Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP-42 Section 11.30
Reference 9
Report Sect. 4
Reference 6

PARTICULATE ANALYSES

of

DRIER AND MILL BAGHOUSE EXHAUST EMISSIONS

at

SILBRICO PERLITE PLANT
NO AGUA, NEW MEXICO

by
Kramer, Callahan & Associates

February 1980

Introduction

Exhaust emissions from two baghouses at Silbrico's No Agua Perlite Plant were sampled by Kramer, Callahan and Associates personnel on February 5 and 6, 1980. One baghouse removed particulates from the kiln drier exhaust and the other collected dust from miscellaneous operations throughout the plant; hence they will be referred to in this report as the drier and miscellaneous stacks respectively. The following individuals were present during the sampling period:

1. Gary Kramer and Bill Ristau - Kramer, Callahan and Associates
2. Aziz - New Mexico EIA
3. Calvin Junker - Silbrico Corp.

Methods and Procedures

Each stack emission was sampled according to procedures in the Federal Register, Vol. 42, No. 160; Thursday, August 18, 1977. The drier dust was sampled for 4 minutes per point (16 points) through a 1/4" nozzle, and the miscellaneous duct was sampled for 2 minutes per point (49 points) through a 3/16" nozzle. Sampling locations and matrices are shown in Figures 1 - 3.

The sampling system used was a MISCO Model 7200 Source Sampler which is identical in operation to that shown in Method 5 of the Federal Register, Vol. 42, No. 160: Thursday, August 18, 1977. Gas analyses were performed with an Industro Model Burrell Analyser, and all filters and particulate catches were weighed on a Sartorius Analytical Balance (0.1 mg. sensitivity). Probes, nozzles and associated glassware upstream of the filter were cleaned with acetone which was collected in a jar with lid for transport to the KCA laboratory in Albuquerque for analysis. Jars were emptied and rinsed with acetone into tared beakers for evaporation. Filters were dessicated for at least 24 hours prior to reweighing. All samples were in the custody of Gary Kramer at all times.

Results and Discussion

A general summary of all the data is given in Table 1; original data sheets, calculations and individual data summaries are included in Appendix 1. Equipment calibration and resumes of test personnel are listed in Appendix 2.

Production rate averaged 25 tons per hour during sampling and pressure drops were 5" WG and 3" WG for the drier and miscellaneous baghouses respectively at about noon during a 9-hour operating day (0730-1630).

The data in Table 1 show that drier baghouse flow rates and therefore sample volumes decreased during an operating day to the point that during the final sampling run only 26.9 DSCF of sample was collected. All other samples exceeded 30 DSCF. The corresponding decrease in emissions from the drier would indicate that a buildup of cake on the bags possibly was causing the flow reduction. Pressure drop readings (5" WG) were taken during drier sampling Run 2. Flow rates and emissions from the miscellaneous stack remained stable through the operating day.

Total average emissions from the drier and miscellaneous stacks were 11.5 and 11.2 respectively for an average total emission rate of 22.7 lbs/hr. which is less than the maximum rate of 31 lbs./hr. allowed in New Mexico Air Quality Control regulation #505.

Table 1

Data Summary

	Test #	Sample Volume, SCF	Moisture %	Isokinetic Ratio, %	Emissions #/hr.	
Drier	1	36.63	8.4	97.5	14.2	
	2	33.92	10.8	100.2	11.7	11.5 (ave)
	3	26.9	14.5	107.2	8.6	
Miscellaneous	1	46.7	1.4	101.6	11.2	
	2	46.0	1.5	100.7	11.4	11.2 (ave)
	3	45.0	1.2	99.2	11.0	

Average total = 22.7 lbs./hr.

FIGURE 1
SILBRICO PERLITE PLANT- MISCELLANEOUS

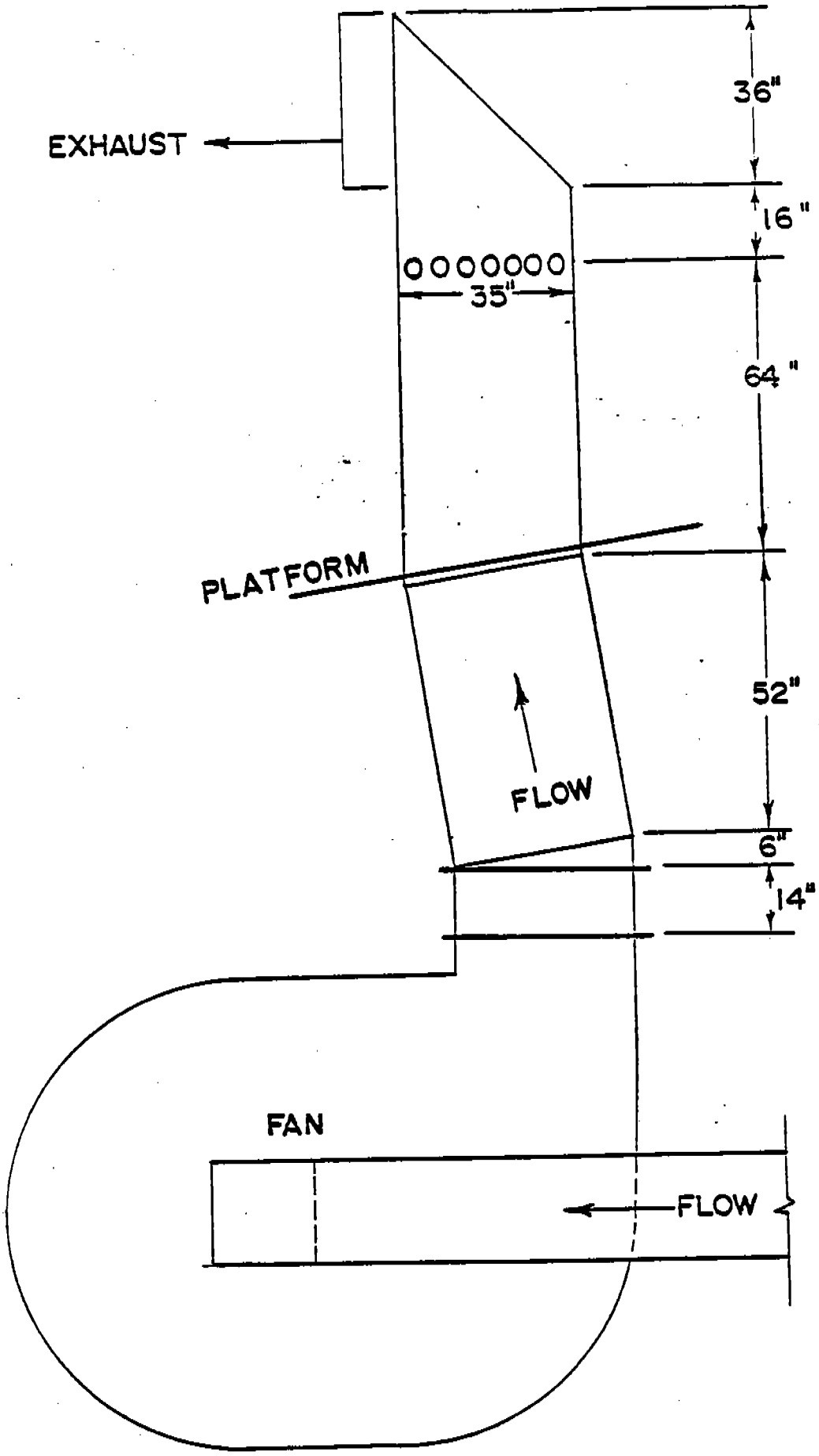


FIGURE 2

SILBRICO PERLITE PLANT— DRIER

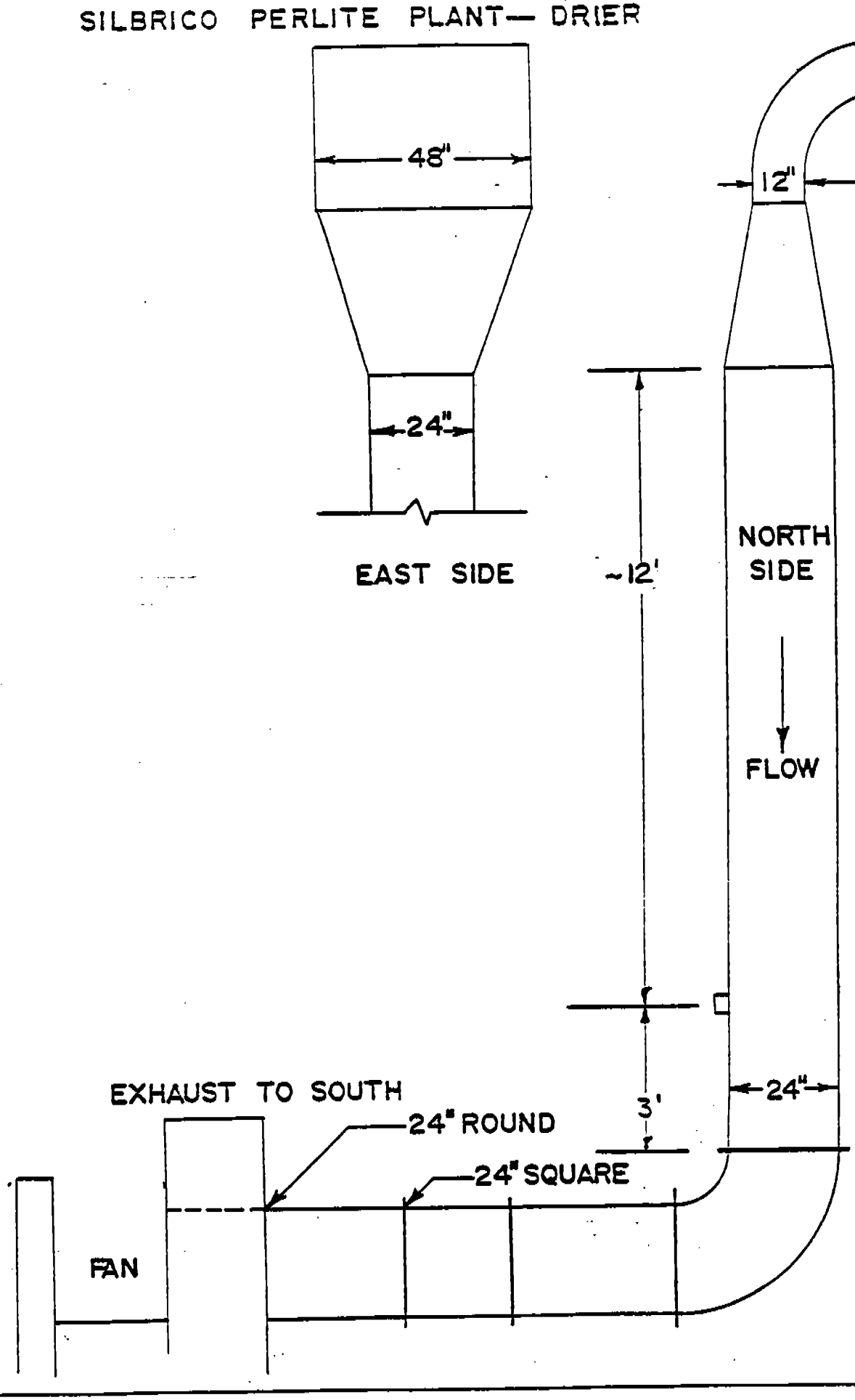
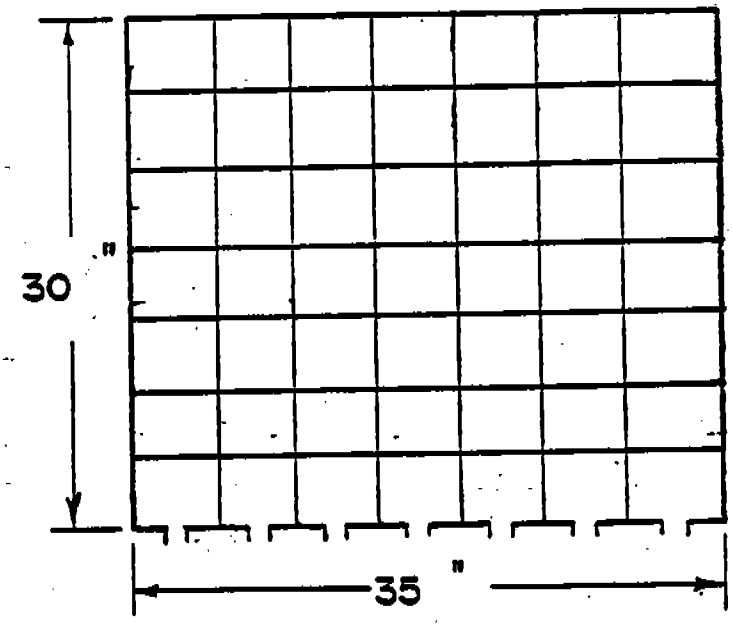


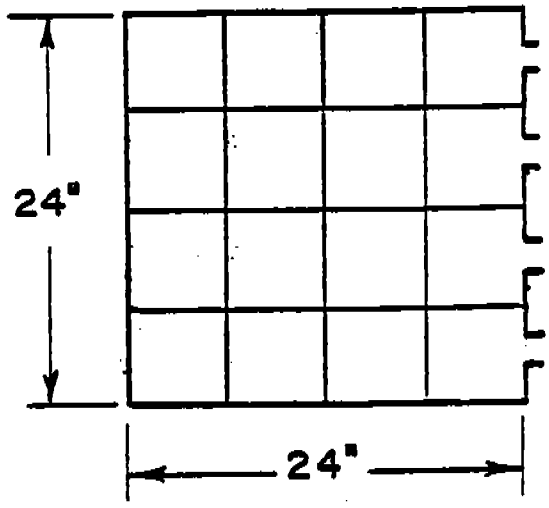
FIGURE 3

STACK SAMPLING MATRIX

MISCELLANEOUS DUCT
(49 TRAVERSE POINTS)



DRYER DUCT
(16 TRAVERSE POINTS)



ALL DIMENSIONS INSIDE

APPENDIX 1

Calculations and Original Data Forms

DRIER EXHAUST DUCT

DRIER EXHAUST

TEST DATA	TEST NO. 1	2	3	4	5
V..... Actual metered volume (CF)	45.83	44.455	35.264		
Pb .... Barometric pressure ("Hg)	22.32	22.32	22.32		
T_m..... Ave. dry gas meter temp. (^oF)	36.6	60	59.3		
W..... Particulate collected (mg)	573.1	487.9	381.1		
V_w..... Total H_2O collected (ml)	70.7	86.8	96.2		
CO_2.... Carbon dioxide in stack gas, %	2.8	2.8	2.8		
O_2..... Oxygen in stack gas, %	17	17	17		
N_2..... Nitrogen in stack gas, %	79.2	79.2	79.2		
P_s..... Absolute stack pressure ("Hg)	21.5	21.5	21.5		
T_s..... Average stack gas temp. (^oF)	183.6	168.5	153.6		
C_p..... S-type pitot correction factor	0.77	0.77	0.77		
ΔP..... Average velocity pressure ("H_2O)	0.60	0.506	0.29		
A..... Area of stack (ft^2)	4	4	4		
t..... Sample time (minutes)	64	64	64		
D_n..... Nozzle diameter (in.)	1/4	1/4	1/4		
ΔH.....Pressure drop across orifice ("H_2O)	1.28	1.17	0.69		

CALCULATED RESULTS	1	2	3	4	5
$V_m$std..Corrected metered volume (SCF)	36.63	33.92	26.9		
$V_w$std..Volume of water collected (SCF)	3.35	4.11	4.56		
B_{wo}... H_2O in stack gas (% by vol.)	8.4	10.8	14.5		
MW.... Molecular wt. of stack gas (wet)	28.3	28.03	27.62		
MW_d... Molecular wt. of stack gas (dry)	29.248	29.248	29.248		
F..... Mole fraction dry stack gas	0.916	0.892	0.855		
$V_s$ave..Average velocity of stack gas (fpm)	3168	2864	2160		
$Q_s$ave..Average stack flow rate (SCFM,dry)	6869	6190	4585		
Q .... Average stack flow rate (ACFM,dry)	11608	10219	7387		
I..... Isokinetic rate, average (%)	97.5	100.2	107.2		
c'_s.... Particulates conc. in stack gas (gr/DSCF)	0.244	0.221	0.28		
W_m.... Particulates conc. in stack gas (mg/m^3)	—	—	—		
G .... Particulates conc. in stack gas (lb/hr)	14.2	11.74	8.6		
Plant processing rate, ~~lb~~ TONS per hour	25	25	25		

CALCULATIONS SUMMARY

RUN 1

DRIER EXAUST

$$V_{M_{STD}} = 17.71\,(45.83)\left(\frac{22.32 + 1.28/13.6}{496.6}\right) = 36.63 \text{ SCF, D}$$

$$V_W = 0.0474\,(70.7) = 3.351$$

$$B_{WO} = 3.351 / 39.98 = 8.4\,\%$$

$$M.W. = \left[44(0.028) + 32\,(0.17) + 40\,(0.01) + 0.792\,(28)\right] 29.248 + 18(0.084)$$

$$= 28.3$$

$$V_{S_{AVE}} = 85.48\,(0.77)(0.78)\left[\frac{643.6}{28.3\,(21.5)}\right]^{1/2} = 52.80 \text{ fps}$$

$$I = \frac{1032\,(643.6)(36.63)}{60(64)(0.916)(0.0625)(21.5)(52.80)} = 97.5\,\%$$

$$Q_{S_{AVE}} = 1062.83\,(52.8)(4)\,(0.916)\left(\frac{21.5}{643.6}\right) = 6869 \text{ DSCFM}$$

$$C_s' = 0.0154\left(\frac{105.4 + 467.7}{36.63}\right) = 0.241 \text{ gr/DSCF}$$

$$G = 0.000143\,(60)(6869)(0.241) = 14.2 \text{ lb/HR.}$$

PARTICULATES SAMPLING AND ANALYSIS DATA

Plant Name and Location SILBRICO DRIER STACK

Run No. 1 Date 2/5/80 Time 0230 Ambient Temp. °F 15

Bar. Press., in. Hg. 22.32 Stack Location DRIER EXHAUST

Stack Diameter, in. 24 x 24 Stack Pressure, in Hg 21.50

Plant Operator C. JUNKER P_s/P_m 0.99

Processing Rate 25 T/HR

Filter Assembly MISCO Filter No. 6

Silica Gel No. — Acetone Jar No. 1 Acetone Bkr No. 1

Probe Tip Diameter, in. 1/4" Assumed Moisture, % 11

Probe Length, Ft. 7½ Cp 0.77 Δ H@ 1.64

Calculator Setting ΔP = 1.0 ΔH = 2.21

Orsat Analysis Data

CO_2	SEE RUN 2		
$CO_2 + O_2$			
$CO_2 + O_2 + CO$			

Leak Test

Initial 0.002 cfm @ 8" Hg

Final 0.002 cfm @ 5" Hg

Moisture Content

Impinger #1	142
Impinger #2	119
Impinger #3	—
Total initial H_2O	200
Net Impinger H_2O	61
Net H_2O in Silica Gel	9.7
Total H_2O Collected	70.7

PARTICULATES SAMPLING DATA

Plant Name and Location Silbrico DRIER EXHAUST Run No. 1

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	954.076	0.55	1.22	1.22	21	18	1.5	175	<30	165
2	4	956.83	0.54	1.20	1.20	25	19	1.5	180	<30	190
3	8	959.575	0.52	1.15	1.15	29	20	1.5	185	30	200
4	12	962.26	0.45	0.95	0.95	31	22	1	190	30	215
	16	964.732									
1	0	964.732	0.50	1.05	1.05	31	25	1	200	30	202
2	4	967.32	0.58	1.20	1.20	35	28	1.5	200	30	200
3	8	969.98	0.63	1.30	1.30	38	30	2.0	200	30	190
4	12	973.02	0.55	1.13	1.13	41	32	1.5	205	32	178
	16	975.754									
1	0	975.754	0.65	1.35	1.35	37	35	2	205	32	170
2	4	978.70	0.72	1.5	1.5	42	36	3	205	32	181
3	8	981.78	0.77	1.6	1.6	47	38	3	205	32	180
4	12	984.975	0.77	1.6	1.6	50	39	3	210	35	175
	16	988.163									
1	0	988.163	0.57	1.2	1.2	47	41	2.5	210	35	160
2	4	990.98	0.60	1.25	1.25	50	42	3	215	40	175
3	8	993.84	0.68	1.45	1.45	53	44	3	215	40	178
4	12	996.92	0.64	1.35	1.35	55	45	3	215	40	178
	16	999.906									
Ave		45.83	$\sqrt{\Delta P}$ = 0.78	1.28	1.28	39.5	32.1	2.5	205	33	183.6

ΔP_{ave} = 0.60

41

31.6

kramer, callahan & associates

CALCULATIONS SUMMARY

RUN 2

DRIER EXHAUST

$$V_{M_{STD}} = 17.71(44.455)\left(\frac{22.32 + 1.17/13.6}{520}\right) = 33.92 \text{ DSCF}$$

$$V_W = 0.0474\ (86.8) = 4.11 \text{ SCF}$$

$$B_{WO} = 4.11 / 38.03 = 10.8\ \%$$

$$M.W. = 29.248(0.892) + 18\ (0.108) = 28.03$$

$$V_{S_{AVE}} = 85.48\ (0.77)(0.71)\left(\frac{628.5}{28.03\ (21.5)}\right)^{1/2} = 47.72 \text{ fps}$$

$$I = \frac{1032\ (628.5)(33.92)}{60\ (64)(0.892)(0.0625)(21.5)(47.72)} = 100.2\ \%$$

$$Q_{S_{AVE}} = 1062.83\ (47.72)(4)(0.892)\left(\frac{21.5}{628.5}\right) = 6190 \text{ DSCFM}$$

$$C_S' = 0.0154\left(\frac{77 + 410.9}{33.92}\right) = 0.221 \text{ gr/DSCF}$$

$$G = 0.000143\ (60)(6190)(0.221) = 11.74 \text{ lb/HR.}$$

PARTICULATES SAMPLING AND ANALYSIS DATA

Plant Name and Location SILBOCO - DRIER - NO AGUA

Run No. 2 Date 2/5/80 Time 1100 Ambient Temp. °F 35

Bar. Press., in. Hg. 22.32 Stack Location DRIER EXHAUST

Stack Diameter, in. 24x24 Stack Pressure, in Hg 21.50

Plant Operator C. JUNIGER P_s/P_m 0.99

Processing Rate 25 T/HR

Filter Assembly MISCO Filter No. 10

Silica Gel No. — Acetone Jar No. 2 Acetone Bkr No. 2

Probe Tip Diameter, in. 1/4" Assumed Moisture, % 10

Probe Length, Ft. 7½' Cp 0.77 Δ H@ 1.70

Calculator Setting ΔP=1 ΔH=2.25

Orsat Analysis Data

CO_2	2.8	2.7	2.8
$CO_2 + O_2$	19.8	19.6	19.8
$CO_2 + O_2 + CO$	19.8	19.6	19.8

Moisture Content

Impinger #1	166
Impinger #2	110
Impinger #3	—
Total initial H_2O	200
Net Impinger H_2O	76
Net H_2O in Silica Gel	10.2
Total H_2O Collected	86.8

Leak Test

Initial 0.005 cfm @ 5" Hg

Final 0.001 cfm @ 4" Hg

PARTICULATES SAMPLING DATA

Plant Name and Location SILARICO DRIER EXHAUST Run No. 2

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	0.353	0.56	1.33	1.33	47	48	2	185	45	185
2	4	3.29	0.54	1.20	1.20	51	48	2	190	45	195
3	8	6.08	0.58	1.3	1.3	55	49	2.5	195	40	192
4	12	8.97	0.58	1.3	1.3	57	50	2.5	205	40	181
	16	11.88									
1	0	11.88	0.58	1.3	1.3	58	52	2.5	205	40	173
2	4	14.80	0.67	1.5	1.5	61	54	3	210	40	170
3	8	17.92	0.75	1.68	1.68	64	55	3	215	40	170
4	12	21.23	0.68	1.55	1.55	66	56	3	215	40	165
	16	24.441									
1	0	24.441	0.54	1.25	1.25	63	58	2.5	215	45	160
2	4	27.34	0.48	1.10	1.10	65	58	2.5	215	45	160
3	8	30.08	0.46	1.05	1.05	65	59	2.5	215	45	160
4	12	32.75	0.40	0.92	0.92	65	59	2.0	215	45	160
	16	35.26									
1	0	35.26	0.45	1.05	1.05	64	60	2	220	45	150
2	4	37.94	0.35	0.81	0.81	65	60	2	220	45	155
3	8	40.33	0.32	0.74	0.74	65	60	2	220	45	160
4	12	42.62	0.29	0.67	0.67	65	61	2	220	45	160
	16	44.808									
		44.455	$\sqrt{\Delta P}$ = 0.71	1.17	1.17	61	55.44	2.5	210	43	168.5

Corr: 64

Ave: 60

Kramer, Callahan & associates

CALCULATIONS SUMMARY

RUN 3

DRIER EXHAUST

$$V_{M_{STD}} = 17.71\,(35.264)\left(\frac{22.32 + 0.69/13.6}{519.3}\right) = 26.9 \text{ DSCF}$$

$$V_W = 96.2\,(0.0474) = 4.56 \text{ SCF}$$

$$B_{WO} = 4.56/31.46 = 14.5\%$$

$$M.W. = (29.248)(0.855) + 0.145\,(18) = 27.62$$

$$V_{S_{AVE}} = 85.48\,(0.77)(0.538)\left[\frac{63.6}{27.62\,(21.5)}\right]^{1/2} = 36.0 \text{ fps}$$

$$I = \frac{1032\,(613.6)(26.9)}{60\,(64)(0.0625)(0.855)(36)(21.5)} = 107.2\ \%$$

$$Q_{S_{AVE}} = 1062.83\,(36)(4)(0.855)\left(\frac{21.5}{613.6}\right) = 4585 \text{ DSCFM}$$

$$C_S' = 0.0154\left(\frac{65.4 + 315.7}{26.9}\right) = 0.218 \text{ gr/DSCF}$$

$$G = 0.000143\,(60)(4585)(0.218) = 8.6 \text{ lbs/HR}$$

PARTICULATES SAMPLING AND ANALYSIS DATA

Plant Name and Location SILBRICO

Run No. 3 Date 2/5/80 Time 1400 Ambient Temp. °F 40

Bar. Press., in. Hg. 22.32 Stack Location DRIER EXHAUST

Stack Diameter, in. 24"x24" Stack Pressure, in Hg 21.50

Plant Operator C. JUNKER P_s/P_m 0.99

Processing Rate ΔP Drier = 5.0" WG 25 T/HR
ΔP MISC = 3.0" WG

Filter Assembly MISCO Filter No. 7

Silica Gel No. — Acetone Jar No. 4 Acetone Bkr No. 4

Probe Tip Diameter, in. 1/4" Assumed Moisture, % 11

Probe Length, Ft. 7½' Cp 0.77 Δ Hℓ 1.70

Calculator Setting _____ _____

Orsat Analysis Data

CO_2	SEE RUN 2		
$CO_2 + O_2$			
$CO_2 + O_2 + CO$			

Leak Test

Initial 0.015 cfm @ 5" Hg

Final 0.004 cfm @ 10" Hg

Moisture Content

Impinger #1	180
Impinger #2	110
Impinger #3	—
Total initial H_2O	700
Net Impinger H_2O	90
Net H_2O in Silica Gel	6.2
Total H_2O Collected	96.2

PARTICULATES SAMPLING DATA

Plant Name and Location SILARICO - DRIER Run No. 3

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	45.300	0.35	0.82	0.82	48	50	1	180	38	135
2	4	47.66	0.29	0.68	0.68	51	50	1	180	38	150
3	8	49.84	0.25	0.59	0.59	53	50	1	185	38	160
4	12	51.89	0.23	0.54	0.54	55	51	.5	190	38	160
	16	53.84									
1	0	53.84	0.35	0.82	0.82	56	52	1	195	38	—
2	4	—	0.35	0.82	0.82	59	54	1	200	38	150
3	8	58.57	0.27	0.63	0.63	59	55	1	200	38	160
4	12	60.67	0.27	0.63	0.63	60	56	1	205	38	155
	16	62.797									
1	0	62.797	0.33	0.80	0.80	60	58	1	210	38	150
2	4	65.14	0.25	0.60	0.60	62	59	1	210	38	160
3	8	67.24	0.28	0.68	0.68	63	60	1	210	38	160
4	12	69.43	0.30	0.72	0.72	65	60	1	215	40	155
	16	71.69									
1	0	71.69	0.40	0.96	0.96	62	60	2	215	40	—
2	4	74.26	0.25	0.60	0.60	64	62	1	215	40	155
3	8	—	0.25	0.60	0.60	65	62	1	215	40	150
4	12	78.47	0.25	0.60	0.60	66	63	1	215	40	160
	16	80.564									
AVE.	—	35.264	$\sqrt{\Delta P}$ = 0.538	0.69	0.69	59.3	56.4	1	205	40	153.6

ΔP = 0.29 Corrected: 62.3

59.3 ave.

kramer, callahan & associates

MISCELLANEOUS EXHAUST DUCT

MISCELLANEOUS EXHAUST

TEST DATA	TEST NO. 1	2	3	4	5
V..... Actual metered volume (CF)	62.163	63.0	60.846		
Pb .... Barometric pressure ("Hg)	22.15	22.15	22.15		
T_m..... Ave. dry gas meter temp. (°F)	64	78.5	72		
W..... Particulate collected (mg)	214.2	214.4	203.6		
V_w..... Total H_2O collected (ml)	14.4	14.4	11.1		
CO_2.... Carbon dioxide in stack gas, %	0.4	0.4	0.4		
O_2..... Oxygen in stack gas, %	21.3	21.3	21.3		
N_2..... Nitrogen in stack gas, %	77.3	77.3	77.3		
P_s..... Absolute stack pressure ("Hg)	22.15	22.15	22.15		
T_s..... Average stack gas temp. (°F)	76.5	73.9	62.5		
C_p..... S-type pitot correction factor	0.79	0.79	0.79		
ΔP..... Average velocity pressure ("H_2O)	0.838	0.826	0.793		
A..... Area of stack (ft^2)	7.6	7.6	7.6		
t..... Sample time (minutes)	98	98	98		
D_n..... Nozzle diameter (in.)	3/16	3/16	3/16		
ΔH.....Pressure drop across orifice ("H_2O)	0.912	0.918	0.86		

CALCULATED RESULTS	1	2	3	4	5
$V_m$std..Corrected metered volume (SCF)	46.7	46.0	45.0		
$V_w$std..Volume of water collected (SCF)	0.682	0.680	0.526		
B_{wo}... H_2O in stack gas (% by vol.)	1.4	1.5	1.2		
MW.... Molecular wt. of stack gas (wet)	28.9	28.9	28.9		
MW_d... Molecular wt. of stack gas (dry)	29.036	29.036	29.036		
F..... Mole fraction dry stack gas	0.986	0.985	0.988		
$V_s$ave..Average velocity of stack gas (fpm)	3396	3364	3258		
$Q_s$ave..Average stack flow rate (SCFM,dry)	18611	18505	18371		
Q .... Average stack flow rate (ACFM,dry)	25448	25182	24464		
I..... Isokinetic rate, average (%)	101.6	100.7	99.2		
c'_s.... Particulates conc. in stack gas (gr/DSCF)	0.07	0.072	0.07		
W_m.... Particulates conc. in stack gas (mg/m^3)	—	—	—		
G .... Particulates conc. in stack gas (lb/hr)	11.2	11.4	11.0		
Plant processing rate, TONS per hour	25	25	25		

CALCULATIONS SUMMARY
RUN 1
MISCELLANEOUS EXHAUST

$$V_{M_{STD}} = 17.71(62.163)\left(\frac{22.15 + 0.912/13.6}{524}\right) = 46.7 \text{ SCF}$$

$$V_W = 0.0474(14.4) = 0.682$$

$$B_{WO} = 0.682 / 47.38 = 1.4\ \%$$

$$M.W. = \left[44(0.004) + 32(0.213) + 40(.01) + 0.773(28)\right]0.986 + 18(0.014)$$

29.036

$$= 28.9$$

$$V_{S_{AVE}} = 85.48(0.79)(0.916)\left[\frac{536.5}{28.9\ (22.15)}\right]^{1/2} = 56.6 \text{ FPS}$$

$$I = \frac{1032(536.5)(46.7)}{60(98)(0.035)(0.986)(22.15)(56.6)} = 101.6\ \%$$

$$Q_{S_{AVE}} = 1062.83(7.6)(56.6)(0.986)\left(\frac{22.15}{536.5}\right) = 18611 \text{ DSCFM}$$

$$C_s' = 0.0154\left(\frac{22.6 + 191.6}{46.7}\right) = 0.07 \text{ gr/DSCF}$$

$$G = 0.000143(60)(18611)(0.07) = 11.2 \text{ lbs/HR.}$$

PARTICULATES SAMPLING AND ANALYSIS DATA

Plant Name and Location SILBRICO MISC. EXHAUST - NO AGUA

Run No. 1 Date 7/6/80 Time 0830 Ambient Temp. °F 80

Bar. Press., in. Hg. 22.15 Stack Location MISC. EXHAUST

Stack Diameter, in. 35" x 30", De: 32 Stack Pressure, in Hg 22.15

Plant Operator C. JUNKER P_s/P_m 1.00

Processing Rate 25 T/HR

Filter Assembly MISCO Filter No. 13

Silica Gel No. — Acetone Jar No. 5 Acetone Bkr No. 5

Probe Tip Diameter, in. 7 1/2 Assumed Moisture, % 1

Probe Length, Ft. 3/16 Cp 0.79 Δ H@ 1.65

Calculator Setting ΔP=1 ΔH = 1.07

Orsat Analysis Data			
CO_2	0.4	0.4	0.4
$CO_2 + O_2$	21.8	21.8	21.6
$CO_2 + O_2 + CO$	21.8	21.8	21.6

Moisture Content	
Impinger #1	96
Impinger #2	102
Impinger #3	
Total initial H_2O	200
Net Impinger H_2O	-2
Net H_2O in Silica Gel	116.4
Total H_2O Collected	114.4

Leak Test

Initial 0.004 cfm @ 10" Hg

Final 0.002 cfm @ 3" Hg

PARTICULATES SAMPLING DATA

Plant Name and Location SILBRICO – MISC. Run No. 1

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	80.75	0.7	0.75	0.75	45	46	<.5	190	35	60
2	2	81.90	0.78	0.84	0.84	46	46	<.5	200	36	62
3	4	83.10	0.81	0.87	0.87	47	46	<.5	200	36	63
4	6	84.32	0.81	0.87	0.87	48	46	<.5	200	36	64
5	8	85.55	0.81	0.87	0.87	50	46	<.5	200	36	64
6	10	86.77	0.79	0.85	0.85	51	47	<.5	200	36	64
7	12	87.99	0.77	0.82	0.82	53	48	<.5	205	36	65
	14	89.17									
1	0	89.17	0.57	0.62	0.62	51	49	<.5	205	36	62
2	2	90.23	0.72	0.78	0.78	54	49	<.5	205	36	60
3	4	91.39	0.76	0.82	0.82	54	50	<.5	205	38	60
4	6	92.58	0.81	0.88	0.88	56	50	<.5	205	38	60
5	8	93.83	0.79	0.86	0.86	57	51	<.5	205	38	60
6	10	95.07	0.77	0.83	0.83	58	52	<.5	210	38	59
7	12	96.27	0.75	0.81	0.81	59	53	<.5	210	38	59
	14	97.46									
1	0	97.46	0.60	0.65	0.65	58	54	<.5	210	38	60
2	2	98.56	0.74	0.80	0.80	59	55	<.5	210	38	60
3	4	99.74	0.77	0.83	0.83	60	56	<.5	210	38	60
4	6	100.95	0.80	0.87	0.87	62	56	<.5	210	38	61
5	8	102.19	0.81	0.88	0.88	63	57	<.5	210	38	61

PARTICULATES SAMPLING DATA

Plant Name and Location SILBRICO MISC. Run No. 1

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
6	10	103.44	0.83	0.90	0.90	64	58	<.5	210	38	63
7	12	104.70	0.83	0.90	0.90	65	59	<.5	210	38	63
	14	105.96									
1	0	106.01	0.68	0.74	0.74	63	60	<.5	210	38	65
2	2	107.15	0.79	0.85	0.85	64	60	<.5	210	38	65
3	4	108.38	0.83	0.90	0.90	65	61	<.5	210	38	65
4	6	109.64	0.85	0.92	0.92	66	61	<.5	210	38	65
5	8	110.92	0.89	0.96	0.96	67	62	<.5	210	38	67
6	10	112.21	0.92	1.0	1.0	68	62	.5	210	38	68
7	12	113.55	0.97	1.05	1.05	69	63	.5	210	38	68
	14	114.9									
1	0	114.9	0.76	0.82	0.82	67	65	<.5	210	40	69
2	2	116.12	0.88	0.95	0.95	68	65	<.5	210	40	70
3	4	117.42	0.90	0.97	0.97	69	66	<.5	210	40	70
4	6	118.74	0.97	1.05	1.05	69	66	0.5	210	40	71
5	8	120.10	1.0	1.08	1.08	70	66	.5	210	40	71
6	10	121.49	1.05	1.15	1.15	70	66	1	210	40	71
7	12	122.92	1.1	1.2	1.2	71	66	1	215	40	71
	14	124.37									

kramer, callahan & associates

PARTICULATES SAMPLING DATA

Plant Name and Location SILBRICO MISC. Run No. 1

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	124.37	0.70	0.76	0.76	68	66	<.5	215	40	71
2	2	125.63	0.87	0.94	0.94	68	67	<.5	215	40	71
3	4	126.85	0.92	1.00	1.00	69	67	<.5	215	40	71
4	6	128.19	0.97	1.05	1.05	70	67	0.5	215	40	71
5	8	129.56	1.05	1.15	1.15	70	67	.5	215	45	71
6	10	130.88	1.1	1.2	1.2	72	67	1	215	45	72
7	12	132.43	1.05	1.15	1.15	72	68	1	215	45	72
	14	133.87									
1	0	133.87	0.60	0.65	0.65	68	67	<.5	215	45	71
2	2	—	0.78	0.84	0.84	69	67	<.5	215	45	73
3	4	136.20	0.83	0.90	0.90	69	67	<.5	215	45	73
4	6	137.47	0.92	1.0	1.0	70	67	0.5	215	45	75
5	8	138.82	0.97	1.05	1.05	71	68	0.5	215	45	75
6	10	140.19	0.97	1.05	1.05	72	68	0.5	215	45	74
7	12	141.55	0.97	1.05	1.05	72	68	0.5	215	45	75
	14	142.913									
Ave		62.163	$\sqrt{\Delta P}$ = 0.916	0.912	0.912	65	59	<.5	210	40	66.5
			ΔP = 0.838			Corr = 68					
						Ave =	64				

CALCULATIONS SUMMARY
RUN 2
MISCELLANEOUS EXHAUST

$$V_{M_{STD}} = 17.71(63)\left(\frac{22.15 + 0.918/13.6}{538.5}\right) = 46 \text{ DSCF}$$

$$V_{W_{STD}} = 0.0474\,(14.4) = 0.68 \text{ SCF}$$

$$B_{WO} = 0.68 / 46.68 = 1.5\%$$

$$M.W. = 29.036\,(0.985) + 18\,(0.015) = 28.9$$

$$V_{S_{AVE}} = 85.48\,(0.79)(0.909)\left(\frac{533.9}{22.15\,(28.9)}\right)^{1/2} = 56.06 \text{ FPS}$$

$$I = \frac{1032\,(533.9)(46)}{60\,(98)(0.035)(0.985)(56.06)(22.15)} = 100.7\%$$

$$Q_{S\,AVE} = 1062.83\,(56.06)(0.985)\left(\frac{22.15}{533.9}\right)(7.6) = 18505 \text{ DSCFM}$$

$$C_s' = 0.0154\left(\frac{27.3 + 187.1}{46}\right) = 0.0718 \text{ gr/DSCF}$$

$$G = 0.000143\,(60)(18505)(0.0718) = 11.4 \text{ lb/Hr}$$

PARTICULATES SAMPLING AND ANALYSIS DATA

Plant Name and Location SILBRICO - NO AGUA

Run No. 2 Date 2/6/80 Time 1300 Ambient Temp. °F 60

Bar. Press., in. Hg. 22.15 Stack Location Misc. Exhaust

Stack Diameter, in. 35 x 30 D_e=32 Stack Pressure, in Hg 22.15

Plant Operator C. Junker P_s/P_m 1.00

Processing Rate 25 T/Hr

Filter Assembly MISCO Filter No. 12

Silica Gel No. — Acetone Jar No. 6 Acetone Bkr No. 6

Probe Tip Diameter, in. 3/16 Assumed Moisture, % 1

Probe Length, Ft. 7 1/2 Cp 0.79 Δ H@ 1.65

Calculator Setting ΔP= ΔH=

Orsat Analysis Data

CO_2	SEE RUN 1		
CO_2 + O_2			
CO_2 + O_2 + CO			

Leak Test

Initial 0.001 cfm @ 4" Hg

Final 0.003 cfm @ 4" Hg

Moisture Content

Impinger #1	95
Impinger #2	103
Impinger #3	
Total initial H_2O	200
Net Impinger H_2O	-2
Net H_2O in Silica Gel	16.4
Total H_2O Collected	14.4

PARTICULATES SAMPLING DATA

Plant Name and Location SILBRICO Run No. 2

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	143.007	0.62	0.67	0.67	68	69	<.5	180	40	75
2	2	144.14	0.75	0.95	0.95	67	69	<.5	185	40	75
3	4	---	0.85	0.92	0.92	68	69	<.5	185	40	75
4	6	146.74	0.90	0.97	0.97	69	69	<.5	190	40	75
5	8	148.05	0.93	1.0	1.0	70	69	<.5	190	40	75
6	10	149.39	0.97	1.05	1.05	70	69	<.5	190	40	75
7	12	150.75	0.97	1.05	1.05	72	70	<.5	195	40	75
	14	152.12									
1	0	152.12	0.65	0.70	0.70	72	70	<.5	195	45	77
2	2	153.27	0.80	0.86	0.86	72	70	<.5	195	45	77
3	4	154.52	0.87	0.94	0.94	73	71	<.5	195	45	78
4	6	155.82	0.97	1.05	1.05	74	71	.5	195	45	78
5	8	157.18	1.0	1.08	1.08	75	72	.5	195	45	78
6	10	158.56	1.05	1.15	1.15	77	72	1	195	45	78
7	12	160.00	1.05	1.15	1.15	78	73	1	200	45	78
	14	161.45									
1	0	161.45	0.72	0.78	0.78	75	73	<.5	200	45	78
2	2	162.67	0.84	0.91	0.91	76	74	<.5	200	45	78
3	4	163.96	0.86	0.93	0.93	77	74	<.5	205	45	78
4	6	165.26	0.92	1.0	1.0	78	74	0.5	205	45	78
5	8	166.60	0.94	1.03	1.03	79	74	0.5	205	45	78

PARTICULATES SAMPLING DATA

Plant Name and Location SILVICO - MISC Run No. 2

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
6	10	167.97	0.97	1.05	1.05	79	75	1	220	45	78
7	12	169.34	1.05	1.13	1.13	80	75	1	220	45	78
	14	170.76									
1	0	170.76	0.63	0.68	0.68	77	76	<.5	220	45	75
2	2	171.9	0.69	0.74	0.74	78	76	<.5	220	50	75
3	4	173.08	0.83	0.90	0.90	77	77	<.5	225	45	75
4	6	174.32	0.87	0.94	0.94	78	77	0.5	225	45	75
5	8	175.69	0.91	0.98	0.98	80	77	1	225	45	73
6	10	177.02	0.93	1.0	1.0	82	78	1	225	45	73
7	12	178.39	0.97	1.05	1.05	82	78	1	225	45	72
	14	179.76									
1	0	179.76	0.60	0.65	0.65	79	78	<.5	220	45	72
2	2	180.84	0.74	0.80	0.80	80	79	<.5	220	45	72
3	4	182.11	0.79	0.85	0.85	81	79	0.5	220	45	72
4	6	183.37	0.82	0.88	0.88	82	80	0.5	220	45	72
5	8	184.65	0.84	0.90	0.90	82	80	0.5	220	45	72
6	10	185.95	0.85	0.91	0.91	83	80	0.5	220	45	71
7	12	187.26	0.86	0.92	0.92	83	80	0.5	220	45	71
	14	188.58									

PARTICULATES SAMPLING DATA

Plant Name and Location Silbrico – MISC Run No. 2

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. $"H_2O$	Orifice ΔH $"H_2O$ Desired	Orifice ΔH $"H_2O$ Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	188.58	0.60	0.65	0.65	81	80	<.5	220	45	71
2	2	189.7	0.71	0.76	0.76	81	80	<.5	220	45	71
3	4	190.90	0.76	0.82	0.82	82	81	0.5	220	45	71
4	6	192.15	0.78	0.84	0.84	83	81	0.5	220	45	71
5	8	193.41	0.78	0.84	0.84	83	81	0.5	220	45	71
6	10	194.68	0.78	0.84	0.84	83	81	0.5	220	45	71
7	12	195.94	0.78	0.84	0.84	83	81	0.5	220	45	71
	14	197.2									
1	0	197.2	0.66	0.72	0.72	79	80	<.5	220	45	70
2	2	—	0.80	0.86	0.86	80	80	<.5	220	45	70
3	4	199.64	0.84	0.90	0.90	81	81	<.5	220	45	69
4	6	200.94	0.85	0.90	0.90	81	80	<.5	220	45	68
5	8	202.23	0.80	0.86	0.86	81	80	<.5	220	45	68
6	10	203.5	0.78	0.84	0.84	81	80	<.5	220	45	67
7	12	204.76	0.78	0.84	0.84	81	80	<.5	220	45	67
	14	206.008									
Ave		63	ΔP = 0.901	0.918	0.918	77.8	76	0.5	25	45	73.9
			ΔP = 0.826			81.3					
						78.5					

kramer, callahan & associates

CALCULATIONS SUMMARY
RUN 3
MISCELLANEOUS EXHAUST

$$V_{M_{STD}} = 17.71\ (60.846)\left(\frac{22.15 + 0.86/13.6}{532}\right) = 45 \text{ DSCF}$$

$$V_{W_{STD}} = 0.0474\ (11.1) = 0.526 \text{ SCF}$$

$$B_{WO} = 0.526/45.526 = 1.2\ \%$$

$$M.W. = (29.036)(0.988) + 18(0.012) = 28.90$$

$$V_{S_{AVE}} = 85.48(0.79)(0.890)\left(\frac{522.5}{28.90\ (22.15)}\right)^{1/2} = 54.3 \text{ fps}$$

$$I = \frac{1032\ (522.5)(45)}{60(98)(0.035)(0.988)(54.3)(22.15)} = 99.2\ \%$$

$$Q_{AVE} = 1062.83\ (54.3)(0.988)(7.6)\left(\frac{22.15}{522.5}\right) = 18371 \text{ DSCFM}$$

$$C_S' = 0.0154\left(\frac{25.6 + 178.0}{45}\right) = 0.07 \text{ gr./DSCF}$$

$$G = 0.000143\ (60)(18371)(0.07) = 11.0 \text{ lb / HR.}$$

PARTICULATES SAMPLING AND ANALYSIS DATA

Plant Name and Location SILBRICO - NO AGUA

Run No. 3 Date 2/6/80 Time 1600 Ambient Temp. °F 45

Bar. Press., in. Hg. 22.15 Stack Location MISC. EXHAUST

Stack Diameter, in. 35 x 30 Stack Pressure, in Hg 22.15

Plant Operator C. JUNKER P_s/P_m 1.00

Processing Rate 25 T/HR

Filter Assembly MISCO Filter No. 9

Silica Gel No. – Acetone Jar No. 7 Acetone Bkr No. 7

Probe Tip Diameter, in. 3/16 Assumed Moisture, % 1

Probe Length, Ft. 7½ Cp 2.79 Δ H@ 1.65

Calculator Setting ΔP=1 ΔH=1.08

Orsat Analysis Data

CO_2	SEE RUN #1		
$CO_2 + O_2$			
$CO_2 + O_2 + CO$			

Leak Test

Initial 0.003 cfm @ 3" Hg

Final 0.004 cfm @ 4" Hg

Moisture Content

Impinger #1 98

Impinger #2 103

Impinger #3

Total initial H_2O 200

Net Impinger H_2O 1

Net H_2O in Silica Gel 10.1

Total H_2O Collected 11.1

PARTICULATES SAMPLING DATA

Plant Name and Location Silbrico - Misc. Run No. 3

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	206.100	0.62	0.67	0.67	71	75	<.5	150	40	65
2	2	207.23	0.69	0.75	0.75	71	75	<.5	150	40	65
3	4	208.40	0.70	0.76	0.76	71	75	<.5	150	40	66
4	6	209.59	0.70	0.76	0.76	72	74	<.5	150	40	66
5	8	210.77	0.70	0.76	0.76	72	74	<.5	150	40	66
6	10	211.96	0.66	0.72	0.72	72	74	<.5	150	40	66
7	12	213.13	0.66	0.72	0.72	73	74	<.5	150	40	66
●	14	214.264									
1	0	214.264	0.60	0.65	0.65	71	72	<.5	150	40	65
2	2	215.37	0.71	0.77	0.77	71	72	<.5	150	40	65
3	4	216.55	0.71	0.77	0.77	71	72	<.5	150	40	65
4	6	217.73	0.71	0.77	0.77	71	72	<.5	150	40	65
5	8	218.91	0.71	0.77	0.77	71	72	<.5	155	40	65
6	10	220.11	0.64	0.70	0.70	71	72	<.5	155	40	65
7	12	221.23	0.67	0.73	0.73	72	72	<.5	155	40	65
●	14	222.375									
1	0	222.375	0.62	0.67	0.67	70	71	<.5	155	40	64
2	2	223.48	0.74	0.80	0.80	70	71	<.5	155	40	64
3	4	224.68	0.76	0.82	0.82	70	70	<.5	155	40	64
4	6	225.81	0.77	0.83	0.83	70	70	<.5	155	40	63
5	8	227.24	0.77	0.83	0.83	71	70	<.5	155	40	62

PARTICULATES SAMPLING DATA

Plant Name and Location SILBRICO - NO AGUA - MISC. Run No. 3

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
6	10	228.33	0.79	0.86	0.86	71	71	<.5	155	40	63
7	12	229.57	0.79	0.86	0.86	71	71	<.5	155	40	63
	14	230.81									
1	0	230.81	0.68	0.74	0.74	69	70	<.5	155	40	62
2	2	231.98	0.83	0.90	0.90	69	70	<.5	155	40	62
3	4	233.22	0.83	0.90	0.90	70	70	<.5	155	40	62
4	6	234.49	0.84	0.91	0.91	70	70	<.5	155	40	62
5	8	235.77	0.87	0.94	0.94	70	70	<.5	155	40	62
6	10	237.05	0.90	0.97	0.97	71	70	<.5	155	40	62
7	12	238.36	0.97	1.05	1.05	71	70	<.5	155	40	62
	14	239.705									
1	0	239.705	0.74	0.80	0.80	68	69	<.5	155	40	62
2	2	240.91	0.91	0.99	0.99	69	69	<.5	150	40	62
3	4	242.24	0.92	1.0	1.0	69	69	<.5	150	40	61
4	6	243.57	0.97	1.05	1.05	70	69	<.5	150	40	61
5	8	244.92	0.97	1.05	1.05	70	69	<.5	150	40	61
6	10	246.28	1.05	1.15	1.15	71	69	0.5	150	40	61
7	12	247.70	0.93	1.00	1.00	71	69	<0.5	150	40	61
	14	249.04									

PARTICULATES SAMPLING DATA

Plant Name and Location SILBRICO- NO AGUA - MISC. Run No. 3

Point	Time	Gas Meter Rdg. Ft^3	ΔP Pitot Rdg. "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Vacuum "Hg. gauge	Hot Box Temp. °F	Impinger Temp. °F	Stack Temp. °F
1	0	249.04	0.69	0.75	0.75	68	68	<.5	150	40	60
2	2	250.22	0.81	0.88	0.88	68	68	<.5	150	40	60
3	4	251.47	0.88	0.95	0.95	68	68	<.5	150	40	60
4	6	252.77	0.92	1.0	1.0	68	68	<.5	150	40	60
5	8	254.10	0.97	1.05	1.05	68	67	<.5	150	40	60
6	10	255.46	0.98	1.06	1.06	68	68	<.5	150	40	60
7	12	256.83	0.95	1.03	1.03	69	67	<.5	150	40	60
	14	258.17									
1	0	258.17	0.62	0.67	0.67	67	66	<.5	150	40	60
2	2	259.29	0.74	0.80	0.80	68	67	<.5	150	40	60
3	4	—	0.81	0.88	0.88	67	66	<.5	150	40	60
4	6	261.73	0.88	0.95	0.95	67	67	<.5	150	40	60
5	8	263.10	0.91	0.99	0.99	68	67	<.5	150	40	60
6	10	264.33	0.90	0.99	0.99	68	66	<.5	150	40	60
7	12	265.65	0.88	0.95	0.95	69	66	<.5	160	40	60
	14	266.946									
Ave:		60.846	$\sqrt{\Delta P}$: 0.896	0.86	0.86	70	70	<.5	150	40	62.5
			ΔP: 0.793		Corr	73.5					
						Ave. = 72					

ACETONE WASH, SILICA GEL AND FILTER WEIGHT RECORDS

FACILITY Silbrico Corp.

TESTING DATES 2/5, 2/6 1980

DATE OF TARE WEIGHING 11/20/79 WEIGHED BY G Kramer

DATE OF FINAL WEIGHING 2/8/80 WEIGHED BY G Kramer

FILTER NO.	TARE WEIGHT, GM.	FINAL WEIGHT, GM.	PARTICULATE WT, GM.
4	0.5814	—	
6	0.5937	0.6991	105.4 mg
7	0.5744	0.6398	65.4 mg
8	—	—	
9	0.5987	0.6243	25.6 mg
10	0.5945	0.6715	77.0 mg
11	0.5894	—	
12	0.5757	0.6030	27.3 mg
13	0.5802	0.6028	22.6 mg
1	65.3290	65.7967	467.7 mg
2	64.6698	65.0807	410.9 mg
4	65.2209	65.5366	315.7 mg
5	64.0698	64.2614	191.6 mg
6	63.8137	64.0008	187.1 mg
7	64.3997	64.5777	178.0 mg

APPENDIX 2

Equipment Calibration Data
Resumes of Test Personnel

DRY METER AND ORIFICE CALIBRATION DATA

Date 1/30/80 Location EIA WAREHOUSE Barometric Pressure, P_b 22.86 in Hg

Control Module Serial No. 7249 Dry Gas Meter No. 83

Orifice Setting ΔH	Metered Gas Volume, Ft^3		Meter Temperature, ^oF		Metering Time Minutes t	Accuracy Ratio G *	Orifice Coefficient $\Delta H_@$ *
	Wet Test V_w	Dry V_d	Wet Test T_w	Dry(ave) T_d			
0.50	5.000	5.213	72	94	10.612	0.997	1.60
1.00	5.000	5.115	72	87	7.59	1.002	1.65
1.50	10.000	10.331	72	90	12.74	0.996	1.737
2.00	10.000	10.462	72	97	11.250	0.995	1.78

$$* \; G = \frac{V_w \, P_b \, (T_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(T_w + 460)}$$

$$H_@ = \frac{0.0317 \, \Delta H}{P_b (T_d + 460)} \left(\frac{(T_w + 460)t}{V_w} \right)^2$$

G = ratio of accuracy of wet test meter to dry test meter

$\Delta H_@$ = orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches Hg

kramer, callahan & associates

PITOT TUBE CALIBRATION SHEET

Pitot Tube No. 1 Pitot Length 7½ Calibration Date 2/26/79 *

Wind Tunnel Location E/A WAREHOUSE Calibrated By G. Kramer

Nozzle Size: 1/4"

P_L	P_S	C_P
0.48	0.77	0.78
0.615	1.05	0.76
0.69	1.15	0.77
0.50	0.80	0.78
0.285	0.475	0.77
0.225	0.36	0.78
0.22	0.35	0.78
	AVE:	0.77

Nozzle Size: 3/8"

P_L	P_S	C_P
0.225	0.375	0.77
0.23	0.39	0.76
0.375	0.605	0.78
0.45	0.725	0.78
0.515	0.885	0.76
0.58	1.00	0.75
0.56	0.96	0.76
	AVE =	0.77

Nozzle Size: 3/16"

P_L	P_S	C_P
0.235	0.385	0.77
0.555	0.915	0.77
0.385	0.600	0.79
0.91	1.45	0.78
0.46	0.71	0.80

Nozzle Size: 3/16"

P_L	P_S	C_P
0.300	048	0.78
1.13	1.70	0.81
	AVE:	0.79

Nomenclature: P_L = Velocity pressure (inches water) measured with Standard Pitot
P_S = Velocity pressure (inches water) measured with S Pitot .
C_p = S pitot correction factor = $0.99(P_L/P_S)^{\frac{1}{2}}$

* SEE CALIBRATION CHECK ON FOLLOWING PAGE.

PITOT TUBE CALIBRATION SHEET

Pitot Tube No. 1 Pitot Length 7½ Calibration Date 9/18/79

Wind Tunnel Location UNM. Calibrated By G.Kramer

Nozzle Size: 3/16"

P_L	P_S	C_P
0.29	0.44	0.804
0.43	0.66	0.799
0.62	0.98	0.787
0.87	1.34	0.798
1.97	3.05	0.796

AVE = 0.797

Nozzle Size:

P_L	P_S	C_P

Nozzle Size:

P_L	P_S	C_P

Nozzle Size:

P_L	P_S	C_P

Nomenclature: P_L = Velocity pressure (inches water) measured with Standard Pitot

P_S = Velocity pressure (inches water) measured with S Pitot .

C_P = S pitot correction factor = $0.99(P_L/P_S)^{1/2}$

TESTING APPARATUS CALIBRATION DATA

Temperature Indicators

Hg Thermometer Bath Temp. °F	Gas Meter Inlet, °F	Gas Meter Outlet, °F	Impinger, °F
76.6	73	76.5	76
100	95.5	100.5	100
120.9	115	121.5	121
62.6	64	63	63
41.9	42	42	42

Thermocouple

Hg. Thermom.	Thermocouple
97	95
106	105
131	130
153	150
168	165
181	180
195	195

GARY R. KRAMER

Education: New Mexico State University
Sc.D., Civil Engineering, 1969
M.S., Civil Engineering, 1966
B.S., Chemical Engineering, 1965

Experience: 11 years--Research, Teaching, Consulting, Administration

Consulting:

(a) 1973 - present; Owner, Kramer, Callahan & Associates

(b) Prior to 1973: treatability and design studies for sulfur mining and petrochemical waste water treatment facilities (Houston area); radioactive waste treatment (Hanford, Washington).

Research and Teaching:

(a) Visiting Lecturer, Dept. of Mechanical Engineering, UNM (1974-present), teaching Air Pollution Control for engineering and non-engineering students.

(b) Manager of Environics Division, CERF, UNM (1972-73), directed 12 professional and technical staff members in air and water pollution research for U.S. Air Force. Studies included: sublethal toxicity monitoring, treatment of photographic, washrack, and electroplating waste water, pyrolysis of pesticides and film.

(c) Assistant Professor, Department of Civil Engineering, Texas A&M University (1969-72). Research in mathemathical modeling and reaeration in the Houston Ship Channel, automatic control of waste water treatment processes, and development of technique for measuring oxygen uptake of benthic deposits. Industrial waste survey. Teaching: graduate and under-graduate courses in Environmental Engineering (water and waste water treatment unit processes, water resources development, engineering economics, public health engineering).

Specialization: Industrial waste water treatment, stack emissions testing, air pollution control systems, environmental engineering R & D, sewage treatment system design.

License: Registered Professional Engineer--Texas, #33386-S, 1972; New Mexico, #5515, 1974.

Patent: Electrolytic Biochemical Oxygem Demand Apparatus, 1974.

WILLIAM T. RISTAU

Education: University of New Mexico
Ph.D., Analytical Chemistry, 1971
University of Houston
M.S., Physical Chemistry, 1967
B.S., Chemistry, 1963

Experience: Ten years--Research, Teaching
Consulting: Kramer, Callahan & Associates, 1973 to present.
Research Scientist and Research Associate Chemist, CERF, University of New Mexico, 1971-73. Principal investigator of air pollution studies in smoke abatement, incineration, and pyrolysis.
Technical Staff, Sandia Laboratories, 1968-71. Principal investigator of utilization of high-temperature polymers in weapons systems, including analytical techniques and processing problems.
Teaching Assistant, Chemistry Department, Florida State University, University of Houston.

Specialization: High-temperature polymers, adhesion, gas-liquid chromatography, laser-induced degradations, pyrolysis, air pollution testing and analyses.

License: Certified Instrument Flight Instructor, No. 1785543, 1965.

Affiliations: ACS, New Mexico Aviation Association, Alpha Chi Sigma.