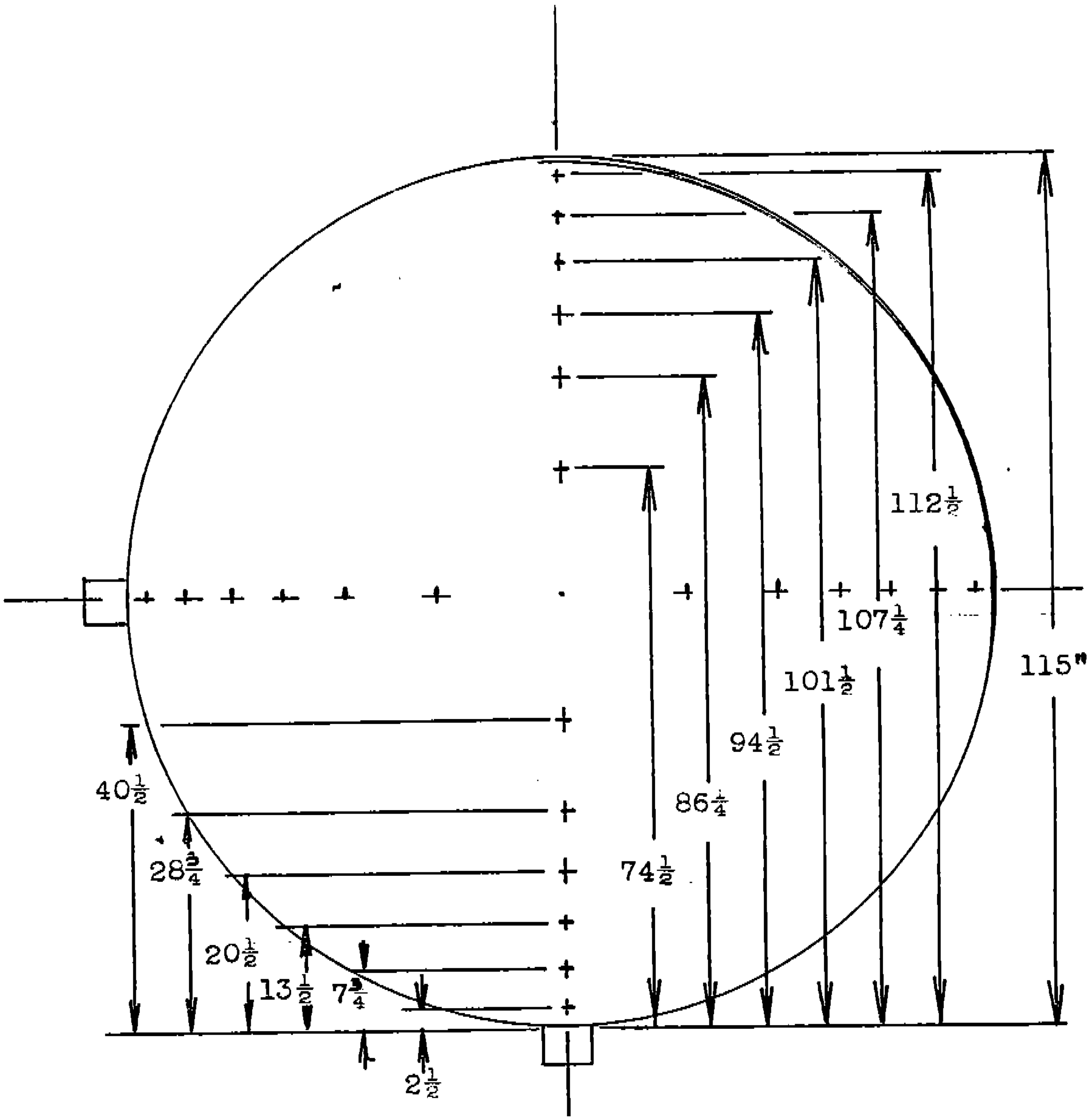
(2) Electrostatic precipitators, though not performing at optimum efficiency, were abating dust at a satisfactory level.

(3) SO_x emissions from the kiln stacks were comparatively low and present no emission problem at this time.

(4) NO_x emissions from the kiln stacks were comparatively low and present no problem at this time.

Fig. 1

BONNER SPRINGS DUST SURVEY
KILN STACK NO. 4
VELOCITY AND PARTICULATE SAMPLING TRAVERSE



PLAN VIEW

* LOCATION OF SAMPLING POINTS

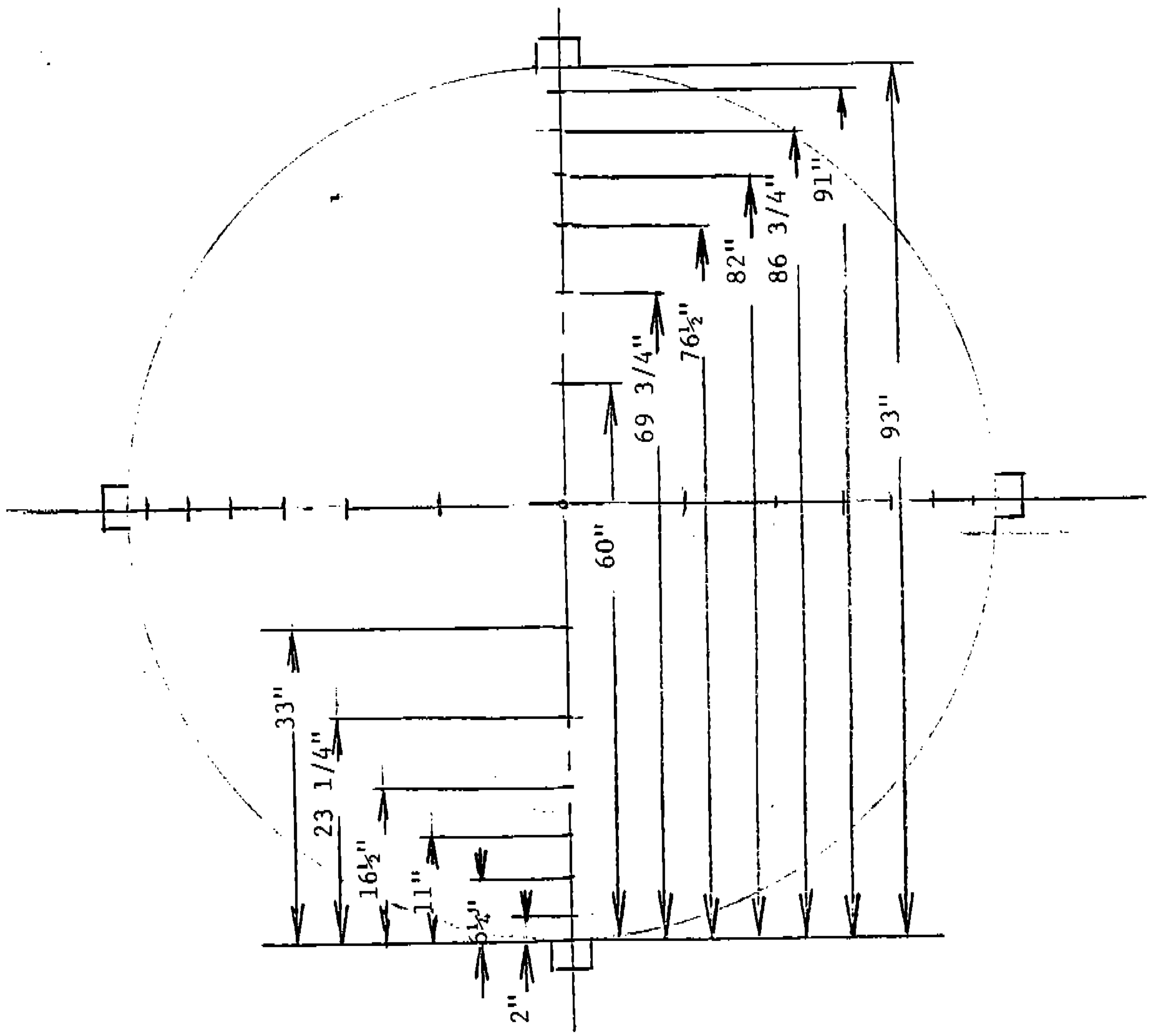
CROSS-SECTIONAL AREA - 72.13 SQ. FT.

Fig. 2

BONNER SPRINGS DUST SURVEY

Kiln Stack No. 2

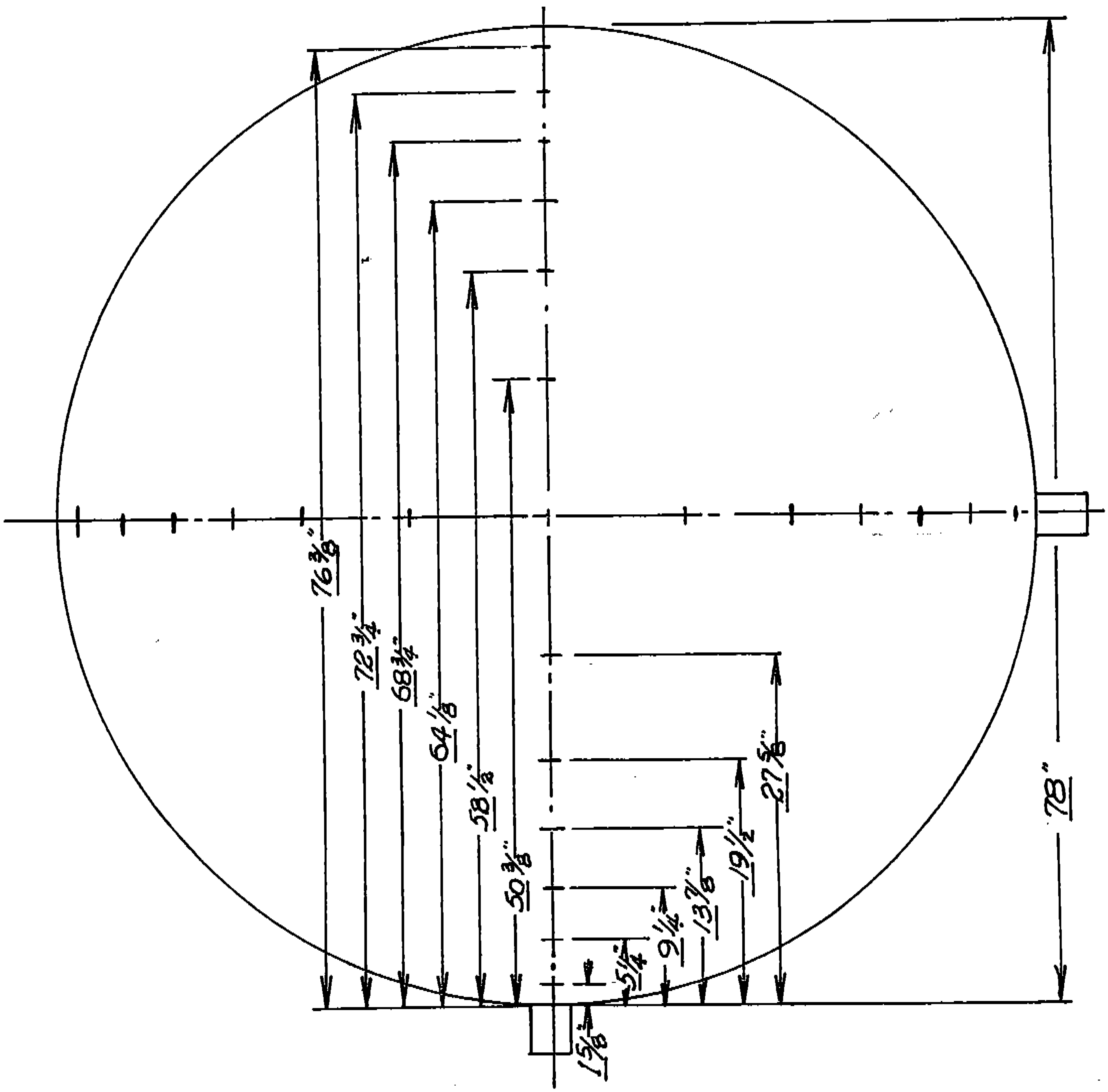
Velocity and Particulate Sampling Traverse



Plan View
*Location of Sampling Points
Cross-Sectional Area - 47.17 Sq.Ft.

Fig. 3

BONNER SPRINGS DUST SURVEY
CLINKER COOLER STACK NO. 1 & 4
VELOCITY AND PARTICULATE SAMPLING TRAVERSE

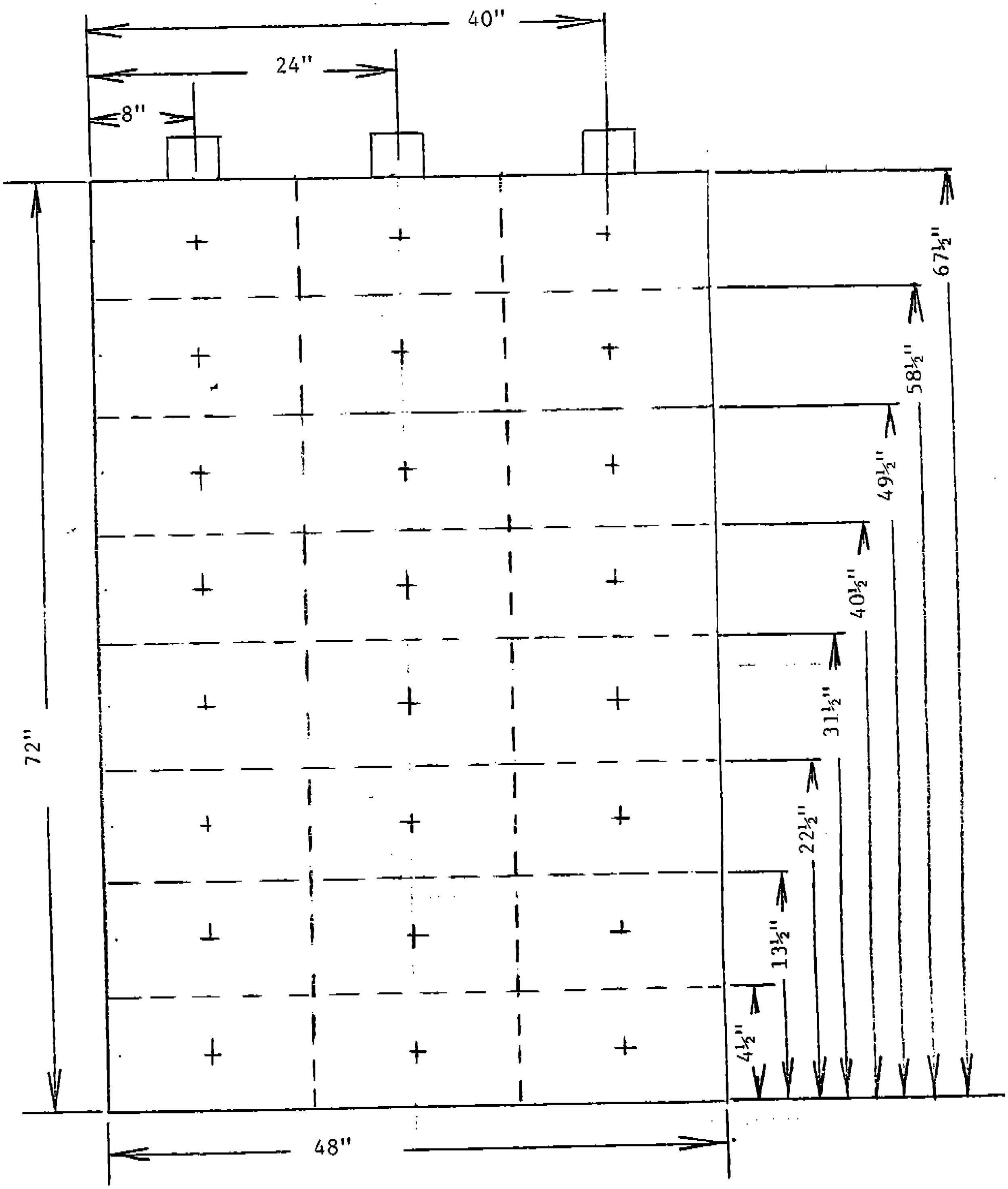


PLAN VIEW

* LOCATION OF SAMPLING POINTS

CROSS-SECTIONAL AREA - 33.18 SQ. FT.

Fig. 4
BONNER SPRINGS DUST SURVEY
PRECIPITATOR INPUT TRAVERSE, KILN SYSTEM NO. 4
VELOCITY AND PARTICULATE SAMPLING TRAVERSE



Plan View
*Location of Sampling Points
Cross-Sectional Area - 24.00 Sq.ft.

TABLE T-1

BONNER SPRINGS STACK EMISSION SURVEY

PARTICULATE EMISSION RATE 1981

Run No.	Test Location	Date	EXHAUST GAS Temp. °F.	EXHAUST GAS Volume ACFM	PARTICULATE EMISSION RATE Grains/ SCF Dry	PARTICULATE EMISSION RATE Lbs./SCF Dry X 10^{-6}	PARTICULATE EMISSION RATE Lbs./Hr.	PARTICULATE EMISSION RATE Ton/Day
1	No. 4 Stk.	9-8	--	--	--	--	--	--
2	"	"	777	75,900	0.1642	23.5	53.0	0.64
5	"	9-9	772	64,100	0.0741	10.6	19.7	0.24
6	"	"	769	72,900	0.0690	9.9	21.2	0.25
9	"	9-10	776	66,700	0.0623	8.9	18.0	0.22
10	"	"	768	67,200	0.0764	10.9	21.0	0.25
15	"	9-11	766	63,500	0.0955	13.6	25.9	0.31
16	"	"	768	55,500	0.0222	3.2	4.7	0.06
AVERAGE			771	66.500	0.0805	11.5	23.4	0.31
21	No. 2 Stk.	9-21	695	99,300	0.0308	4.4	16.3	0.20
22	"	9-21	692	105.400	0.0748	10.7	40.6	0.48
27	"	9-22	668	96,100	0.0206	2.9	11.6	0.14
28	"	9-22	666	100,900	0.0301	4.3	18.4	0.22
33	"	9-23	635	90,300	0.0177	2.5	10.0	0.12
34	"	9-23	635	85,100	0.0199	2.8	10.7	0.13
39	"	9-24	677	108,900	0.0340	4.9	20.4	0.25
40	"	9-24	676	110,600	0.0329	4.7	20.1	0.24
45	"	9-25	680	103,700	0.0607	8.4	34.4	0.41
46	"	9-25	679	111,400	0.0351	5.0	21.0	0.25
51	"	10-5	720	114,700	0.0240	3.4	13.1	0.16
52	"	10-5	724	118,400	0.1080	15.4	62.6	0.75
57	"	10-6	734	119,000	0.0788	11.3	44.8	0.54
58	"	10-6	734	127,200	0.0488	7.0	29.0	0.35
63	"	10-7	702	102,600	1.0470	147.0	531*	6.8
64	"	10-7	703	97,400	0.6930	99.0	352*	4.2
AVERAGE			688	105,700	0.1472	20.8	77.25	0.93
*Average not including Runs 63 & 64					0.042		25.2	

TABLE T-1 (Continued)

BONNER SPRINGS STACK EMISSION SURVEY

PARTICULATE EMISSION RATE 1981

Run No.	Test Location	Date	EXHAUST GAS Temp. °F.	EXHAUST GAS Volume ACFM	PARTICULATE EMISSION RATE Grains/ SCF Dry	Lbs./SCF Dry X 10^{-6}	Lbs./Hr.	Ton/Day
67	No. 4 Stk.	10-8	734	70,500	.1032	14.7	32.2	.386
68	No. 4 Pptr.	10-8	722	106,100	5.469	781	2613	31.4
73	No. 4 Stk.	10-9	742	75,500	0.0413	5.9	12.5	.15
74	No. 4 Pptr.	10-9	795	80,200	7.960	1137	2.391	28.7
77	No. 4 Stk.	10-22	758	74,900	.0177	2.5	5.5	.06
78	No. 4 Pptr.	10-22	780	71,600	6.804	972	1864	22.4
83	No. 4 Stk.	10-23	751	74,700	.0183	2.6	5.8	.06
84	No. 4 Pptr.	10-23	761	74,400	6.446	920	1940	23.3
AVERAGE - Stack			746	73,900	0.0451	6.4	14.0	0.17
AVERAGE - Pptr.			765	83,000	6.67	953	2202	26.4
87	No. 1	11-2	638	47,200	0.0092	1.31	3.0	.04
88	& 4	11-2	638	52,300	0.0167	2.39	6.0	.07
89	Cooler	11-3	635	48,400	0.0024	0.34	0.8	.01
90	Stack	11-3	637	52,100	0.0039	0.55	1.4	.02
91	"	11-4	671	51,100	0.0027	0.39	0.9	.01
92	"	11-4	672	57,600	0.0034	0.48	1.3	.02
AVERAGE			649	51,500	0.0063	0.91	2.2	.03

TABLE T-1-A

BONNER SPRINGS STACK EMISSION SURVEY

ELECTROSTATIC PRECIPITATOR EFFICIENCY DATA 1981

No. 4 KILN SYSTEM

Run Nos.	Date	Precipitator Input Lbs/Hr.	Stack Lbs/Hr.	Precipitator Efficiency (Input - Output) / Input
67,68	10-8	2613	32.2	98.7
73,74	10-9	2391	12.5	99.5
77,78	10-22	1864	5.5	99.7
83,84	10-23	1940	5.8	99.7
AVERAGE		2202	14.0	99.4

TABLE T-2

BONNER SPRINGS STACK EMISSION SURVEY

SULFUR EMISSION DATA 1981

Run No.	Date 1981	Test Location	EXHAUST GAS Temp. °F.	Volume ACFM	SULFUR EMISSION RATE AS SO_2 Grains/ SCF Dry	Lbs/SCF Dry $X10^{-6}$	Lbs/ Hr.	Ton/ Day	ppm Vol.
3	9-8	No. 4 Stk.	777	76,700	1.096	156.5	338	4.06	949
4	9-8	"	777	77,700	1.153	164.7	333	4.00	999
7	9-9	"	772	64,000	0.481	68.7	116	1.39	416
8	9-9	"	769	73,700	0.448	64.0	131	1.58	389
11	9-10	"	776	68,100	0.707	100.9	185	2.22	607
12	9-10	"	768	67,900	0.692	98.8	182	2.18	599
17	9-11	"	766	64,500	0.912	130.2	229	2.75	789
18	9-11	"	768	54,500	0.731	104.5	169	2.03	633
23	9-21	No. 2 Stk.	695	99,900	0.500	71.5	257	3.09	433
24	9-21	"	692	105,600	0.521	74.4	283	3.39	451
29	9-22	"	668	95,600	0.134	19.1	77	0.92	116
30	9-22	"	666	102,900	0.365	52.1	202	2.42	316
35	9-23	"	635	90,600	0.199	28.4	112	1.34	172
36	9-23	"	635	85,100	0.194	27.7	104	1.24	168
41	9-24	"	677	108,800	0.370	52.9	223	2.67	321
42	9-24	"	676	110,800	0.405	57.8	245	2.94	350
47	9-25	"	680	104,200	0.486	69.4	269	3.73	421
48	9-25	"	679	111,100	0.402	57.5	244	2.93	348
53	10-5	"	720	115,800	0.669	95.6	355	4.26	579
54	10-5	"	724	155,300	0.711	101.5	498	5.97	615
59	10-6	"	734	117,100	0.184	26.3	113	1.35	160
60	10-6	"	734	124,700	0.315	45.0	205	2.46	273
65	10-7	"	702	101,800	0.372	53.11	210	2.52	322
66	10-7	"	703	97,500	0.556	79.5	281	3.36	482
69	10-8	No. 4 Stk.	734	69,100	0.652	93.1	226	2.72	564
70	10-8	No. 4 Pptr.	--	--	--	--	--	--	--
75	10-9	No. 4 Stk.	742	71,300	0.169	24.2	68	0.82	147
76	10-9	No. 4 Pptr.	795	80,500	1.524	217.7	448	5.37	1319
79	10-22	No. 4 Stk.	758	74,800	1.187	169.5	372	4.46	1027
80	10-22	No. 4 Pptr.	--	--	--	--	--	--	--
85	10-23	No. 4 Stk.	751	74,900	1.622	231.7	505	6.06	1404
86	10-23	No. 4 Pptr.	761	74,200	1,465	209.0	446	5.36	1269

TABLE T-3

BONNER SPRINGS STACK EMISSION SURVEY

NO_x SUMMARY

(Average of Six Grab Samples) 1981

Run No.	Date 1981	Location	NO_2 Lbs/Hr.	ppm by Vol. Dry
1	9-9	No. 4 Kiln Stack	35	123
2	9-9	"	8	35
3	9-10	"	16	69
4	9-10	"	69	292
5	9-11	"	52	250
6	9-11	"	4	20
7	9-12	No. 2 Kiln Stack	80	163
8	9-12	"	91	187
9	9-23	"	61	133
10	9-23	"	66	143
11	9-24	"	129	254
12	9-24	"	114	225
13	9-25	"	136	280
14	9-25	"	135	278
15	10-5	"	194	412
16	10-5	"	149	317
17	10-6	"	272	613
18	10-6	"	256	528
19	10-9	No. 4 Pptr. Input	82	342
20	10-9	No. 4 Kiln Stack	89	374

No [illegible] 188

TABLE T-4

BONNER SPRINGS STACK EMISSION SURVEY

RATE PRODUCTION AND CONSUMPTION 1981

Date 1981 (Runs)	System Under Test	Fuel Used: Coal Lbs/Min.	Fuel Used: Moisture %	Raw Mix Used: Ton/Hr. Dry	Raw Mix Used: Slurry Moist - %	Raw Mix Used: $CaCO_3$ %	Clinker Produced Ton/Hr.
9-8 (1-2)	No. 4 Kiln Stk.	156	8.0	31.0	34.7	79.2	16.8
9-9 (5,6)	"	146	6.1	31.0	35.0	79.2	16.9
9-10 (9,10)	"	150	8.0	31.4	34.5	79.3	17.0
9-11 (15,16)	"	150	7.1	32.0	34.1	79.2	17.4
9-21 (21,22)	No. 2 Kiln Stk.						
	Kiln 1-24 Hr.	83	7.4	17.86	34.1	80.3	9.92
	Kiln 2-24 Hr.	88	7.4	17.17	34.1	80.3	9.54
	Kiln 3-0 Hr.	--	--	--	--	--	--
9-22 (27,28)	Kiln 1-0 Hr.	--	--	--	--	--	--
	Kiln 2-24 Hr.	84	5.8	16.72	34.5	80.4	9.29
	Kiln 3-0 Hr.	--	--	--	--	--	--
9-23 (33,34)	Kiln 1-0Hr.	--	--	--	--	--	--
	Kiln 2-24 Hr.	85	6.5	16.88	34.0	80.3	9.38
	Kiln 3-12 Hr.	90	6.5	15.61	34.0	80.3	8.67
9-24 (39,40)	Kiln 1-0 Hr.	--	--	--	--	--	--
	Kiln 2-24 Hr.	84	8.0	17.17	34.1	80.3	9.54
	Kiln 3-24 Hr.	80	8.0	16.88	34.1	80.3	9.38
9-25 (45,46)	Kiln 1-0 Hr.	--	--	--	--	--	--
	Kiln 2-24 Hr.	84	7.8	17.41	34.0	80.3	9.67
	Kiln 3-24 Hr.	77	7.8	16.96	34.0	80.3	9.42
10-5 (51,52)	Kiln 1-24 Hr.	87	7.2	18.23	33.8	79.9	10.13
	Kiln 2-24 Hr.	88	7.2	17.69	33.8	79.9	9.83
	Kiln 3-20.5 Hr.	80	7.2	17.55	33.8	79.9	9.75
10-6 (57,58)	Kiln 1-20 Hr.	89	7.5	18.18	34.3	79.8	10.10
	Kiln 2-24 Hr.	87	7.5	17.26	34.3	79.8	9.59
	Kiln 3-23.75 Hr.	84	7.5	17.21	34.3	79.8	9.56
10-7 (63,64)	Kiln 1-18 Hr.	89	7.0	16.31	34.1	79.7	9.06
	Kiln 2-23 Hr.	82	7.0	17.14	34.1	79.7	9.52
	Kiln 3-24 Hr.	84	7.0	16.43	34.1	79.7	9.13

TABLE T-4 (Continued)

BONNER SPRINGS STACK EMISSION SURVEY

RATE PRODUCTION AND CONSUMPTION 1981

Date 1981	System Under Test	Fuel Used		Raw Mix Used			Clinker Produce Ton/Hr.
		Coal Lbs/Min.	Moisture %	Ton/Hr. Dry	Slurry Moist - %	$CaCO_3$ %	
10-8	No. 4 Stack & Pptr. Input	151	8.3	31.3	33.9	79.7	17.0
10-9	"	150	7.8	30.7	33.7	79.6	16.7
10-22	"	154	8.0	30.6	35.3	79.9	16.6
10-23	"	155	7.8	30.1	35.0	79.9	16.7
11-2	No. 1 & 4 Clinker Cooler Stack	150	8.5	31.1	33.7	79.9	17.3
11-3	"	130	7.2	29.0	34.1	79.8	16.1
11-4	"	149	7.7	30.8	34.4	79.6	17.0

TABLE T-5

BONNER SPRINGS STACK EMISSION SURVEY
EXHAUST GAS CHARACTERISTICS

1981

Run No.	Pitot Tube Factor	Temp. °R. T_s	% Water in Gas	Gas Density Lbs/Lb-Mole	Static Gas Press. "H_2O	Stack Gas Press. "Hg.
1	.84	--	-- L O	S T --	--	--
2	"	777	24.5	28.18	-.53	28.86
3	"	777	28.6	27.63	-.53	28.92
4	"	777	34.0	26.90	-.53	28.86
5	"	772	26.9	27.72	-.49	28.86
6	"	769	26.1	27.83	-.48	28.86
7	"	772	33.5	27.81	-.49	28.86
8	"	769	30.2	27.28	-.48	28.86
9	"	776	23.0	28.25	-.51	28.81
10	"	768	28.1	27.57	-.49	28.81
11	"	776	31.6	27.11	-.51	28.81
12	"	768	32.0	27.05	-.49	28.81
15	"	766	25.2	28.02	-.53	28.85
16	"	768	33.1	26.96	-.45	28.85
17	"	766	32.0	27.11	-.53	28.94
18	"	768	25.6	27.97	-.45	28.95
21	"	695	15.8	28.21	-.25	29.00
22	"	692	18.9	27.83	-.25	29.00
23	"	695	18.6	27.87	-.25	29.00
24	"	692	18.8	27.85	-.25	28.86
27	"	668	11.7	28.60	-.24	29.35
28	"	666	9.3	28.89	-.25	29.35
29	"	668	9.5	28.87	-.24	29.35
30	"	666	19.7	27.74	-.25	29.35
33	"	635	10.4	28.35	-.06	29.48
34	"	635	10.9	28.29	-.12	29.47
35	"	635	11.8	28.19	-.06	29.47
36	"	635	10.7	28.31	-.12	29.47
39	"	677	16.4	27.88	-.22	29.45
40	"	676	16.2	27.91	-.12	29.46
41	"	677	16.3	27.90	-.22	29.45
42	"	676	17.4	27.77	-.12	29.46

TABLE T-5 (Continued)

BONNER SPRINGS STACK EMISSION SURVEY
EXHAUST GAS CHARACTERISTICS

1981

Run No.	Pitot Tube Factor	Temp. °R. T_s	% Water in Gas	Gas Density Lbs/Lb-Mole	Static Gas Press. "H_2O	Stack Gas Press. "Hg.
45	.84	680	16.3	27.98	-.21	29.24
46	"	679	17.7	27.71	-.16	29.25
47	"	680	18.5	27.71	-.21	29.24
48	"	679	16.5	27.95	-.16	29.25
51	"	720	21.8	27.94	-.22	29.12
52	"	724	20.2	28.13	-.17	29.12
53	"	720	25.2	27.51	-.22	29.12
54	"	724	26.1	27.39	-.17	29.13
57	"	734	21.7	27.82	.23	29.57
58	"	734	23.5	27.59	.17	29.57
59	"	734	14.6	28.71	.23	29.57
60	"	734	14.6	28.71	.17	29.57
63	"	702	16.6	28.23	-.29	29.49
64	"	703	18.2	28.03	-.29	29.50
65	"	702	13.1	28.66	-.29	29.50
66	"	703	18.7	27.97	-.29	29.50
67	"	734	25.5	27.98	-.44	29.31
68	"	722	25.2	28.28	-8.16	28.74
69	"	734	17.1	29.12	-.44	29.31
70	"	722	--	L O S T	--	--
73	"	742	32.5	27.11	-.48	29.14
74	"	795	31.3	27.44	-8.00	28.59
75	"	742	5.2	30.19	-.48	29.14
76	"	795	33.1	27.14	-8.00	28.59
77	"	758	29.9	27.54	-.54	29.61
78	"	780	32.3	27.40	-8.20	29.05
79	"	758	29.3	27.62	-.54	29.62
80	"	--	--	L O S T	--	--
83	"	751	29.9	27.28	-.630	29.80
84	"	761	30.6	27.53	-7.8	29.20

TABLE T-5 (Continued)

BONNER SPRINGS STACK EMISSION SURVEY
EXHAUST GAS CHARACTERISTICS

1981

Run No.	Pitot Tube Factor	Temp. °R. T_s	% Water in Gas	Gas Density Lbs/Lb-Mole	Static Gas Press. "H_2O	Stack Gas Press. "Hg.
85	.84	751	30.8	27.15	-.63	29.77
86	"	761	29.6	27.66	-7.8	29.24
87	"	638	10.2	28.73	.12	29.37
88	"	638	15.7	28.67	.14	29.37
89	"	635	18.6	28.63	.16	29.43
90	"	637	15.9	28.67	.14	29.43
91	"	671	14.8	28.67	.14	29.27
92	"	672	14.7	28.67	.10	29.27

TABLE T-6

BONNER SPRINGS STACK EMISSION SURVEY

EXHAUST GAS FLOW RATE

1981

Run No.	Barometric Press. "Hg.	Stack Area Sq.Ft.	$\sqrt{\Delta P}$ H_2O	Velocity Ft./Sec.	Volume ACFM	Volume CFH (Dry) @ Stand. Cond. X 10^6
1	--	--	--	L O S T	--	--
2	28.90	72.13	.25	17.54	75,900	2.260
3	"	"	.25	17.72	76,700	2.159
4	"	"	.25	17.95	77,700	2.022
5	"	"	.21	14.81	64,100	1.860
6	"	"	.24	16.86	73,000	2.149
7	"	"	.21	14.79	64,000	1.689
8	"	"	.24	17.02	73,700	2.050
9	28.85	"	.22	15.42	66,800	2.026
10	"	"	.22	15.53	67,200	1.925
11	"	"	.22	15.75	68,100	1.837
12	"	"	.22	15.68	67,900	1.838
15	28.89	"	.21	14.68	63,500	1.800
16	"	"	.18	12.84	55,500	1.683
17	"	"	.21	14.90	64,500	1.758
18	"	"	.18	12.58	54,500	1.622
21	29.02	47.17	.53	35.07	99,300	3.703
22	"	"	.56	37.23	105,400	3.802
23	"	"	.53	35.28	99,900	3.601
24	"	"	.56	37.31	105,600	3.797
27	29.37	"	.53	33.95	96,000	3.957
28	"	"	.56	35.63	100,900	4.279
29	"	"	.53	33.79	95,600	4.037
30	"	"	.56	36.37	102,900	3.867
33	29.48	"	.51	31.92	90,300	3.989
34	"	"	.48	30.08	85,100	3.737
35	"	"	.51	32.01	90,600	3.938
36	"	"	.48	30.06	85,100	3.744
39	29.47	"	.59	38.46	108,900	4.203
40	"	"	.60	39.06	110,600	4.286
41	"	"	.59	38.45	108,800	4.208

TABLE T-6 (Continued)

BONNER SPRINGS STACK EMISSION SURVEY

EXHAUST GAS FLOW RATE

1981

Run No.	Barometric Press. "Hg.	Stack Area Sq.Ft.	$\sqrt{\Delta P}$ H_2O	Velocity Ft./Sec.	Volume ACFM	Volume CFH (Dry) @ Stand. Cond. X 10^6
42	29.47	47.17	.60	39.16	110,800	4.236
45	29.26	"	.56	36.65	103,700	3.965
46	"	"	.60	39.36	111,400	4.192
47	"	"	.56	36.83	104,200	3.879
48	"	"	.60	39.26	111,100	4.242
51	29.14	"	.60	40.52	114,700	3.851
52	"	"	.62	41.83	118,400	4.037
53	"	"	.60	40.84	115,600	3.713
54	"	"	.62	42.41	120,000	4.903
57	29.56	"	.62	42.04	119,000	3.986
58	"	"	.66	44.94	127,200	4.162
59	"	"	.62	41.39	117,100	4.280
60	"	"	.66	44.06	124,700	4.556
63	29.52	"	.55	36.26	102,600	3.818
64	"	"	.52	34.42	97,400	3.551
65	"	"	.55	35.98	101,900	3.948
66	"	"	.52	34.46	97,500	3.533
67	29.34	72.13	.24	16.29	70,500	2.228
78	"	24.00	1.09	73.76	106,100	3.355
69	"	72.13	.24	15.98	69,200	2.431
70	"	24.00	--	L O S T	--	--
73	29.18	72.13	.25	17.44	75,500	2.125
74	"	24.00	.77	55.68	80,200	2.103
75	"	72.13	.25	16.48	71,300	2.820
76	"	24.00	.77	55.96	80,600	2.058
77	29.65	72.13	.25	17.31	74,900	2.178
78	"	24.00	.70	49.76	71,600	1.918
79	"	72.13	.25			
80	"	--	--	L O S T	--	--
83	29.82	72.13	.25	17.26	74,700	2.204

TABLE T-6 (Continued)

BONNER SPRINGS STACK EMISSION SURVEY

EXHAUST GAS FLOW RATE

1981

Run No.	Barometric Press. "Hg.	Duct or Stack Area Sq.Ft.	$\sqrt{\Delta P}$ H_2O	Velocity Ft./Sec.	Volume ACFM	Volume CFH (Dry) @ Stand. Cond. X 10^6
84	29.82	24.00	.74	51.66	74,400	2.106
85	"	72.13	.25	17.30	74,900	2.180
86	"	24.00	.74	51.53	74,200	2.131
87	29.36	33.18	.38	23.73	47,200	2.285
88	"	"	.42	26.25	52,300	2.514
89	29.42	"	.39	24.31	48,400	2.337
90	"	"	.42	26.20	52,200	2.518
91	29.26	"	.40	25.68	51,100	2.332
92	"	"	.45	28.91	57,600	2.620

TABLE T-7

BONNER SPRINGS STACK EMISSION SURVEY

GAS SAMPLING AND TESTING PARAMETERS

1981

Run No.	Test Nozzle Size Sq.Ft.	Test Duration Min.	Meter Temp. °R.	Meter Vol. @ Meter Cond. Cu.ft.	Meter Vol. @ Stand. Cond. Cu.ft. dry	Meter Press. "Hg	Meter Press. ΔH "H_2O	% Isokinetic
1	--	--	--	L O S T	--	--	--	--
2	.000341	144	532	26.30	25.82	28.92	.28	99.49
3	--	135	532	62.94	60.60	28.92	.28	--
4	--	135	532	67.01	64.51	28.92	.28	--
5	.000726	144	541	46.92	44.45	28.94	.59	99.80
6	.000726	144	541	54.16	51.32	28.95	.62	99.63
7	--	120	541	56.33	53.37	28.94	.59	--
8	--	120	541	58.60	55.53	28.95	.62	--
9	.000726	144	538	49.15	46.74	28.89	.51	96.26
10	.000726	144	534	49.64	47.56	28.89	.54	103.23
11	--	155	538	77.08	73.29	28.89	.51	--
12	--	155	534	62.14	59.54	28.89	.54	--
15	.000726	144	541	46.91	44.42	28.92	.45	97.60
16	.000726	144	537	40.62	38.73	28.92	.36	111.42
17	--	151	541	76.25	72.41	29.01	.45	--
18	--	151	537	73.01	69.84	29.00	.36	--
21	.000341	144	545	61.52	58.13	29.08	.81	90.76
22	.000341	144	542	64.56	61.36	29.10	.94	93.41
23	--	126	545	71.75	67.80	29.08	.81	--
24	--	126	542	79.86	75.59	28.97	.94	--
27	.000341	144	533	60.27	58.92	29.42	.68	85.94
28	.000341	144	540	63.66	61.43	29.42	.76	82.85

TABLE T-7

BONNER SPRINGS STACK EMISSION SURVEY

GAS SAMPLING AND TESTING PARAMETERS

1981

Run No.	Test Nozzle Size Sq.Ft.	Test Duration Min.	Meter Temp. °R.	Meter Vol. @ Meter Cond. Cu.ft.	Meter Vol. @ Stand. Cond. Cu.ft. dry	Meter Press. "Hg	Meter Press. ΔH "H_2O	% Isokinetic
29	--	135	533	68.09	65.71	29.43	.68	--
30	--	135	540	68.09	65.71	29.43	.76	--
33	.000341	144	538	73.80	71.78	29.54	.90	103.8
34	.000341	144	540	69.17	67.01	29.54	.83	103.4
35	--	142	538	74.38	72.34	29.55	.90	--
36	--	142	540	91.46	88.61	29.45	.83	--
39	.000341	144	538	83.99	81.73	29.56	1.24	112.2
40	.000341	144	536	86.21	84.21	29.56	1.28	113.4
41	--	105	538	55.23	53.74	29.56	1.24	--
42	--	105	536	61.19	59.77	29.56	1.28	--
45	.000341	144	538	76.54	73.92	29.34	1.09	107.9
46	.000341	144	536	82.72	80.22	29.35	1.23	110.6
47	--	142	538	90.63	87.54	29.34	1.09	--
48	--	142	536	85.12	82.54	29.35	1.23	--
51	.000341	144	540	71.55	68.55	29.21	1.01	103.0
52	.000341	144	538	74.68	71.83	29.22	1.08	102.9
53	--	110	540	48.45	46.42	29.21	1.01	--
54	--	110	538	61.04	58.71	29.21	1.08	--
57	.000341	144	534	72.15	70.91	29.64	1.02	102.7
58	.000341	144	532	77.58	76.56	29.64	1.18	106.2
59	--	132	534	74.81	73.53	29.64	1.02	--
60	--	132	532	60.32	59.53	29.65	1.18	--

TABLE T-7

BONNER SPRINGS STACK EMISSION SURVEY

GAS SAMPLING AND TESTING PARAMETERS

1981

Run No.	Test Nozzle Size Sq.Ft.	Test Duration Min.	Meter Temp. °R.	Meter Vol. @ Meter Cond. Cu.ft.	Meter Vol. @ Stand. Cond. Cu.ft. dry	Meter Press. "Hg	Meter Press. ΔH "H_2O	% Isokinetic
63	.000341	144	533	62.71	61.63	29.58	.80	93.15
64	.000341	144	531	59.62	58.80	29.57	.68	95.58
65	--	153	533	90.32	88.76	29.58	.80	--
66	--	145	531	82.34	81.21	29.57	.68	--
67	.000725	144	536	53.99	52.42	29.38	.61	100.2
68	.000192	144	538	68.13	65.97	29.38	1.01	103.1
69	--	206	536	98.69	95.82	29.41	.61	--
70	--	--	--	L O S T	--	--	--	--
73	.000725	144	532	56.24	54.72	29.22	.66	107.8
74	.000192	144	534	48.12	46.63	29.22	.49	116.3
75	--	120	532	61.36	59.70	29.23	.66	--
76	--	56	534	15.19	14.71	29.23	.49	--
77	.000725	144	529	56.23	55.90	29.70	.64	106.4
78	.000192	144	533	43.76	43.16	29.68	.41	117.4
79	--	142	529	75.53	75.09	29.70	.64	--
80	--	--	--	L O S T	--	--	--	--
83	.000725	144	523	56.23	56.86	29.87	.64	106.9
84	.000192	144	523	36.99	37.39	29.84	.38	92.4
85	--	95	523	41.47	41.94	29.86	.64	--
86	--	60	523	12.73	12.87	29.85	.38	--
87	.000314	144	532	53.85	52.71	29.40	.61	102.1
88	.000314	144	529	59.60	58.68	29.41	.73	102.2
89	.000314	144	527	54.35	53.82	29.46	.62	101.4
90	.000314	144	525	59.77	59.43	29.47	.74	103.9
91	.000314	119	527	50.03	49.28	29.31	.71	112.5
92	.000314	119	525	52.91	52.33	29.32	.82	106.4

TABLE T-8

BONNER SPRINGS GAS EMISSION SURVEY
GAS ANALYSIS

1981

Run Nos.	Test Location	Date	Analysis CO_2	O_2	N_2
1-4	No. 4 Stack	9-8	20.0	7.2	72.8
5-8	"	9-9	18.4	8.8	72.8
9-14	"	9-10	18.6	8.4	73.0
15-20	"	9-11	19.4	7.4	73.2
21-24	No. 2 Stack	9-21	9.6	14.8	75.6
27-32	"	9-22	8.8	15.0	76.2
33-38	"	9-23	5.2	18.0	76.8
39-44	"	9-24	7.5	16.8	76.0
45-50	"	9-25	8.2	15.2	76.6
51-56	"	10-5	14.2	11.0	74.8
57-62	"	10-6	12.8	12.2	75.0
63-66	"	10-7	11.0	12.6	76.4
67,69	No. 4 Stack	10-8	19.4	7.8	72.8
68,70	No. 4 Pptr-Input	"	22.6	4.6	72.8
71,73,75	No. 4 Stack	10-9	20.0	5.6	72.4
72,74,76	No. 4 Pptr-Input	"	22.0	3.6	74.4
77,79	No. 4 Stack	10-22	22.8	7.0	72.2
78,80	No. 4 Pptr-Input	"	22.6	5.4	72.2
83,85	No. 4 Stack	10-23	16.0	9.8	75.2
84,86	No. 4 Pptr-Input	"	21.8	6.0	72.2
87,88	No. 1 and 4	11-2	0	21.0	79.0
89,90	Clinker Cooler Stack	11-3	0	21.0	79.0
91,92	"	11-4	0	21.0	79.0

TABLE T-9

BONNER SPRINGS STACK EMISSION SURVEY
METEOROLOGICAL CONDITIONS

1981

Run No.	Date	% Relative Humidity	Ambient Temp. °F.	Barometric Pressure, "Hg.
1-4	9-8	69	72	30.16
5-8	9-9	63	77	28.90
9-14	9-10	80	65	28.85
15-20	9-11	61	73	28.89
21-24	9-21	71	66	29.02
27-32	9-22	83	60	29.37
33-38	9-23	71	67	29.48
39-44	9-24	77	72	29.47
45-50	9-25	86	70	29.26
51-56	10-5	78	74	29.14
57-62	10-6	72	58	29.56
63-66	10-7	79	57	29.52
67-70	10-8	76	56	29.34
71-76	10-9	89	60	29.18
77-80	10-22	28	55	29.65
83-86	10-23	69	32	29.82
87-88	11-2	73	60	29.36
89-90	11-3	87	53	29.42
91-92	11-4	88	54	29.26
AVERAGE		74	62	29.35

TABLE T-10

BONNER SPRINGS STACK EMISSION SURVEY

CHEMICAL ANALYSIS - RAW MATERIAL & PRODUCT

(AVERAGE DURING TESTING PERIOD) 1981

	Raw Mix*	Clinker
SiO_2	13.77	21.46
Al_2O_3	2.82	4.40
Fe_2O_3	1.96	3.06
CaO	--	64.56
$CaCO_3$	73.99	--
MgO	--	4.32
$MgCO_3$	5.82	--
SO_3	0.59	0.92
Loss	0.25	0.39
Free Lime	--	0.53
Na_2O	0.13	0.20
K_2O	0.31	0.49

*Calculated from Clinker Analysis

APPENDIX

SAMPLE CALCULATION FOR STACK RUN

NOMENCLATURE

A_n - Cross-sectional area of sample nozzle, sq. ft.

A - Cross-sectional area of stack, ft.^{3}

B_{wo} - Proportion by volume of water vapor in the gas stream, dimensionless

C_p - Pitot tube coefficient, dimensionless

C_p std. - Pitot tube coefficient of standard type tube @ .99

C_p test - Pitot tube coefficient of type "S" pitot tube

c'_s - Concentration of particulate matter in stack gas, gr./s.c.f. dry basis

c_s - Concentration of particulate matter in stack gas lb./s.c.f.

D_s - Inside diameter of stack at sample port, Ft.

E - Particulate emission rate

ΔH - Average pressure drop across the orifice meter, inches H_2O

I - Percent of Isokinetic sampling. Test acceptable between 90% - I - 110%.

K_p - $85.48 \frac{ft.}{sec.} \frac{lbs.}{lb.\text{-mole} \, ^\circ R}$

M_d - Dry molecular weight of stack gas

M_{H_2O} - Molecular weight of water, 18 lb./lb.mole

M_s - Molecular weight of stack gas (wet basis) lbs./lb.mole $M_d (1-B_{wo}) + 18 B_{wo}$

M_m - Total amount of particule matter collected, mg.

P_{bar} - Barometric pressure at the orifice meter, inches Hg.

$P_{std.}$ - Absolute pressure at standard conditions, 29.92 inches Hg.

P_s - Absolute stack gas pressure, inches Hg.

$\Delta P_{std.}$	-	Velocity head measured by standard type pitot tube
ΔP_{test}	-	Velocity head measured by type "S" pitot tube
$\sqrt{\Delta P}_{avg.}$	-	Average velocity head of stack gas, inches H_2O
Q_s	-	Volymetric flow rate, dry basis, standard conditions, ft.^{3}/hr.
R	-	Ideal gas constant
^oR	-	Degrees of temperature, Rankin (F+460)
ρH_2O	-	Density of water, 1 gm./ml.
$(T_s)_{avg.}$	-	Average absolute stack gas temperature, ^oR
$T_{std.}$	-	Absolute temperature at standard conditions, 530^oR
T_m	-	Average dry gas meter, temperature, ^oR
θ	-	Total sampling time, min.
$V_{m\ std.}$	-	Volume of gas sample through the dry gas meter (standard conditions), cu.ft.
$V_{s\ (avg.)}$	-	Stack gas velocity, feet per second (f.p.s.)
V_m	-	Volume of gas sample through the dry gas meter (meter conditions) cu. ft.
V_{ic}	-	Total volume of liquid collected in impingers and silica gel
17.71	-	^oR per inch. Hg @ std. cond. of 530 & 29.92
24.1	-	Liters water per gram-mole
28.3	-	Liters dry air per cu. ft.
1.667	-	100/60 min./sec.
13.6	-	Specific gravity of mercury
2.205×10^{-6}	-	mg/lb.
0.0154	-	Grains per mg.
32	-	Molecular weight of oxygen

1. Velocity of Stack Gas (See Run No. 2)

$$V_{s\ avg.} = K_p C_p \sqrt{\Delta P_{avg.}} \sqrt{\frac{T_{s\ avg.}}{P_m M_s}}$$

$$V_{s\ avg.} = (85.48)(0.84)(0.25) \sqrt{\frac{777}{(28.86)(28.18)}}$$

$$V_{s\ avg.} = 17.54 \text{ ft./sec.}$$

2. Volume of Gas (Actual) from Stack

$$\text{Volume} = (V_{s\ avg.})(A)(60)$$

$$\text{Volume} = (17.54)(72.13)(60) = 75{,}900 \text{ ACFM}$$

3. Volume Dry Gas @ Standard Conditions

$$Q_s = 3600(1-B_{wo})(V_s)(A) \left(\frac{T_{std.}}{T_{avg.}}\right)\left(\frac{P_s}{P_{std.}}\right)$$

$$Q_s = 3600(1-0.245)(17.54)(72.13) \frac{(530)}{(777)}\frac{(28.86)}{(29.92)}$$

$$Q_s = 2.26 \text{ X } 10^6 \text{ SCFH}$$

4. Sample Gas Volume @ Standard Conditions

$$V_{m\ std.} = 17.71\ V_m \left(\frac{P_{bar} + \Delta H/13.6}{T_m}\right)$$

4. <u>Sample Gas Volume @ Standard Conditions, Cont'd.</u>

$$V_{m\ std.} = (17.71)(26.30)\left(\frac{28.90 + \frac{0.28}{13.6}}{532}\right)$$

$$V_{m\ std.} = 25.32 \text{ cu.ft.}$$

5. <u>Percent of Isokinetic - EPA Method</u>

$$I = \frac{(1.667\ T_s)\left[(.00267)(V_{ic}) + \left(\frac{V_m}{T_m}\left(P\ bar + \frac{\Delta H}{13.6}\right)\right)\right]}{(0)V_s)(P_s)(A_n)}$$

$$I = \frac{(1.667)(777)(0.480 + 1.43)}{(144)\ (17.54)\ (28.86)\ (.000341)}$$

$$I = 99.5$$

% Isokinetic for all runs (from Run No. 1 to Run No. 92) were calculated using the same method as above, and are presented in Table T-7.

Miscellaneous Calculations
(SOX Emissions)

Calculation of ppm on stack emissions by volume, dry as SO_2.

Obviously, the ppm remains the same irrespective of S.C. since SO_2, which is a gas like flue gas, expands or contracts with changes in temperature and pressure in the same proportion.

The laboratory presented us with "gms. of $BaSO_4$" determined in 50-100 ml. of sample, which was only a part of the solution used to absorb the SO_2. Usually the absorption solution was 800 ml. + 50 ml. and 60-70 cu.ft. of dry stack gases were bubbled through absorbing solution.

then

$$\frac{(\text{gms. }BaSO_4\text{-Blank})(\text{Total ml.})\dfrac{(\text{Cu.ft.})}{(\text{Mol. at S.C.})}(10^6)}{(\text{Cu.ft. Gas Sampled})(\text{Aliquot ml})(BaSO_4)\dfrac{(\text{gms.})}{(\text{Lbs.})}\dfrac{(\text{Lbs.})}{(\text{Mol.})}} =$$

$$= \text{ppm by Volume Dry}$$

$$\frac{(\text{gms.}BaSO_4\text{ - Blank})}{(\text{Cu.Ft. Gas Sampled})}\ \frac{(\text{Total ml.})}{(\text{Aliquot ml.})\ (23.46)}\ \frac{(387)}{(453.6)}\ (1{,}000{,}000) =$$

$$= \text{ppm}$$

$$\frac{(\text{gms.}BaSO_4\text{ - Blank})}{(\text{Cu.Ft. Gas Sampled})}\ \frac{(\text{Total ml.})}{(\text{Aliquot ml.})}\ (3654.5) = \text{ppm}$$

also -

$$\frac{\text{mg. }SO_2}{\text{Cu.Ft.}} \times 13.331 = \text{ppm}$$

SAMPLE CALCULATIONS FOR RUN 1 A

NOMENCLATURE

A - Absorbance of sample under investigation

A_1 - Absorbance of the 100 μG NO_2 standard

A_2 - Absorbance of the 200 μG NO_2 standard

A_3 - Absorbance of the 300 μG NO_2 standard

A_4 - Absorbance of the 400 μG NO_2 standard

C - Concentration of NO_2, dry basis, corrected to standard conditions @ 29.92" Hg and 528° R. Metric System = mg/dsm^3 or English System = Lbs./D.S.Ft.^{3}

Kc - Spectrophotometer Calibration Factor

M - Mass of NO_x as NO_2 in gas sample, μG.

Pf - Final absolute pressure of flask, inches Hg.

Pi - Initial absolute pressure of flask, inches Hg.

Pstd - Standard absolute pressure, 29.92" Hg.

P.P.M. - Part per million by volume on dry basis.

Tf - Final absolute temperature, °R

Ti - Initial absolute temperature, °R

Tstd - Standard absolute temperature, 528° R

Vsc - Sample volume at standard conditions, dry basis, ml & Ft.^{3}

SAMPLE CALCULATIONS FOR RUN 1 A

NOMENCLATURE

Vf - Volume of flask and value, ml

Vo - Volume of absorbing solution, 25 ml

K_1 - Metric, $K_1 = 0.3858 \frac{^oK}{mm\ Hg} \frac{(293)}{(760)}$

English, $K_1 = 17.64 \frac{^oR}{in.\ Hg} \frac{(528)}{(29.92)}$

K_2 - Metric, $K_2 = 1000 \frac{mg/M^3}{\mu g/ml} \frac{(1,000,000)}{(1,000)} \frac{ml/M^3}{\mu g/mg}$

- English, $K_2 = 6.243 \times 10^{-5} \frac{Lb./scf}{\mu g/ml} \frac{28,317}{453,600,000} \frac{ml/Ft.^3}{\mu g/Lb.}$

K_3 - $\frac{(28,317)(387)(1,000,000)}{(453,600,000)(46)} = 525.2 \frac{ml}{\mu g}$

28,317 - ml per cubic foot

387 - Cu.Ft. of gas at std. cond. (29.92" Hg & 528^o R) per Lb.-Mole

46 - Lb.-Mole of NO_2

453.6 - Grams/Lb.

μg - .000,001 Gram

USING SPECTROPHOTOMETER READINGS FROM
APPROPRIATE STANDARDS, IT FOLLOWS:
(See Run 1A, NOX Calculation Sheet)

1. $$K_c = 100 \frac{(A_1 + 2A_2 + 3A_3 + 4A_4)}{(A^2_1 + A_2^2 + A^2_3 + A^2_4)}$$ etc.

$$K_2 = 100 \frac{(.07 + .26 + .60 + 1.04)}{(.0049 + .0169 + .04 + .0676)}$$

$$= 100 \frac{(1.97)}{(.1294)} = \underline{1522.4}$$

2. $$V_{sc} = \frac{T_{std}}{P_{std}} (VF - VO) \frac{Pf}{Tf} - \frac{Pi}{Ti}$$

$$V_{sc} = K_1 \ (Vf - 25ml) \frac{Pf}{Tf} - \frac{Pi}{Ti}$$

$$V_{sc} = 17.64 \ (2002 + 19.5 - 25) \left(\frac{29.22}{530} - \frac{3.70}{524}\right)$$

$$V_{sc} = 17.64 \ (2007.5)(.0481) = \underline{1702} \text{ ml/sample}$$

OR $$\frac{(1702)}{(28,317)} = .0600 \text{ Cu.Ft./Sample}$$

3. Total NO_2 per sample

$$m = \frac{\text{Total Ml}}{\text{Aliquot Ml}} \times K_c \times A$$

$$m = (5)(1522.4)(.072) = \frac{548 \text{ Mg}/NO_2}{\text{Sample}}$$

4. Sample Concentration

$$C = K_2 \frac{m}{V_{sc}}$$

Metric System:

$$C = 1000 \frac{(548)}{(1702)} = \underline{322} \text{ mg } NO_2/DSM^3$$ OR

English System:

$$C = 6.243 \times 10^5 \frac{(548)}{(1702)} = \underline{2.00} \times 10^{-5} \text{ Lbs/ } NO_2/\text{D.S. Ft.}^3$$

5. Lbs. NO_2 Emitted/Hr.

$$(\text{Lbs./D.S. Ft.}^3) \times (\text{D.S. Ft.}^3/\text{Hr.})$$

$$(2.00 \times 10^{-5})(2.004 \times 10^6) = \underline{40.3} \text{ Lbs/ } NO_2/\text{Hr.}$$

6. P.P.M. by volume & dry emitted.

$$\text{P.P.M.} = \frac{m}{V_{sc}} \times K_3$$

$$\text{P.P.M.} = \frac{(548)}{(1702)}(525.2) = \underline{169}$$

APPENDIX

Material Balance Calculations

(Based on No. 4 Kiln Operation)

I. Fuel Consumption Calculation - Molal Basis

A. Coal Analysis

See Appendix for the copy of letter enclosed from Pittsburgh Testing Laboratory showing ultimate analysis of average sample gathered during testing, on the dry basis. Accordingly, ultimate coal analysis corrected for moisture of 7.70 (Table T-4) is:

% Component	Dry Basis	Coal Mill Feed "As Used"
Carbon	69.25	63.92
Hydrogen	4.81	4.44
Nitrogen	1.27	1.17
Oxygen	4.04	3.73
Sulfur	3.55	3.28
Water	None	7.70
Ash	17.08	15.76
Total	100	100
BTU per Pound:	12,553	11,586

B. Distribution of Combustibles and Products

Line	Constituent	Lbs./100 Lbs. Coal	Mol. Wt. Divisor	Moles Fuel Constituent	O_2 Multiplier	O_2 Moles Theo. Required	MOLES/100 LBS. COAL AS USED CO_2	SO_2	O_2	N_2	H_2O
		Fuel, Oxygen and Air per 100 Lbs. Coal as used									
1	C to CO_2	63.92	12	5.33	1	5.33	5.33	--	--	--	--
2	H_2 to H_2O	4.44	2	2.22	0.5	1.11	--	--	--	--	2.22
3	S to SO_2	3.28	32	0.10	1	0.10	--	0.10	--	--	--
4	O_2(Deduct)	3.73	32	0.12	--	-0.12	--	--	--	--	--
5	N_2	1.17	28	0.04	--	0	--	--	--	0.04	--
6	Water	7.70	18	0.43	--	0	--	--	--	--	0.43
7	Ash	15.76	--	--	--	0	--	--	--	--	--
8	Total	100.00	--	--	--	6.42	5.33	0.10	--	0.04	2.65
9	Therefore, "O_2" required, Line 8 - 6.42										
10	Recall, Mole Ratio of N_2 to O_2 in Air is 3.76										
11	Then, "N_2" with Air 6.42 X 79/21 = 24.15									24.15	
12	Dry Air supplied (Line 9 + 11) 6.42 + 24.15 = 30.57										
13	H_2O in Air (0.009)* X 30.57 = 0.28										0.28
14	Wet Air supplied (Line 12 + 13) 30.57 + 0.28 = 30.85										
15	Flue Gas Constituents (Line 1 to 14) Total						5.33	0.10		24.19	2.95

Total Moles Dry Flue Gas/100 Lbs. Coal as Used 30.57
Total Moles Wet Flue Gas/100 Lbs. Coal as Used 30.57 + 2.95 + .28 = 33.8

* Molal Humidity for Ambient Air at 62°F. and 74% Relative Humidity.

See Psychromatic Chart, Page 27, Fan Engineering, Buffalo Forge Co., 7th Edition.

II. Theoretical Combustion Gas Quantities (No Excess Air)

1. The Average fuel coal used per Kiln during testing was 149 lbs/min. (Table T-4)

   Accordingly, 100 lbs. coal supplies fuel for:

$$\frac{100}{149} = .671 \text{ min. of kiln operation (single kiln operation under test)}$$

2. Therefore, referring to I-B:

   (a) Theoretical dry air supplied for total combustion:

$$\frac{(30.57)(387)}{(0.671)} = 17{,}631 \text{ SCFM}$$

   (Standard Conditions: 70°F. and 29.92 in. Hg.)

   Wet Air Supplied:

$$\frac{(33.80)(387)}{(0.671)} = 19{,}494 \text{ SCFM}$$

$$H_2O \text{ in Flue Gas} = 19{,}494 - 17{,}631$$

$$= 1{,}863 \text{ SCFM}$$

   (b) Flue Gas Components From Combustion Process

$$CO_2 = \frac{(5.33)(44)}{(0.671)} = 349.5 \text{ Lbs./Min.}$$

$$H_2O = \frac{(2.95)(18)}{(0.671)} = 79.1 \text{ Lbs./Min.}$$

$$N_2 = \frac{(24.19)(28)}{(0.671)} = 1009.4 \text{ Lbs/Min.}$$

$$SO_2 = \frac{(0.10)(64)}{(0.671)} = 9.54 \text{ Lbs./Min.}$$

II. Theoretical Combustion Gas Quantities Cont'd.

3. Breakdown of Water Source:

(a) Combustion Water:

$$\frac{(22.2)(18)}{(0.671)} = 59.6 \text{ Lbs./Min.}$$

(b) Water in Coal as used:

$$\frac{(0.43)(18)}{(0.671)} = 11.5 \text{ Lbs./Min.}$$

(c) Water in supplied air:

$$\frac{(0.30)(18)}{(0.671)} = 8.0 \text{ Lbs./Min.}$$

TOTAL 79.1 Lbs./Min. from combustion process & Water in Combustion Air

III. Other Sources for CO_2 and H_2O:

(a) Liberation of CO_2 from kiln feed:

Average raw mix feed rate during testing period at Stacks 30.8 Tons/Hr. or 1027 Lbs./Min. dry solids for single kiln system under test. (See T-4).

Kiln feed chemical analysis (Table T-10) was used to determine the available CO_2 liberated from $CaCO_3$ and $MgCO_3$:

Raw Mix - Kiln
Feed Analysis
(Table T-10)

SiO_2	13.77
Al_2O_3	2.82
Fe_2O_3	1.96
$CaCO_3$	73.99
$MgCO_3$	5.82
SO_3	0.59
Loss	0.25
Na_2O	0.13
K_2O	0.31

From $CaCO_3$, $CO_2 = \frac{(73.99)(44)}{(100)}$ = 32.56 Lbs./100 Lbs. kiln feed

From $MgCO_3$, $CO_2 = \frac{(5.82)(44)}{(84)}$ = 3.05 Lbs./100 Lbs. kiln feed

Total CO_2 = 35.61 Lbs./100 Lbs. kiln feed

or

Total CO_2 liberated from kiln feed $= \frac{(35.61)(30.8)(2000)}{(100)\qquad(60)}$

= <u>365.6</u> Lbs./Min./Kiln under test

III. Other Sources for CO_2 and H_2O, Cont'd.

(b) H_2O from kiln feed slurry:

Average moisture in kiln feed slurry is 34.4 (Table T-4), therefore, water from kiln feed slurry:

$$\frac{(30.8)(2000)(.344)}{(60)(.656)} = 538 \text{ Lbs./Min.}$$

IV. Theoretical Kiln Exit Gas (No Excess Air)

1. Total Exit Gas Quantities (per min. of kiln operation)

Source	CO_2(Lb.)	H_2O(Lb.)	N_2(Lb.)
(a) Combustion Process	349.5	79.1	1009.4
(b) Kiln Feed Liberation	365.6	538	--
TOTAL	715.1	617.1	1009.4

2. Exit Gas Analysis - Wet Basis

$$CO_2 \text{ (moles)} = \frac{715.1}{44} = 16.3$$

$$H_2O \text{ (moles)} = \frac{617.1}{18} = 34.3$$

$$N_2 \text{ (moles)} = \frac{1009.4}{28} = 36.1$$

TOTAL 86.7 Moles/Min.

Hence:

$$CO_2 = \frac{16.3}{86.7} = 18.80\%$$

$$H_2O = \frac{34.3}{86.7} = 39.56\%$$

$$N_2 = \frac{36.1}{86.7} = 41.64\%$$

3. Exit Gas Analysis - Dry Basis

$$CO_2 = \frac{18.8}{(100-39.56)} = 31.10\%$$

$$N_2 = \frac{41.64}{(100-39.56)} = 68.90\%$$

4. Theoretical Exit Gas Volume (Standard Conditions 70°F. and 29.92 in. Hg.)

$$\text{Volume} = (86.7)(387) = 33,553 \text{ SCFM (wet)}$$

$$\text{or} = \frac{(33.553)(100-39.56)}{100} = 20,279 \text{ SCFM (dry)}$$

V. Actual Stack Gas at Sampling Ports (Calculated):

1. Exhaust gas included not only theoretical combustion flue gas but also excess air for actual combustion and infiltrated air at location such as kiln exit, precipitator, etc. From here forward, the term "Excess Air" will be used to indicate "Excess and Infiltrated Air".

2. Average Orsat Analysis taken from exhaust gas is showing along with theoretical gas analyis:

Orsat Analysis (Dry)		Theoretical Analysis (Dry)	
CO_2	19.1	CO_2	31.10
O_2	8.0	O_2	0
N_2	72.9	N_2	68.90

3. Excess Air Calculations:

(a) CO_3 Balance (using above analysis)

$$(\text{Vol. Comb. Gas})(\%\ CO_2) + (\text{Vol. Excess Air})(\%\ CO_2) = (\text{Vol. Actual Gas})(\%\ CO_2)$$

Let X = Vol. Combustion Gas (Relative)
(100-X) = Vol. Excess Air (Relative)
100 = Vol. Actual Gas (Relative)

then,

$$(X)(31.10) = (100-X)(0) = (100)(19.1)$$

$$31.10\ X = 19.1 \times 100$$

$$X = 61.4\%\ (\text{Comb. Gas})$$

$$(100-X) = 38.6\%\ (\text{Excess Air})$$

From IV-4 foregoing, the theoretical dry exit gas was 20,279 SCFM, therefore, actual kiln exit gas (dry) would be

$$\frac{20{,}279}{.614} = 33{,}028\ \text{SCFM (dry)}$$

and Excess Air: 33,028-20,279 = 12,749 SCFM (Dry)

(b) Oxygen Balance (using above analysis)

$$(\text{Vol. Comb. Gas})(\%\ O_2) + (\text{Vol. Excess Air})(\%\ O_2) = (\text{Vol. Actual Gas})(\%\ O_2)$$

V. Actual Stack Gas, Cont'd.

(b) Oxygen Balance, Cont'd.

Using the same symbol X as in 3, foregoing:

$$(X)(0) = (100-X)(21) = (100) - (8.0) = \frac{2100 - 800}{21}$$

$$= 61.90 \text{ (Comb. Gas)}$$

$$(100-X) = 38.10 \text{ (Excess Air)}$$

Hence,

$$\text{Actual kiln exit} = \frac{20,279}{61.9}$$

$$= 32,761 \text{ SCFM (Dry)}$$

$$\text{Excess Air} = 32,761-20,279 = 12,482 \text{ SCFM (dry)}$$

(c) Reconciliation of Balance

The CO_2 and O_2 balance should give the same quantity of excess air for a given location. They did not agree exactly due to experimental error, but the average of the balances may represent the true condition.

$$\text{(Average) Excess Air} = \frac{12,749 + 12,482}{2} = 12,616 \text{ SCFM (dry)}$$

4. Excess Air Components:

Lbs./Min. of kiln operation:

$$O_2 = \frac{(12,616)(.21)(32)}{(387)} = 219 \text{ Lbs./Min.}$$

$$N_2 = \frac{(12,616)(.79)(28)}{(387)} = 721 \text{ Lbs./Min.}$$

$$H_2O = \frac{(12,616)(0.0108)(18)}{(387)} = 6 \text{ Lbs./Min.}$$

$$\text{or } (12,616)(0.009) = 136 \text{ SCFM}$$

(Recall 0.009 was the average molal humidity of air at testing period.)

V. Actual Stack Gas, Cont'd.

5. Actual Stack Exit Gas Volume:

(a) Theoretical kiln exit gas (IV-4)	=	33,553 SCFM (wet)
(b) Excess Air (V-3 and V-4)	=	12,616 + 136 = 12,752 SCFM (wet)
(c) Actual Stack Exit Gas (at standard conditions 70°F., and 29.92 in.Hg.)	=	33,553 + 12,752
	=	46,305 SCFM (wet)
(d) Actual Stack Exit Gas at Stack Conditions	=	$\frac{(46,305)(772)(29.92)}{(530)(28.89(}$
(312°F. and 28.89 in. Hg.)	=	69,853 ACFM (wet)

VI. Actual Stack Gas (Measured)

1. Gas Volume:

Average volume of stack gas measured was 66,572 ACFM (wet) at average stack conditions of 312°F. (or 772°F.) and 28.89 in Hg. Therefore, at standard conditions (70°F. and 29.92 in. Hg.), stack gas volume is:

$$\frac{(66,572)(530)(28.89)}{(772)(29.92)} = 44,130 \text{ SCFM (wet)}$$

2. Gas Components:

(a) On the average 26.7% of stack was water vapor based on condensate collected during test. This was 26.7% by volume since we compared moisture content of stack gas while water was in vapor state. Therefore, stack gas contained:

$$(44,130)\frac{(26.7)}{(100)} = 11,782 \text{ SCFM}$$

or,

$$\frac{(11,782)(18)}{(387)} = 548 \text{ Lbs./Min.}$$

(b) Orsat analysis shows 19.1% CO_2, 8.0% O_2, and 72.9% N_2 on the dry basis.

With 26.7% H_2O, the analysis can be reported on the wet basis as follows:

CO_2	:	(19.1)(1 - 0.267)	=	14.00%
O_2	:	(8.0)(1 - 0.267)	=	5.86%
N_2	:	(72.9)(1 - 0.267)	=	53.44%
H_2O	:		=	26.70%
		TOTAL		100.0%

VI. Actual Stack Gas Cont'd.

(c) From VI-I foregoing the total volume of stack gas was measured as 44,130 SCFM (wet). The rate of each gaseous component emitted from the stack can be calculated as follows:

$$CO_2 = \frac{(44,130)(0.1400)(44)}{(387)} = 702 \text{ Lbs./Min.}$$

$$O_2 = \frac{(44,130)(0.0586)(32)}{(387)} = 214 \text{ Lbs./Min.}$$

$$N_2 = \frac{(44,130)(0.5344)(28)}{(387)} = 1706 \text{ Lbs./Min.}$$

H_2O = 548 Lbs./Min. (from VI 2(a))

VII. Gas Balance

(1) CO_2 :

CO_2 Input = 715.1 Lbs./Min. (from IV-I)

CO_2 Output = 702 Lbs./Min. (from VI - 2(c))

Measuring Efficiency (°/I) = 98

(2) O_2 :

O_2 Input = 219 Lbs./Min. (from V-4)

O_2 Output = 214 Lbs./Min. (from VI - 2(c))

Measuring Efficiency (°/I) = 98

(3) N_2 :

N_2 Input = 1730 Lbs./Min. (from IV-1 and V-4)

N_2 Output = 1706 Lbs./Min. (from VI - 2(c))

Measuring Efficiency (°/I) = 99

(4) Water:

H_2O Input = 623 Lbs./Min. (from IV-1 and V-4)

H_2O Output = 548 Lbs./Min. (from VI - 2(c))

Measuring Efficiency (°/I) = 88

(5) Total Gas Volume:

Calculated Gas Volume = 69,853 ACFM (from V-5)

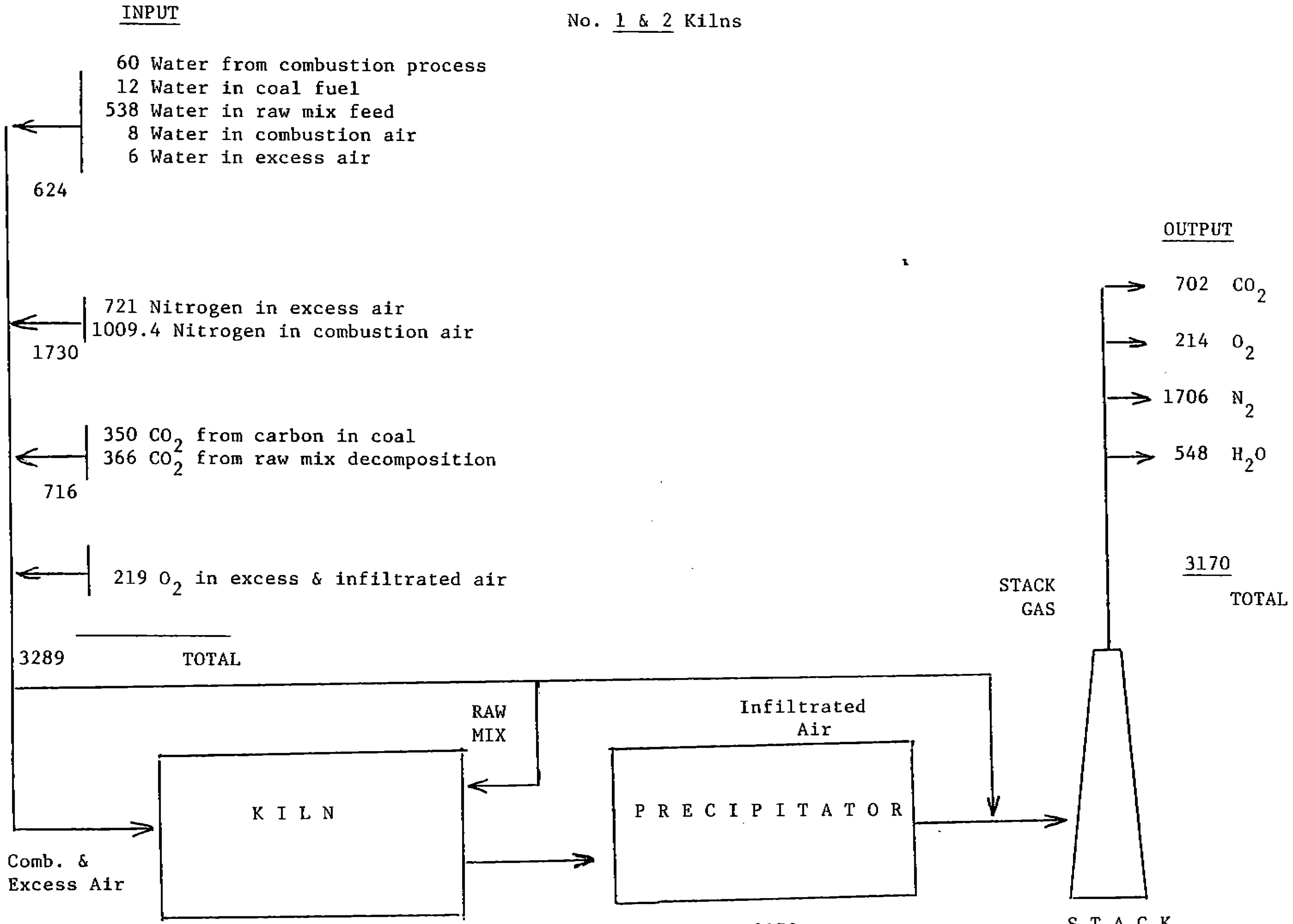
Measured Gas Volume = 66,572 ACFM (from VI-1)

Measuring Efficiency = 95

DUST SURVEY
STACK EMISSIONS

SUMMARY SCHEMATIC
UNITS: LB/MIN.

No. 1 & 2 Kilns



MEASURING EFFICIENCY = $\frac{3170}{3289}$ = 96%

FORM 407 REV.-PG

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LABORATORY No. 823098

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CLIENT'S No. P.O. #140

REPORT

Nov. 4, 1981

Sample Description: C O A L

Sample Identification: Bonner Springs
Composite Sample

Submitted by: Lone Star Industries, Inc.

Reported to: Lone Star Industries, Inc.
P. O. Box 297
Bonner Springs, KS. 66012

	As Received	Dry Basis
Moisture	1.66%	--
B.T.U. Per Pound	12,345	12,553
Carbon	- -	69.25%
Hydrogen	- -	4.81%
Oxygen	- -	4.04%
Nitrogen	- -	1.27%
Sulfur	- -	3.55%
Ash	- -	17.08%

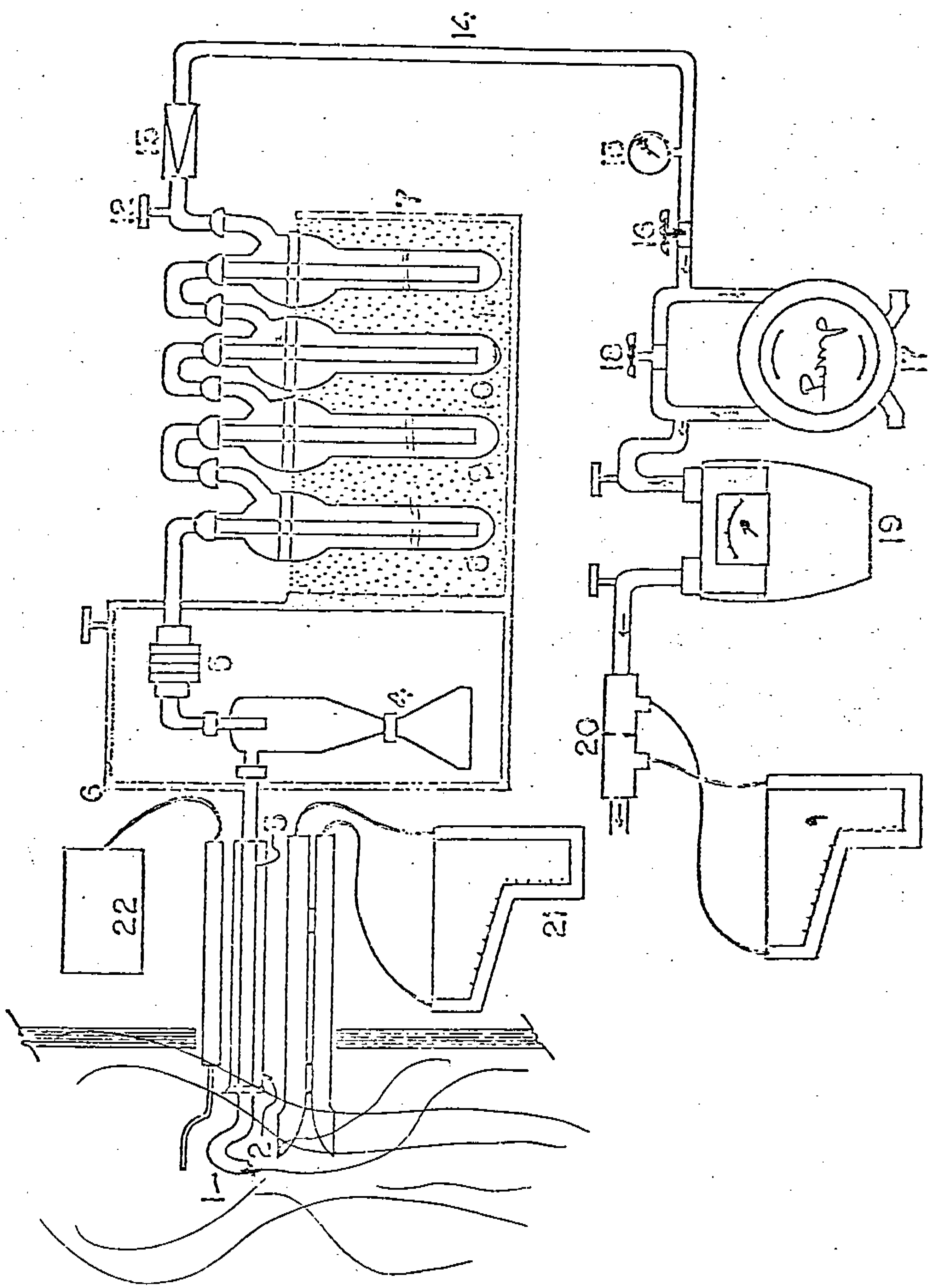
PITTSBURGH TESTING LABORATORY

William S. Carlson
Manager, Chemical Department

2-Client
Attn: W. W. Hurst
Attn: Mr. Calvin Radcliff

ear

EPA METHOD 5
Particulate Sampling Train



EPA METHOD 5 SAMPLING TRAIN

1. Sampling Nozzle
2. Sampling probe sheath
3. Heated sample probe liner
4. Cyclone assembly (proposed regulations do not require this cyclone)
5. Out of stack filter assembly
6. Heated filter compartment maintained about 250°F (proposed = ≤ 248°F ± 25°F)
7. Impinger case
8. First impinger filled with H_2O (100 ml)
9. Greenburg-Smith (or modified Greenburg-Smith) impinger filled with H_2O (100 ml)
10. Third impinger - Dry
11. Fourth impinger - filled with H_2O absorption media (200 - 300 gm)
12. Impinger exit gas thermometer
13. Check valve to prevent back pressure
14. Umbilical cord - vacuum line
15. Pressure guage
16. Coarse adjustment valve
17. Leak free pump
18. By-pass valve
19. Dry gas meter with inlet and outlet dry gas meter thermometer
20. Orifice meter with manometer
21. "S" type pitot tube with manometer
22. Stack temperature sensor

STATE OF KANSAS

AIR POLLUTION EMISSION CONTROL REGULATIONS

(JANUARY 1,1974)

SPECIAL NOTE

In order to restrict the necessity of multiple permits or licenses for a single facility or installation, the review of facilities or installations within the environmental responsibilities of the state department of health will, where appropriate, be considered from the standpoint of the total environment. The primary function of the facility or installation will be determined by department staff and where possible a single permit or license will be issued for the total facility or installation which may include considerations in the air quality, water quality, solid waste, and radiation protection program areas.

28-19-6 STATEMENT OF POLICY

It is the intent of these regulations to establish emission reporting requirements, emission control requirements, and requirements for open burning believed necessary to protect human health and safety, prevent injury to plant and animal life and property, and consider and foster the comfort and convenience of the State's inhabitants. The emission limitations established herein are intended to reflect those values which are considered to be attainable with technology available at the time of their adoption; where advances in technology will permit more stringent control, it is the intent of the Kansas State Board of Health that the Director shall encourage those persons responsible for new or altered emission sources to voluntarily provide the highest degree of control that he deems to be technically and economically feasible at the time that such controls are provided. It is also the intent of the Board of Health that where existing installations have been exempted from regulations limiting the amount of emissions of specific contaminants, but are equipped with control devices effecting such emissions, such control devices shall be continually operated so as to maintain the maximum practical degree of efficiency attainable with such equipment. It is further intended in establishing these regulations that reasonable effort will be made to encourage voluntary cooperation by person or groups, affected by these requirements, and upon failure to obtain and/or maintain such cooperation, such administrative and judicial proceedings as are required to secure compliance with them is to be initiated. (Authorized by K. S. A. 1970 Supp. 65-3001, 65-3005, 65-3006, 65-3007, 65-3010: Effective January 1, 1971, Amended January 1, 1972)

28-19-7 DEFINITIONS

All terms and abbreviations used in emission and open burning control regulations shall have the meanings set forth herein:

Alter shall mean any physical change in, or change in the method of operation of, any machine, equipment, device, or other article, or combination thereof which constitutes a source of pollutant emissions subject to the provisions of these regulations, and which increases the amount of such emissions.

and daily frequency schedule for such excessive emissions. (Authorized by K. S. A. 1970 Supp. 65-3005, 65-3006, 65-3010: Effective January 1, 1971, Amended January 1, 1973, Amended January 1, 1974)

28-19-12 MEASUREMENT OF EMISSIONS

A. The Department may require any person responsible for the operation of an emission source to make or have tests made to determine the rate of contaminant emissions from the source whenever it has reason to believe on the basis of estimates of potential contaminant emission rates from the source and due consideration to probable efficiency of any existing control device, or visible emission determinations made by an official observer, that existing emissions exceed the limitations specified in these control regulations. Such tests may also be required pursuant to verifying that any newly installed control device meets performance specifications. If such a test demonstrates that the applicable emission requirement is met, no more than one (1) such test shall be required during any twelve (12) consecutive calender month period. Provided, however, that should the Department determine that the test do not represent normal operating conditions or emissions additional tests may be required. Such a requirement shall be considered as an order as provided for in K. S. A. 1970 Supp. 65-3011 and subject to all administrative and legal requirements specified therein.

Required tests shall be conducted in accordance with procedures approved by the Director as being in accordance with sound analytical and sampling procedures. Such tests shall be conducted by reputable, qualified individuals, as approved by the Department, and a certified written copy of the test results signed by the person conducting the test shall be provided to the Department.

B. The Department may conduct tests of emissions of contaminants from any source. Upon written request from the Department, the person responsible for the source to be tested shall cooperate with the Department in providing all necessary test ports in stacks or ducts and such other safe and proper facilities, exclusive of instruments and sensing devices, as may be reasonably required to conduct the test with due regard being given to expenditures and possible disruption of normal operation of the source. A report concerning the findings of such tests shall be furnished to the person responsible for the source upon request.

C. The Director may require the owner or operator of any emission source which is subject to the provisions of these regulations to install, use, and maintain such stationary monitoring equipment as is required to demonstrate continuing compliance with any applicable emission limitations, and to maintain records and make reports regarding such measured emissions to the Department in a manner and on a schedule to be determined by the Director.

PROCESSING OPERATION EMISSIONS

28-19-20 PARTICULATE EMISSION LIMITATIONS

Subject to the provisions of Regulations 28-19-9 and 28-19-11:

A. No person shall cause, suffer, allow or permit the emission of particulate from any processing machine, equipment, device or other articles, or combination thereof, excluding indirect heating equipment and incinerators, in excess of the amounts allowed in Table P-1 during any one hour.

Table P-1

Process Weight Table

Maximum Allowable Emission Rate

Process Weight Rate		Rate of Emission	Process Weight Rate		Rate of Emission
lb/hr	tons/hr	lb/hr	lb/hr	tons/hr	lb/hr
100	0.05	0.551	16,000	8.00	16.5
200	0.10	0.877	18,000	9.00	17.9
400	0.20	1.40	20,000	10.	19.2
600	0.30	1.83	30,000	15.	25.2
800	0.40	2.22	40,000	20.	30.5
1,000	0.50	2.58	50,000	25.	35.4
1,500	0.75	3.38	60,000	30.	40.0
2,000	1.00	4.10	70,000	35.	41.3
2,500	1.25	4.76	80,000	40.	42.5
3,000	1.50	5.38	90,000	45.	43.6
3,500	1.75	5.96	100,000	50.	44.6
4,000	2.00	6.52	120,000	60.	46.3
5,000	2.50	7.58	140,000	70.	47.8
6,000	3.00	8.56	160,000	80.	49.0
7,000	3.50	9.49	200,000	100.	51.2
8,000	4.00	10.4	1,000,000	500.	69.0
9,000	4.50	11.2	2,000,000	1,000.	77.6
10,000	5.00	12.0	6,000,000	3,000.	92.7
12,000	6.00	13.6			

Interpolation of the data in Table P-1 for other process weights shall be accomplished by use of the following equations:

Process weights $\leq$ 30 Ton/hr - $E = (4.1)(P^{0.67})$
Process weights $>$ 30 Ton/hr - $E = (55)(P^{0.11}) - 40$

Where: E = rate of emissions in lb/hr
P = process weight in Ton/hr

B. For the purposes of this regulation the following definitions shall apply:

(1) Process Weight shall mean the total weight of all materials introduced into a source operation which may constitute, or form, a source of particulate emissions. In the case of direct heating operations solid fuels used shall be included as part of the process weight, but liquid and gaseous fuels and combustion air shall not be included.

(2) Process Weight Rate shall mean the total process weight introduced into the source operation over a specific time period divided by that time period, in hours. For a cyclical or batch operation, the time period shall be that required to complete one operation or an integral number of cycles, and for continuous or long-run steady-state operations it shall be the total operating period or a typical portion thereof.

(3) Source Operation shall mean the last operation preceeding the emission of particulate matter, which results in the separation of the particulate emissions from the processed materials or the conversion of the processed materials into the particulate emissions, excluding those operations which are an integral part of the functioning of a control device.

Where the nature of any process or operation or design of any equipment is such as to permit more than one interpretation of these definitions, that interpretation which results in the minimum allowable Emission Rate shall apply. (Authorized by K.S.A. 1970 Supp. 65-3005, 65-3010: Effective January 1, 1971)

28-19-21 ADDITIONAL EMISSION RESTRICTIONS

Certain particulate emissions may, because of their chemical and/or physical nature, require emissions rates lower than those provided for in Regulation 28-19-20. In such cases the Department shall notify the person responsible for the emission, in writing, of the reasons for special concern regarding the existing or proposed contaminant emission and specify an alternate emission rate which is not to be exceeded. Such notification shall be considered an order as provided for in K.S.A. 1970 Supp. 65-3011 and subject to administrative and legal procedures therein. (Authorized by K.S.A. 1970 Supp. 65-3005, 65-3011: Effective January 1, 1971)

28-19-22 SULFUR COMPOUND EMISSIONS

A. No person shall cause or permit the emission of sulfur oxides from any primary non-ferrous smelters to exceed the amounts allowed in Table P-2 during any one hour.

TABLE P-2

Non-Ferrous Smelter Allowable Emissions

Type of Smelter	Sulfur Oxide Emissions (lb/hr)
Zinc Smelters	$0.564X^{0.85}$
Lead Smelters	$0.98X^{0.77}$
Where : X = total sulfur fed to smelter in lb/hr	

B. No person shall cause or permit the emission or combustion of any process gas stream that contains H_2S in concentrations greater than 10 grains per 100 cubic feet of gas without removal of the hydrogen sulfide in excess of this concentration. The provisions of this regulation shall not apply to:

(1) The combustion of such fuels for indirect heating purposes

(2) The combustion of such fuels where the gaseous products of combustion are used as raw materials for other processes

(3) The incineration of such gases having a gross heating value of less than 300 BTU per cubic feet at standard conditions and the fuel used to incinerate such waste gases does not contain sulfur or sulfur compounds in excess of the amount specified by this regulation.

C. Installations and equipment existing on January 1, 1972 shall be exempt from the provisions of this regulation. (Authorized by K.S.A. 1970 Supp. 65-3005, 65-3010: Effective January 1, 1972; Amended December 27, 1972)

28-19-23 HYDROCARBON EMISSIONS - STATIONARY SOURCES

A. No person shall place, store, or hold in any stationary tank reservoir or other container of more than 40,000 gallons capacity any gasoline or any petroleum distillate having a vapor pressure of 3.0 pounds per square inch, absolute, or greater under actual storage conditions unless

11.250
.140
11.390

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 7/29/81
Ambient Temperature ________ °F
Barometric Pressure ________ " Hg
Dry Test Meter No. 673497
Wet Test Meter Correction Factor ________
Meter Volume Rate ________

Run ______
(A.) Wet Test Meter Volume 93.81
(B.) Dry Test Meter - Final 764.78
Initial 663.28
Net 101.50

(DGMCF) = $\frac{A}{B}$ = $\frac{93.81}{101.50}$ = .9242

Run ______
(A.) Wet Test Meter Volume 43.61
(B.) Dry Test Meter - Final 815.99
Initial 764.82
Net 51.17

(DGMCF) = $\frac{A}{B}$ = $\frac{43.61}{51.17}$ = .8523

Run ______
(A.) Wet Test Meter Volume ______
(B.) Dry Test Meter - Final 823.56
Initial 815.88
Net 7.68

(DGMCF) = $\frac{A}{B}$ = $\frac{7.07}{7.68}$ = .9206

Run ______
(A.) Wet Test Meter Volume 11.39
(B.) Dry Test Meter - Final 835.36
Initial 823.58
Net ______

(DGMCF) = $\frac{A}{B}$ = $\frac{11.39}{11.78}$ = .9889

Run ______
(A.) Wet Test Meter Volume ______
(B.) Dry Test Meter - Final ______
Initial ______
Net ______

(DGMCF) = $\frac{A}{B}$ = ______ =

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 8/29/81
Ambient Temperature ______ °F
Barometric Pressure ______ " Hg
Dry Test Meter No. 679707
Wet Test Meter Correction Factor ______
Meter Volume Rate ______

Run ______
(A.) Wet Test Meter Volume 93.805
(B.) Dry Test Meter - Final 437.35
- Initial 338.64
Net 98.71

(DGMCF) = $\frac{A}{B}$ = $\frac{93.81}{98.71}$ = .9504

Run ______
(A.) Wet Test Meter Volume 43.61
(B.) Dry Test Meter - Final 484.87
Initial 437.36
Net 47.51

(DGMCF) = $\frac{A}{B}$ = $\frac{43.61}{47.51}$ = .9179

Run ______
(A.) Wet Test Meter Volume ______
(B.) Dry Test Meter - Final 491.73
Initial 484.17
Net 7.56

(DGMCF) = $\frac{A}{B}$ = $\frac{7.07}{7.56}$ = 9352

Run ______
(A.) Wet Test Meter Volume ______
(B.) Dry Test Meter - Final 503.07
Initial 491.74
Net 11.33

(DGMCF) = $\frac{A}{B}$ = $\frac{11.39}{11.33}$ = 1.0053

Run ______
(A.) Wet Test Meter Volume ______
(B.) Dry Test Meter - Final ______
Initial ______
Net ______

(DGMCF) = $\frac{A}{B}$ = ______ =

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 8/14/81
Ambient Temperature ________ °F
Barometric Pressure ________ " Hg
Dry Test Meter No. C
Wet Test Meter Correction Factor ________
Meter Volume Rate ________

Run 1
(A.) Wet Test Meter Volume 35.77
(B.) Dry Test Meter - Final 327.80
- Initial 288.60
Net 39.20

(DGMCF) = $\frac{A}{B}$ = $\frac{35.77}{39.20}$ = .9125

Run 2
(A.) Wet Test Meter Volume ________
(B.) Dry Test Meter - Final ________
Initial 327.80
Net ________

(DGMCF) = $\frac{A}{B}$ = ________ =

Run ________
(A.) Wet Test Meter Volume ________
(B.) Dry Test Meter - Final ________
Initial ________
Net ________

(DGMCF) = $\frac{A}{B}$ = ________ =

Run ________
(A.) Wet Test Meter Volume ________
(B.) Dry Test Meter - Final ________
Initial ________
Net ________

(DGMCF) = $\frac{A}{B}$ = ________ =

Run ________
(A.) Wet Test Meter Volume ________
(B.) Dry Test Meter - Final ________
Initial ________
Net ________

(DGMCF) = $\frac{A}{B}$ = ________ =

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 8/14/81
Ambient Temperature ______ °F
Barometric Pressure ______ " Hg
Dry Test Meter No. 13
Wet Test Meter Correction Factor ______
Meter Volume Rate ______

Run 1
(A.) Wet Test Meter Volume 35.77
(B.) Dry Test Meter - Final 180.37
Initial 140.02
Net 40.35

(DGMCF) = A/B = 35.77 / 40.35 = .8865

Run 2
(A.) Wet Test Meter Volume 72.80
(B.) Dry Test Meter - Final 255.93
Initial 180.87
Net 75.06

(DGMCF) = A/B = 72.80 / 75.06 = .9699

Run 3
(A.) Wet Test Meter Volume 25.25
(B.) Dry Test Meter - Final 281.82
Initial 255.93
Net 25.89

(DGMCF) = A/B = 25.25 / 25.89 = .9753

Run 4
(A.) Wet Test Meter Volume 38.05
(B.) Dry Test Meter - Final 320.56
Initial 281.82
Net ______

(DGMCF) = A/B = 38.05 / 38.74 = .9822

Run 5
(A.) Wet Test Meter Volume 13.10
(B.) Dry Test Meter - Final 335.19
Initial 321.76
Net 13.43

(DGMCF) = A/B = 13.10 / 13.43 = .9754

367.83
335.60
31.92
32.23
.9904

395.49
367.83
27.875
27.66
1.0078

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 8/14/81
Ambient Temperature ____ °F
Barometric Pressure ____ " Hg
Dry Test Meter No. A
Wet Test Meter Correction Factor ____
Meter Volume Rate ____

Run 1
(A.) Wet Test Meter Volume 35.77
(B.) Dry Test Meter - Final 481.14
Initial 436.25
Net 44.89

(DGMCF) = A/B = 35.77 / 44.89 = .7968

679.34 / 648.76 — 31.92 / 30.58 — 1.0438

Run 2
(A.) Wet Test Meter Volume 72.80
(B.) Dry Test Meter - Final 564.89
Initial 481.69
Net 83.20

(DGMCF) = A/B = 72.80 / 83.20 = .8750

705.45 / 679.34 — 27.875 / 26.11 = 1.0676

Run 3
(A.) Wet Test Meter Volume 25.25
(B.) Dry Test Meter - Final 592.03
Initial 564.84
Net 27.19

(DGMCF) = A/B = 25.25 / 27.19 = .9287

796.71 / 705.46 — 94.88 / 91.25 . 1.039

Run
(A.) Wet Test Meter Volume 38.05
(B.) Dry Test Meter - Final 632.14
Initial 592.02
Net 40.12

(DGMCF) = A/B = 38.05 / 40.12 = ~~.94.~~84 .9484

875.64 / 796.71 — 79.15 / 78.93

Run
(A.) Wet Test Meter Volume 13.10
(B.) Dry Test Meter - Final 648.38
Initial 633.61
Net 14.77

(DGMCF) = A/B = 13.10 / 14.77 = .8869

932.77 / 875.64 — 57.13 — 57.00 / 57.13

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 8/14/81

Ambient Temperature ________ °F

Barometric Pressure ________ " Hg

Dry Test Meter No. E

Wet Test Meter Correction Factor ________

Meter Volume Rate ________

Run 1

(A.) Wet Test Meter Volume 35.77

(B.) Dry Test Meter - Final 645.12

- Initial 600.21

Net 44.91

$$(DGMCF) = \frac{A}{B} = \frac{35.77}{44.91} = .7965$$

Run 2

(A.) Wet Test Meter Volume 72.80

(B.) Dry Test Meter - Final 728.56

Initial 645.66

Net

$$(DGMCF) = \frac{A}{B} = \frac{72.80}{82.90} = .8782$$

Run 3

(A.) Wet Test Meter Volume 25.25

(B.) Dry Test Meter - Final 755.75

Initial 728.56

Net 27.19

$$(DGMCF) = \frac{A}{B} = \frac{25.25}{27.19} = .9287$$

Run

(A.) Wet Test Meter Volume 38.05

(B.) Dry Test Meter - Final 795.37

Initial 750.75

Net

$$(DGMCF) = \frac{A}{B} = \frac{38.08}{39.62} = .9604$$

Run

(A.) Wet Test Meter Volume 13.10

(B.) Dry Test Meter - Final 811.36

Initial 796.90

Net 14.46

$$(DGMCF) = \frac{A}{B} = \frac{13.10}{14.42} = .9059$$

31.92
842.19
811.75

$\frac{31.92}{30.44}$ 1.0486

868.19
842.19

$\frac{27.875}{26000}$ 1.0727

962.73
868.20

$\frac{94.88}{94.53}$ 1.0031

DRY GAS METER CALIBRATION FORM

LONE STAR INDUSTRIES

ENVIRONMENTAL TESTING LABORATORY

Date 8/14/81
Ambient Temperature ______ °F
Barometric Pressure ______ " Hg
Dry Test Meter No. D
Wet Test Meter Correction Factor ______
Meter Volume Rate ______

Run 1
(A.) Wet Test Meter Volume 35.77
(B.) Dry Test Meter - Final 714.94
Initial 669.94
Net 4500

(DGMCF) = A/B = 35.77 / 45.00 = .7949

Run 2
(A.) Wet Test Meter Volume 72.80
(B.) Dry Test Meter - Final 797.97
Initial ~~714.94~~ 715.49
Net ______

(DGMCF) = A/B = 72.80 / 82.48 = .8826

Run ______
(A.) Wet Test Meter Volume 25.25
(B.) Dry Test Meter - Final 825.68
Initial 797.99
Net 27.69

(DGMCF) = A/B = 25.25 / 27.69 = .9119

Run ______
(A.) Wet Test Meter Volume 38.05
(B.) Dry Test Meter - Final 865.83
Initial 825.71
Net 40.12

(DGMCF) = A/B = 38.05 / 40.12 = .9484

Run ______
(A.) Wet Test Meter Volume 13.10
(B.) Dry Test Meter - Final 882.89
Initial 868.05
Net ______

(DGMCF) = A/B = 13.10 / 14.84 = .8827

31.92
915.73
883.32

31.92 / 32.41 .9849

943.44
915.73

27.875 / 27.7100 1.0060

ORIFICE METER CALIBRATION
LONE STAR CENTRAL RESEARCH

OPERATOR YED 1/30/81

METER CONSOLE NO. A DGM NO.

BAROMETRIC PRESSURE (PM) 30.04 In. Hg. DGM Corr. Factor (DGMCF) 1.000

	ΔH In. H_2O	V_1 Initial DGM Dial Reading	Θ Minutes	V_2 Final DGM Dial Reading	Qm (CFM)	Tm °F	K_m
41/43	.25	580.75	2	581.27	.26	86	.66
45	.50	581.27	2	581.98	.36	87	.64
47	.75	581.98	2	582.85	.44	86	.64
46	1.00	582.85	2	583.85	.50	85	.63

AVERAGE (K_{-m}) .64

$$Q_m \text{ (CFM)} = \frac{(V_2 - V_1) \times DGMCF}{\Theta \text{ Minutes}}$$

$$K_m = Q_m \left[\frac{P_m M_m}{T_m \, {}^\circ R \Delta H}\right]^{1/2}$$

30.04 28.84 546 (.25)

$(6.347)^{1/2}$ 2.519 (.26) = .66
$(3.173)^{1/2}$ 1.781 (.36) = .64
$(2.116)^{1/2}$ 1.45664 = .64
$(1.587)^{1/2}$ 1.259 (.50) = .63

$$\Delta H_@ = \frac{0.92}{(K_{\bar{m}})^2}$$

ORIFICE METER CALIBRATION
LONE STAR CENTRAL RESEARCH

OPERATOR VED 1/30/81

METER CONSOLE NO. B DGM NO. ______

BAROMETRIC PRESSURE (PM) 30.04 In. Hg. DGM Corr. Factor .994 (DGMCF)

	ΔH In. H_2O	V_1 Initial DGM Dial Reading	⊖ Minutes	V_2 Final DGM Dial Reading	Qm (CFM)	Tm °F	K_m
30	.25	950.41	2	950.94	.23	92	.58
32	.50	950.94	2	951.35	.21	92	.37
34	.75	951.35	2	952.19	.42	90	.61
36	1.00	952.19	2	953.19	.50	89	.63

AVERAGE (K_{-m}) .61

$$Q_{m\,(CFM)} = \frac{(V_2 - V_1) \times DGMCF}{\ominus \text{ Minutes}}$$

$$K_m = Q_m \left[\frac{P_m M_m}{T_m \, {}^oR \Delta H}\right]^{1/2}$$

30.04 28.84

551 (.25)

$(6.289)^{1/2}$ 2.508 (.23) = .58

$(3.145)^{1/2}$ 1.773 (.21) = .37

$(2.096)^{1/2}$ 1.448 (.42) = .61

$(1.572)^{1/2}$ 1.253 (.50) = .63

$$\Delta H_@ = \frac{0.92}{(K_{\bar{m}})^2}$$

ORIFICE METER CALIBRATION
LONE STAR CENTRAL RESEARCH

OPERATOR VED 1/30/81

METER CONSOLE NO. C DGM NO. ____

BAROMETRIC PRESSURE (PM) 30.04 In. Hg. DGM Corr. Factor .991 (DGMCF)

	ΔH In. H_2O	V_1 Initial DGM Dial Reading	⊖ Minutes	V_2 Final DGM Dial Reading	Qm (CFM)	Tm °F	K_m
.5 .17	.25	211.38	2	211.94	.28 ~~.278~~	98	.70
.15	.50	211.94	2	212.69	.38	99	.67
21	.75	212.69	2	213.63	.47	98	.68
23	1.00	213.63	2	214.70	.54	99	.67

AVERAGE (K_m) .68

$$Q_{(CFM)} = \frac{(V_2 - V_1) \times DGMCF}{\ominus \text{ Minutes}}$$

$$K_m = Q_m \left[\frac{P_m \; M_m}{T_m \; {}^\circ R \Delta H}\right]^{1/2}$$

30.04 28.84

559 .25

$$\Delta H_@ = \frac{0.92}{(K_m)^2}$$

$(6.199)^{1/2}$ 2.490

$(3.0977)^{1/2}$ 1.761

$(2.066)^{1/2}$ 1.437

$(1.550)^{1/2}$ 1.245

ORIFICE METER CALIBRATION
LONE STAR CENTRAL RESEARCH

1/30/81

OPERATOR VED

METER CONSOLE NO. D DGM NO. ______

BAROMETRIC PRESSURE (PM) 30.04 In. Hg. DGM Corr. Factor .975 (DGMCF)

ΔH In. H_2O	V_1 Initial DGM Dial Reading	⊙ Minutes	V_2 Final DGM Dial Reading	Qm (CFM)	Tm °F	K_m
.25	373.36	2	373.97	.30	73	.77
.50	373.97	2	374.61	.32	73	-.58
.75	374.61	2	375.42	.44	73	.60
1.00	375.42	2	376.35	.47	73	.60

AVERAGE (K_m) .64

$$Q_m \text{ (CFM)} = \frac{(V_2 - V_1) \times DGMCF}{\odot \text{ Minutes}}$$

$$K_m = Q_m \left[\frac{P_m M_m}{T_m \, {}^{o}R \Delta H}\right]^{1/2}$$

30.04 28.84 533

$$\Delta H_@ = \frac{0.92}{(K_m)^2}$$

$(6.501)^{1/2} = 2.549$

$(3.250)^{1/2} = 1.803$

$(2.167)^{1/2} = 1.472$

$(1.625)^{1/2} = 1.275$

ORIFICE METER CALIBRATION
LONE STAR CENTRAL RESEARCH

OPERATOR VED 1/30/81

METER CONSOLE NO. 5 DGM NO.

BAROMETRIC PRESSURE (PM) 30.04 In. Hg. DGM Corr. Factor [illegible] (DGMCF)

ΔH In. H_2O	V_1 Initial DGM Dial Reading	⊙ Minutes	V_2 Final DGM Dial Reading	Qm (CFM)	Tm °F	K_m
.25	207.85	2	208.36	.25	99	.64
.50	208.36	2	209.10	.36	76	.65
.75	209.10	2	209.99	.44	76	.65
1.00	209.99	2	211.01	.50	76	.64

AVERAGE (K_m) .65

$$Q_{m\,(CFM)} = \frac{(V_2 - V_1) \times DGMCF}{\odot \text{ Minutes}}$$

$$K_m = Q_m \left[\frac{P_m M_m}{T_m \; {}^{\circ}R \Delta H}\right]^{1/2}$$

30.04 28.84 537

$$\Delta H_@ = \frac{0.92}{(K_m)^2}$$

$(6.453)^{1/2} = 2.540$

$(3.227)^{1/2} = 1.796$

$(2.151)^{1/2} = 1.467$

$(1.613)^{1/2} = 1.270$

P.O. Box 297
Bonner Springs,
KS 66012

August 13, 1981

PERSONAL AND
BUSINESS CONFIDENTIAL

TO : D. L. GRAMMES

FROM : W. W. Hurst

SUBJECT : Environmental Testing Program
Bonner Springs - 1981

cc: S. T. Hellstrom
D. W. Connelly
L. W. Necessary
C. D. Fehnel
G. F. Messinger

The morning of August 9th, Sig Hellstrom, Dennis Connelly, Larry Necessary, Victor DeLoach and myself met at the Bonner Plant Office to consider the testing program needs and scope of activity necessary for local and Corporate requirements.

Accordingly, a testing plan and program is proposed for consideration by all concerned. You are invited to modify or alter the proposed program in any manner toward improving its effectiveness or to encompass your special interest. If no comment is forthcoming, the plan will proceed strictly as proposed. Since the proposed plan will get underway in the near future, please be so kind as to make your recommendations both expeditiously and explicitly.

A. PRELIMINARY EFFORT

The mobile laboratory was moved from LaCygne to Bonner on August 10th. The LaCygne tour exceeded the estimated testing period by a considerable amount for a number of reasons, not least of which, was due to lack of local plant maintenance support. No criticism is intended but the LaCygne operation is very small compared to a cement plant resulting in the lack of tools, manpower and knowledge that we are accustomed to receiving. Consequently, we have a back log of repairs and equipment adjustment which will require the major portion of this week to renovate. Therefore, in view of our scheduled "break" next week, testing at Bonner Will not get underway until August 24th.

B. BONNER TEST PROGRAM SCOPE

Particulate emission from both kiln stacks and clinker cooler stack are needed for Kansas Regulatory considerations. Further, it is deemed necessary to get current data on the electrostatic precipitators efficiency and infiltrated air to evaluate normal wear since last tests were performed in 1974. Of particular interest is the possibility of accelerated precipitator deterioration due to the conversion from primarily natural gas fuel to coal within recent years. (Coal, of course, possesses a significant amount of sulfur component, whereas, natural gas does not.) Also, it is suspected that the drastic lowering of flue gas temperature in the precipitators resulting from the upgrading of kiln chain section in line with the Blue Circle study, might have an adverse influence on precipitator wear rate.

Accordingly, in addition to regulatory requirements for particulates, it seems important to obtain the current SO_x and NO_x level of kiln stack emissions, not only for the record, but also possible labeling and association with precipitator degradation.

If time permits, we recommend performing a few chloride emission tests so as to obtain a base level for chloride in "Limestone Plant" stack emissions for comparison with chloride emissions on stacks in plants using marine calcareous material. Also, of interest for both local and Corporate records, we should perform a few ammonia and hydrogen sulfide tests.

C. TARGET DATES

Accordingly, the required work along with processing time, is --

1. Particulates
   (3 stacks + 3 precipitators)(3 runs/location) = 18 run days

   Since tests are run simultaneously, there would be 36 tests.

2. SO_x

SO_x runs are made simultaneously with particulate runs. Therefore, 30 SO_x tests would be performed - excluding SO_x runs on clinker cooler dust collector.

3. NO_x

NO_x run will be performed once during each of the 18 run days simultaneously with either chloride, ammonia or hydrogen sulfide.

In addition to 18 run days, 6-8 days will be required for relocation of equipment within the plant and processing samples collected for the various tests performed.

C. TARGET DATES (Continued)

If all goes well and there are no unforeseen delays, the Bonner project should be completed around the middle of October.

D. TESTING PROCEDURE

1. EPA Method 1-5 will be used for stack particulate emissions, whereas, ASTM Method will be used for precipitator input particulates. The ASTM Method is better suited to particulate loads of 7-15 grains/cu. ft. commonly experienced at the precipitator "In Put".

2. EPA Method 7 will be used to determine NO_x concentration.

3. The Los Angeles Method will be used for SO_x testing.

4. The Los Angeles Method and/or Texas Method will be used for chloride/chlorine testing, ammonia and hydrogen sulfide.

E. REPAIRS AND MODIFICATIONS

1. All stack sampling facilities are in excellent condition; however, we will need a simple outrigger at each stack to facilitate hoisting equipment to test location. We will spot exact location for outrigger in the field.

2. We will need three(3) 3" or 4" ports on the top of the input duct to the No. 4 kiln precipitator just ahead of the isolation guillotine gate and expansion section.

3. In general, a mechanic should remove all port covers since they have likely rusted and/or corroded to the nipples. Covers with essentially no remaining threads should be replaced so that a tight seal can be made between cover and nipple.

F. SUPPLIES

Please obtain for our use 48 - 1 liter plastic bottles. Also, please have available a gross supply of 4 oz. plastic sample bottles with tops.

G. POWER

We will require 440 volts - 60 amp single phase power supply within 100 to 150' of the sampling area at ground level. This power is taken directly to the mobile laboratory and disseminated at lower voltage as required. Thus, it is not necessary to have power outlets at testing locations.

H. WORK SCHEDULE

Generally, we will work a 6-2-6 plan meaning we will work six(6) 10-hour days which will probably average 12 hours/day, travel two(2) days and be off six(6) days. This procedure will start when we arrive at Bonner, Monday, August 10th, so that we will work August 10 through 15, travel August 16, be off August 17 through 22, travel back to Bonner August 23 and start work August 24, etc. We will work all holidays that fall on work days during the course of tour.

Accordingly, please provide two(2) people to help us handle equipment. They should be scheduled to match our work plan when possible. Ideally, we would have the same two(2) people all the time, but we realize this is seldom possible. However, please keep personnel changes to a minimum so that we can maintain a good testing pace and not have to spend too much time training people.

It is not necessary for our people to possess any particular technical skills. The work we have for them is essentially physical, often hot but not to strenuous. On occasions, short term strength is required so that we prefer men to women. However, an exceptionally strong girl would possibly meet our needs.

I. LABORATORY SUPPORT

We will need some analytical work done by the laboratory. Of course, the plant operation and it's analytical needs comes first. Generally, our work can fill the gaps since seldom, if ever, do we have to meet a deadline as in the case of plant operation. On occasion, the backlog of testing might build to the point where some overtime is justifiable.

With the help of the Lab, we will collect samples of kiln input and output product necessary to determine a system balance. This data is needed for correlation with stack emission products. This activity produces quite an inventory of samples for temporary housing. Later, we will composite samples for analysis and ultimate discard.

Thus we need for the days we operate:

1. Raw Mix (Daily Composite)
   - (a) Carbonate
   - (b) Moisture
   - (c) Consumption Rate
2. Clinker (Daily Composite)
   - (a) Composition
   - (b) Production Rate

I. LABORATORY SUPPORT (Continued)

3. Fuel Coal (Daily Composite)

(a) Moisture of coal as it is fed to kiln
(b) SO_3
(c) Save a portion of each daily composite for an overall composite which we will send out for "ultimate analysis"
(d) Consumption Rate

4. Kiln Dust

(a) Average production rate
(b) Composite Composition

J. REPORTING

We estimate data can be assembled with results reported within two(2) to three(3) weeks following completion of work - on or around November 1st to 15th.

W. W. HURST
Process Development Engineer

WWH/ld