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.

MIDWEST RESEARCH INSTITUTE

Section 1.8

3

Reference 13

REPORT

STATIONARY SOURCE TESTING OF BAGASSE FIRED BOILERS AT THE HAWAIIAN COMMERCIAL AND SUGAR COMPANY PUUNENE, MAUI, HAWAII

FINAL REPORT

EPA Contract No. 68-02-1403
MRI Project No. 3927-C(12)

Feb 1976

For

Environmental Protection Agency
Research Triangle Park
North Carolina 27711

Attn: Mr. Tom Lahre

MIDWEST RESEARCH INSTITUTE 425 VOLKER BOULEVARD, KANSAS CITY, MISSOURI 64110 • 816 561-0202

STATIONARY SOURCE TESTING OF BAGASSE FIRED BOILERS
AT
THE HAWAIIAN COMMERCIAL AND SUGAR COMPANY
PUUNENE, MAUI, HAWAII

By

Emile Baladi
Midwest Research Institute

FINAL REPORT

EPA Contract No. 68-02-1403
MRI Project No. 3927-C(12)

For

Environmental Protection Agency
Research Triangle Park
North Carolina 27711

Attn: Mr. Tom Lahre

PREFACE

The work reported herein was conducted by Midwest Research Institute (MRI) under Environmental Protection Agency (EPA) Contract No. 68-02-1403, Task 12.

The project was under the technical supervision of Mr. Paul C. Constant, Jr., Head, Environmental Measurements Section of the Physical Sciences Division. Mr. Emile Baladi served as project leader and was assisted by Messrs. George Cobb, Bruce Daros and Tom Merrifield. Analysis of the samples was done under the supervision of Dr. James Spigarelli.

Approved for:

MIDWEST RESEARCH INSTITUTE

Paul C. Constant, Jr.
Program Manager

February 19, 1976

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

The purpose of this project is to quantify emissions from an existing sugar cane processing operation as part of a program for the development and support of emission factors for AP-42, Compilation of Air Pollutant Emission Factors.

The testing was performed by Midwest Research Institute (MRI) during the period of July 22 to July 29, 1975, at the Hawaiian Commercial and Sugar Company, Puunene, Maui, Hawaii. The plant processes sugarcane. The operation of the process is continuous. Bagasse (a fibrous residue remaining after sugar extraction) or oil is burned in three boilers (Nos. 1, 2 and 3) to energize the process and produce electricity. Part of the electricity produced is exported to the local electric company.

Samples were drawn from two locations. Location OA is at the stack that is fed by two boilers (Nos. 1 and 2), each of which is equipped with Western Precipitator cyclones for emission control (see Figure 1). Location OB is at the stack of a new boiler (No. 3) which is equipped with a Zurn, two-stage cyclonic control (see Figure 2). All samples were taken from the cyclone outlets only.

In summary, MRI tests conducted for this project consisted of:

1. Two mass particulate-polycyclic organic matter (POM) runs at Location OA.

2. Two mass particulate-POM runs at Location OB.

3. Three nitrogen oxides runs at Location OA.

4. Three nitrogen oxides runs at Location OB.

5. One particulate sizing run at Location OA.

6. One particulate sizing run at Location OB.

A parallel test for particulate was conducted by the plant personnel on Location OB using a Joy train. The collecting media of the train consisted of an in-stack, alundum thimble. The results of this test are not included in this report.

Section II of this report is a summary and discussion of results. Section III is a presentation of the process description and operation. Section IV presents the location of sampling points. Section V presents the sampling and analytical procedures. The appendices comprise raw field data, as well as results of the analysis performed by MRI.

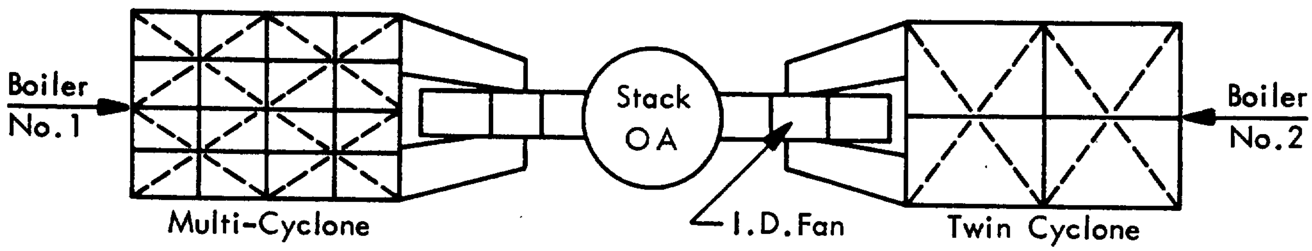


Figure 1 - Schematic Illustration of Boilers Nos. 1 and 2 Outlets

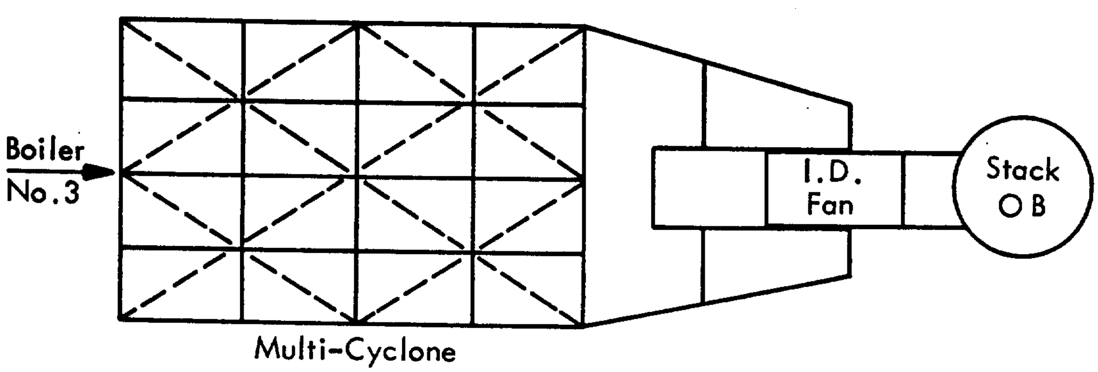


Figure 2 - Schematic Illustration of Boiler No. 3 Outlet

II. SUMMARY AND DISCUSSION OF PRINCIPAL RESULTS

No abnormal operating conditions occurred during any of the sampling runs. However, on July 23, 1975, the plant was operating at about 50% capacity and on July 28, 1975, the plant was down for maintenance. No sampling was performed during these 2 days.

Appendix A contains the analytical data for the samples. The field log is contained in Appendix B.

A. Particulate-POM Tests

Two particulate-POM runs were accomplished at each sampling location (Figures 3 and 4). Tables 1 and 2 present a summary of the results for these runs in metric and English units, respectively. The total particulate data include the catches on the probe, cyclone, filter, impingers and condenser trap (see Table A-1, Appendix A). Since some of the gravimetric analysis procedures (i.e., drying and desiccating) would decompose some of the POM compounds; inorganic particulate caught in the Tenax plug were not gravimetrically analyzed and therefore, are not included in the total particulate data (Tables 1 and 2). Table 3 presents the POM results in detail. The Tenax plug of Run No. 1-OA was discarded due to contamination that occurred when the plug container broke in the lab before the analysis was undertaken.

A computer printout of the particulate sampling parameters and loading is contained in Appendix C. Appendix D contains sample calculations of particulate emissions. The particulate field data are contained in Appendix E.

An example calculation of the emission factor as kilogram per metric-ton feed (lb/ton-feed) based on a calculated process feed rate is given in Appendix F.

B. NO_x Tests

Three NO_x runs were accomplished at each sampling location (Figures 3 and 4). Tables 4 and 5 present a summary of the results for these tests in metric and English units, respectively. The average NO_x concentration of Runs Nos. 1, 2 and 3 is 18.822×10^{-5} kg/dscm (1.175×10^{-5} lb/dscf) or 0.18822 μg/ml (98.8 ppm) at Location OA and 8.036×10^{-5} kg/dscm (0.502×10^{-5} lb/dscf) or 0.08036 μg/ml (42.2 ppm) at Location OB.

Appendix G contains sample calculations. A computer printout of the calculated results is contained in Appendix H. Appendix I contains the NO_x field data.

C. Particulate Sizing Tests

One particulate sizing run was accomplished at each sampling location (Figures 3 and 4), using the Andersen Sampler (Mark III), manufactured by Andersen 2000, Inc. Table 6 presents a summary of the sampling parameters and grain loading data at the sampling point. Methods 3 and 4 of the Federal Register were followed in the determination of the major components of the flue gas (CO_2, O_2, CO, N_2, H_2O) for each run.

The difference in grain loading between the Andersen runs (Table 6) and Method 5 runs (Table 2) can be attributed mainly to the following:

1. The grain loading of an Andersen run represents only one sampling point; while that of a Method 5 train run represents multiple points: 44 sampling points (Location OA), and 40 sampling points (Location OB).

2. The Andersen runs were performed on July 29, 1975; while Method 5 runs were performed on July 24 and 25, 1975.

Summaries of the analyses for Runs Nos. 1-OA and 1-OB are presented in Tables 7 and 8, respectively. The particle diameter (in microns) is based on unit density particles (1 cc = 1 g). Figure 5 illustrates graphically the particle diameter versus the percent weight less/greater than stated size for these runs. The differential mass loading is presented in Table 9 in metric and English units. Figures 6 through 9 illustrate graphically the stage loadings versus the geometrical mean of the particulate diameter in metric and English units for Runs Nos. 1-OA and 1-OB, respectively. Since the percent loading on the stages represents mass, the geometrical mean of Dp was used to plot the abscissa of these figures.

Appendix J contains example calculations; Appendix K contains the field data.

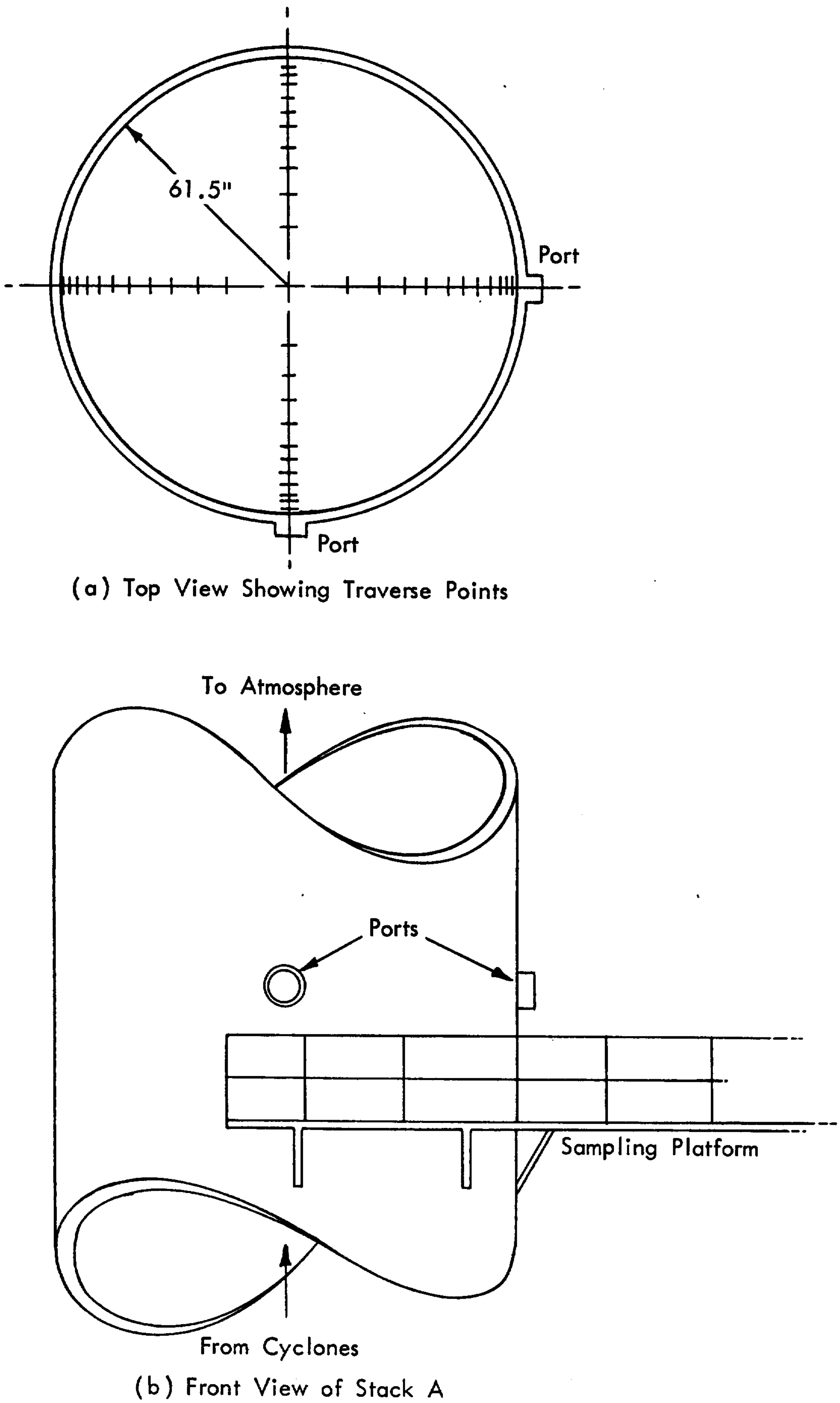
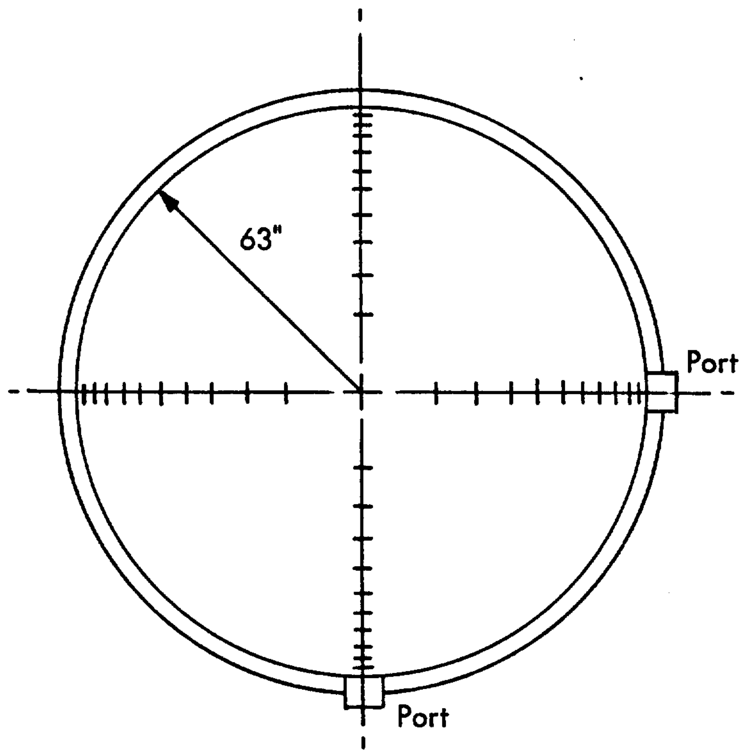
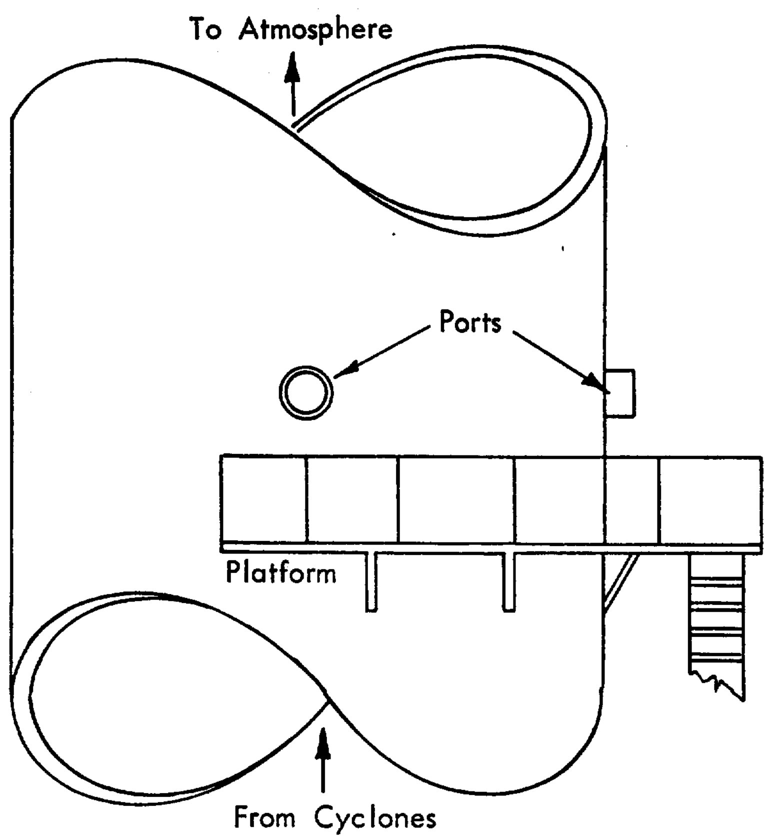


Figure 3 - Schematic Illustration of Sampling Location OA



(a) Top View Showing Traverse Points



(b) Front View of Stack B

Figure 4 - Schematic Illustration of Sampling Location OB

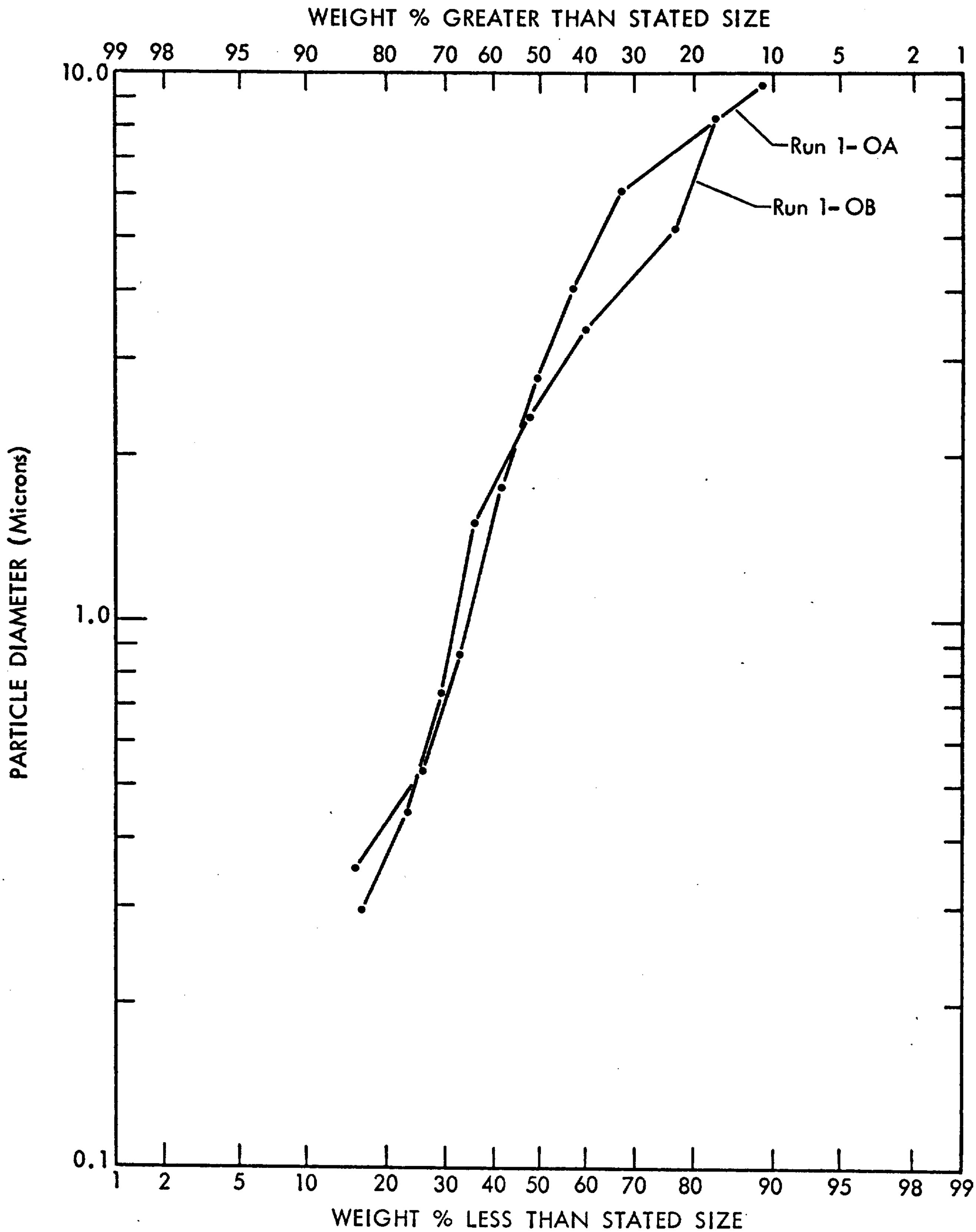


Figure 5 - Particle Diameter Versus Percent Less/Greater Than Stated Size for Andersen Tests

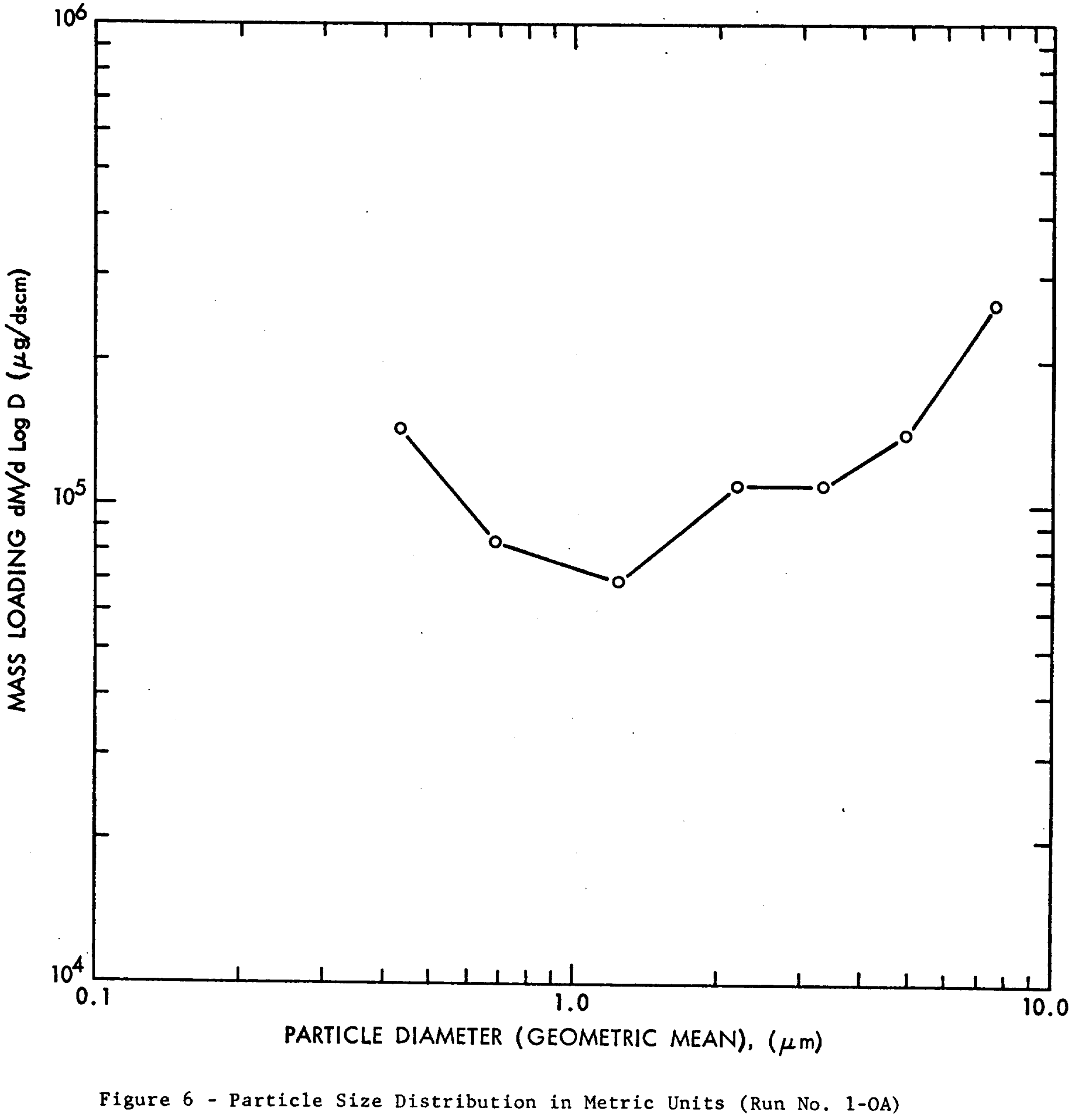


Figure 6 - Particle Size Distribution in Metric Units (Run No. 1-0A)

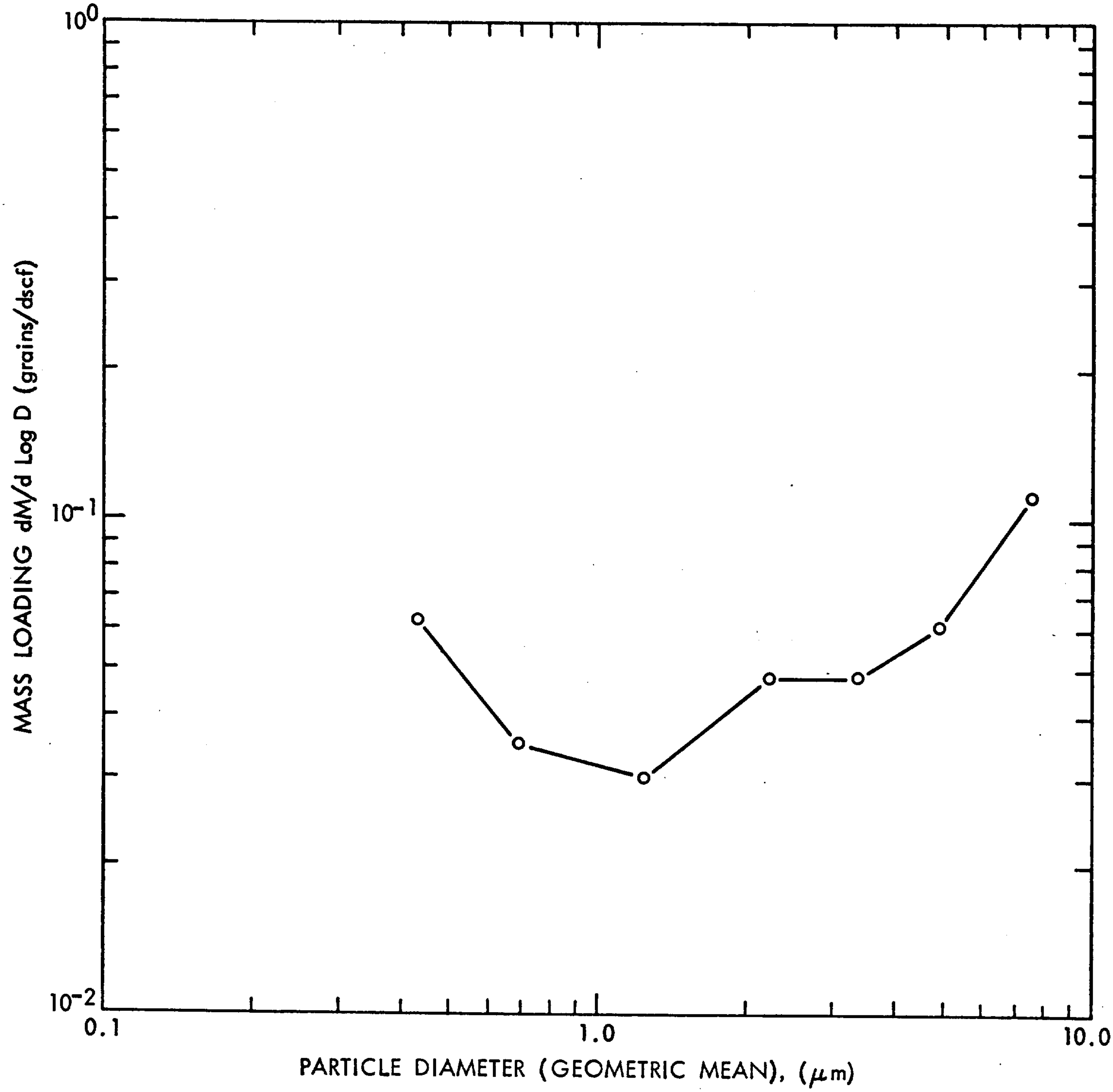


Figure 7 - Particle Size Distribution in English Units (Run No. 1-OA)

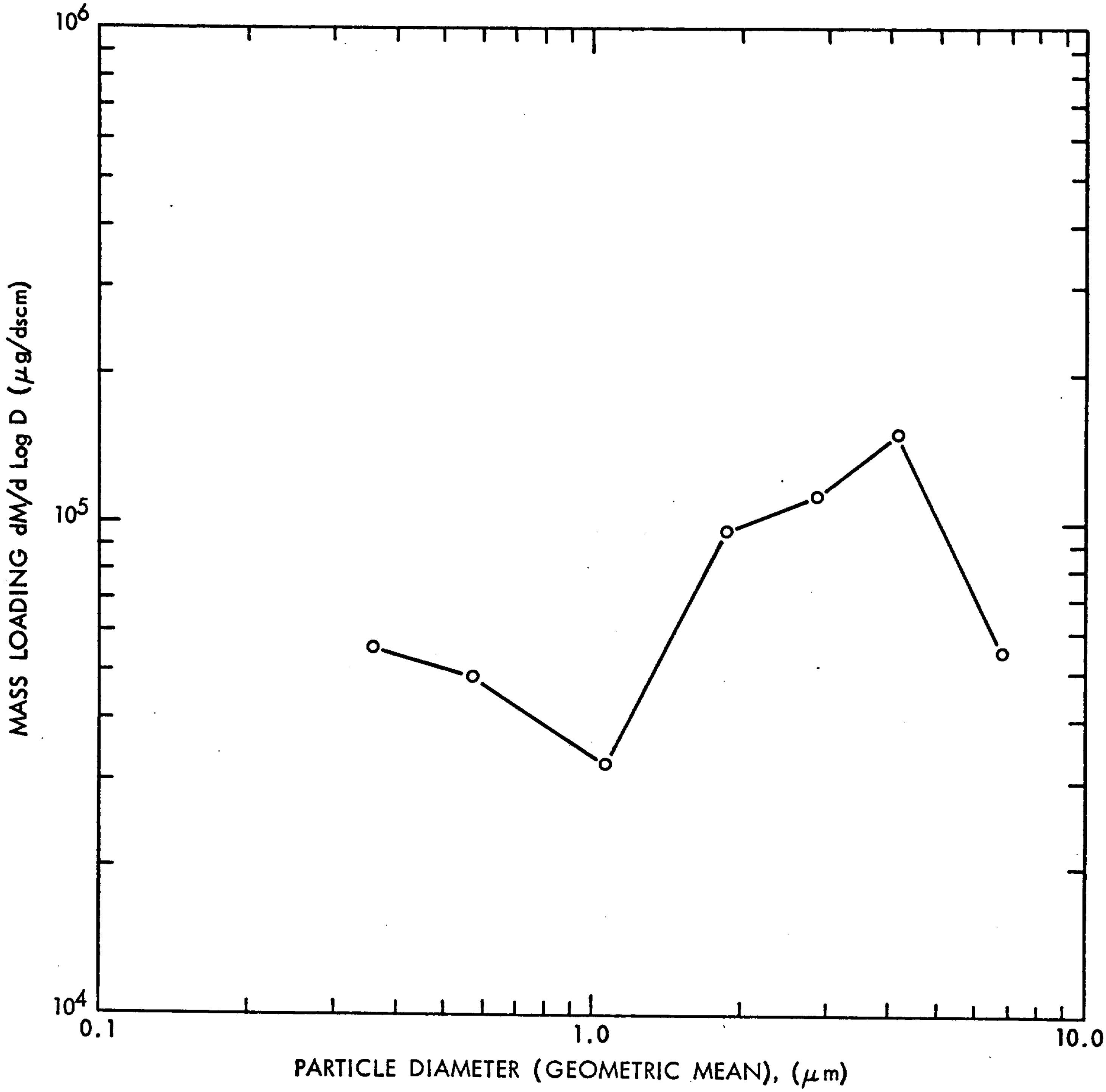


Figure 8 - Particle Size Distribution in Metric Units (Run No. 1-OB)

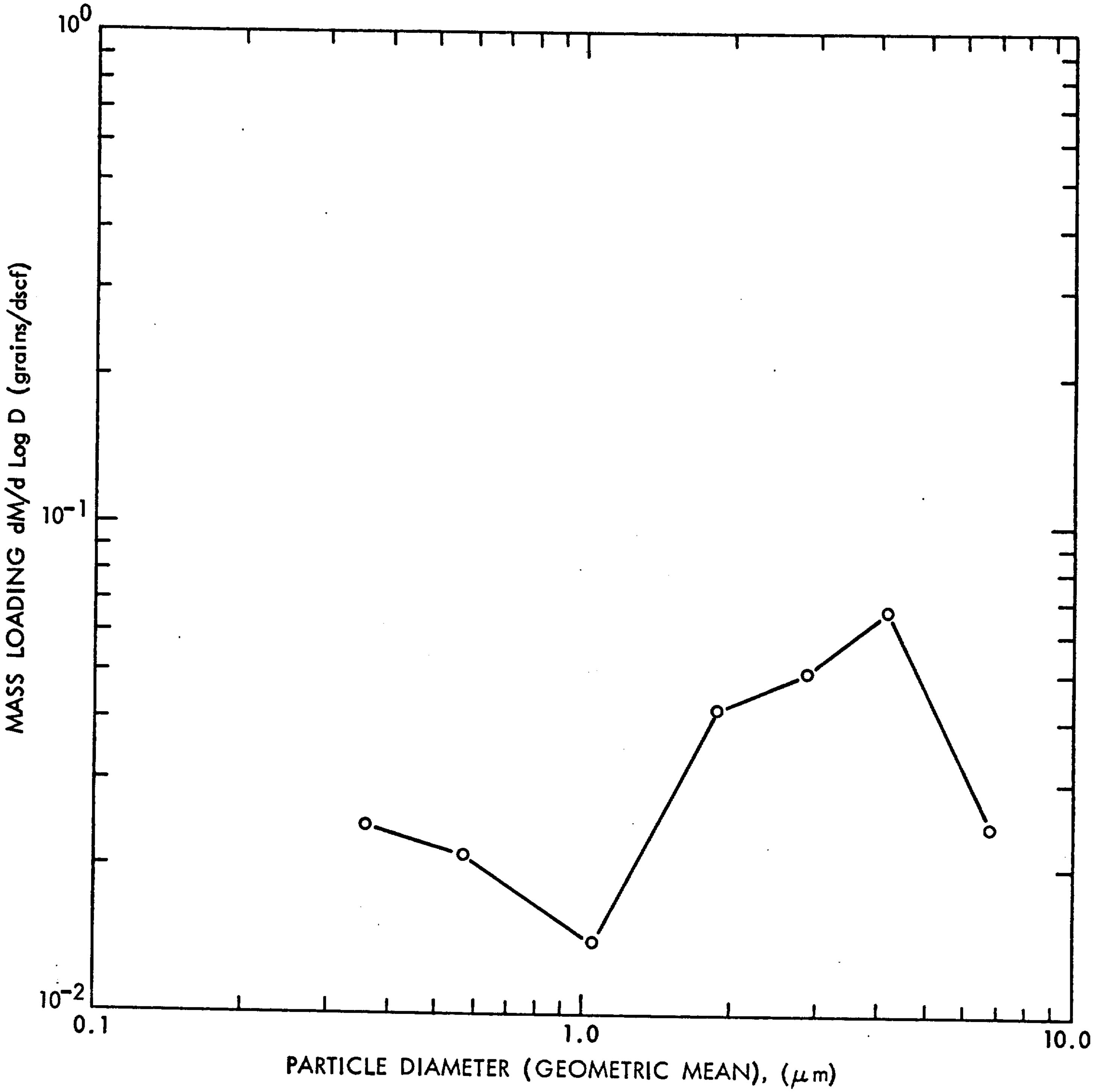


Figure 9 - Particle Size Distribution in English Units (Run No. 1-0B)

TABLE 1

PARTICULATE AND POM RESULTS IN METRIC UNITS

Run Number	1		2		Averages	
Date	7-24-75		7-25-75			
Sampling Location	OA	OB	OA	OB	OA	OB
Volume of Gas Sampled, dscm[a]	2.734	1.788	1.228	1.785	1.981	1.787
Percent Moisture by Volume	16.2	25.0	17.0	21.1	16.6	23.05
Average Stack Gas Temperature, °C	189.1	180.2	187.1	189.8	188.1	185.0
Stack Gas Volumetric Flow Rate, dscmm	3,246.9	2,408.7	3,136.5	2,599.1	3,191.7	2,503.9
Stack Gas Volumetric Flow Rate, acmm	6,060.4	4,922.7	5,886.8	5,157.7	5,973.6	5,040.2
Percent IsoKinetic	102.6	104.4	107.4	99.1	105.0	101.7
Bagasse Feed Rate, M-Ton/hr[a]	30.6	41.3	31.6	40.5	31.1	40.9
Heat Input, 10^9 Joule/hr[b]	322.615	435.759	324.324	416.462	323.469	426.111
Particulate-Probe and Filter						
mg[c]	4,754.9	2,474.1	2,229.4	1,826.5	3,492.1	2,150.3
mg/dscm[c]	1,735.75	1,380.97	1,811.80	1,021.20	1,773.77	1,201.09
mg/acm[c]	929.94	675.70	965.33	514.62	947.63	595.16
kg/hr[c]	338.09	199.54	340.91	159.23	339.50	179.39
kg/M-Ton Feed[c]	11.05	4.83	10.79	3.93	10.92	4.38
kg/10^3 Joule-Heat Input	1.05	0.46	1.05	0.38	1.05	0.42
Particulate-Total						
mg	4,796.3	2,512.6	2,262.8	1,846.4	3,529.5	2,179.5
mg/dscm	1,750.86	1,402.46	1,838.93	1,032.34	1,794.89	1,217.4
mg/acm	938.04	686.22	979.79	520.23	958.91	603.23
kg/hr	341.0	202.6	346.0	161.0	343.5	181.8
kg/M-Ton Feed	11.14	4.90	10.95	3.97	11.05	4.43
kg/10^3 Joule-Heat Input	1.06	0.46	1.07	0.39	1.065	0.425
Percent Impinger Catch	0.86	1.53	1.48	1.08	1.17	1.31
POM-Total						
mg ($\times 10^{-3}$)	-	381.6	176.3	71.8	176.3	226.7
mg/dscm ($\times 10^{-3}$)	-	213.4	143.6	40.2	143.6	126.9
mg/acm ($\times 10^{-3}$)	-	104.4	76.5	20.2	76.5	62.3
kg/hr ($\times 10^{-3}$)	-	30.8	27.0	6.3	27.0	18.5
kg/M-Ton Feed ($\times 10^{-3}$)	-	0.74	0.85	0.15	0.85	0.44
kg/10^3 Joule-Heat Input ($\times 10^{-3}$)	-	0.07	0.08	0.01	0.08	0.04

a/ Metric tons per hour (2,205 lb = 1 MT). Dry standard cubic meter at 21.1°C and 760 mm.
b/ Grains per dscf.
c/ mg = milligrams
mg/dscm = milligrams per dry standard cubic meter
mg/acm = milligrams per actual cubic meter
kg/hr = kilograms per hour
kg/M-Ton Feed = kilograms per metric-ton feed

TABLE 2

PARTICULATE AND POM RESULTS IN ENGLISH UNITS

Run Number	1		2		Averages	
Date	7-24-75		7-25-75			
Sampling Location	OA	OB	OA	OB	OA	OB
Volume of Gas Sampled, dscf[a/]	96.54	63.14	43.36	63.03	69.95	63.09
Percent Moisture by Volume	16.2	25.0	17.0	21.1	16.6	23.1
Average Stack Gas Temperature, °F	372	356	369	374	370.5	365.0
Stack Gas Volumetric Flow Rate, dscfm	114,664	85,061	110,764	91,787	112,714	88,424
Stack Gas Volumetric Flow Rate, acfm	214,021	173,844	207,889	182,141	210,955	177,992.5
Percent IsoKinetic	102.6	104.4	107.4	99.1	105.0	101.7
Bagasse Feed Rate, Ton/hr	33.7	45.5	34.8	44.6	34.3	45.1
Heat Input, 10^6 Btu/hr	305.78	413.02	307.40	394.73	306.59	403.87
Particulate-Probe and Filter						
mg[b/]	4,754.9	2,474.1	2,229.4	1,826.5	3,492.1	2,150.3
gr/dscf[c/]	0.7585	0.6035	0.7917	0.4463	0.7751	0.5249
gr/acf[c/]	0.4064	0.2953	0.4218	0.2249	0.4141	0.2601
lb/hr[d/]	745.37	439.92	751.57	351.04	748.47	395.48
lb/Ton-Feed[d/]	22.12	9.67	21.60	7.87	21.86	8.77
lb/10^6 Btu-Heat Input	2.44	1.06	2.44	0.89	2.44	0.97
Particulate-Total						
mg	4,796.3	2,512.6	2,262.8	1,846.4	3,529.5	2,179.5
gr/dscf	0.7651	0.6129	0.8036	0.4511	0.7843	0.5320
gr/acf	0.4099	0.2999	0.4282	0.2273	0.4191	0.2636
lb/hr	751.86	446.77	762.82	354.87	757.34	400.82
lb/Ton-Feed	22.31	9.82	21.92	7.96	22.11	8.89
lb/10^6 Btu-Heat Input	2.46	1.08	2.48	0.90	2.47	0.99
Percent Impinger Catch	0.86	1.53	1.48	1.08	1.17	1.31
POM-Total						
mg (x 10^{-3})	-	381.6	176.3	71.8	176.3	226.7
gr/dscf (x 10^{-3})	-	0.09	0.06	0.02	0.06	0.05
gr/acf (x 10^{-3})	-	0.04	0.03	0.01	0.03	0.02
lb/hr (x 10^{-3})	-	65.6	56.9	15.7	56.9	40.6
lb/Ton-Feed (x 10^{-3})	-	1.44	1.63	0.35	1.63	0.89
lb/10^6Btu-Heat Input (x 10^{-3})	-	0.16	0.18	0.04	0.18	0.10

a/ Dry standard cubic ft at 70°F and 29.92 in Hg.
b/ milligrams
c/ gr/dscf = grains per dry standard cubic foot
gr/acf = grains per actual cubic foot
d/ Pounds per hour
Pounds per Ton-Feed

TABLE 3

POM ANALYSIS

Run No.		1				2					
Date		7-24-75				7-25-75				Blank	Minimum Detectable Limits
Sampling Location		OA		OB		OA		OB			
POM d/	Units	T.P. a/	P.C. a/	T.P. a/	P.C. a/	T.P. a/	P.C. a/	T.P. a/	P.C. a/		
A	µg e/	- b/	ND c/	ND c/	ND c/	ND c/	ND c/	ND c/	66.5	ND c/	1.0
B	µg	-	ND	ND	ND	ND	ND	ND	ND	ND	1.0
C	µg	-	1.9	ND	1.6	ND	2.3	0.1	ND	ND	0.1
D	µg	-	ND	ND	ND	ND	ND	ND	ND	ND	1.0
E	µg	-	ND	380.0	ND	174.0	ND	ND	ND	ND	-
F	µg	-	ND	ND	ND	ND	ND	5.2	ND	ND	-
Total	µg	-	1.9	380.0	1.6	174.0	2.3	5.3	66.5	ND	
Total POM	µg	b/		381.6		176.3		71.8		ND	
Concentration:	µg/dscm f/			213.4		143.6		40.2			
	µg/dscf f/			6.0		4.1		1.1			

a/ T.P. = Tenax Plug Analysis.
P.C. = Particulate Catch Analysis (probe, filter, dry catch, cyclone rinse and ether-chloroform extract of condenser catch).

b/ The Tenax Plug Container of Run 1-OA broke in the lab before assay.

c/ N.D. = No Detection

d/ A = 7,12-dimethylbenz[a]anthracene
B = benzo[a]pyrene
C = 3-methylcholanthrene
D = dibenz[a,h]anthracene
E = Unknown POM (retention time is similar to A)
F = Unknown POM (Retention time is similar to B)

e/ µg = micrograms

f/ µg/dscm = micrograms per dry standard cubic meter
µg/dscf = micrograms per dry standard cubic foot

TABLE 4

NITROGEN OXIDES RESULTS IN METRIC UNITS

Run Number	1		2		3			
Date	7-24-75		7-25-75		7-29-75		Averages	
Sampling Location	OA	OB	OA	OB	OA	OB	OA	OB
Volumes: Flask-Absorbing Soln., ml[a/]	2,040.00	2,037.00	1,997.00	2,014.00	2,034.00	2,005.00	2,022.00	2,018.67
Initial Absolute Flask Pressure, mm Hg	36.8	153.7	82.55	331.5	137.4	147.6	85.6	210.9
Initial Absolute Flask Temperature, °K[a/]	302.2	299.4	302.2	297.8	303.3	302.8	302.6	300.0
Final Absolute Flask Pressure, mm Hg	731.8	762.2	746.9	762.2	758.4	758.4	745.7	760.9
Final Absolute Flask Temperature, °K	295.5	297.8	296.1	298.9	297.8	297.8	296.5	298.2
Sample Volume, dsml[a/]	1,860.61	1,615.24	1,722.98	1,121.42	1,650.20	1,599.96	1,744.60	1,445.54
NO_x as NO_2								
Mass, μg	329.8	88.3	281.3	160.0	376.3	72.5	329.1	106.9
Concentrations: kg/dscm[b/] ($\times 10^{-5}$)	17.604	5.430	16.211	14.176	22.650	4.501	18.822	8.036
μg/ml[b/]	0.17604	0.05430	0.16211	0.14176	0.22650	0.04501	0.18822	0.08036
kg/hr[b/]	34.2951	7.8475	30.5075	22.10690	43.3752	6.7620	36.0593	12.2388
kg/M-ton feed	1.12	0.19	0.97	0.55	1.39	0.16	1.16	0.30

a/ ml = milliliters
°K = degrees Kelvin
dsml = dry standard milliliters

b/ kg/dscm = kilograms per dry standard cubic meter
μg/ml = micrograms per milliliter
kg/hr = kilograms per hour

TABLE 5

NITROGEN OXIDES RESULTS IN ENGLISH UNITS

Run Number	1		2		3		Averages	
Date	7-24-75		7-25-75		7-29-75			
Sampling Location	OA	OB	OA	OB	OA	OB	OA	OB
Volumes: Flask-Absorbing Soln., ml[a]	2,040.00	2,037.00	1,992.00	2,014.00	2,034.00	2,005.00	2,022.00	2,018.67
Initial Absolute Flask Pressure, in. Hg	1.45	6.05	3.25	13.05	5.41	5.81	3.37	8.30
Initial Absolute Flask Temperature, °R[a]	544.0	539.0	544.0	536.0	546.0	545.0	544.7	540.0
Final Absolute Flask Pressure in. Hg	28.81	30.01	29.21	30.01	29.86	29.86	29.29	29.96
Final Absolute Flask Temperature, °R	532.0	536.0	533.0	538.0	536.0	536.0	533.7	536.7
Sample Volume, dsml[a]	1,860.61	1,615.24	1,722.98	1,121.42	1,650.20	1,599.96	1,744.60	1,445.54
NO_x as NO_2								
Mass, μg[b]	329.8	88.3	281.3	160.0	376.3	72.5	329.1	106.9
Concentrations: lb/dscf[b] (x 10^{-5})	1.099	0.339	1.012	0.885	1.414	0.281	1.175	0.502
ppm[b]	92.4	28.5	85.1	74.4	118.9	23.6	98.8	42.2
lb/hr[b]	75.6077	17.3008	67.2575	48.7374	95.6259	14.9076	79.4970	26.9819
lb/ton feed	2.24	0.38	1.93	1.09	2.79	0.33	2.32	0.60

a/ ml = milliliters
°R = degrees Rankine
dsml = dry standard milliliters

b/ μg = micrograms
lb/dscf = pounds per dry standard cubic foot
ppm = parts per million
lb/hr = pounds per hour

TABLE 6

SUMMARY OF ANDERSEN SAMPLING PARAMETERS

	Run 1-OA	Run 1-OB
Date	7-29-75	7-29-75
Start Time	10:50	10:40
Duration, min	5	5
Sampling Location	OA	OB
Stack Gas Composition		
CO_2	9.2	9.9
O_2	10.2	9.5
CO	0.0	0.0
N_2	80.6	80.6
% H_2O	17	22
Molecular Weight		
Dry	29.88	29.95
Wet	27.86	27.32
Stack Temp. (°F)[a]	370	365
Barometric Pressure, in. Hg[a]	30.01	30.01
Static Pressure, in. H_2O[a]	0.0	0.0
Sample Volume, cf[a]	2.81	3.63
Sample Rate, acfm[a]	1.033	1.398
Sample Volume, dscf[a]	2.75	3.51
Nozzle diameter, in.[a]	0.25	0.25
Grain Loading		
gr/dscf[a]	0.109	0.069
mg/dscm[a]	248.73	157.43

a/ °F = degrees Fahrenheit
in. Hg = inches of mercury
in. H_2O = inches of water
cf = cubic feet, meter condition
acfm = actual cubic feet per minute
dscf = dry standard cubic feet
in. = inches
gr/dscf = grains per dry standard cubic foot
mg/dscm = milligrams per dry standard cubic meter

TABLE 7

ANDERSEN ANALYSIS SUMMARY--RUN 1-OA

DATE 072975 DENSITY= 1.000 IMP.EFF.C= .140 SAMPLING RATE = 1.03350 CFM FILTER WT= .00297 GM TOTAL WT= .01941 GM

STAGE/ PLATE	SAMPLE PLATE + PAN	PAN FOR SAMPLE	TARE PLATE + PAN	PAN FOR TARE	TARE OF PLATE	SAMPLE WEIGHT (GM)	-WITHOUT FILTER- WEIGHT PERCENT	CUM. WEIGHT PERCENT	--WITH FILTER-- WEIGHT PERCENT	CUM. WEIGHT PERCENT	JET VEL. (CM/S)	PARTIC. DIAM. (MICR)
/0	.18590	0.00000	.18590	0.00000	.18590	0.00000	0.00	0.00	0.00	0.00		
0/1	.19532	0.00000	.19314	0.00000	.19314	.00218	13.26	13.26	11.23	11.23	79.58	9.54
1/2	.18374	0.00000	.17950	0.00000	.17950	.00424	25.79	39.05	21.84	33.08	148.40	5.95
2/3	.19725	0.00000	.19540	0.00000	.19540	.00185	11.25	50.30	9.53	42.61	247.58	4.03
3/4	.17987	0.00000	.17842	0.00000	.17842	.00145	8.82	59.12	7.47	50.08	409.27	2.74
4/5	.19813	0.00000	.19644	0.00000	.19644	.00169	10.28	69.40	8.71	58.78	727.59	1.75
5/6	.18560	0.00000	.18417	0.00000	.18417	.00143	9.91	79.32	8.40	67.18	1760.60	.87
6/7	.20096	0.00000	.19961	0.00000	.19961	.00135	8.21	87.53	6.96	74.14	3208.69	.53
7/8	.18664	0.00000	.18459	0.00000	.18459	.00205	12.47	100.00	10.56	84.70	6417.38	.35

TABLE 8

ANDERSEN ANALYSIS SUMMARY--RUN 1-OB

DATE 072975 DENSITY= 1.000 IMP.EFF.C= .140 SAMPLING RATE = 1.39808 CFM FILTER WT= .00254 GM TOTAL WT= .01568 GM

							-WITHOUT FILTER-		--WITH FILTER--			
STAGE/ PLATE	SAMPLE PLATE + PAN	PAN FOR SAMPLE	TARE PLATE + PAN	PAN FOR TARE	TARE OF PLATE	SAMPLE WEIGHT (GM)	WEIGHT PERCENT	CUM. WEIGHT PERCENT	WEIGHT PERCENT	CUM. WEIGHT PERCENT	JET VEL. (CM/S)	PARTIC. DIAM. (MICR)
F/0	.18259	0.00000	.18259	0.00000	.18259	0.00000	0.00	0.00	0.00	0.00		
0/1	.20204	0.00000	.19947	0.00000	.19947	.00257	19.56	19.56	16.39	16.39	107.65	8.19
1/2	.17345	0.00000	.17232	0.00000	.17232	.00113	8.60	28.16	7.21	23.60	200.74	5.11
2/3	.19846	0.00000	.19586	0.00000	.19586	.00260	19.79	47.95	16.58	40.18	334.92	3.45
3/4	.18895	0.00000	.18704	0.00000	.18704	.00191	14.54	62.48	12.18	52.36	553.65	2.34
4/5	.19019	0.00000	.18834	0.00000	.18834	.00185	14.08	76.56	11.80	64.16	984.26	1.50
5/6	.17804	0.00000	.17704	0.00000	.17704	.00100	7.61	84.17	6.38	70.54	2381.67	.73
6/7	.20040	0.00000	.19933	0.00000	.19933	.00107	8.14	92.31	6.82	77.36	4340.60	.44
7/8	.18394	0.00000	.18293	0.00000	.18293	.00101	7.69	100.00	6.44	83.80	8681.19	.29

TABLE 9

DIFFERENTIAL STAGES LOADING IN METRIC AND ENGLISH UNITS

Stage/ Plate	Dp (μm)a/		Dp (geom. mean) (μm)a/		Loading (μg/dscm x 10^3)b/		Loading (gr/dscf x 10^{-2})c/		dM/d Log D (μg/dscm x 10^3)b/		dM/d Log D (gr/dscf x 10^{-2})c/	
	Run 1-0A	Run 1-0B	Run 1-0A	Run 1-0B	Run 1-0A	Run 1-0B	Run 1-0A	Run 1-0B	Run 1-0A	Run 1-0B	Run 1-0A	Run 1-0B
/0	-	-	-	-	-	-	-	-	-	-	-	-
0/1	9.54	8.19	-	-	27.941	25.790	1.221	1.127	-	-	-	-
1/2	5.95	5.11	7.53	6.47	54.325	11.350	2.374	0.496	264.959	55.403	11.374	2.421
2/3	4.03	3.45	4.90	4.20	23.707	26.110	1.036	1.141	140.102	153.046	6.122	6.688
3/4	2.74	2.34	3.32	2.84	18.581	19.176	0.812	0.838	110.895	113.734	4.846	4.970
4/5	1.75	1.50	2.19	1.87	21.648	18.581	0.946	0.812	111.179	96.212	4.858	4.204
5/6	0.87	0.73	1.23	1.05	20.892	10.046	0.913	0.439	68.833	32.120	3.008	1.403
6/7	0.53	0.44	0.68	0.57	17.300	10.732	0.756	0.469	80.374	48.811	3.512	2.133
7/8	0.35	0.29	0.43	0.36	26.270	10.137	1.148	0.443	145.776	55.990	6.370	2.447

a/ μm = micrometer
b/ μg/dscm = micrograms per dry standard cubic meter
c/ gr/dscf = grains per dry standard cubic foot

III. PROCESS DESCRIPTION AND OPERATION

A. Process Description

Hawaii Commercial and Sugar Company (HC&S) operates these three boilers as part of a large sugar cane process complex. The steam produced from the boilers is used to energize the process and produce electricity. Bagasse is the only fuel used in the boilers 5 to 6 days/week; No. 6 oil is fired the remaining time. This bagasse is a by-product of the raw sugar cane crusing operation. Figure 10 shows a block diagram of the operating process.

The boilers tested are numbered 1, 2 and 3. Boilers 1 and 2 are older Riley traveling grate spreader stokers, each rated at 120,000 lb of steam per hour. Boiler 3 is a new Foster Wheeler traveling grate spreader stoker rated at 280,000 lb of steam per hour. Test Location OA included the output gas from Boilers Nos. 1 and 2; while Test Location OB included the output gas from Boiler No. 3. The two test locations are located on two vertical stacks, downstream from the I.D. fans, which make the absolute pressure at the sampling ports slightly positive or zero. The flue gases are emitted to the atmosphere from the top of the stacks.

The major emission control devices at the outlet of each boiler are 9 in. diameter cyclones installed before the I.D. fans (see Figures 1 and 2). Each of Nos. 1 and 2 boilers is equipped with 160 Western Precipitator one-stage cyclones. The actual efficiency of these cyclones is estimated by Mr. Bob Mounts of HC&S to be 85 to 90%. The plant had no record of the design efficiency of the cyclones. The average measured emission of these two boilers is 1.10 lb particulate per 100 lb of bagasse fired (see Table 2). The pressure drop across the cyclones is 2.1 in. of water at rated capacity of bagasse fuel. Boiler No. 3 is equipped with a Zurn, two-stage cyclonic control (400 primary cyclones and 868 secondary cyclones). Mr. Bob Mounts estimated that the collection efficiency of these cyclones to be over 95%. The average measured emission of this boiler is 0.44 lb particulate per 100 lb of bagasse fired (see Table 2). The pressure drop across the first stage cyclones is 2.5 in. of water; and that of the second stage is 3 in. of water.

B. Process Operation

All of the tests reported in the result tables were performed while the process was operating normally and at production rate shown in Table 10; however, there were two tests which had to be delayed because of process-operation malfunction and routine maintenance. The first of these occurred on July 23. Sampling could not begin because of a malfunctioning of two mills, which necessitated that the plant be run at about 50% capacity. The second delay occurred on July 28. Sampling was canceled due to plant routine repairs.

There were no indications of any malfunction of the process during any of the test runs.

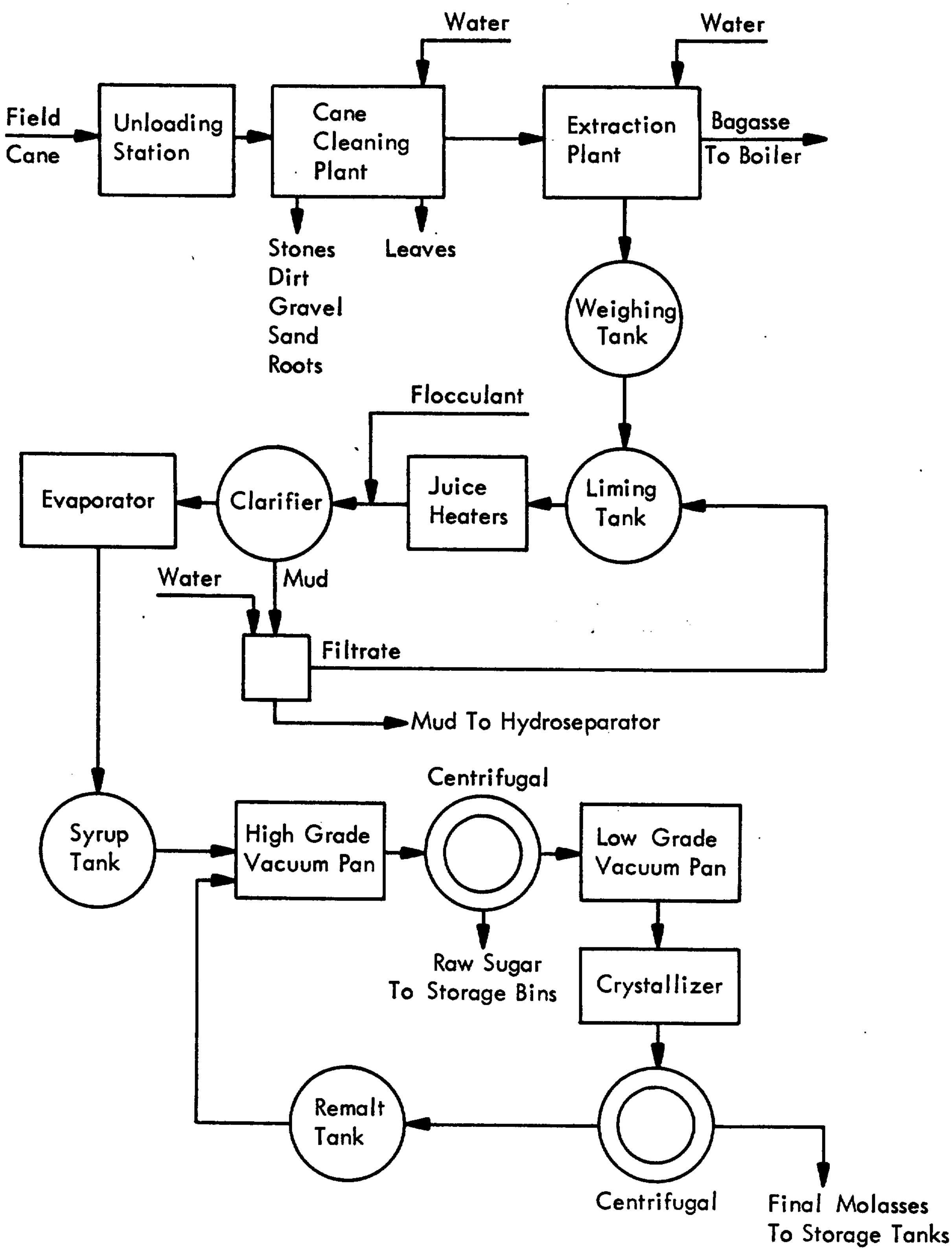


Figure 10 - Block Diagram of the Operating Process

TABLE 10

BOILER PRODUCTION RATES

	Rated Capacity (lb steam/hr)	Operating Rate (lb steam/hr) 7/24/75	7/25/75	7/29/75
Boilers 1 and 2	240,000	174,000	178,000	196,000
Boiler 3	280,000	225,000	225,000	200,000

IV. LOCATION OF SAMPLING POINTS

There were two sampling locations: Stack OA which is the common outlet of the cyclones of Boilers Nos. 1 and 2, and Stack OB which follows the cyclones of Boiler No. 3 (Figures 1 and 2).

A. Location OA (Boilers Nos. 1 and 2 Outlet)

A schematic illustration of the sampling location at this outlet is shown in Figure 3. Two sampling ports are located at a distance of 23 ft (2.2 stack diameters) downstream and more than 30 ft (> 2 stack diameters) upstream from any flow disturbance in the stack. These two ports are 90 degrees apart and located in a plane perpendicular to the flow.

Table 11 gives information on the location of the particulate traverse points. The number of traverse points was determined according to Method 1 of the Federal Register. The sampling points are shown in Figure 3.

B. Location OB (Boiler No. 3 Outlet)

Schematic illustrations of the sampling location and points are shown in Figure 4. Two sampling ports are located at a distance of 35 ft (3.3 stack diameters) downstream and more than 22 ft (> 2 stack diameters) upstream from any flow disturbance in the stack. These two ports are in a plane perpendicular to the flow and 90 degrees apart.

The locations of the sampling points and their distances from the stack wall are given in Figure 4 and Table 12.

TABLE 11

LOCATION OF PARTICULATE TRAVERSE POINTS (Test Location 0A)

Traverse Point Number	Percent of Stack I.D.	Stack I.D. (in.)	Product of Columns 2 and 3 (in.)
1/23	1.1	123	1.3
2/24	3.5	123	4.3
3/25	6.0	123	7.4
4/26	8.7	123	10.7
5/27	11.6	123	14.3
6/28	14.6	123	17.9
7/29	18.0	123	22.1
8/30	21.8	123	26.8
9/31	26.1	123	32.1
10/32	31.5	123	38.7
11/33	39.3	123	48.3
12/34	60.7	123	74.7
13/35	68.5	123	84.2
14/36	73.9	123	90.9
15/37	78.2	123	96.2
16/38	82.0	123	100.9
17/39	85.4	123	105.0
18/40	88.4	123	108.7
19/41	91.3	123	112.3
20/42	94.0	123	115.6
21/43	96.5	123	118.7
22/44	98.9	123	121.6

TABLE 12

LOCATION OF PARTICULATE TRAVERSE POINTS (Test Location OB)

Traverse Point Number	Percent of Stack I.D.	Stack I.D. (in.)	Product of Columns 2 and 3 (in.)
1/21	1.3	126	1.6
2/22	3.9	126	4.9
3/23	6.7	126	8.4
4/24	9.7	126	12.2
5/25	12.9	126	16.2
6/26	16.5	126	20.8
7/27	20.4	126	25.7
8/28	25.0	126	31.5
9/29	30.6	126	38.6
10/30	38.8	126	48.9
11/31	61.2	126	77.1
12/32	69.4	126	87.4
13/33	75.0	126	94.5
14/34	79.6	126	100.3
15/35	83.5	126	105.2
16/36	87.1	126	109.7
17/37	90.3	126	113.8
18/38	93.3	126	117.6
19/39	96.1	126	121.1
20/40	98.7	126	124.4

V. SAMPLING AND ANALYTICAL PROCEDURES

Methods 1 through 5 of the Federal Register (Vol. 36, No. 159, August 17, 1971, and Vol. 36, No. 247, December 23, 1971) were followed in the sampling and analysis of particulate. Figure 11 is a schematic illustration of the train used for sampling particulate and POM concurrently. Ten feet glass condenser in an ice bath was used to keep the temperature of the flue gas reaching the Tenax plug below 60°F. The Tenax plug was used to catch any residual POM that passed the filter and the condenser.

Preliminary velocity and moisture contents of the flue gas were determined, according to Methods 2 and 4 of the Federal Register, before the actual test was started. The data from the preliminary run were used to set the sampling equipment for isokinetic sampling for the particulate, POM and particle-sizing tests.

Particulate sampling was done according to Method 5 of the Federal Register. Forty traverse points were used to sample for particulate from Location OA. The sampling time at this outlet was 2 min per traverse point for a total of 80 min. Location OB was divided into 44 traverse points for particulate sampling. The sampling time at this location was 2 min per traverse point for a total of 88 min.

Aluminum foil was wrapped around each sampling container to protect the sample from light, since light could decompose some of the POM compounds. The particulate catch was combined and extracted with benzene to remove any POM compounds. The sodium carbonate impingers were extracted with three 60-ml portions of benzene and concentrated to 1 ml by evaporation of benzene with nitrogen. No detectable amount of any POM compounds could be found on any filter blank and none has been found on any of several previous projects. Analysis of POM compounds was made on a Varian Model 1440 gas chromatograph equipped with a $5c^3H$ electron capture detector. A 6 ft x 1/4 in. glass column packed with 3% Dexsil 300 on Supelcoport was used. Only five of the eight POM compounds of interest could be obtained as standards, i.e., 7,12-dimethylbenz[a]anthracene, benzo[a]pyrene, 3-methylchloranthrene, dibenz[a,h]anthracene and dibenzo[a,i]pyrene.

Electron capture detection of POM's is 1,000 times more sensitive than MRI's mass spectrometer.

Gas sampling for flue gas compositions was done from the particulate ports. Method 3 of the Federal Register was followed in sampling and analyzing for CO, CO_2, O_2, and N_2.

Sampling for the determination of nitrogen oxides was accomplished from the particulate ports. Method 7 of the Federal Register was followed in sampling and analyzing for NO_x. Figure 12 is a schematic drawing of the NO_x sampling train used.

Andersen Sampler (Mark III), manufactured by Andersen 2000, Inc., was used as an impaction device for the particulate sizing runs. Figure 13 is a schematic drawing of the Andersen impactor in sampling position. The following procedures were followed chronologically in sampling and analyzing for each particulate sizing run:

1. The Andersen impaction filters were desiccated for 24 hr, weighed and placed in the impactor.

2. The temperature, velocity, moisture, static pressure and compositions of the flue gas at the sampling point were determined.

3. The impactor's tip diameter was chosen conveniently using Method 5 type nomograph.

4. The sample flow rate through the impactor was calculated to the dry test meter conditions such that, the face input velocity of the impactor's tip is equal to the flue gas velocity at the sampling point (isokinetic sampling).

5. The impactor was then preheated in the stack for 30 min at the predetermined sampling point with the impactor's tip closed off by aluminum foil.

6. The flow rate was set at the meter (Step 4) for isokinetic sampling.

7. The sampling was then started at the set flow rate (Step 6) and after opening the impactor's tip (Step 5).

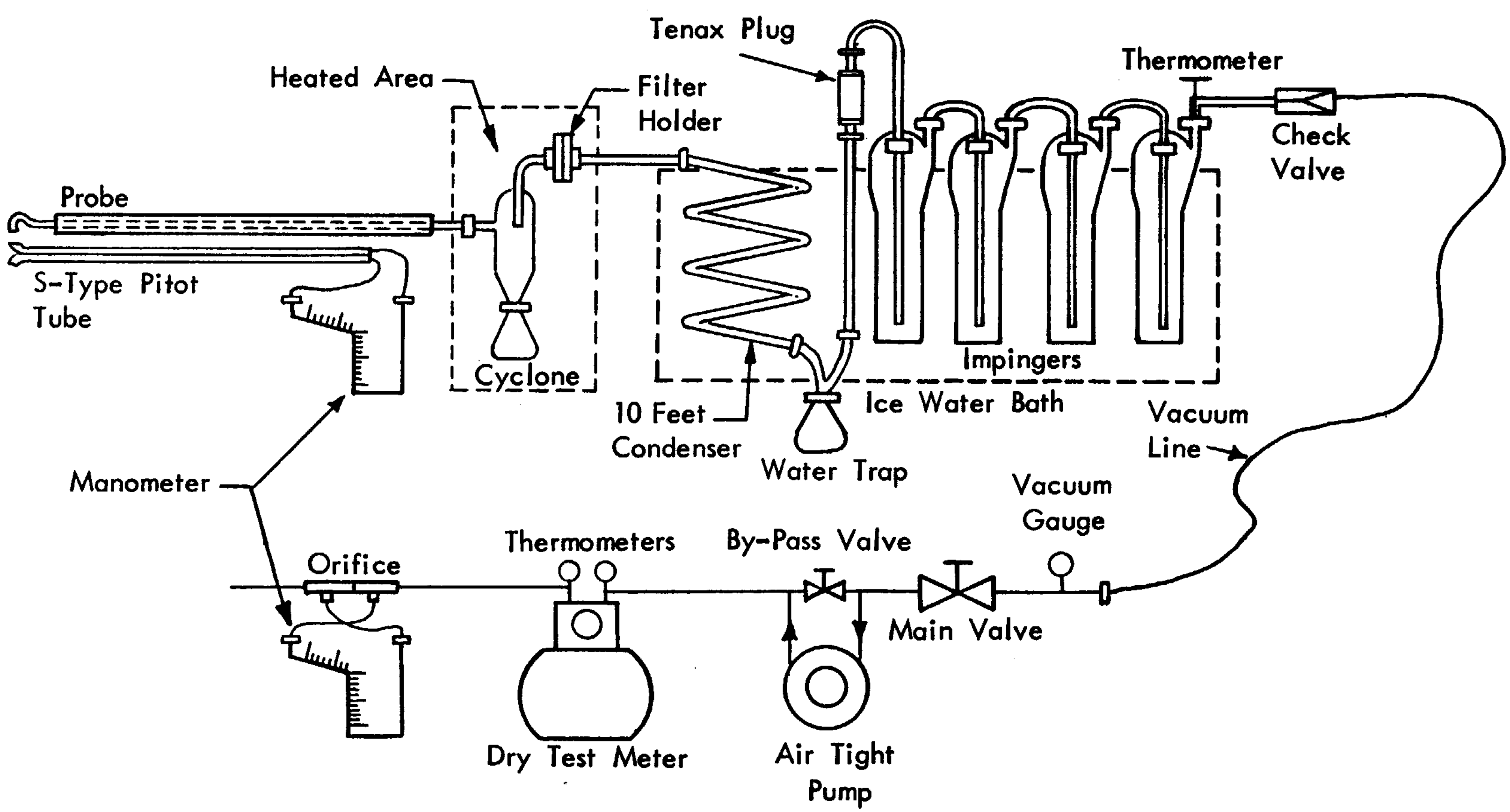


Figure 11 - Particulate-POM Sampling Train

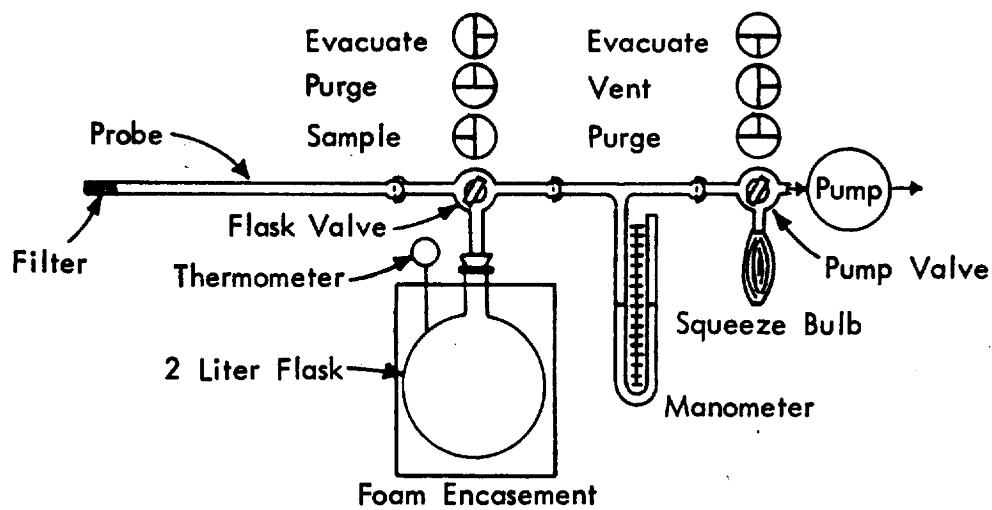


Figure 12 - NO_x Sampling Train

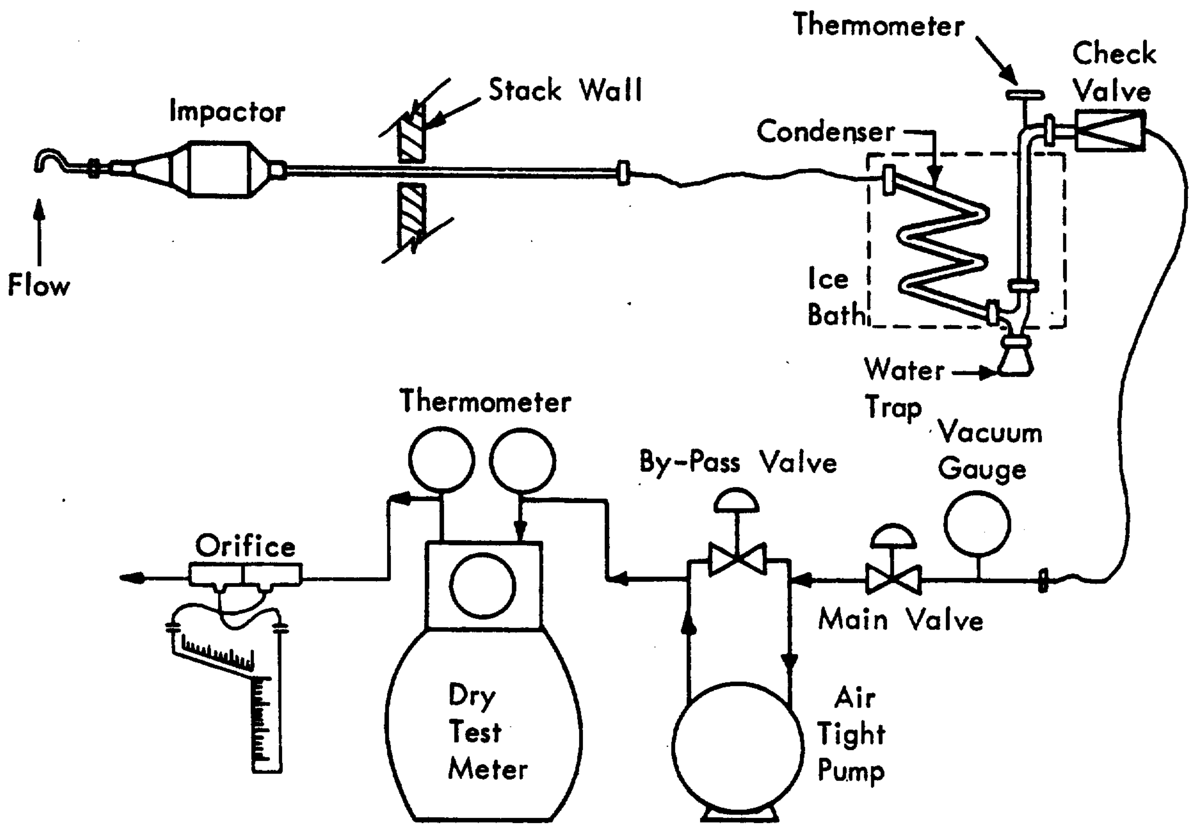


Figure 13 - Schematic Illustration of the Impactors in Sampling Positions

MRI REPORT

PRELIMINARY TEST SURVEY REPORT
of
Hawaiian Commercial and Sugar Company
for
Air Pollution Sampling Tests

by

Paul C. Constant, Jr.

PRESURVEY REPORT
25 April 1975

EPA Contract No. 68-02-1403, Task No. 8
MRI Project No. 3927-C, Task No. 8

For

Environmental Protection Agency
Emission Measurement Branch
Research Triangle Park
North Carolina 27711

Attn: Mr. Tom Bibb
Contract Project Officer

PRELIMINARY TEST SURVEY REPORT
of
Hawaiian Commercial and Sugar Company
for
Air Pollution Sampling Tests

by

Paul C. Constant, Jr.

PRESURVEY REPORT
25 April 1975

EPA Contract No. 68-02-1403, Task No. 8
MRI Project No. 3927-C, Task No. 8

For

Environmental Protection Agency
Emission Measurement Branch
Research Triangle Park
North Carolina 27711

Attn: Mr. Tom Bibb
Contract Project Officer

PREFACE

This is a report of survey of the Hawaiian Commercial and Sugar Company. This survey was conducted by Midwest Research Institute (MRI) in conjunction with the Environmental Protection Agency (EPA), pursuant to Task Order No. 8 of EPA Contract No. 68-02-1403.

Approved for:

MIDWEST RESEARCH INSTITUTE

Paul C. Constant, Jr.
Program Manager

25 April 1975

TABLE OF CONTENTS

I. INTRODUCTION

During the week of 7 April 1975, MRI, in conjunction with EPA, conducted a preliminary survey of the bagasse-fired boilers of the Hawaiian Commercial and Sugar Company (HC&S). This Company, which is located in Puunene, Maui, Hawaii, processes sugar cane generally as shown in Figure 1. The bagasse, which is a by-product of the crushing operation, is a fiber that is used as a fuel for the bagasse-fired boilers.

The purpose of this sampling task at HC&S is to acquire stack-emission data that the EPA will use for its development and support of national, new-source, performance standards.

There are two locations at which sampling will take place (see Figures 2 and 3). Location 1 is in the stack that is fed by two boilers, each of which uses Western Precipitator Cyclones for control devices. Location 2 is the emissions stack of a new boiler that uses a Zurn, two-stage cyclonic control.

Sampling will be done at each location for mass particulate, polycyclic organic matter (POM), particle-size distribution, and NO_x. The mass particulate and POM samples will be obtained simultaneously with the modified Method 5 train described in Section VI. Particle sizing will be done using a cascade impactor. One NO_x sample will be taken by Method 7 during each particulate/POM run and each particle-size run.

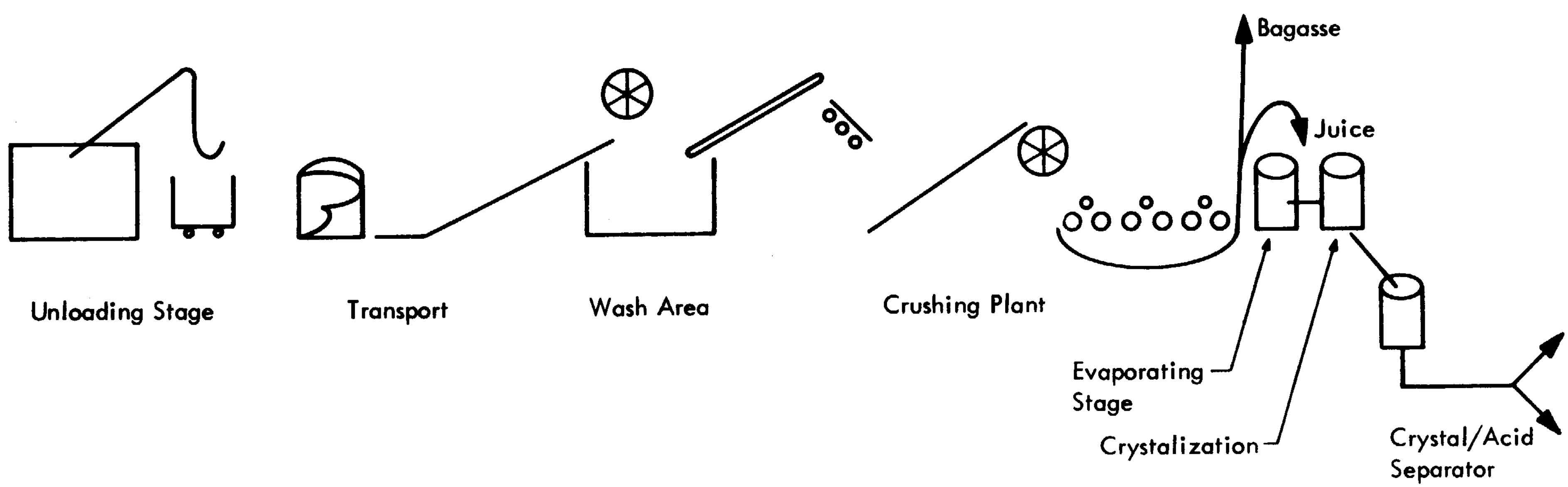


Figure 1 - General Process

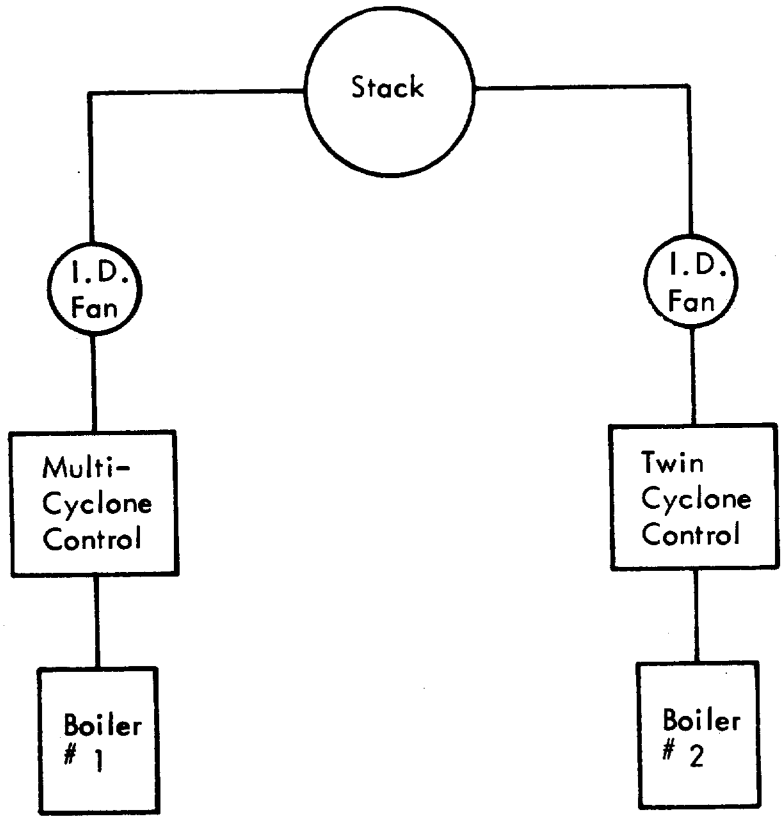


Figure 2 - Test Location No. 1

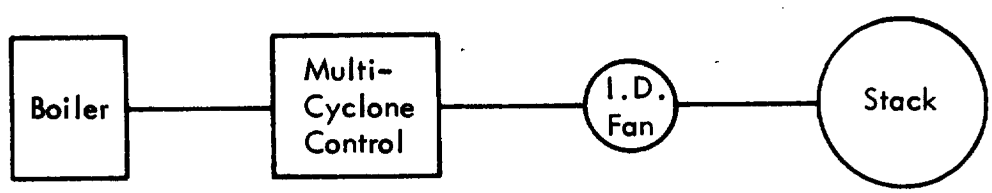


Figure 3 - Test Location No. 2

This field sampling task will result in the following type and number of samples to be analyzed:

Type	Number of Samples
Mass particulate	Four filters and four wash
POM	Four filters, four solutions, and four Tenax Plugs
Particle size	Two sets
NO_x	Six

The four filters specified with the mass particulate and the POM in the preceding testing are the same four filters. The results from the particle size samples will provide two additional mass particulate results, as well as particle size distribution by mass.

Mr. Thomas F. Lahre's (EPA Project Officer) participation in the survey was quite valuable. His participation in the field test would enhance the activities--especially with regard to relationships with the Company and the State regulatory body.

II. DESCRIPTION

The HC&S plant processes sugar cane to obtain sugar, generally as shown in Figure 1. The crushing operation of the process provides two major products: juice, which is the primary one, and which then is further processed into sugar crystals; and bagasse, which is a by-product of significance. The bagasse is used as a fuel for the boilers that energize the process, as well as provides power for other use.

The process of making sugar is a continuous one--24 hr/day, Monday through Friday, with three operational shifts: 0700 to 1500; 1500 to 2300; and 2300 to 0700. The boilers are operated 24 hr/day, 7 days/week, with the following operational shifts: 0600 to 1400; 1400 to 2200; and 2200 to 0600.

During a week's operation of the process, there is usually sufficient bagasse to operate the boilers 5-2/3 days of the week--Monday through part of Saturday. When the bagasse supply is depleted, oil is used.

Although there is no restriction on the time to sample, the best time is during daylight hours and when bagasse is being used for fuel. Testing should be scheduled for days since that is when the boilers use bagasse for fuel. There is the possibility of testing on Saturday if sufficient bagasse is available.

The principal contingencies that will affect sampling are adverse weather conditions and process problems. Mr. Takuzo Inouye, Assistant Manager of HC&S, stated in our 11 April meeting that it is highly likely that both these contingencies will be experienced. There can be rain that will affect the harvesting of the sugar cane and then oil will be used for fuel. Mr. Inouye was quite clear that process problems would be highly likely. He suggested that we plan to be there more than a week.

III. SAMPLE SITE AND METHOD REQUIREMENTS

The two test locations (see Figures 2 and 3) will not require any major modifications. The only modifications necessary are to remove some existing railings at one port of Location 1 and at both ports of Location 2, and then replace them after the sampling is completed, as well as to erect a hoist at each sampling location.

Pertinent aspects of the two sampling locations are summarized below:

Item	Location 1	Location 2
Stack shape	Circular	Circular
Stack I.D. at sampling location	10 ft 3 in.	10 ft 6 in.
Number of existing ports	two 4-in., 90 degrees apart	two 4-in., 90 degrees apart
Location of ports:		
(a) Downstream from disturbance	2 stack dimensions	2-1/2 stack dimensions
(b) Upstream from disturbance	> 8 stack dimensions	> 8 stack dimensions
Access to sampling platforms	Steel stairways and catwalks with rails	Steel stairways and catwalks with rails
Electrical service	110-V, 20-A, within 80 ft	110-V, 20-A at ports

The sampling platforms are approximately 50 ft above ground level, and are reached by safe-steel stairways. At each platform, a hoist will be installed to lift and lower equipment and materials.

Space will be provided by the plant for MRI's use as a field laboratory. The distance from the sampling locations to the laboratory is not over 400 ft.

IV. SAFETY EQUIPMENT

The safety equipment and services provided by MRI and the plant are listed in the Presurvey Safety Checklist that is at the end of the report.

V. PLANT ENTRY

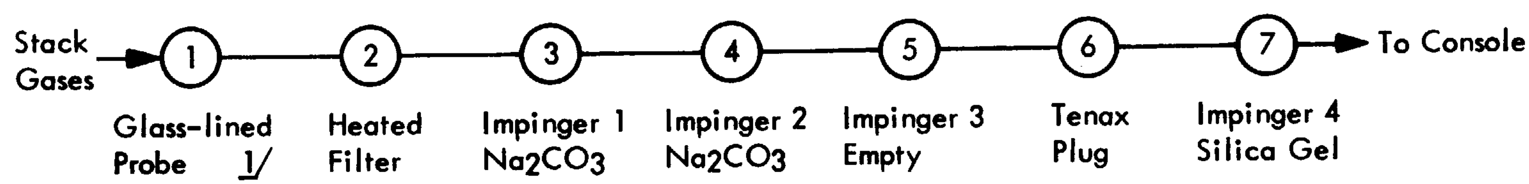
There are no restrictions or requirements on entry to the plant other than the plant be furnished the names of MRI's employees who will be performing the work.

VI. SAMPLE HANDLING

There are four types of samples that will be taken: mass particulate, POM, particle size, and NO_x. The mass particulate and the POM samples will be taken with the modified Method 5 train shown in Figure 4. The filters will be prepared at MRI and placed in glycene folders to be hand carried to the field by crew personnel. After being used in the train, these filters will be prepared in MRI's field laboratory for shipment back to MRI for analysis. They will either be placed in glycene folders or glass jars and sent to MRI by air freight.

The particulate-wash sample will be handled as per Method 5 of the 23 December 1971 Federal Register.

The contents of Impingers 3, 4, and 5 of Figure 4 will be combined into one sample at MRI field laboratory. The samples will be placed in glass jars (previously cleaned at MRI and shipped to the field by air freight)



Analysis	Sample 2/ 1	2	3	4	5
Particulate	●	●			
POM	●	●	●	●	●

1/ Stainless steel will be substituted if glassliners do not arrive unbroken or if the 10' length is not workable.

2/ Particulate samples will be saved for EPA's future analysis. MRI's Mass analysis of particulate samples will be done at MRI, as will its analysis of the POM samples.

Figure 4 - Modified Method 5 Train and Summary of Analysis of Samples from Train

and returned to MRI for analysis by air freight. Likewise, the Tenax-plug samples will be placed in glass jars and returned to MRI for analysis.

The cascade impactor collection media will be prepared at MRI and hand carried to the field by MRI personnel. The samples taken will be processed at MRI's field laboratory for particle size information. These samples will then be placed in glass petri containers or in glass bottles for return to MRI by air freight. The petri containers will be used if the Andersen cascade impactor is used to collect the samples, and this is most likely. The bottles will be used if the Brink cascade impactor is used in sampling.

The NO_x samples will be prepared according to Method 7. They will be returned to MRI by air freight for analysis.

All samples will be packaged to insure against breakage, spillage, etc. All samples will be returned to MRI at the conclusion of field testing, unless otherwise directed by the EPA project officer. It may be that he will direct the impactor samples be sent directly to EPA.

VII. LEVEL OF EFFORT

An estimate of the level of effort for the task defined in this report is given in Table I. This effort is broken down by major cost items.

VIII. FIELD TEST SCHEDULE

The schedule to perform the sampling specified in Section I is given in Table II. This is MRI's best estimate.

TABLE I

LEVEL OF EFFORT

Cost Item	Estimated Man-hours	Estimated Dollars
Planning and Administration	60	
Travel	84	
Set-up and Clean-up	60	
Field Testing	160	
Laboratory Analysis	70	
Report Writing and Clerical	80	
Subtotal Man-hours	514	
Cost of Labor		8,350
Other Direct Cost:		
Air Travel		2,000
Local Travel (Kansas City and Hawaii)		600
Subsistence and Lodging		1,260
Site Rail Modifications		500
Materials (filters, chemicals, lumber, ice, etc.)		300
Shipment of Materials		3,000
Report Reproduction		500
Telephone		150
Miscellaneous		100
Subtotal		8,730
Total Cost		16,760

TABLE II

FIELD TEST SCHEDULE

Time of Day	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Four-man field crew travel to Maui, Hawaii	Men 1 and 2 pick up truck and transport equipment from airport to test site. Men 3 and 4 go to site to establish contact, check laboratory area, test locations, etc. Crew unloads truck.	Men 1 and 2 perform Run 1* (particulate, POM and NO_x) at Location 1. Men 3 and 4 perform Run 1 (particulate, POM and NO_x) at Location 2 . One man collects process data.	Men 1 and 2 perform Run 2 (particle sizing and NO_x) at Location 2. Men 3 and 4 perform Run 2 (particle sizing and NO_x) at Location 2 . One man collects process data.	Men 1 and 2 perform Run 3 (particulate, POM and NO_x) at Location 1. Men 3 and 4 perform Run 3 (particulate, POM and NO_x) at Location 2 . One man collects process data.
PM	Four-man field crew travel to Maui, Hawaii	Crew prepares laboratory and both site locations; prepares trains and impactors for sampling; initiates preliminary checkout --velocity and temperature, profiles, moisture, etc.	Crew prepares samples for shipment to MRI and prepares impactors and NO_x sampling trains for Run 2. Data is organized and edited.	Crew analyzes particle size samples and prepares them for shipment to MRI. Crew prepares mass and NO_x trains for Run 3. Data is organized and edited.	Crew prepares samples for shipment to MRI, and packages equipment for shipment to MRI. Data is organized and edited.
AM	Crew returns to MRI				
PM	Crew returns to MRI				

*

Run	Samples: Location 1	Samples: Location 2
1	Particulate, POM, NO_x	Particulate, POM, NO_x
2	Particle sizing, NO_x	Particle sizing, NO_x
3	Particulate, POM, NO_x	Particulate, POM, NO_x

Note: The high probability of process problems may require testing to be carried over into the second week.

PRELIMINARY SURVEY

Name of Company Hawaiian Commercial & Sugar Co. Date of survey 4/9-11/75

Address Puunene, Maui, Hawaii City Puunene Maui State Hawaii

Name of Contacts Takuzo Inouye Title Assistant Manager

Andrew Hirose Title Head, Production Dept.

Bob Mounts Title Head, Power & Process Eng. Dept.

Plant Telephone Number 808-877-0081 FTS Number

Description of Process Bagasse-fired boilers for generating electrical power

Operating Schedule of Process 24 hr/day, 7 days a week: 06-00-1400; 1400-2201; 2200-0600

Batch or Continuous Process Continuous

Feed Composition and Rates

Type of Fuel Bagasse Production Rate

Description of Air Pollution Control Equipment and Operation Boilers 1 and 2 feed a common stack. Each boiler uses Western Precipitator cyclones. Boiler 3, which feeds a second stack, uses a Zurn, two-stage cyclonic control

Assumed Constituents of Stack Gas for Each Sampling Site Mass particulates, NO_x and POM

Possible Testing Sites (1) Common stack of boilers 1 and 2

(2) Stack of boiler 3

(3)

(4)

Can Samples be Collected of:

a.	Raw materials	x	e.	Product	x
b.	Control equipment effluent	x	f.	Fuel	x
c.	Ash	x	g.	Other	-
d.	Scrubber water	-			

Signature Required on Passes No pass required Waivers -

Best Time to Test 0600-1400

Are the Following Available at the Plant?

a.	Parking Facilities	x	h.	Weighing Balance	x
b.	Electric Extension Cords	x	i.	Clean-up Area	x
c.	Electrician	x	j.	Laboratory Facilities	
d.	Safety Equipment		k.	Sampling Ports	x
e.	Ice		l.	Scaffolding	x
f.	Acetone	if needed	m.	Restroom	x
g.	Distilled water		n.	Vending Machines	

1. Electricity Source
   a. Amperage per circuit: 20a, 115-v
   b. Location of fuse box: 80' from Location 1; at Location 2
   c. Extension cord lengths: 100'
   d. Adapters needed?: yes (Plant will furnish)

2. Safety Equipment Needed
   a. Hard hats: x
   b. Safety glasses: x
   c. Goggles: ______
   d. Safety shoes: x
   e. Alarms: ______
   f. Other: ______

3. Ice
   a. Vendor: 76 Sv. Station
   b. Location: 2 blocks (east) from Maui Beach Motel on Highway 32

4. Acetone
   a. Vendor: ______
   b. Location: ______
   c. Telephone: ______

5. Sampling Ports
   a. Who will provide: HC&S
   b. Size opening: 4"

6. Scaffolding
   a. Height: Not needed - platform there
   b. Length: ______
   c. Vendor: ______
      Address: ______
      Telephone: ______

7. Motels:

   a. Maui Beach Hotel Phone 877-0051 Rate $16/day

   b. Maui Hukilau - Lono and Highway 32 Phone 922-5333 Rate $16/day

   c. ______ Phone ______ Rate ______

8. Restaurants:

   a. Near Plant at motels and within a mile of motel

   b. Near Motel ______

PRESURVEY SAFETY CHECKLIST
EPA SOURCE-TESTING

PLANT C&H Sugar Co. LOCATION Puunene, Maui, Hawaii

I. MEDICAL:

Plant First Aid Representative Mr. Yoshimi Phone Ex. 222
Plant Doctor No Phone -
Plant Nurse No Phone -
Location Plant First Aid Unmanned station Phone -
Local Ambulance Maui Memorial Hospital Phone 244-9056
Local Hospital Maui Memorial - 3 miles Phone 244-9056
Comments

II. OSHA SAFETY CHECK:

Ladders: Check if OK, note exceptions.

Rungs x Diameter x Length x
Distance between rungs x Side clearance x
Back clearance x Pitch x
Step-across distance to platform x
Comments

Scaffolds: Check if OK, note exceptions.

Footings Bearing planks
Cross-bracing Diagonal bracing
Guardrails Toeboards
Safety screen around platform
Comments Not applicable

<u>Sampling Platforms</u>: Check if OK, note exceptions.

Footings___x___ Bearing planks___x___
Cross-bracing___x___ Diagonal bracing___x___
Guardrails___x___ Toeboards___x___
Safety screen around platform___Railing___
Comments___

<u>Personal Protection Equipment Needed</u>: Check if needed.

Safety glasses___x___ Side shields___x___ Face shields___x___
Goggles___-___ Hard hat___x___ Safety shoes___x___
Respiratory protection: Air-purifying___-___
Air supplied___-___
Self-contained___-___
Body protection: Chemical protective garments___-___
Heat protective garments___-___
Go-Glo safety vests___-___
Chemical gloves___-___
Heat resistance gloves___-___
Protective creams___-___
Safety belts___-___ Safety harness___-___
Noise exposure protection___-___
Comments___

III. SPECIAL OR UNUSUAL TEST PROCEDURES AND SAFETY PRECAUTIONS: None