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CENTURY INDUSTRIAL PRODUCTS FRP-100 WET SCRUBBER EVALUATION

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CENTURY INDUSTRIAL PRODUCTS FRP-100 WET SCRUBBER EVALUATION

by

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ABSTRACT

The performance of the Century Industrial Products FRP-100 wet scrubber installed on a lightweight aggregate kiln was evaluated with a field test. Inlet-outlet tests for particle-size distribution with cascade impactors and extractive sampling with an electrical aerosol size analyzer, and plume opacity with a plant process visiometer were conducted. The scrubber, operating at 80 percent of the rated capacity, had an aerodynamic cut diameter (50 percent collection efficiency) of 0.8 microns at a theoretical hydraulic power of 15.8 watts/am^3/min (0.6 hp/1000 acfm). The liquid-to-gas ratio was about 2.16 l/m^3 (16 gal/1000 acf).

The formation of submicron aerosol from the evaporation in the gas cooling section of water containing dissolved solids was observed during all tests. Also, the carryover of spray from the scrubber (there was no mist eliminator) was observed at flow rates greater than 23.7 m^3/sec (50,000 acfm).

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SECTION 1

INTRODUCTION

The Century Industrial Products FRP-100 wet scrubber was evaluated with field measurements of collection efficiency and analysis of power consumption. The scrubber is a horizontal spray chamber with a low pressure drop on the gas side. Most of the scrubbing power is introduced through the water side by pressure drop through spray nozzles.

The scope of the study was limited to the field test of a single unit. The following tests were conducted:

- Cascade impactor tests at the inlet and outlet
- Extractive sampling and measurement of submicron particles with a ThermoSystems, Inc., Electrical Aerosol Size Analyzer (EASA) at the inlet and outlet
- Opacity measurement with a Meteorology Research, Inc. Plant Process Visiometer (PPV) at the inlet and outlet

The energy use of this scrubber was compared to other scrubber types and particle-size dependent penetration determined for this unit.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

This evaluation was one of a series of such evaluations being conducted by the Industrial Environmental Research Laboratory of the Environmental Protection Agency (EPA) to identify and test novel devices which are capable of high efficiency collection of fine particulates. The test methods used were not the usual compliance-type methods but were, rather, state-of-the-art techniques for measuring efficiency as a function of particle size using cascade impactors and an Electrical Aerosol Size Analyzer.

The following conclusions were made during this study:

1. The performance of the scrubber was compared to that of a theoretical venturi scrubber and found to have about a 60 percent smaller aerodynamic cut diameter on the average for the same theoretical power requirements. However, the standard deviation of the aerodynamic cut diameter was about 30 percent of the mean. Thus, much of the difference is contained within the error band of the measurement.

2. Water carryover from the scrubber was detected at gas flows in excess of 23.6 m^3/sec (50,000 acfm). The subject scrubber was not equipped with a mist eliminator.

3. Submicron particles were generated in the cooling section of the scrubber from evaporation of dissolved solids in the water. This phenomena tended to obscure the requirements of the test to quantify the fine particle collection efficiency of the scrubber. The subject device did not meet the objectives of EPA to identify fine particle collectors.

It is recommended, for operations where scrubbers are practical, the Century scrubber should be considered if the emissions are not predominantly fine particles.

SECTION 3

DESCRIPTION OF SITE AND SCRUBBER

SITE DESCRIPTION

The field tests were conducted at a plant producing lightweight aggregate. Shale mined from a nearby quarry is transported to the site and stored in a covered area. The crushed shale is conveyed to two rotary kilns which are fired by pulverized coal. In the kilns, the shale is expanded to reduce the density of the material. The expanded shale is allowed to cool in stockpiles and is crushed to the desired size. The exhaust gases from the kiln are ducted to a single wet scrubber. The saturated gases are then exhausted to the atmosphere through a 2.4 m (8-foot) diameter stack.

SCRUBBER DESCRIPTION

General Description

A diagram of the scrubber is shown in Figure 3-1. The unit consists of three sections: cooling section, scrubbing section, and the stack. In the cooling section, the gas is quenched to a temperature less than 77°C (170°F) by evaporation of a water spray.

The scrubbing section is a large circular chamber consisting of two sections of nozzles, a high-pressure and low-pressure. The high-pressure nozzles are suspended from horizontal headers and the low-pressure nozzles from vertical headers. The high-pressure nozzles (fine droplet) are located near the front of the chamber, while the low-pressure nozzles (coarse droplet) are near the rear of the chamber. The mechanism for collection is claimed to be capture of the particles with the fine droplets and then removal of the droplet-particle with the coarse droplets.

The stack may contain baffles or a demister, depending on the installation.

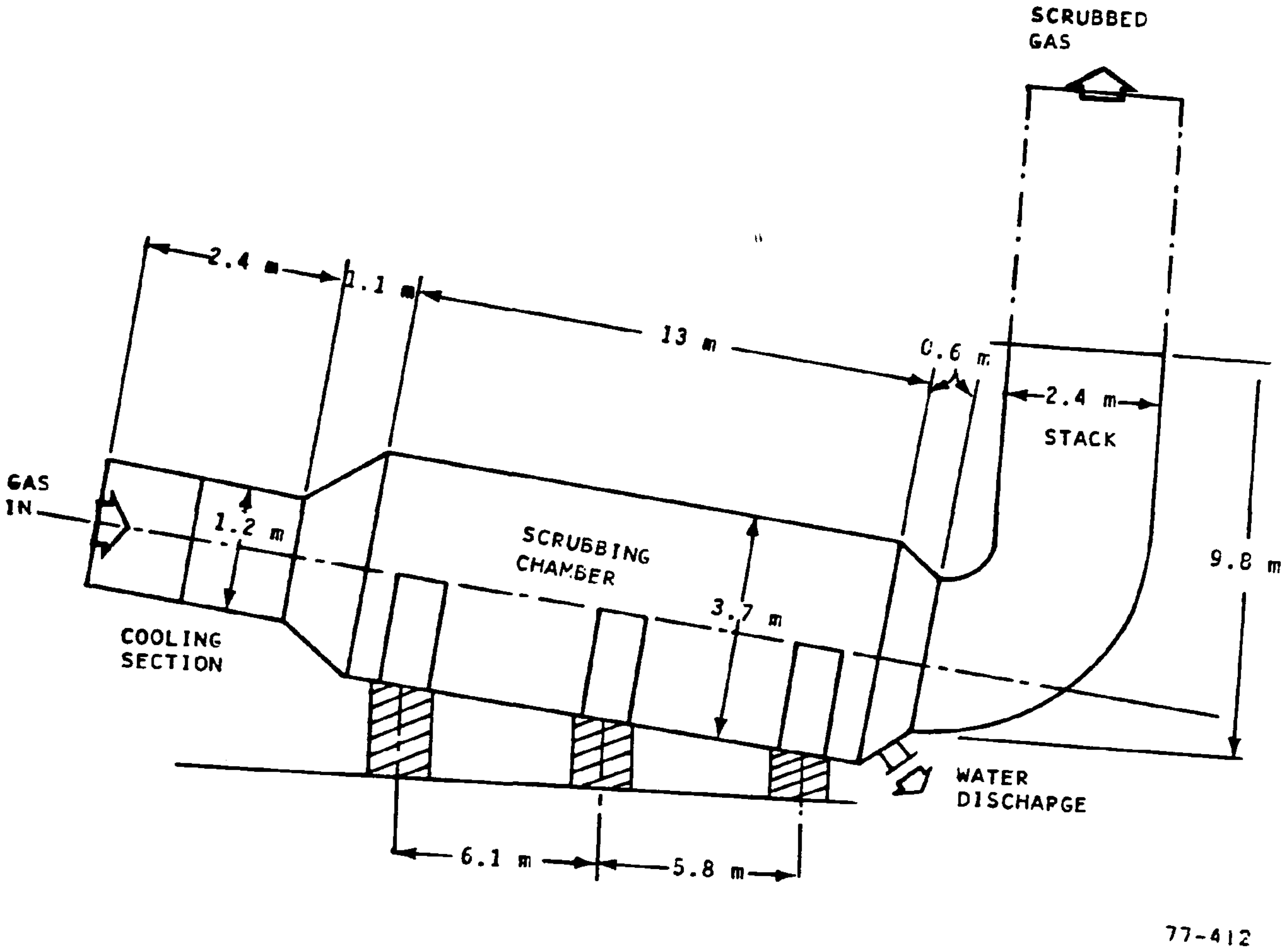

Figure 3-1. Diagram of FRP-100 Scrubber

Configuration of Scrubber at Site

The subject scrubber had some features which were unique to the site.

- The scrubber had no mist eliminators. The scrubber only had a diagonal baffle at the outer radius of the exhaust elbow
- The nozzle configuration consisted of 43 high-pressure and 23 low-pressure nozzles
- The cooling section was modified by plant personnel from that supplied by the vendor. The spray rings were replaced by a pair of low-pressure nozzles directed into the gas flow
- The water was recirculated through a series of four settling ponds. Sufficient water was added at the final pond to make up for evaporation from the ponds and in the scrubber

- A high-pressure pump with a 40 hp motor and a low-pressure pump with a 50 hp motor were installed at the site. A rather long piping run of about 100 m was between the pump and scrubber
- The scrubber is operated at about 80 percent the rated gas volume

SECTION 4

FIELD TEST

TEST PLAN

General

The test plan called for measurement of the size fractional collection efficiency for normal operating conditions. Cascade impactors were used for measurement of particles above 0.50 micron in diameter, and a Model 3030 ThermoSystems, Inc., Electrical Aerosol Size Analyzer (EASA) was used to measure particle distribution from 0.003 to 1.0 microns in diameter. Supporting measurements included gas composition with an Orsat analyzer, gas velocity, process flows, opacity, and power required.

The small size of the sampling platform prevented truly simultaneous tests. However, inlet-outlet EASA and four inlet and two outlet impactor tests were completed on the same day.

Schedule

The scrubber was tested three days in an "as is" condition. The rupture of a waterline on the scrubber forced an outage of the plant to repair the scrubber. Inspection of the scrubber indicated a buildup of material at the dry-wet interface, a deposit of material in the lower 1/3 of the scrubber, and several items (such as missing nozzles) requiring maintenance.

The scrubber was cleaned and maintenance performed on the unit. The scrubber was again tested under normal operation conditions. A total of three days of testing was conducted under conditions of a maintained unit. These data are presented in this report as being representative of operation of the scrubber as designed.

GAS MEASUREMENT

The gas volumetric flow was obtained using a multipoint traverse with a pitot probe following EPA Methods 1 and 2. The concentration of O_2, CO, and CO_2 was measured with an Orsat analysis following EPA Method 3. The water content of the flue gas was obtained with the impinger catch during the cascade impactor tests.

SIZE DISTRIBUTION MEASUREMENT

Cascade Impactor

The Meteorology Research, Inc. (MRI) Model 1502 Cascade Impactor was used in the test. The MRI Cascade Impactor is an annular jet-collector type, similar to that reported by Cohen and Montan (1967). A cut-away drawing of the instrument is shown in Figure 4-1. The body of the device consists of quick connect rings supporting jet plates, collection discs, and a built-in filter holder. The design permits flexibility in application to various sampling situations.

The particulate matter is collected on collection discs. The discs are a lightweight metal stamping (730 mg) of 316 stainless steel. The discs were used only once, thereby permitting a permanent record of the test.

The surface of the collection disc for the outlet tests was prepared with a solution of high-vacuum grease in toluene. The solution was painted onto the discs. It was found that the thickness of the coating is important in the performance of the impactor. After air drying, the discs were heated at 149°C (300°F) for 4 hours to remove volatiles. The collection discs were handled with clean forceps by the edge to prevent contamination and weight changes.

The filter was held by Kapton washers and was backed by a porous metal plate. A tared aluminum foil dish was used to weigh the filter and Kapton washers.

The inlet impactors utilized Reeve Angel 934AH glass fiber filter mats as collection substrates held down with a stainless steel rim.

The weighing of the collection discs was a critical part of the test. The collection disc was designed to fit the weighing chamber of a Cahn 4100 Electrobalance. The weighings were conducted at the motel to avoid disruptions due to low-frequency plant vibration. The discs and filters were desiccated for 24 hours before weighing to stabilize the water content.

A weighing by substitution method was used.

Quality Control Tests--

Two types of quality control tests were conducted.

Controls--

Collection discs were prepared normally and transported to the test site, but not mounted into an impactor. The control collection disc was a good check of the performance in weighing of the samples. The tests of

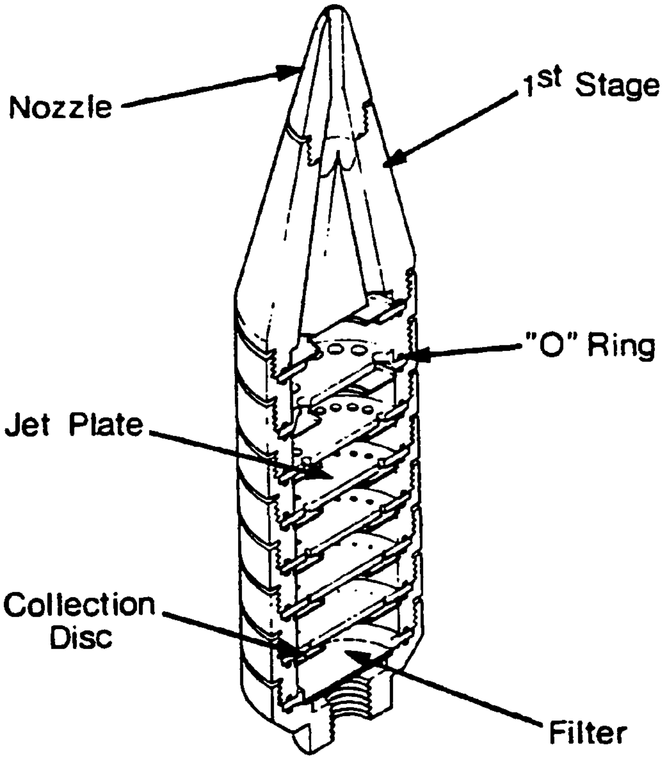

Figure 4-1. Assembly Drawing of Model 1502 Inertial Cascade Impactor

weighing repeatability were conducted with the collection discs under field conditions during the normal pattern of work. Thus, problems with static charges, balance adjustments, and handling were identified.

Blank tests--

Blank tests are impactors prepared in the normal manner which sampled only filtered stack gas. These runs can identify problems from chemical reactions of the substrate with stack gas, loss of substrate from vaporization or abrasion, and contamination of the substrates from leaks, or during assembly and disassembly. The blank runs also have at least one control disc.

The results of the control and blank test at the inlet are shown in Table 4-1. The control value of 0.04 mg is within precision of the balance. The blank value of 0.18 mg is probably due to the high SO_2 concentration and elevated temperature of 277°C (530°F). The tests were conducted for long enough times to obtain sufficient particulate matter to reduce the effects of substrate weight changes.

The outlet impactors were modified with a 30 cm (12-inch) nozzle extension. The nozzle extension was heated with a 50 watt heater, and the impactor body was heated with a 350 watt heater. The heaters were sealed with tape to insulate and waterproof the assembly. The temperature of the gas at the outlet of the impactor was monitored during the test. A temperature of at least 82°C (180°F) was maintained to avoid water condensation.

The sample train used for the impactor tests consisted of:

- An in-stack impactor with a stainless steel probe
- Hose to four Greenberg-Smith impingers containing 100 ml water in each of the first two impingers, the third dry, and the final containing silica gel
- A dry gas meter and pump following the impingers

Submicron Particles

The measurement of the size distribution of submicron particles was a two-stage process:

1. The aerosol sample was removed from the stack and diluted with clean, dry air
2. The particulate matter in the diluted gas was then measured with an EASA

TABLE 4-1. RESULT OF CONTROL AND BLANK TEST

Run No.:	30	
Substrates:	Reeve Angle 934 AH	
Time:	5 min.	
Location:	Inlet	
Temperature:	277°C (530°F)	
Date:	8/30/76	
Control Discs[a], mg:	0.04	
	0.04	
		mean 0.04
Blank Discs[b], mg:	0.06	
	0.15	
	0.20	
	0.28	
	0.23	
		mean: 0.18
		Standard deviation: 0.08
Blank backup filter[b], mg: 0.67		

a--taken to the field but not mounted in impactor

b--taken to the field and exposed to filtered stack gas

The sample was extracted at nonisokinetic flow rates due to system design and instrumentation specifications. This should not affect sample collection of the submicron particles of interest.

A precutter was used to prevent large particle contamination of the fine particle sample train. A modified MRI Model 1502 Cascade Impactor was used to mate with the environment being sampled. The advantage of using the modified impactor by eliminating collection discs and filter media is the flexibility of determining the d_{50} separation point by manipulation of stage jet diameters. When assembled properly, the impactor allows samples to be collected for approximately eight hours without plugging. The inlet of the precutter-impactor should face downstream of particle flow.

Diluting the sample served a dual purpose:

- Matching sample concentrations to particle detection capabilities
- Reducing the dew point of the sample

Dry dilution air was created by recirculating air through a bed of $CaSO_4$ desiccant (dew point, -68 °C) and then filtering to prevent contamination. Dilution was accomplished by a three-stage process of mixing the dry, particle-free dilution air with the sample. Sample flow was measured by venturi-type flow meters preceding each dilution stage, while dilution flows are measured across orifice-type meters. Temperatures and pressures were also monitored throughout the flow scheme. Tubing diameters in the sample path are reasonably large (0.95 cm diameter) to minimize particle loss due to diffusion, and tubing lengths were short to minimize sample residence time. Flow control was accomplished by manipulation of the dilution air control valves.

Dilution ratios of about 6:1 to 1000:1 can be obtained by adjustment of the control valves.

Figures 4-2 and 4-3 illustrate the extractive sampling systems at the inlet and outlet of the scrubber. The outlet cascade impactor precutter and probe required electrical heat tracing to evaporate entrained droplets before dilution.

The operation of the EASA for source measurements was described by Sem (1976). The EASA must be protected from dirt and moisture and isolated from vibration for successful operation.

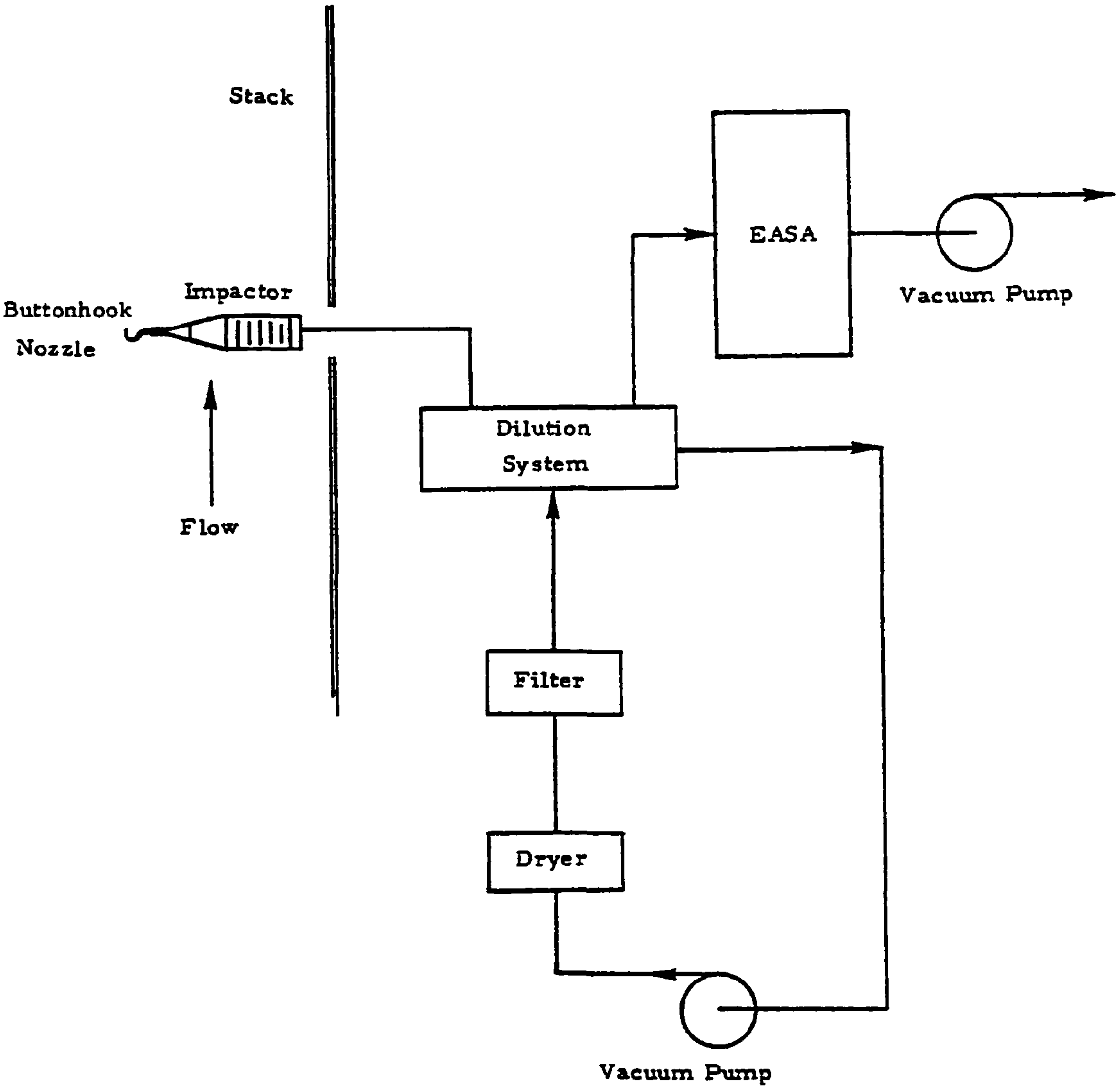

Figure 4-2. Inlet Extractive Sampling System

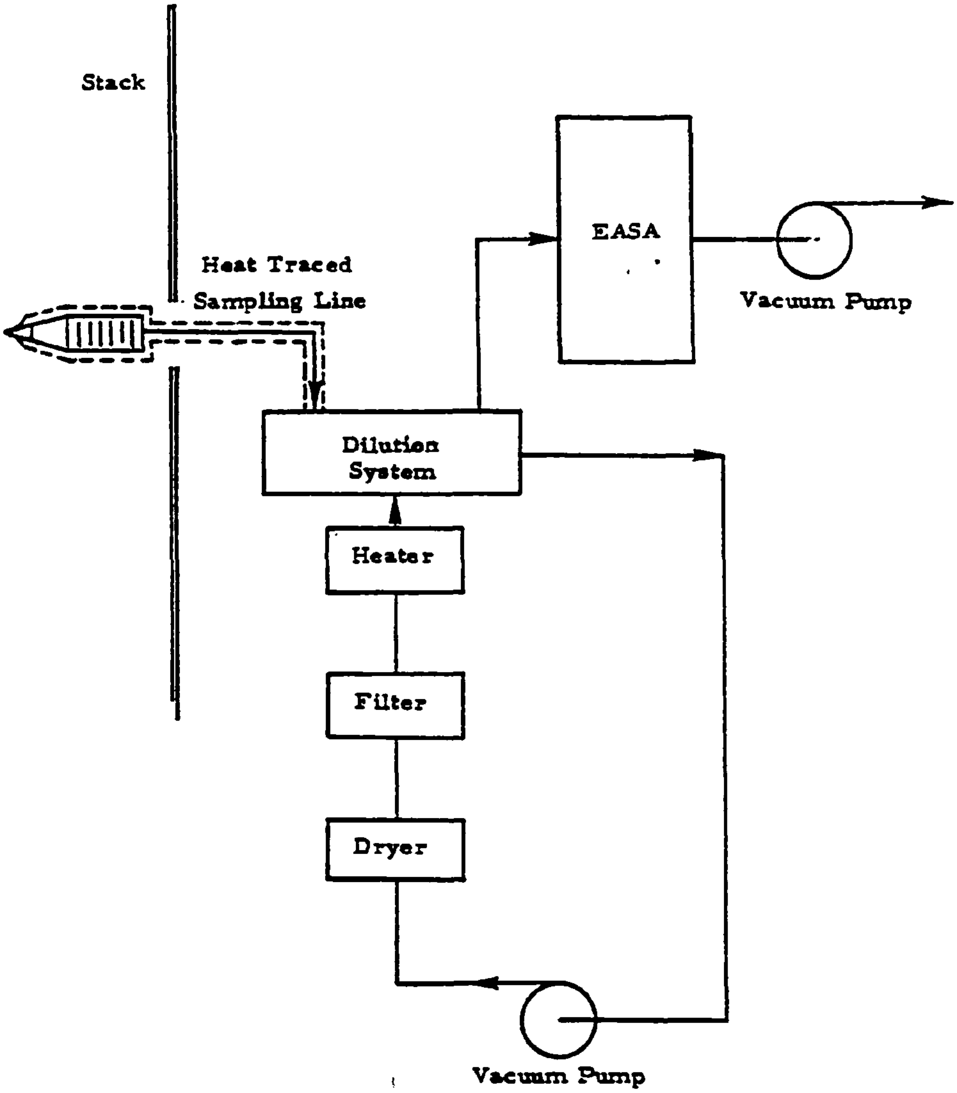

Figure 4-3. Outlet Extractive Sampling System

OPACITY MEASUREMENT

The opacity at the inlet and outlet of the scrubber was measured with an MRI Plant Process Visiometer. The instrument was installed in a 3-inch port, and the sample was heated to remove water vapor. A diagram of the instrument is shown in Figure 4-4. The aerosol particles in the chamber are illuminated by a flash lamp. The optics have been designed so that the output of the photomultiplier tube is proportional to the extinction coefficient due to scattered light. The instrument is a physical analog of the following equation:

$$b_{scat} = 2\pi \int_0^{\pi} \beta(\theta) \sin\theta \, d\theta$$

where

b_{scat} = the scattering coefficient due to scattered light

$\beta(\theta)$ = volume scattering function

θ = scattering angle

If there is no light absorption, the scattering coefficient is identical to the extinction coefficient. The extinction coefficient is related to plume opacity with the Bouguer Law.

$$\text{Opacity (percent)} = \left[1 - \exp(-b_{ext} L)\right] 100$$

where

b_{ext} = extinction coefficient, m^{-1}

L = stack diameter, m

The instrument is spanned with an internal calibrator consisting of an opal glass lens of known scattering coefficient. The lens is mechanically placed in the view of the detector for calibration and was retracted into a sealed chamber between calibrations. The PPV calibrator is calibrated with oil smoke with reference instruments using both an integration nephelometer and a transmissometer. The PPV was described in detail by Ensor, et al (1974).

The PPV at the inlet of the scrubber was mounted on a support at the ground. The sample was removed from the stack with a 1/2-inch ID stainless steel probe extending 0.65 m (2 feet) into the stack through an elbow and down through a vertical 1-inch diameter pipe 2.1 m (7 feet) long to the optical chamber. The inlet probe was aligned with the flow, and near isokinetic sampling rate was maintained. The sample rate was estimated to be 0.28 m^3/min (10 cfm). A high-efficiency aspirator at the exhaust of the optical

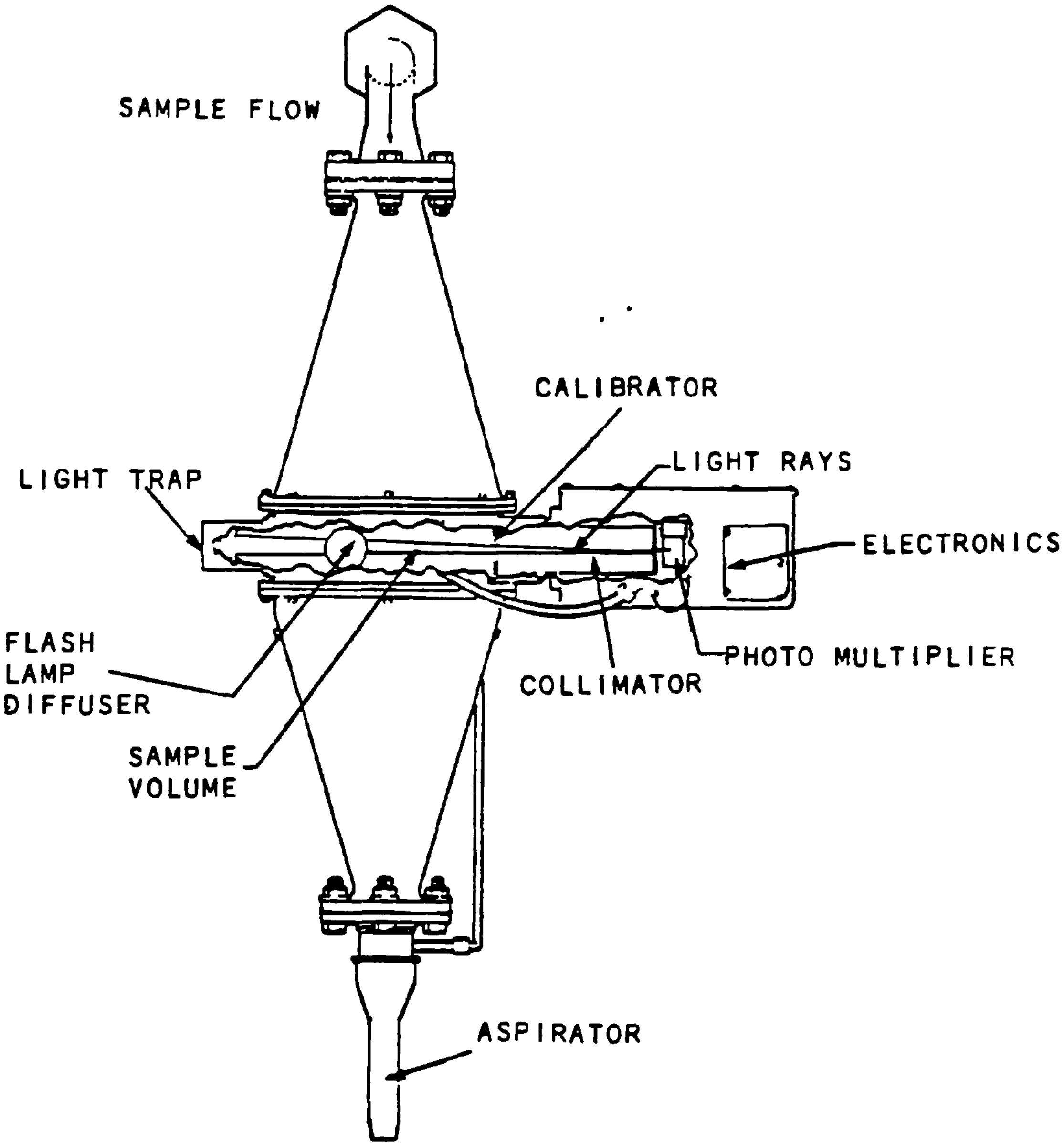

Figure 4-4. Diagram of the Plant Process Visiometer

chamber was supplied with compressed air from a Rotron blower. The inlet piping and optical chamber were insulated and heated to keep the aerosol above the water dew point.

The PPV at the outlet was mounted on the sampling platform. The electrically heated probe extended about 0.65 m (2 feet) into the stack. The inlet of the probe was protected by a flat splash plate to prevent entrained water droplets from entering the probe.

In both instruments, the optical chamber was electrically heated. A remote control panel was rack-mounted in the truck. The light scattering coefficients were recorded on strip charts. The remote control panel has controls to allow remote operation of the instruments. Each PPV was adjusted to provide a typical midscale reading.

The internal opal glass calibrator is used as a field reference. After installation, the instruments were operated continuously. The zero and span were checked at least three times per day by back-flushing with clean air and activating the calibrator. Thus both a check of the electronics and drift and contamination of the optical surfaces were obtained. When required, the units were cleaned and adjusted.

SECTION 5

FIELD TEST RESULTS

CALCULATION OF SCRUBBER PERFORMANCE

The performance of this scrubber was compared to other types of scrubbers with the following procedure:

- The theoretical hydraulic power required for the scrubber was computed from both the gas and water flows and pressure drop
- The scrubber performance aerodynamic cut diameter was computed from the cascade impactor results. The cut diameter as defined by Calvert, et al (1972) is the particle size collected with 50 percent efficiency in the scrubber
- Utilizing results reported by Calvert (1974) and adapted by Cooper and Anderson (1975), the performance of the subject scrubber was compared to the theoretical performance of other common types of scrubbers

PROCESS FLOWS AND POWER REQUIRED

Gas Flows

The gas flows were determined by using an S-type pitot tube. A 36-point traverse at the inlet upstream of the cooling section and a 48-point traverse at the outlet were conducted each day. In addition, a 1.22 m (4-foot) extension was added to the stack to reduce the effect of local winds on the stack velocity.

The results of the gas flow measurement are summarized in Table 5-1. The inlet velocity traverse is more reliable than the outlet tests for the following reasons:

- The outlet test location was about one stack diameter downstream from a bend and 1/2 upstream diameter from the exhaust [with 1.22 m (4-foot) extension]

TABLE 5-1. SUMMARY OF GAS VOLUME MEASUREMENTS

Date:	8/29		8/30		8/31	
Location	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Temperature, °C	277	46	275	46	284	43
°F	531	115	527	115	543	110
Velocity, cm/sec	1067	381	1210	427	1173	515
ft/sec	35.0	12.5	39.7	14.0	38.5	16.9
Static Pressure, cm H_2O	0.20	0.25	0.18	0.13	0.20	0.18
in. H_2O	0.08	0.10	0.07	0.05	0.08	0.07
Pressure Drop, cm H_2O	---		0.05		0.03	
in. H_2O			0.02		0.01	
Gas Flow, am^3/sec	36.0	18.0	41.3	30.0	41.3	24.1
acfm	77,000[a]	38,000[b]	87,400	42,400	87,500	51,100
Water Vapor, percent	3.0	11.5	5.8	32.7	4.6	23.9
Saturated Water Vapor, percent[c]		10.2		10.2		8.0
Gas Flow, sd m^3/sec	18.5	14.5	20.5	16.3	19.7	20.0
sd cfm	39,100	30,800[c]	43,400	34,600[c]	41,800	42,400[c]
Gas Flow In/Gas Flow Out	1.27		1.25		0.99	
Gas Flow from Inlet Traverse Corrected to Scrubber Conditions[d], a m^3/sec	22.8		25.2		24.5	
acfm	48,300		53,400		51,900	
Liquid Carryover[e], l/sec	0.208		4.10		2.71	
gpm	3.3		65		43	
Velocity in Scrubber[f] cm/sec	216		241		232	
ft/sec	7.1		7.9		7.6	

a--Inlet duct cross sectional area, 3.407 m^2 (36.68 ft^2)
b--Outlet duct cross sectional area, 4.694 m^2 (50.53 ft^2)
c--Computed using saturated water concentration at scrubber outlet conditions
d--Computed using dry gas volume from inlet traverse and saturated water concentration
e--Assumed to be the excess water above saturation
f--Scrubber cross sectional area, 10.51 m^2 (113.1 ft^2)
Standard conditions 21.1°C, 76 cm Hg (70°F, 29.92 in. Hg)

- There was minor gas leakage at the juncture of the duct work and scrubber
- The inlet traverse point was a good sampling location and had sufficient flow for good measurement accuracy
- The outlet gas velocity was low [about 3.66 m/sec (12 ft/sec)] thus prone to measurement error. Also, the drop laden emissions tended to fill the pitot pressure lines with water

The inlet velocity adjusted to scrubber conditions and a saturated water content were used for the actual gas volumetric flow rate.

The water carry-over summarized in Table 5-1 and Figure 5-1, was estimated by the additional water in excess of saturation. Based on the limited data, the carry-over is a sensitive function of gas velocity in the scrubber. Unless an entrainment separator is installed, carry-over might limit the capacity of the unit.

Gas Composition Measurements

Results from the Orsat tests are summarized in Table 5-2.

Water Flows

The water flow was estimated by counting the number of high and low pressure nozzles and using the rated water flow rate. The calculation is summarized in Table 5-3.

Power Requirements

The determination of the hydraulic power required is shown in Table 5-4. The power loss computations developed by Semrau, as reported in Strauss (1974), were used to compute the theoretical energy required. The power measured at the pumps is also included for comparison.

PARTICLE COLLECTION EFFICIENCY

Size Distribution

The impactor and EASA results were combined to obtain particle size distribution and fractional penetration curves over the particle size ranges of both instruments. The particle density was assumed to be 2 g/cm^3 during the computation of the actual particle diameter for the impactor tests. The stage calibration constant for the impactor (Ψ_{50}) was assumed to be 0.38.

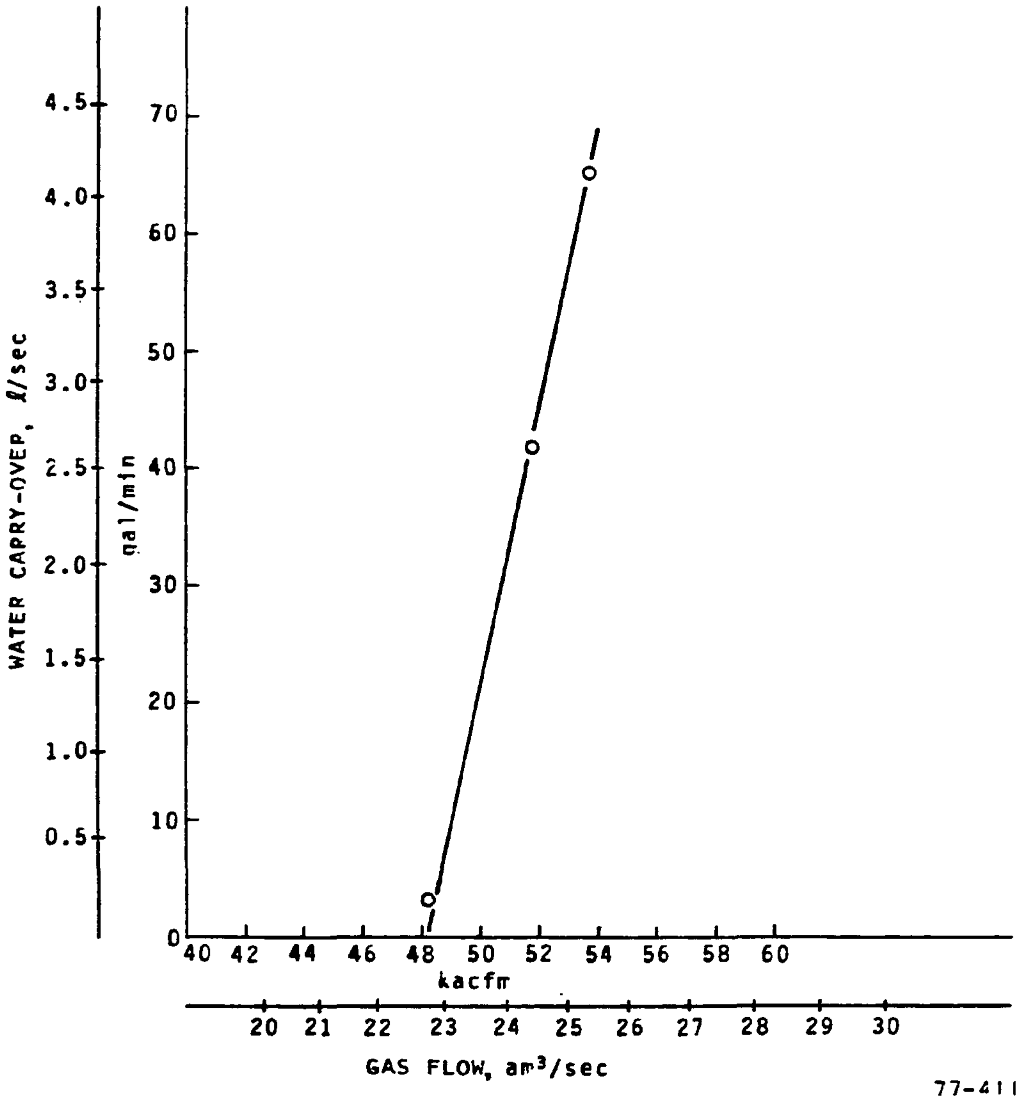

Figure 5-1. Gas Flow Water Carry Over From Scrubber

TABLE 5-2. SUMMARY OF ORSAT GAS ANALYSIS

Date	Location	CO_2 %	O_2 %	CO %	N_2 %	Dry Molecular Weight gm/gm mole
8/20	Outlet	5.8	14.0	0.2	80.0	29.6
8/20	Inlet	5.8	12.6	1.0	80.6	29.6
8/21	Outlet	5.5	13.1	1.1	80.3	29.6
8/25	Outlet	5.2	13.9	0.6	80.3	29.6
8/25	Inlet	5.8	12.6	0.0	81.6	29.6
8/30	Inlet[a]	5.0	12.6	0.6	81.8	29.5
8/31	Inlet	5.3	12.6	1.61	80.5	29.5

a. Mercury used as fluid

TABLE 5-3. ESTIMATION OF WATER FLOWS

Location	Number[b]	Type	Related Flow, l/sec (gpm)	Total Flow, l/sec (gpm)
Cooler	2	Low pressure	1.78 (28.3)	3.57 (56.6)
Front Section Scrubber	47	High pressure	0.25 (4.0)	11.86 (188.0)
Back Section Scrubber	21	Low pressure	1.79 (28.3)	37.5 (594.3)
				52.9 (838.9)

Low pressure nozzle -- 3.1×10^5 N/M^2 (45 psig)

High pressure nozzle -- 8.7×10^5 N/M^2 (125 psig)

b. Number of nozzles determined by inspection

TABLE 5-4. ESTIMATION OF HYDRAULIC POWER REQUIRED

Date	Gas: Flow, m^3/sec (acfm)	Gas: ΔP cmH_2O (in H_2O)	Gas: Hydraulic Power, $Watts/am^3/min$ (hp/1000acfm)	Liquid: Flow, l/sec (gpm)	Liquid: ΔP, n/m^2 (psig)	Liquid: Hydraulic Power $Watts/am^3/min$ (hp/1000 acfm)	Total Hydraulic Power $Watts/am^3/min$ (hp/1000 acfm)	L/G l/m^3 (gal/1000 acf)	Measured Power at Pump $Watts/am^3/min$ (hp/1000 acfm)
8/29	22.7 (48,000)	---	(0.00[a])	41 (651) 12 (188)	$3x10^5$ (45) $8.6x10^5$ (125)	9.2 (0.35[b]) 7.4 (0.28)	16.6 (0.63)	2.35 (17.4)	N.D.
8/30	25.2 (53,400)	0.051 (0.02)	0.079 (0.003)	41 (651) 12 (188)	$3x10^5$ (45) $8.6x10^5$ (125)	8.4 (0.32) 6.8 (0.26)	15.3 (0.58)	2.12 (15.7)	45.6 (1.73[c])
8/31	24.5 (51,900)	0.025 (0.01)	0.053 (0.002)	41 (651) 12 (188)	$3x10^5$ (45) $8.6x10^5$ (125)	8.7 (0.33) 6.85 (0.26)	15.5 (0.59)	2.19 (16.2)	47.9 (1.82)

a--Hydraulic power loss gas computed with the equation: $P_G = 0.157\ \Delta P_G$, ΔP_G = pressure drop in H_2O

b--Hydraulic power loss liquid computed with the equation: $P_L = 0.583\ \Delta P_L (Q_L/Q_G)$, ΔP_L = liquid pressure drop, psig
Q_L = liquid flow, gpm
Q_G = gas flow, acfm

c--Determined by measuring the applied voltage and amperage at the two pumps. The difference between the hydraulic power and measured power was due to line pressure drop, pump efficiency, and power factor.

N. D. --Not determined.

The size distribution statistics are reported in Table 5-5. The geometric mass mean diameter and geometric standard deviations were determined by a least squares fit to a lognormal size distribution. These statistics indicate the mean diameter and width of the distribution. The correlation coefficient indicates the goodness of the fit. The inlet particulate matter was very coarse and in many tests the major fraction of the weight was on the first stage of the impactor.

The particle size distributions are shown in Figures 5-2 to 5-4. These curves were computed with a procedure reported by Markowski and Ensor (1977) which is a modification of a technique developed by Calvert and reported by Ensor et al (1975). The impactor data is plotted as cumulative "smaller than" mass versus diameter curves. These curves are then interpolated to consistent selected size increments with a fitting routine utilizing overlapping parabolas. The differential curves in Figures 5-2 to 5-4 are the slopes of the cumulative curve at the selected diameters. The mean and standard deviation are computed for the differential distributions from all tests at a given operating condition.

Penetration

The penetration of particles through the scrubber shown in Figures 5-5 to 5-7 is simply the outlet differential size distribution divided by the inlet differential size distribution. The standard deviation for the penetration is given by:

$$\frac{S_{P_t}}{P_t} = \sqrt{\left(\frac{S_{in}}{F_{in}}\right)^2 + \left(\frac{S_{out}}{F_{out}}\right)^2}$$

where

S	=	Standard deviation
F	=	Differential distribution
P_t	=	Penetration
in	=	Inlet
out	=	Outlet

The Standard deviation contains both process variation and measurement errors. The cascade impactor reduced data are reported in Appendix C.

TABLE 5-5. SUMMARY OF SIZE DISTRIBUTION STATISTICS

	Day	Run	Geometric Mass Mean Dia. micron	Geometric Standard Deviation	Correlation Coefficient to Lognormal Distribution
Inlet	8/29/76	31	12.3	8.4	0.970
		32	57.3	11.4	0.974
		33	61.6	13.5	0.972
		34	117.7	23.5	0.981
Mean			62.2	14.2	0.974
Standard Deviation			43.18	6.54	0.005
Outlet		25	9.95	48.8	0.958
		35	8.10	16.7	0.900
Mean			9.03	32.8	0.929
Standard Deviation			1.31	22.7	0.041
Inlet	8/30/76	40	68	19.3	0.986
		41	91.5	11.5	0.986
		42	70.2	16.5	0.977
		43	101.7	15.3	0.991
Mean			82.93	15.65	0.985
Standard Deviation			16.35	3.23	0.006
Outlet		36	0.970	24.8	0.974
		37	0.404	58.0	0.967
		38	0.516	13.0	0.960
Mean			0.630	31.93	0.969
Standard Deviation			0.30	23.33	0.010
Inlet	8/31/76	44	108.3	11.4	0.985
		45	174.5	12.0	0.986
		47	55.2	5.41	0.983
		49	53.0	14.70	0.983
Mean			114.7	10.68	0.983
Standard Deviation			62.4	3.42	0.003
Outlet		39	7.15	205.4	0.982
		48	0.84	45.9	0.969
		50	2.02	6.83	0.971
Mean			3.34	86.0	0.974
Standard Deviation			3.35	105.2	0.007

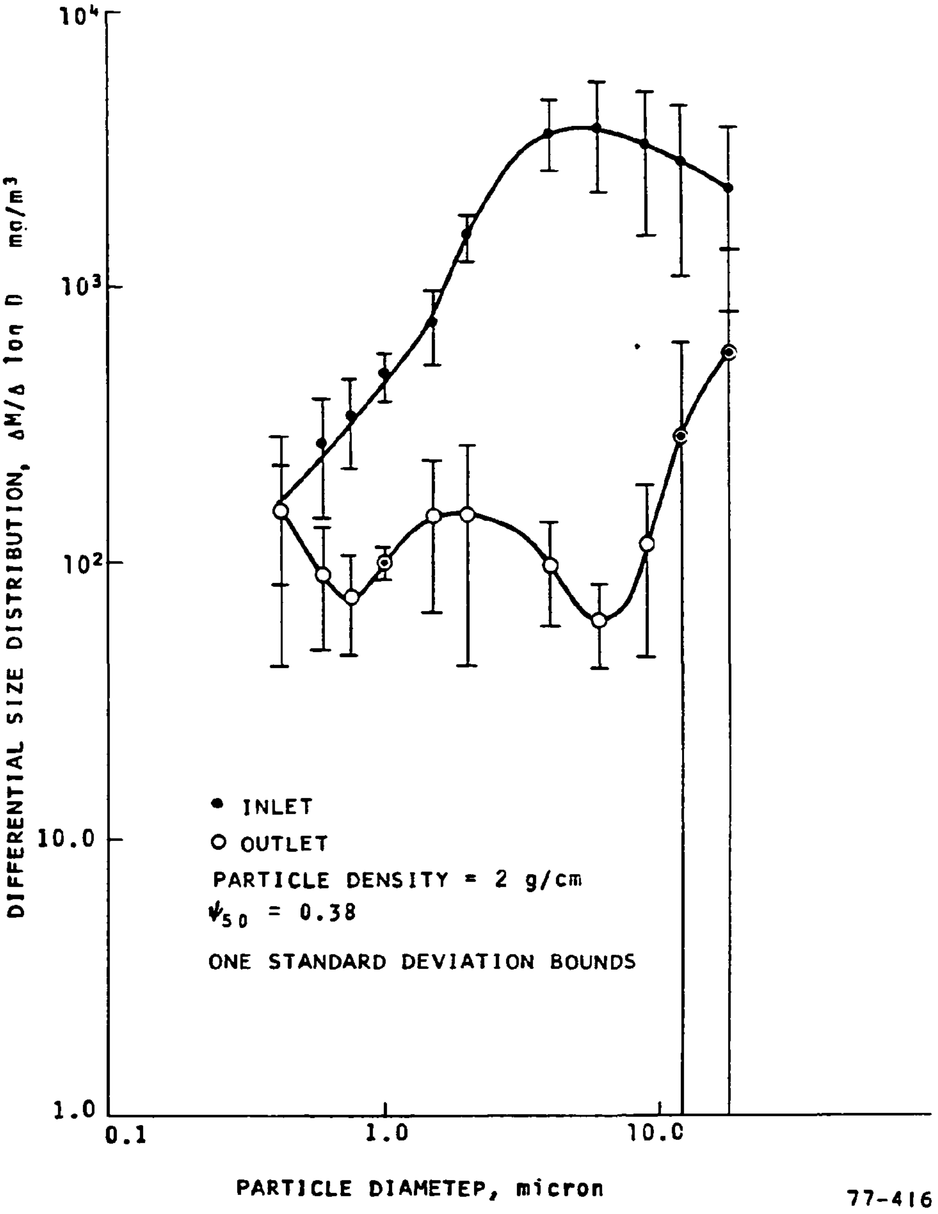

Figure 5-2. Differential Particle Size Distribution for August 29, 1976

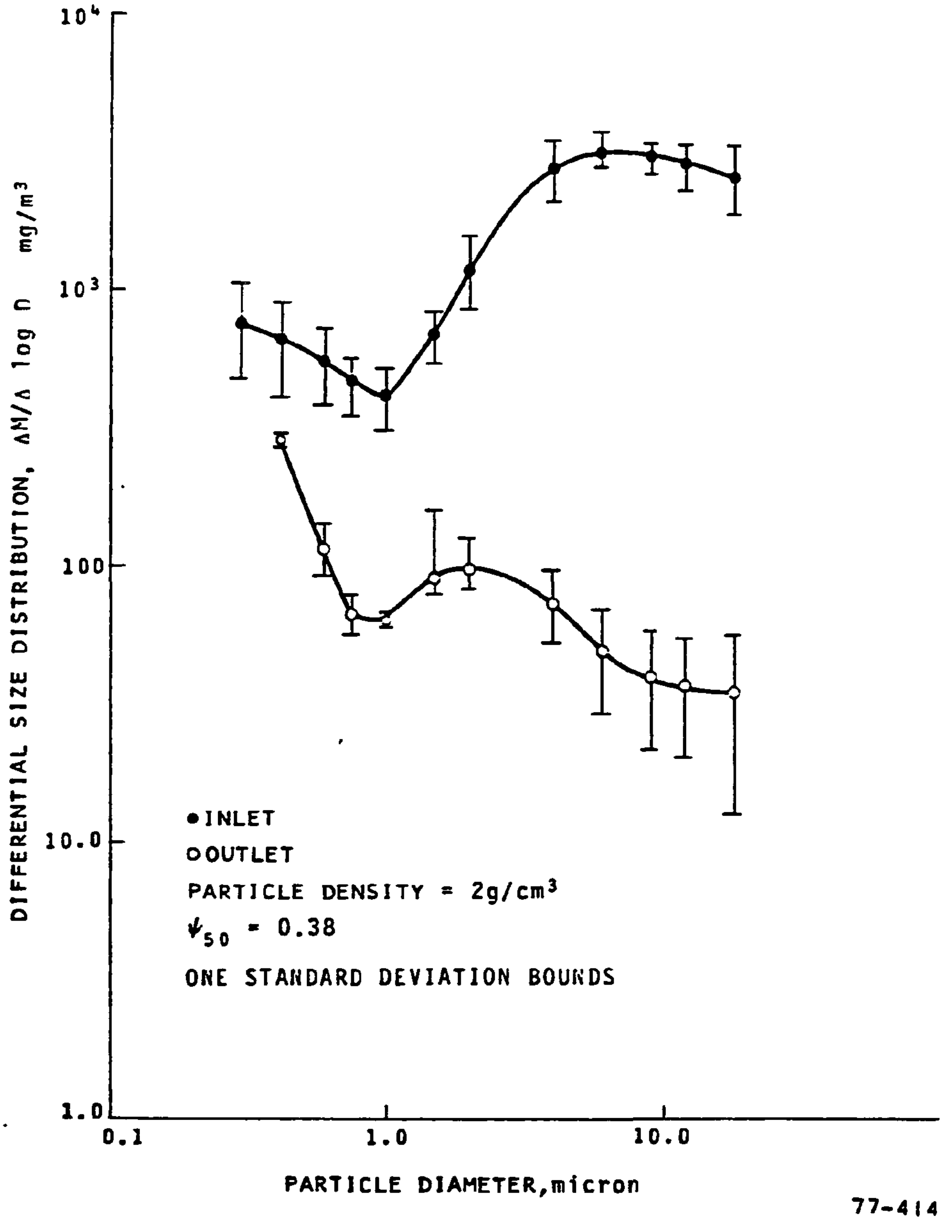

Figure 5-3. Differential Particle Size Distribution for August 30, 1976

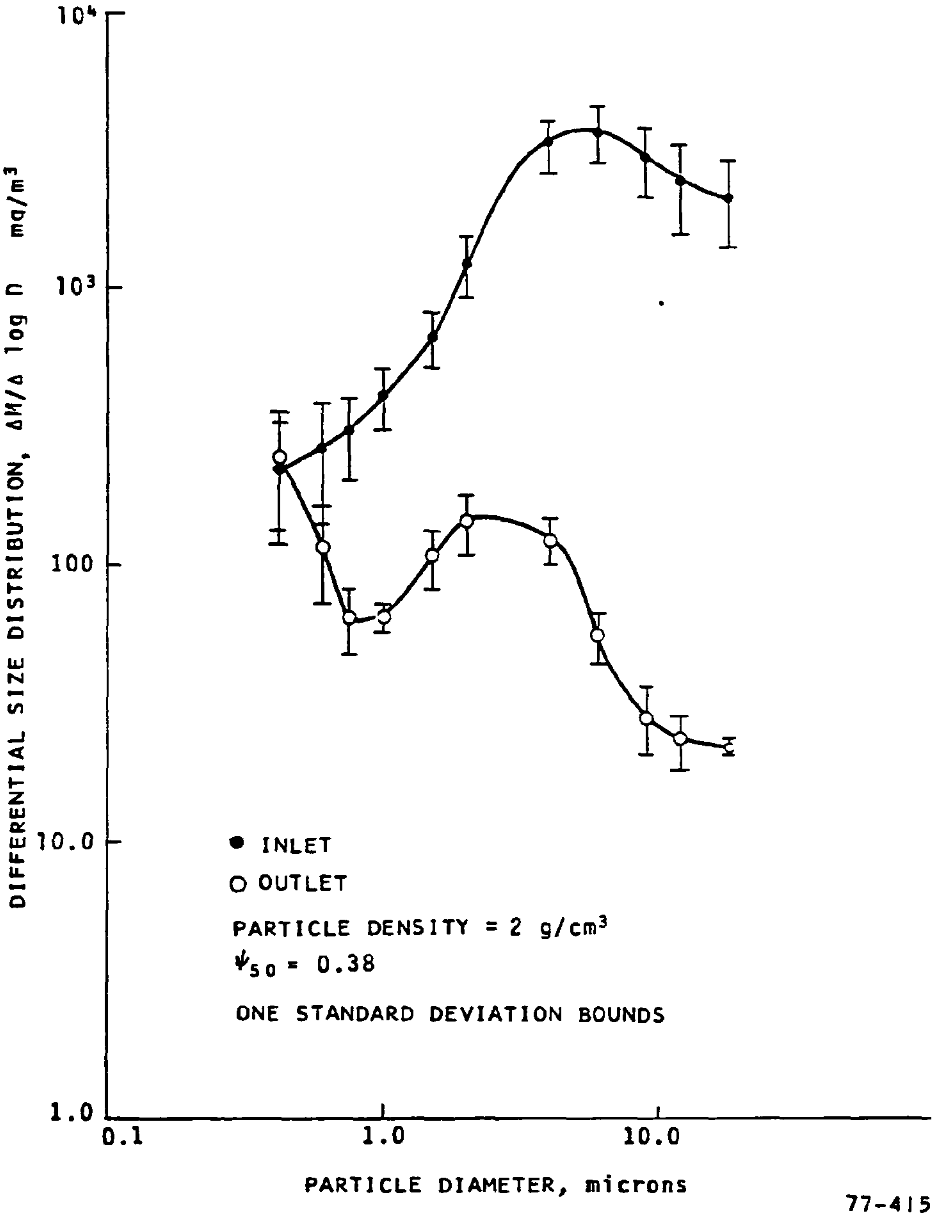

Figure 5-4. Differential Particle Size Distribution for August 31, 1976

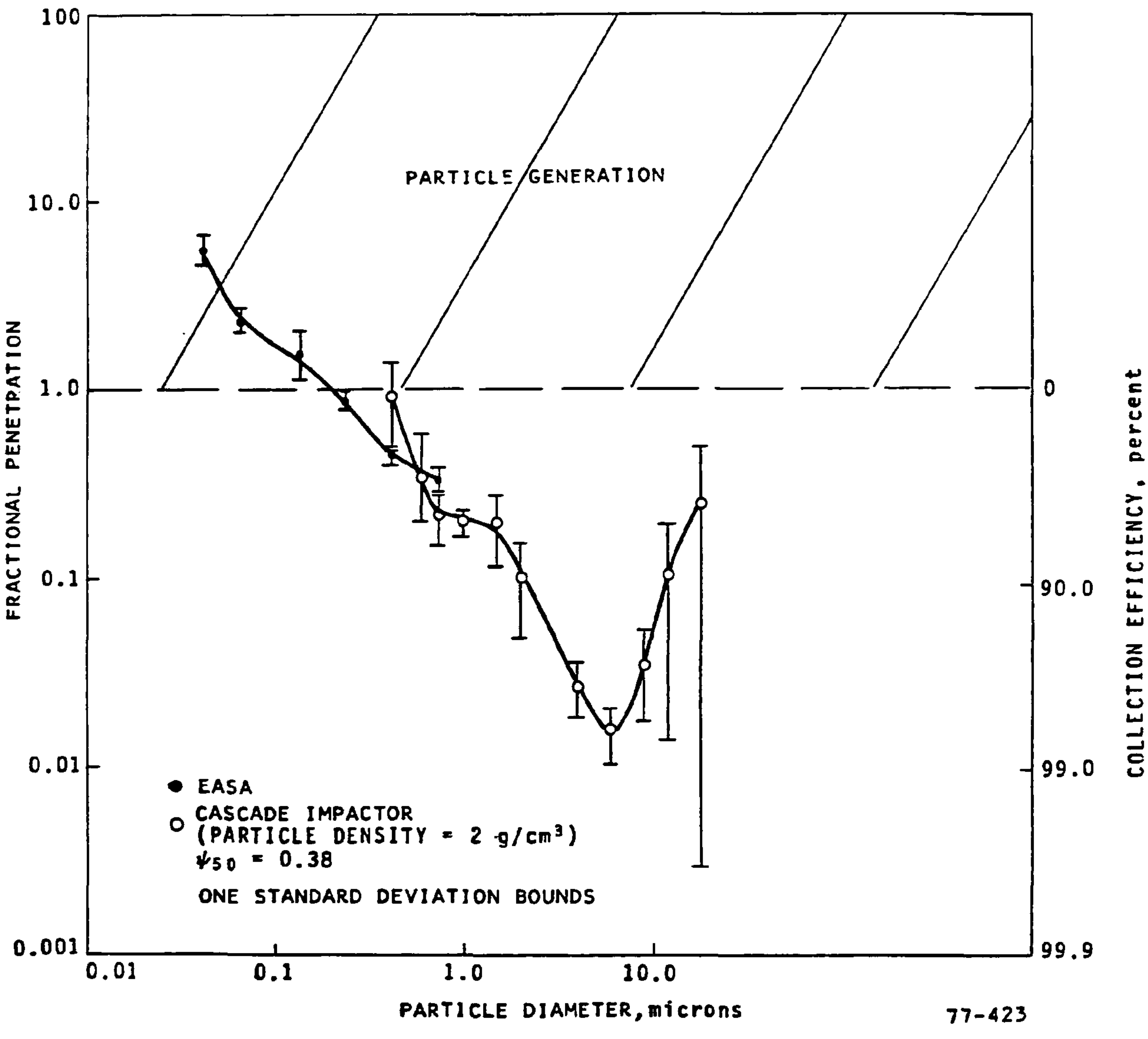

Figure 5-5. Fractional Penetration As a Function of Actual Particle Diameter for August 29, 1976

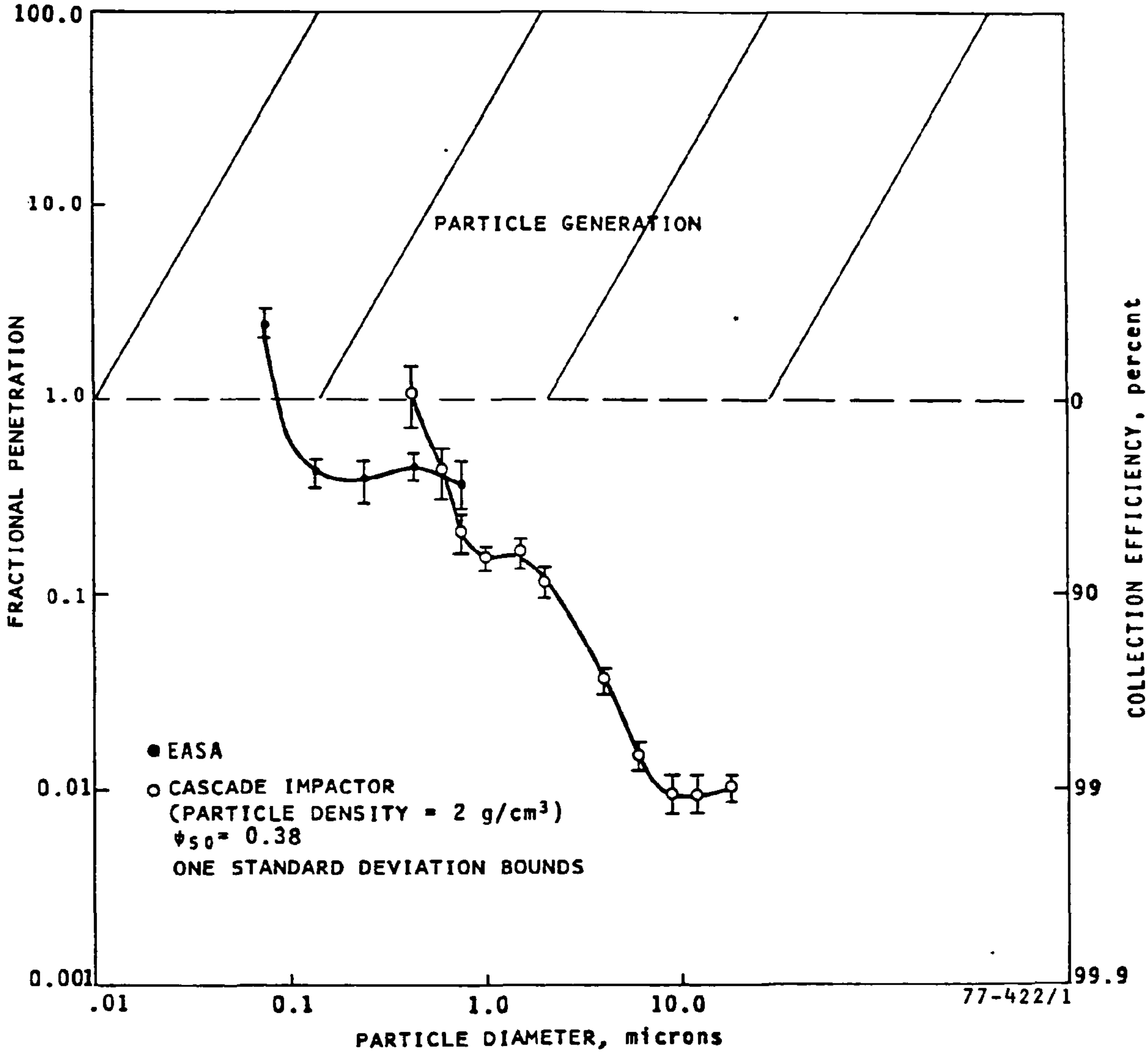

Figure 5-6. Fractional Penetration As a Function of Actual Particle Diameter for August 29, 1976

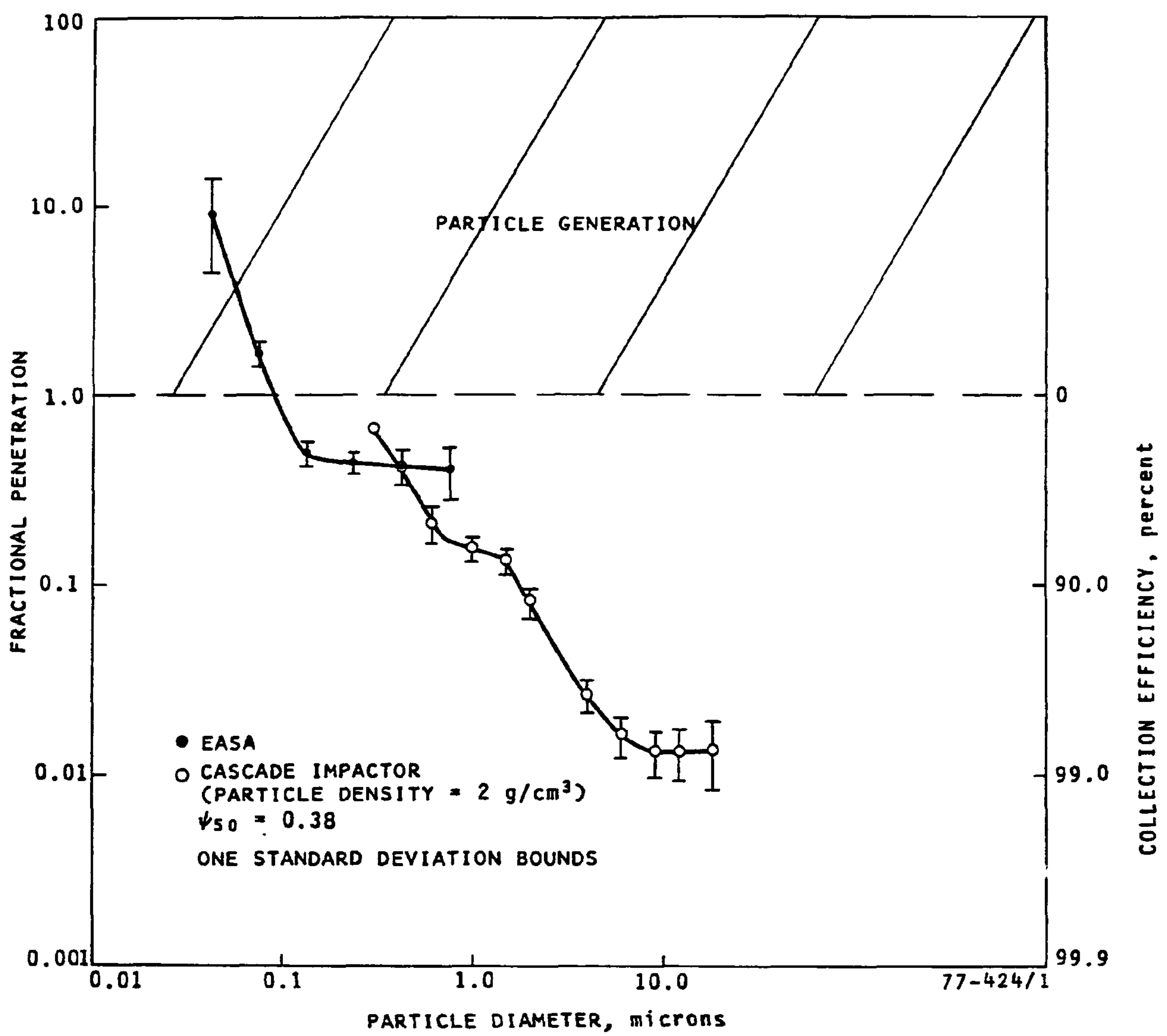

Figure 5-7. Fractional Penetration as a Function of Actual Particle Diameter for August 31, 1976

Particle Generation

Submicron particle generation was observed during all three days. An estimation of the amount of particulate matter formed is reported in Table 5-6.

The temperature of the gas at the cooling section outlet was measured with a dial thermometer, and the gas was assumed to be saturated with water at that point. The rate of water evaporated was used with the concentration of dissolved solids in the supply water to estimate the amount of solids formed in the scrubber. These estimates of particulate formation do explain the day-to-day variation of aerosol generation in a qualitative fashion.

The particulate matter is believed to form primarily from evaporation of water in the cooling section. In the remainder of the scrubber, water vapor is being condensed, probably from sensible heat transfer from the incoming scrubbing water. The condensing conditions may possibly aid the scrubber efficiency through particle growth and phoretic forces. However, it is apparent that the submicron particles formed in the cooling section are not efficiently captured in the main chamber of the scrubber. The efficiency of the scrubber could be improved by using water with low dissolved solids in the cooling section.

The increased concentration of particles greater than 5 microns in diameter observed in some impactor tests was not due to particulate generation in the scrubber. The water droplets were not separated from the aerosol by a precutter but were evaporated with a heated nozzle at the inlet of the impactor. The residue of the droplets was collected on the first two or three stages of the impactor. Thus, the effects of liquid carry-over on emissions can be measured.

SCRUBBER PERFORMANCE

Calculation of Aerodynamic Cut Diameter

The aerodynamic diameter as defined by Calvert et al (1972) is given by

$$d_{aero} = d_{actual} \sqrt{C\rho}$$

where

C = Cunningham correction factor

ρ = Particle density, g/cm^3

d_{actual} = Actual cut diameter, microns

TABLE 5-6. ESTIMATION OF AEROSOL GENERATION

Date	8/29/76			8/30/76			8/31/76		
Location	Inlet	Cooler Outlet	Scrubber Outlet	Inlet	Cooler Outlet	Scrubber Outlet	Inlet	Cooler Outlet	Scrubber Outlet
Temperature, °C	277	52	69	275	54	69	284	54	643
(°F)	(531)	(125)	(115)	(527)	(130)	(115)	(543)	(130)	(110)
Absolute Humidity, (lb H_2O/lb Gas)	0.0509[a]	0.0955[b]	0.0692[b]	0.0992[a]	0.11[b]	0.0692	0.0793[a]	0.11[b]	0.0595[b]
Gas Flow, m^3/sec	18.5			20.5			19.7		
(dscfm)	(39,100)			(43,400)			(41,800)		
Increase H_2O Concentration through Cooler, gmH_2O/gm Gas		0.0446			0.0108			0.0307	
(lb H_2O/lb Gas)		(0.0446)			(0.0108)			(0.0307)	
Water Evaporated in Cooler kg/min (lb/min)		60.6 (133.4)			16.3 (35.9)			44.6 (98.2)	
Suspended Solids, mg/l	nil		4,000	100		3,300	60		3,000
Dissolved Solids, mg/l	6,440		6,480	6,190		6,170	6,200		6,000
Dissolved Solids Evaporated, gm/min		390			101			276	
Evaporated Solids Concentration, gm/dsm^3		0.34			0.082			0.23	
(gr/dscf)		(0.15)			(0.036)			(0.10)	

a--Measured

b--Assuming gas saturated with water (Perry, 1963)

The actual cut diameters were taken from Figures 5-5 to 5-7. The aerodynamic cut diameters were then computed using the above formula. The calculation is summarized in Table 5-6.

Comparison To Other Scrubber Types

The aerodynamic cut diameters calculated in Table 5-7 combined with the power requirements from Table 5-4 are shown in Figure 5-8. The mean aerodynamic cut diameters are below the theoretical performance curve for the venturi scrubber. This suggests that the horizontal spray chamber is more efficient particle collector for a given power input than the venturi case. However, the error bounds are sufficiently broad to limit conclusions.

OPACITY

The PPV proved to be a useful monitor of real-time operation of the scrubber. The inlet PPV performance was limited by the buildup of particulate matter on the flash lamp lens. An example of the opacity data is shown in Figure 5-9. The opacity at the inlet and outlet are summarized in Table 5-8. The outlet opacity was about 30 percent of the inlet opacity from particulate removal in the scrubber.

TABLE 5-7. CALCULATION OF AERODYNAMIC CUT DIAMETERS

Date	Cut Diameters (Density = 2g/cm^3) micron		C	$\sqrt{\rho C}$ (g/cm^3)	d_{aero} micron
8/29	+Standard Deviation	0.70	1.275	1.60	1.12
	Mean	0.50	1.39	1.67	0.83
	-Standard Deviation	0.35	1.55	1.76	0.62
8/30	+Standard Deviation	0.46	1.42	1.69	0.78
	Mean	0.39	1.50	1.73	0.68
	-Standard Deviation	0.33	1.59	1.78	0.59
8/31	+Standard Deviation	0.70	1.275	1.60	1.12
	Mean	0.58	1.33	1.63	0.95
	-Standard Deviation	0.46	1.42	1.69	0.78

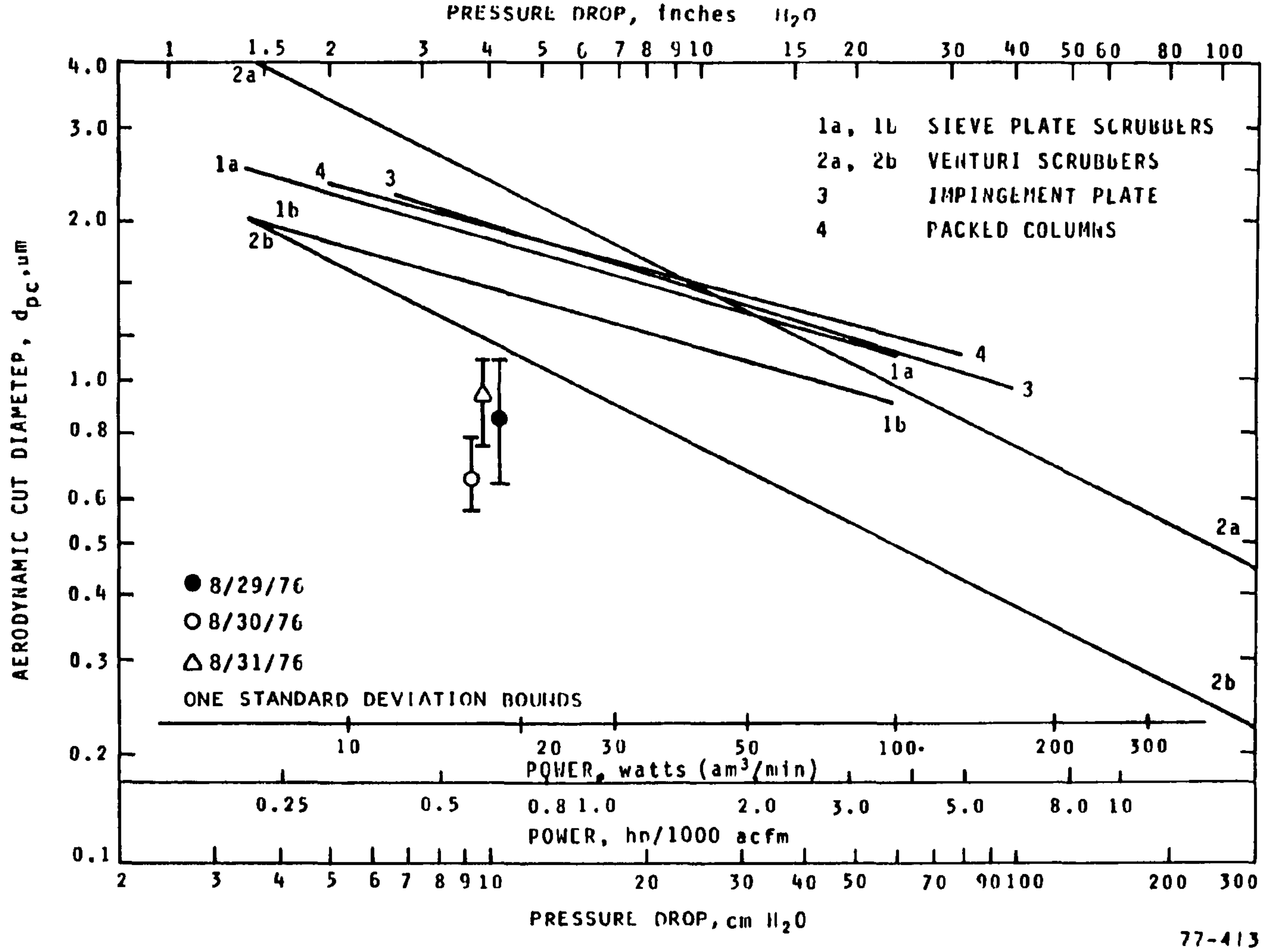

Figure 5-8. Aerodynamic Cut-Diameters of the FRP-100 Scrubber Compared to the Theoretical Performance of Other Scrubber Types, (after Cooper and Anderson (1975), adapted from Calvert (1974)

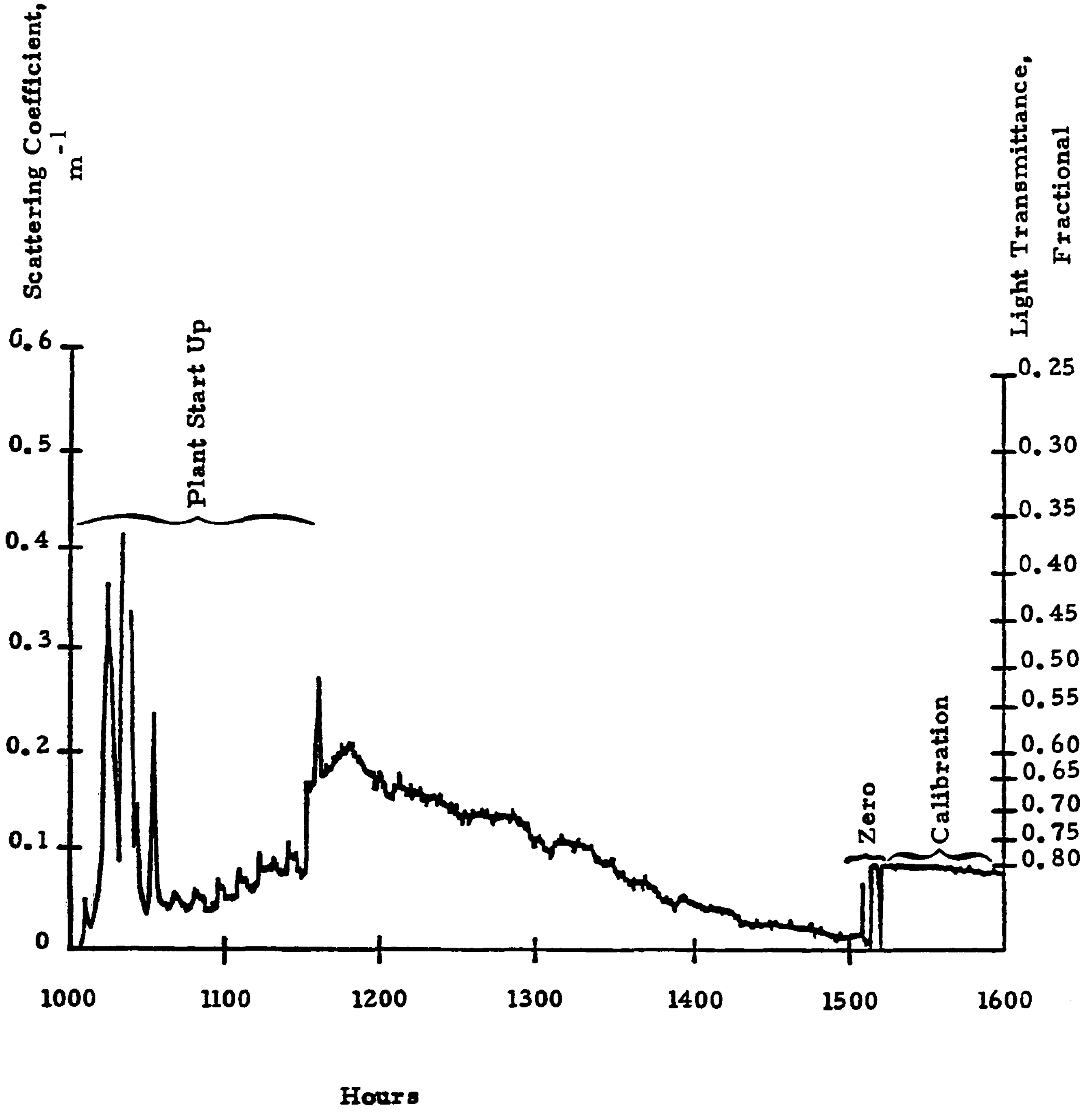

Figure 5-9. Outlet Scattering Coefficients Measured with Plant Process Visiometer, August 29, 1976

TABLE 5-8. SUMMARY OF MEASURED OPACITY

	Duct Temp. °C (°F)	PPV Temp. °C (°F)	b_{scat} m^{-1}	Opacity[a] %
Inlet				
Typical	288-304	116-127	1.4	97
Range	(550-580)	(240-260)	0.62-1.86	77-99
Outlet				
Typical	43-46	82-93	0.162	33
Range	(110-115)	(180-200)	0.134-0.165	28-33

a -- Computed using an 8-foot path length.
$\text{Opacity} = 100\ (1 - \exp\ (-b_{scat}8 \times 0.3048))$

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APPENDIX A

MANUFACTURER'S DESCRIPTION OF SCRUBBER

The following is a description of the control device provided in a brochure prepared by Century Industrial Products. It indicates the principles guiding the design and the specifications for the scrubber.

Cooling -- Hot, particulate-laden gases, often containing oxides of sulfur and other noxious fumes, are first introduced to a cooling section where rapid quenching occurs through exposure to cooling sprays. Inlet temperatures of over 500°F are acceptable. Gases are cooled to approximately 170°F upon entering the main scrubbing shell. A film cooling technique is employed to augment the evaporative cooling sprays in maintaining temperatures well below tolerance levels of the fiberglass used in the cooling system housing the main scrubber shell.

Particulate Scrubbing -- The capture of fine particulates by water spray and subsequent removal of the particulate-laden water droplets have been the principal mechanisms for the control of this type of emission from industrial processes for many years. In most devices based on these mechanisms, the dust particle and the water droplet is important to efficient dust capture. Hence, many scrubber designs in use today are of the so-called medium to high energy types.

Century's research efforts have determined that the most important parameter governing the performance of a scrubber is the mean free path* in collisions between dust particles and water droplets; and that mean free path does not depend on the relative velocity between the dust particle and the water droplet, but rather on the density of water droplets (the number of droplets per unit volume). The higher the density, the shorter the mean free path, and the higher will be the probability of collisions between particulates and water droplets.

However, if the water droplets are too small, they are swept away readily by the gas stream and droplet-particulate

*The path an object takes before it hits another object.

collisions become unlikely. Required, then, is a low velocity gas stream in order to maximize the scrubbing action available in a high density field of fine water droplets. The FRP-100 achieves this by utilizing a long, horizontal shell configuration with a large diameter. Gas velocity is thus dramatically reduced and, therefore, the time available for particulates to collide with the fine water droplets is increased.

The collisions between particles and water droplets occur mainly in the forward section of the scrubber shell where four arrays of nozzles produce fine spray droplets of about 200 microns in diameter. Once these droplets have captured dust particles, the new droplet-particle combinations must themselves be trapped and coalesced into a stream for discharge out of the scrubber before they can be swept out of the scrubber by the gas stream.

Capture of the droplet-particle combinations is accomplished by another four arrays of nozzles producing coarse spray droplets of about 2,000 microns in diameter. These coarse droplets capture the particulate-laden small water droplets in much the same way the latter captured the still smaller dust particles. The large droplets are not swept away by the gas stream due to their greater mass, but impinge directly against the inside wall of the scrubber shell. They then flow by gravity to the bottom of the shell and collect for drainage out of the rear of the scrubber.

SO_2 Removal -- The same principles of operation (moving gases at low velocity through multi-stages of water droplets) provide a means for absorbing the water-soluble gases. The FRP-100 utilizes 900 GPM of fluid, which, when atomized by the spray nozzles, creates an exceedingly high liquid surface area for contact with gases. While efficiencies in SO_2 removal are dependent upon the alkalinity of the scrubbing fluid, the SO_2 concentration, and gas flow rate through the scrubber, significant removal is obtainable using only moderately alkaline (not slurry) water supplies.

Dimensions of the FRP-100 Scrubber

The scrubbing section of the FRP-100 Scrubber is 12 feet inside diameter and 40 feet long. The cooling section is 8 feet long by approximately 6 feet in diameter. Exhaust stacks are custom designed for particular applications.

APPENDIX B

ESTIMATION OF CAPITAL AND INSTALLATION COSTS FOR FRP-100 SCRUBBER

Scrubber rated at 100,000 acfm with 70-foot stack	$120,000
Freight (1500 to 1800 miles)	4,000
Foundations, material and labor	4,000
Pumps (assumes water is available 500 feet from scrubber)	8,000
1. 60 psig main pump	
2. 60 psig main standby	
3. Booster pump	
Electrical components and labor	2,000
Pipe, valves, and fittings (Schedule 80, PVC pipe)	4,000
Ducting	5,000
Support for 70-foot stack	
Steel	8,000
Foundation	2,000
Installation labor (200 manhours)	3,000
Testing	3,000
Spare parts	3,000

The above costing is based on information supplied by Century Industrial Products. The actual installation costs may vary greatly depending on site and availability of water.

APPENDIX C
TEST DATA

COAL ANALYSIS

Heat Content	7341	cal/gm
Moisture	2.96	percent
Volatiles	41.4	percent
Fixed Carbon	48.8	percent
Ash	10.15	percent
Sulfur	1.26	percent

TITLE: OUTLET 25A 8/29/76 2005 HRS IMPACTOR 120 JET PLATE 106 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	5.0	MINUTES	TEMP IMPACTOR =	121.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.39	IN.	VELOCITY =	20.21	FT/SEC
BARO. PRES =	29.29	INCH HG	SAMPLE RATE =	.57	CF(STACK COND.)
NOZZLE DIA. =	.3125	INCHES	TOTAL VOLUME(STACK) =	2.85	CF(STACK COND.)
VOL. METER =	2.28	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.735E-02	INCH HG
COND. WATER =	6.1	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	12.17	
VOLUME GAS STD. DRY =	.632E-01	CUBIC METER
PERCENT ISOKINETIC =	88.16	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SURT PSI50
1	1.01	8.	.864E+00	.193E+02	.573E+02	.133E+02	.210E+03	.468E+03	.697E+03	.38
2	1.02	12.	.476E+00	.963E+01	.126E+03	.957E+00	.151E+02	.258E+03	.502E+02	.38
3	1.05	24.	.203E+00	.374E+01	.345E+03	.202E+01	.320E+02	.243E+03	.778E+02	.38
4	1.11	24.	.125E+00	.175E+01	.916E+03	.131E+01	.207E+02	.211E+03	.629E+02	.38
5	1.18	24.	.889E-01	.102E+01	.180E+04	.149E+01	.236E+02	.190E+03	.100E+03	.38
6	1.43	24.	.541E-01	.441E+00	.487E+04	.248E+01	.392E+02	.167E+03	.108E+03	.38
7	1.67	12.	.541E-01	.288E+00	.974E+04	.295E+01	.467E+02	.127E+03	.253E+03	.38
				FILTER WEIGHT		.510E+01	.807E+02	.807E+02		
				TOTAL WEIGHT		.296E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	85.91	293.
2	.420	123.0	203.
3	.600	146.1	123.
4	.750	156.6	97.0
5	1.00	166.2	90.8
6	1.50	183.9	91.1
7	2.00	194.2	74.6
8	4.00	213.3	71.2
9	6.00	227.3	77.8
10	9.00	240.7	68.2
11	12.0	248.5	56.3
12	18.0	256.9	40.8

TITLE: INLET2 SIF 8/29/76 1726 HRS IMPACTOR 118 JET PLATE 102 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	3.0	MINUTES	TEMP IMPACTOR =	538.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	36.09	FT/SEC
BARO. PRES =	29.29	INCH HG	SAMPLE RATE =	.18	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.54	CF(STACK COND.)
VOL. METER =	.28	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 3.22
VOLUME GAS STD. DRY = .776E-02 CUBIC METER
PERCENT ISOKINETIC = 98.46

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.416E+02	.185E+02	.845E+01	.109E+04	.352E+04	.361E+04	.38
2	1.02	12.	.476E+00	.208E+02	.401E+02	.450E+00	.580E+02	.243E+04	.192E+03	.38
3	1.04	20.	.203E+00	.808E+01	.110E+03	.204E+01	.263E+03	.238E+04	.641E+03	.38
4	1.10	24.	.125E+00	.380E+01	.292E+03	.585E+01	.754E+03	.211E+04	.230E+04	.38
5	1.16	24.	.889E-01	.222E+01	.575E+03	.423E+01	.545E+03	.136E+04	.234E+04	.38
6	1.38	24.	.541E-01	.967E+00	.155E+04	.292E+01	.377E+03	.814E+03	.105E+04	.38
7	1.95	6.	.541E-01	.406E+00	.621E+04	.350E+00	.451E+02	.437E+03	.120E+03	.38
				FILTER WEIGHT		.304E+01	.392E+03	.392E+03		
				TOTAL WEIGHT		.273E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	392.6	46.0
3	.600	404.8	112.
4	.750	417.6	190.
5	1.00	443.6	466.
6	1.50	580.9	.108E+04
7	2.00	742.7	.163E+04
8	4.00	1419.	.247E+04
9	6.00	1846.	.217E+04
10	9.00	2168.	.132E+04
11	12.0	2282.	738.
12	18.0	2368.	348.

TITLE: INLET2 32F 8/29/76 1732 HRS IMPACTOR 108 JET PLATE 103 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	3.0	MINUTES	TEMP IMPACTOR =	538.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.01	IN.	VELOCITY =	36.09	FT/SEC
BARO. PRES =	29.29	INCH HG	SAMPLE RATE =	.18	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.54	CF(STACK COND.)
VOL. METER =	.28	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.22	
VOLUME GAS STD. DRY =	.776E-02	CUBIC METER
PERCENT ISOKINETIC =	98.46	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.416E+02	.183E+02	.532E+02	.685E+04	.134E+05	.227E+05	.38
2	1.02	12.	.476E+00	.208E+02	.401E+02	.705E+01	.909E+03	.653E+04	.301E+04	.38
3	1.04	24.	.203E+00	.808E+01	.110E+03	.132E+02	.171E+04	.562E+04	.416E+04	.38
4	1.10	24.	.125E+00	.380E+01	.292E+03	.151E+02	.194E+04	.392E+04	.592E+04	.38
5	1.16	24.	.889E-01	.222E+01	.575E+03	.686E+01	.885E+03	.197E+04	.379E+04	.38
6	1.38	24.	.541E-01	.967E+00	.155E+04	.181E+01	.233E+03	.109E+04	.648E+03	.38
7	1.95	6.	.541E-01	.406E+00	.621E+04	.900E+00	.116E+03	.856E+03	.308E+03	.38
				FILTER WEIGHT		.573E+01	.739E+03	.739E+03		
				TOTAL WEIGHT		.104E+03				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	741.5	148.
3	.600	775.4	291.
4	.750	807.9	399.
5	1.00	864.9	545.
6	1.50	979.0	648.
7	2.00	1060.	.154E+04
8	4.00	2103.	.516E+04
9	6.00	3131.	.588E+04
10	9.00	4143.	.510E+04
11	12.0	4711.	.429E+04
12	18.0	5405.	.365E+04

TITLE: INLET1 33F 8/29/76 1837 HRS IMPACTOR 117 JET PLATE 104 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	3.0	MINUTES	TEMP IMPACTOR =	522.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.01	IN.	VELOCITY =	36.72	FT/SEC
BARO. PRES =	29.29	INCH HG	SAMPLE RATE =	.18	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.54	CF(STACK COND.)
VOL. METER =	.28	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.588E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.22	
VOLUME GAS STD. DRY =	.776E-02	CUBIC METER
PERCENT ISOKINETIC =	95.19	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.417E+02	.180E+02	.444E+02	.573E+04	.111E+05	.190E+05	.38
2	1.02	12.	.476E+00	.208E+02	.394E+02	.416E+01	.536E+03	.532E+04	.178E+04	.38
3	1.04	24.	.203E+00	.810E+01	.108E+03	.136E+02	.175E+04	.478E+04	.427E+04	.38
4	1.09	24.	.125E+00	.381E+01	.288E+03	.114E+02	.148E+04	.304E+04	.450E+04	.38
5	1.16	24.	.889E-01	.222E+01	.566E+03	.378E+01	.487E+03	.156E+04	.209E+04	.38
6	1.37	24.	.541E-01	.973E+00	.153E+04	.177E+01	.228E+03	.107E+04	.635E+03	.38
7	1.92	6.	.541E-01	.411E+00	.611E+04	.850E+00	.110E+03	.845E+03	.293E+03	.38
				FILTER WEIGHT		.570E+01	.735E+03	.735E+03		
				TOTAL WEIGHT		.857E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	736.2	127.
3	.600	767.0	272.
4	.750	797.7	323.
5	1.00	846.1	372.
6	1.50	917.0	660.
7	2.00	1022.	.114E+04
8	4.00	1644.	.344E+04
9	6.00	2397.	.462E+04
10	9.00	3262.	.477E+04
11	12.0	3841.	.440E+04
12	18.0	4557.	.350E+04

TITLE: INLET3 34F 8/29/76 1843 HRS IMPACTOR 109 JET PLATE 101 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	3.0	MINUTES	TEMP IMPACTOR =	529.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.01	IN.	VELOCITY =	37.51	FT/SEC
BARO. PRES =	29.29	INCH HG	SAMPLE RATE =	.18	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.54	CF(STACK COND.)
VOL. METER =	.28	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.588E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.22	
VOLUME GAS STD. DRY =	.776E-02	CUBIC METER
PERCENT ISOKINETIC =	93.87	

SIZE DISTRIBUTION RESULTS

PLATE	CUN CUR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.417E+02	.181E+02	.550E+02	.709E+04	.117E+05	.235E+05	.38
2	1.02	12.	.476E+00	.208E+02	.397E+02	.515E+01	.663E+03	.460E+04	.220E+04	.38
3	1.04	24.	.203E+00	.809E+01	.109E+03	.648E+01	.836E+03	.394E+04	.204E+04	.38
4	1.09	24.	.125E+00	.380E+01	.290E+03	.796E+01	.103E+04	.310E+04	.313E+04	.38
5	1.16	24.	.889E-01	.222E+01	.570E+03	.725E+01	.935E+03	.207E+04	.400E+04	.38
6	1.37	24.	.541E-01	.970E+00	.154E+04	.180E+01	.232E+03	.114E+04	.645E+03	.38
7	1.93	6.	.541E-01	.409E+00	.616E+04	.126E+01	.162E+03	.907E+03	.431E+03	.38
				FILTER WEIGHT		.578E+01	.745E+03	.745E+03		
				TOTAL WEIGHT		.907E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	749.1	328.
3	.600	807.0	419.
4	.750	850.3	487.
5	1.00	915.5	579.
6	1.50	1029.	645.
7	2.00	1110.	.172E+04
8	4.00	2153.	.373E+04
9	6.00	2733.	.300E+04
10	9.00	3205.	.238E+04
11	12.0	3474.	.208E+04
12	18.0	3821.	.198E+04

TITLE: OUTLET SSF 8/29/76 2057 HRS IMPACTOR 116 JET PLATE 105 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	10.0	MINUTES	TEMP IMPACTOR =	121.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.24	IN.	VELOCITY =	20.21	FT/SEC
BARO. PRES =	29.29	INCH HG	SAMPLE RATE =	.43	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	4.33	CF(STACK COND.)
VOL. METER =	3.47	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.735E-02	INCH HG
COND. WATER =	9.3	CC	VISCOSITY =	.191E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	12.16	
VOLUME GAS STD. DRY =	.962E-01	CUBIC METER
PERCENT ISOKINETIC =	104.78	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PS150
1	1.01	8.	.864E+00	.221E+02	.436E+02	.212E+02	.221E+03	.920E+03	.733E+03	.38
2	1.02	12.	.476E+00	.111E+02	.956E+02	.290E+02	.301E+03	.699E+03	.999E+03	.38
3	1.04	24.	.203E+00	.430E+01	.265E+03	.183E+01	.190E+02	.598E+03	.464E+02	.38
4	1.09	24.	.125E+00	.202E+01	.697E+03	.636E+01	.661E+02	.579E+03	.202E+03	.38
5	1.16	24.	.889E-01	.118E+01	.137E+04	.522E+01	.543E+02	.313E+03	.233E+03	.38
6	1.36	24.	.541E-01	.517E+00	.370E+04	.205E+01	.214E+02	.259E+03	.595E+02	.38
7	1.56	12.	.541E-01	.342E+00	.741E+04	.192E+01	.200E+02	.237E+03	.111E+03	.38
					FILTER WEIGHT	.209E+02	.217E+03	.217E+03		
					TOTAL WEIGHT	.885E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	228.1	99.8
3	.600	239.4	61.3
4	.750	243.9	56.0
5	1.00	252.4	109.
6	1.50	281.3	212.
7	2.00	311.8	234.
8	4.00	374.1	129.
9	6.00	385.9	48.1
10	9.00	394.1	172.
11	12.0	421.1	540.
12	18.0	584.3	.116E+04

TITLE: OUTLET 36A 8/30/76 1128 HRS IMPACTOR 116 JET PLATE 105 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	10.0	MINUTES	TEMP IMPACTOR =	121.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	70.	DEGS. F
METER PRES =	.19	IN.	VELOCITY =	16.56	FT/SEC
BARO. PRES =	29.36	INCH HG	SAMPLE RATE =	.54	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	5.36	CF(STACK COND.)
VOL. METER =	3.22	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.36	INCH HG	STACK SUCTION =	.441E-02	INCH HG
COND. WATER =	32.3	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 34.14
VOLUME GAS STD. DRY = .894E-01 CUBIC METER
PERCENT ISOKINETIC = 158.29

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL. CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.199E+02	.540E+02	.648E+01	.724E+02	.423E+03	.240E+03	.38
2	1.02	12.	.476E+00	.993E+01	.118E+03	.111E+01	.124E+02	.351E+03	.411E+02	.38
3	1.05	24.	.203E+00	.386E+01	.325E+03	.260E+01	.291E+02	.338E+03	.708E+02	.38
4	1.10	24.	.125E+00	.181E+01	.863E+03	.350E+01	.391E+02	.309E+03	.119E+03	.38
5	1.18	24.	.889E-01	.105E+01	.170E+04	.209E+01	.233E+02	.270E+03	.994E+02	.38
6	1.41	24.	.541E-01	.457E+00	.458E+04	.277E+01	.310E+02	.247E+03	.853E+02	.38
7	1.64	12.	.541E-01	.300E+00	.917E+04	.579E+01	.647E+02	.216E+03	.353E+03	.38
				FILTER WEIGHT		.135E+02	.151E+03	.151E+03		
				TOTAL WEIGHT		.379E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	151.6	442.
2	.420	205.7	275.
3	.600	232.9	125.
4	.750	241.8	70.0
5	1.00	246.8	64.2
6	1.50	261.9	105.
7	2.00	275.7	115.
8	4.00	310.9	98.2
9	6.00	325.2	72.2
10	9.00	336.3	55.6
11	12.0	342.6	45.9
12	18.0	349.6	32.2

TITLE: OUTLET 37A 8/30/76 1231 HRS IMPACTOR 120 JET PLATE 106 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	10.0	MINUTES	TEMP IMPACTOR =	121.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	75.	DEGS. F
METER PRES =	.17	IN.	VELOCITY =	16.56	FT/SEC
BARO. PRES =	29.36	INCH HG	SAMPLE RATE =	.51	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	5.09	CF(STACK COND.)
VOL. METER =	3.06	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.36	INCH HG	STACK SUCTION =	.441E-02	INCH HG
COND. WATER =	30.7	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	34.13	
VOLUME GAS STD. DRY =	.850E-01	CUBIC METER
PERCENT ISOKINETIC =	150.41	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.204E+02	.513E+02	.675E+01	.794E+02	.476E+03	.263E+03	.38
2	1.02	12.	.476E+00	.102E+02	.112E+03	.139E+01	.164E+02	.396E+03	.544E+02	.38
3	1.05	24.	.203E+00	.396E+01	.309E+03	.150E+01	.176E+02	.380E+03	.430E+02	.38
4	1.10	24.	.125E+00	.186E+01	.820E+03	.205E+01	.242E+02	.362E+03	.735E+02	.38
5	1.17	24.	.889E-01	.108E+01	.161E+04	.196E+01	.231E+02	.338E+03	.985E+02	.38
6	1.40	24.	.541E-01	.471E+00	.436E+04	.265E+01	.312E+02	.315E+03	.861E+02	.38
7	1.62	12.	.541E-01	.309E+00	.871E+04	.531E+01	.625E+02	.284E+03	.343E+03	.38
				FILTER WEIGHT		.188E+02	.221E+03	.221E+03		
				TOTAL WEIGHT		.404E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	269.7	282.
3	.600	298.8	135.
4	.750	308.3	76.5
5	1.00	314.4	66.6
6	1.50	328.9	93.6
7	2.00	340.6	86.6
8	4.00	362.2	55.7
9	6.00	370.3	43.6
10	9.00	377.6	43.8
11	12.0	383.3	49.4
12	18.0	392.9	57.5

TITLE: OUTLET 38F 8/30/76 1939 HRS IMPACTOR 120 JET PLATE 106 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	10.0	MINUTES	TEMP IMPACTOR =	121.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.16	IN.	VELOCITY =	16.56	FT/SEC
BARO. PRES =	29.30	INCH HG	SAMPLE RATE =	.52	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	5.21	CF(STACK COND.)
VOL. METER =	3.13	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.30	INCH HG	STACK SUCTION =	.441E-02	INCH HG
COND. WATER =	31.4	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 34.18

VOLUME GAS STD. DRY = .868E-01 CUBIC METER

PERCENT ISOKINETIC = 153.95

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.202E+02	.525E+02	.233E+01	.269E+02	.317E+03	.890E+02	.38
2	1.02	12.	.476E+00	.101E+02	.115E+03	.470E+00	.542E+01	.291E+03	.180E+02	.38
3	1.05	24.	.203E+00	.391E+01	.316E+03	.111E+01	.128E+02	.285E+03	.312E+02	.38
4	1.10	24.	.125E+00	.183E+01	.839E+03	.281E+01	.324E+02	.272E+03	.985E+02	.38
5	1.17	24.	.889E-01	.107E+01	.165E+04	.147E+01	.169E+02	.240E+03	.723E+02	.38
6	1.40	24.	.541E-01	.464E+00	.446E+04	.176E+01	.203E+02	.223E+03	.560E+02	.38
7	1.63	12.	.541E-01	.305E+00	.892E+04	.647E+01	.745E+02	.203E+03	.407E+03	.38
					FILTER WEIGHT	.111E+02	.128E+03	.128E+03		
					TOTAL WEIGHT	.275E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	188.9	287.
3	.600	209.0	88.4
4	.750	214.4	56.0
5	1.00	221.4	60.8
6	1.50	233.2	78.8
7	2.00	243.9	92.4
8	4.00	272.9	68.0
9	6.00	280.4	33.3
10	9.00	284.6	20.2
11	12.0	286.8	17.7
12	18.0	289.9	14.2

TITLE: INLET 2 40F 8/30/76 1537 HRS IMPACTOR 109 JET PLATE 101 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	4.0 MINUTES		TEMP IMPACTOR =	530.	DEGS. F
METER TEMP. =	70. DEGS. F		TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.04 IN.		VELOCITY =	42.10	FT/SEC
BARO. PRES =	29.35 INCH HG		SAMPLE RATE =	.30	CF(STACK COND.)
NOZZLE DIA. =	.1250 INCHES		TOTAL VOLUME(STACK) =	1.21	CF(STACK COND.)
VOL. METER =	.61 CUBIC FEET		PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.35 INCH HG		STACK SUCTION =	.367E-02	INCH HG
COND. WATER =	.8 CC		VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 6.12
VOLUME GAS STD. DRY = .169E-01 CUBIC METER
PERCENT ISOKINETIC = 141.08

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.321E+02	.306E+02	.804E+02	.475E+04	.906E+04	.157E+05	.38
2	1.02	12.	.476E+00	.160E+02	.670E+02	.155E+02	.915E+03	.431E+04	.303E+04	.38
3	1.06	24.	.203E+00	.619E+01	.184E+03	.237E+02	.140E+04	.340E+04	.340E+04	.38
4	1.12	24.	.125E+00	.289E+01	.489E+03	.110E+02	.649E+03	.200E+04	.196E+04	.38
5	1.21	24.	.889E-01	.167E+01	.962E+03	.498E+01	.294E+03	.135E+04	.124E+04	.38
6	1.51	24.	.541E-01	.712E+00	.260E+04	.334E+01	.197E+03	.105E+04	.531E+03	.38
7	2.40	6.	.541E-01	.282E+00	.104E+05	.560E+01	.331E+03	.858E+03	.824E+03	.38
					FILTER WEIGHT	.892E+01	.527E+03	.527E+03		
					TOTAL WEIGHT	.153E+03				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	552.1	956.
2	.420	683.7	846.
3	.600	805.6	671.
4	.750	866.5	566.
5	1.00	923.0	503.
6	1.50	1024.	761.
7	2.00	1136.	.109E+04
8	4.00	1583.	.188E+04
9	6.00	1964.	.267E+04
10	9.00	2520.	.333E+04
11	12.0	2947.	.347E+04
12	18.0	3559.	.326E+04

TITLE: INLET2 4IF 8/30/76 1544 HRS IMPACTOR 118 JET PLATE 102 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	2.0	MINUTES	TEMP IMPACTOR =	530.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.05	IN.	VELOCITY =	42.10	FT/SEC
BARO. PRES =	29.35	INCH HG	SAMPLE RATE =	.28	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.56	CF(STACK COND.)
VOL. METER =	.28	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.35	INCH HG	STACK SUCTION =	.367E-02	INCH HG
COND. WATER =	.4	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	6.06	
VOLUME GAS STD. DRY =	.777E-02	CUBIC METER
PERCENT ISOKINETIC =	129.44	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.335E+02	.281E+02	.505E+02	.649E+04	.101E+05	.215E+05	.38
2	1.02	12.	.476E+00	.167E+02	.615E+02	.345E+01	.444E+03	.363E+04	.147E+04	.38
3	1.06	24.	.203E+00	.648E+01	.169E+03	.758E+01	.975E+03	.319E+04	.237E+04	.38
4	1.12	24.	.125E+00	.302E+01	.448E+03	.891E+01	.115E+04	.221E+04	.347E+04	.38
5	1.20	24.	.889E-01	.175E+01	.882E+03	.410E+01	.528E+03	.107E+04	.223E+04	.38
6	1.49	24.	.541E-01	.750E+00	.238E+04	.132E+01	.170E+03	.540E+03	.460E+03	.38
7	2.31	6.	.541E-01	.301E+00	.953E+04	.122E+01	.157E+03	.371E+03	.396E+03	.38
				FILTER WEIGHT		.166E+01	.214E+03	.214E+03		
				TOTAL WEIGHT		.787E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	267.9	387.
3	.600	329.8	417.
4	.750	370.6	438.
5	1.00	428.1	457.
6	1.50	509.1	833.
7	2.00	641.2	.163E+04
8	4.00	1480.	.338E+04
9	6.00	2096.	.323E+04
10	9.00	2606.	.256E+04
11	12.0	2902.	.220E+04
12	18.0	3249.	.176E+04

TITLE: INLET1 42F 8/30/76 1635 HRS IMPACTOR 108 JET PLATE 103 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	3.0	MINUTES	TEMP IMPACTOR =	524.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.05	IN.	VELOCITY =	42.10	FT/SEC
BARO. PRES =	29.32	INCH HG	SAMPLE RATE =	.29	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.87	CF(STACK COND.)
VOL. METER =	.44	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.33	INCH HG	STACK SUCTION =	.735E-02	INCH HG
COND. WATER =	.5	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 6.07
VOLUME GAS STD. DRY = .122E-01 CUBIC METER
PERCENT ISOKINETIC = 134.73

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.327E+02	.242E+02	.545E+02	.447E+04	.804E+04	.148E+05	.38
2	1.02	12.	.476E+00	.163E+02	.640E+02	.593E+01	.486E+03	.358E+04	.161E+04	.38
3	1.06	24.	.203E+00	.633E+01	.176E+03	.145E+02	.119E+04	.309E+04	.290E+04	.38
4	1.12	24.	.125E+00	.295E+01	.467E+03	.111E+02	.906E+03	.190E+04	.274E+04	.38
5	1.21	24.	.889E-01	.171E+01	.918E+03	.292E+01	.239E+03	.992E+03	.101E+04	.38
6	1.49	24.	.541E-01	.731E+00	.248E+04	.141E+01	.116E+03	.752E+03	.312E+03	.38
7	2.34	6.	.541E-01	.292E+00	.992E+04	.236E+01	.193E+03	.637E+03	.485E+03	.38
				FILTER WEIGHT		.541E+01	.444E+03	.444E+03		
				TOTAL WEIGHT		.981E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	450.4	569.
2	.420	528.7	503.
3	.600	601.3	389.
4	.750	638.5	313.
5	1.00	664.6	279.
6	1.50	726.1	485.
7	2.00	796.5	825.
8	4.00	1310.	.259E+04
9	6.00	1823.	.305E+04
10	9.00	2373.	.298E+04
11	12.0	2732.	.276E+04
12	18.0	3178.	.211E+04

TITLE: INLET3 43F 8/30/76 1642 HRS IMPACTOR 117 JET PLATE 104 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	3.0	MINUTES	TEMP IMPACTOR =	525.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.02	IN.	VELOCITY =	45.47	FT/SEC
BARO. PRES =	29.32	INCH HG	SAMPLE RATE =	.24	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.71	CF(STACK COND.)
VOL. METER =	.36	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.33	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.4	CC	VISCOSITY =	.28E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 6.07

VOLUME GAS STD. DRY = .998E-02 CUBIC METER

PERCENT ISOKINETIC = 102.11

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.362E+02	.239E+02	.653E+02	.654E+04	.110E+05	.217E+05	.38
2	1.02	12.	.476E+00	.181E+02	.524E+02	.495E+01	.997E+03	.450E+04	.330E+04	.38
3	1.05	24.	.203E+00	.701E+01	.144E+03	.109E+02	.109E+04	.351E+04	.267E+04	.38
4	1.11	24.	.125E+00	.328E+01	.382E+03	.115E+02	.115E+04	.241E+04	.308E+04	.38
5	1.19	24.	.889E-01	.191E+01	.752E+03	.419E+01	.420E+03	.126E+04	.178E+04	.38
6	1.44	24.	.541E-01	.824E+00	.203E+04	.169E+01	.169E+03	.845E+03	.464E+03	.38
7	2.14	6.	.541E-01	.337E+00	.812E+04	.307E+01	.308E+03	.675E+03	.793E+03	.38
					FILTER WEIGHT	.367E+01	.368E+03	.368E+03		
					TOTAL WEIGHT	.110E+03				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	455.3	879.
3	.600	581.0	726.
4	.750	649.0	536.
5	1.00	693.4	414.
6	1.50	771.7	668.
7	2.00	868.9	.120E+04
8	4.00	1543.	.315E+04
9	6.00	2159.	.335E+04
10	9.00	2704.	.283E+04
11	12.0	3038.	.266E+04
12	18.0	3503.	.290E+04

TITLE: OUTLET 39F 8/31/76 1442 HRS IMPACTOR 116 JET PLATE 105 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	10.0	MINUTES	TEMP IMPACTOR =	110.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.16	IN.	VELOCITY =	17.44	FT/SEC
BARO. PRES =	29.24	INCH HG	SAMPLE RATE =	.42	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	4.23	CF(STACK COND.)
VOL. METER =	2.94	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.25	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	19.1	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 25.16

VOLUME GAS STD. DRY = .813E-01 CUBIC METER

PERCENT ISOKINETIC = 118.52

SIZE DISTRIBUTION RESULTS

PLATE	CUN CUR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.223E+02	.426E+02	.196E+02	.241E+03	.576E+03	.800E+03	.38
2	1.02	12.	.476E+00	.111E+02	.933E+02	.690E+00	.848E+01	.335E+03	.281E+02	.38
3	1.04	24.	.203E+00	.433E+01	.256E+03	.173E+01	.213E+02	.326E+03	.519E+02	.38
4	1.09	24.	.125E+00	.204E+01	.680E+03	.437E+01	.537E+02	.305E+03	.164E+03	.38
5	1.15	24.	.889E-01	.119E+01	.134E+04	.239E+01	.294E+02	.251E+03	.126E+03	.38
6	1.35	24.	.541E-01	.522E+00	.361E+04	.166E+01	.204E+02	.222E+03	.570E+02	.38
7	1.54	12.	.541E-01	.346E+00	.723E+04	.195E+01	.240E+02	.201E+03	.134E+03	.38
				FILTER WEIGHT		.144E+02	.177E+03	.177E+03		
				TOTAL WEIGHT		.468E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	189.9	128.
3	.600	205.1	77.5
4	.750	210.8	57.6
5	1.00	217.8	69.1
6	1.50	233.2	117.
7	2.00	250.1	152.
8	4.00	299.7	128.
9	6.00	315.8	65.1
10	9.00	324.2	36.3
11	12.0	327.4	29.2
12	18.0	332.7	24.2

TITLE: INLET2 40F 8/31/76 1124 HRS IMPACTOR 109 JET PLATE 101 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	2.0	MINUTES	TEMP IMPACTOR =	545.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.01	IN.	VELOCITY =	40.81	FT/SEC
BARO. PRES =	29.30	INCH HG	SAMPLE RATE =	.20	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.40	CF(STACK COND.)
VOL. METER =	.20	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.31	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.29E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	4.92	
VOLUME GAS STD. DRY =	.554E-02	CUBIC METER
PERCENT ISOKINETIC =	95.61	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.398E+02	.201E+02	.384E+02	.692E+04	.106E+05	.230E+05	.38
2	1.02	12.	.476E+00	.199E+02	.440E+02	.366E+01	.660E+03	.369E+04	.219E+04	.38
3	1.05	24.	.203E+00	.773E+01	.121E+03	.296E+01	.534E+03	.303E+04	.130E+04	.38
4	1.10	24.	.125E+00	.362E+01	.321E+03	.661E+01	.119E+04	.250E+04	.363E+04	.38
5	1.17	24.	.889E-01	.211E+01	.632E+03	.374E+01	.675E+03	.131E+04	.288E+04	.38
6	1.40	24.	.541E-01	.917E+00	.171E+04	.146E+01	.263E+03	.632E+03	.727E+03	.38
7	2.03	6.	.541E-01	.381E+00	.682E+04	.950E+00	.171E+03	.368E+03	.450E+03	.38
					FILTER WEIGHT	.109E+01	.197E+03	.197E+03		
					TOTAL WEIGHT	.588E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	210.2	339.
3	.600	271.6	454.
4	.750	319.2	426.
5	1.00	371.1	442.
6	1.50	460.2	857.
7	2.00	598.3	.174E+04
8	4.00	1473.	.355E+04
9	6.00	2123.	.331E+04
10	9.00	2607.	.202E+04
11	12.0	2788.	.133E+04
12	18.0	2992.	.140E+04

TITLE: INLET, 45F 8/31/76 1129 HRS IMPACTOR 118 JET PLATE 102 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	2.0	MINUTES	TEMP IMPACTOR =	545.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.02	IN.	VELOCITY =	40.81	FT/SEC
BARO. PRES =	29.30	INCH HG	SAMPLE RATE =	.21	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.42	CF(STACK COND.)
VOL. METER =	.21	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.31	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.29E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	4.92	
VOLUME GAS STD. DRY =	.582E-02	CUBIC METER
PERCENT ISOKINETIC =	100.39	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PS150
1	1.01	8.	.864E+00	.388E+02	.211E+02	.595E+02	.102E+05	.147E+05	.339E+05	.38
2	1.02	12.	.476E+00	.194E+02	.462E+02	.454E+01	.780E+03	.448E+04	.259E+04	.38
3	1.05	24.	.203E+00	.753E+01	.127E+03	.817E+01	.140E+04	.370E+04	.342E+04	.38
4	1.10	24.	.125E+00	.353E+01	.337E+03	.706E+01	.121E+04	.230E+04	.369E+04	.38
5	1.18	24.	.889E-01	.206E+01	.663E+03	.316E+01	.543E+03	.108E+04	.231E+04	.38
6	1.41	24.	.541E-01	.891E+00	.179E+04	.108E+01	.186E+03	.541E+03	.511E+03	.38
7	2.07	6.	.541E-01	.369E+00	.716E+04	.650E+00	.112E+03	.356E+03	.291E+03	.38
				FILTER WEIGHT		.142E+01	.244E+03	.244E+03		
				TOTAL WEIGHT		.856E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	255.1	212.
3	.600	295.0	303.
4	.750	327.1	381.
5	1.00	381.2	466.
6	1.50	471.2	558.
7	2.00	535.0	.122E+04
8	4.00	1268.	.328E+04
9	6.00	1909.	.376E+04
10	9.00	2581.	.366E+04
11	12.0	3021.	.342E+04
12	18.0	3600.	.307E+04

TITLE: INLET2 46F 8/31/76 1203 HRS IMPACTOR 108 JET PLATE 103 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	2.0	MINUTES	TEMP IMPACTOR =	545.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	40.81	FT/SEC
BARO. PRES =	29.30	INCH HG	SAMPLE RATE =	.21	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.42	CF(STACK COND.)
VOL. METER =	.21	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.31	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.29E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	4.92	
VOLUME GAS STD. DRY =	.582E-02	CUBIC METER
PERCENT ISOKINETIC =	100.38	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.388E+02	.211E+02	.327E+02	.562E+04	.950E+04	.186E+05	.38
2	1.02	12.	.476E+00	.194E+02	.462E+02	.305E+01	.524E+03	.388E+04	.174E+04	.38
3	1.05	24.	.203E+00	.754E+01	.127E+03	.533E+01	.916E+03	.336E+04	.223E+04	.38
4	1.10	24.	.125E+00	.353E+01	.337E+03	.894E+01	.154E+04	.244E+04	.467E+04	.38
5	1.18	24.	.889E-01	.206E+01	.663E+03	.331E+01	.569E+03	.903E+03	.242E+04	.38
6	1.41	24.	.541E-01	.891E+00	.179E+04	.134E+01	.229E+03	.334E+03	.632E+03	.38
7	2.07	6.	.541E-01	.369E+00	.716E+04	.360E+00	.619E+02	.105E+03	.161E+03	.38
				FILTER WEIGHT		.250E+00	.430E+02	.430E+02		
				TOTAL WEIGHT		.553E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	46.92	85.6
3	.600	66.90	172.
4	.750	86.24	312.
5	1.00	136.3	502.
6	1.50	247.6	672.
7	2.00	326.5	.130E+04
8	4.00	1150.	.408E+04
9	6.00	1970.	.440E+04
10	9.00	2663.	.312E+04
11	12.0	2975.	.224E+04
12	18.0	3308.	.181E+04

TITLE: INLETS 47F 8/31/76 1208 HRS IMPACTOR 117 JET PLATE 104 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	2.0	MINUTES	TEMP IMPACTOR =	545.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.01	IN.	VELOCITY =	40.81	FT/SEC
BARO. PRES =	29.30	INCH HG	SAMPLE RATE =	.16	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.32	CF(STACK COND.)
VOL. METER =	.16	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.31	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.29E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	4.92	
VOLUME GAS STD. DRY =	.443E-02	CUBIC METER
PERCENT ISOKINETIC =	76.48	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.445E+02	.161E+02	.552E+02	.124E+05	.175E+05	.413E+05	.38
2	1.02	12.	.476E+00	.222E+02	.352E+02	.403E+01	.909E+03	.502E+04	.302E+04	.38
3	1.04	24.	.203E+00	.866E+01	.967E+02	.578E+01	.130E+04	.412E+04	.318E+04	.38
4	1.09	24.	.125E+00	.407E+01	.257E+03	.706E+01	.159E+04	.281E+04	.486E+04	.38
5	1.15	24.	.889E-01	.238E+01	.505E+03	.300E+01	.677E+03	.122E+04	.291E+04	.38
6	1.35	24.	.541E-01	.104E+01	.136E+04	.121E+01	.273E+03	.541E+03	.762E+03	.38
7	1.87	6.	.541E-01	.444E+00	.546E+04	.260E+00	.586E+02	.268E+03	.158E+03	.38
				FILTER WEIGHT		.930E+00	.210E+03	.210E+03		
				TOTAL WEIGHT		.774E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	-99.00	-99.0
3	.600	221.5	127.
4	.750	236.4	190.
5	1.00	263.5	454.
6	1.50	388.2	762.
7	2.00	483.5	.115E+04
8	4.00	1190.	.392E+04
9	6.00	2021.	.487E+04
10	9.00	2873.	.415E+04
11	12.0	3310.	.337E+04
12	18.0	3860.	.299E+04

TITLE: OUTLET 48A 8/31/76 1637 HRS IMPACTOR 120 JET PLATE 106 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	10.0	MINUTES	TEMP IMPACTOR =	110.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.17	IN.	VELOCITY =	17.44	FT/SEC
BARO. PRES =	29.24	INCH HG	SAMPLE RATE =	.42	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	4.21	CF(STACK COND.)
VOL. METER =	2.93	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.25	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	19.0	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	25.15	
VOLUME GAS STD. DRY =	.811E-01	CUBIC METER
PERCENT ISOKINETIC =	118.11	

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SORT PSI50
1	1.01	8.	.864E+00	.223E+02	.424E+02	.656E+01	.809E+02	.394E+03	.268E+03	.38
2	1.02	12.	.476E+00	.111E+02	.930E+02	.560E+00	.691E+01	.313E+03	.229E+02	.38
3	1.04	24.	.203E+00	.434E+01	.255E+03	.106E+01	.131E+02	.306E+03	.319E+02	.38
4	1.09	24.	.125E+00	.204E+01	.678E+03	.349E+01	.431E+02	.293E+03	.131E+03	.38
5	1.15	24.	.889E-01	.119E+01	.133E+04	.154E+01	.190E+02	.250E+03	.816E+02	.38
6	1.35	24.	.541E-01	.523E+00	.360E+04	.154E+01	.190E+02	.231E+03	.531E+02	.38
7	1.54	12.	.541E-01	.347E+00	.720E+04	.404E+01	.498E+02	.212E+03	.279E+03	.38
				FILTER WEIGHT		.132E+02	.162E+03	.162E+03		
				TOTAL WEIGHT		.319E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	188.9	261.
3	.600	215.4	110.
4	.750	220.5	53.1
5	1.00	227.1	57.3
6	1.50	238.4	79.8
7	2.00	249.4	110.
8	4.00	288.9	99.7
9	6.00	300.6	43.0
10	9.00	305.6	20.7
11	12.0	307.2	18.9
12	18.0	311.4	21.5

TITLE: INLET2 09A 8/31/76 1906 HRS IMPACTOR 109 JET PLATE 101 STAGES 7 HOLES 6

TEST DATA

TEST DURATION =	2.0	MINUTES	TEMP IMPACTOR =	545.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.01	IN.	VELOCITY =	40.81	FT/SEC
BARO. PRES =	29.20	INCH HG	SAMPLE RATE =	.23	CF(STACK COND.)
NOZZLE DIA. =	.1250	INCHES	TOTAL VOLUME(STACK) =	.46	CF(STACK COND.)
VOL. METER =	.23	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.21	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	.2	CC	VISCOSITY =	.291E-03	POISE

TEST RESULTS

PERCENT MOISTURE = 4.93
VOLUME GAS STD. DRY = .635E-02 CUBIC METER
PERCENT ISOKINETIC = 109.97

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.371E+02	.231E+02	.206E+02	.324E+04	.639E+04	.107E+05	.38
2	1.02	12.	.476E+00	.185E+02	.506E+02	.245E+01	.386E+03	.315E+04	.128E+04	.38
3	1.05	24.	.203E+00	.719E+01	.139E+03	.584E+01	.920E+03	.277E+04	.224E+04	.38
4	1.11	24.	.125E+00	.337E+01	.369E+03	.535E+01	.842E+03	.185E+04	.255E+04	.38
5	1.19	24.	.889E-01	.196E+01	.727E+03	.209E+01	.328E+03	.101E+04	.140E+04	.38
6	1.44	24.	.541E-01	.844E+00	.196E+04	.820E+00	.129E+03	.678E+03	.353E+03	.38
7	2.15	6.	.541E-01	.345E+00	.785E+04	.715E+00	.113E+03	.549E+03	.290E+03	.38
					FILTER WEIGHT	.277E+01	.436E+03	.436E+03		
					TOTAL WEIGHT	.406E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	458.7	272.
3	.600	502.7	297.
4	.750	532.4	242.
5	1.00	555.2	247.
6	1.50	610.7	508.
7	2.00	686.8	925.
8	4.00	1182.	.228E+04
9	6.00	1631.	.261E+04
10	9.00	2093.	.245E+04
11	12.0	2383.	.221E+04
12	18.0	2744.	.178E+04

TITLE: OUTLET SOF 8/31/76 1851 HRS IMPACTOR 116 JET PLATE 105 STAGES 7 HOLES 12

TEST DATA

TEST DURATION =	5.0	MINUTES	TEMP IMPACTOR =	110.	DEGS. F
METER TEMP. =	70.	DEGS. F	TEMP ATMOS. =	80.	DEGS. F
METER PRES =	.17	IN.	VELOCITY =	17.44	FT/SEC
BARO. PRES =	29.20	INCH HG	SAMPLE RATE =	.43	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	2.16	CF(STACK COND.)
VOL. METER =	1.50	CUBIC FEET	PARTICLE DENSITY =	2.00	GRAM/CC
STACK PRESSURE =	29.21	INCH HG	STACK SUCTION =	.514E-02	INCH HG
COND. WATER =	9.7	CC	VISCOSITY =	.19E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	25.18	
VOLUME GAS STD. DRY =	.414E-01	CUBIC METER
PERCENT ISOKINETIC =	120.99	

SIZE DISTRIBUTION RESULTS

PLATE	CUN CUR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CONC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PSI50
1	1.01	8.	.864E+00	.220E+02	.454E+02	.154E+01	.372E+02	.316E+03	.123E+03	.38
2	1.02	12.	.476E+00	.110E+02	.952E+02	.320E+00	.772E+01	.279E+03	.256E+02	.38
3	1.04	24.	.203E+00	.428E+01	.262E+03	.820E+00	.198E+02	.271E+03	.483E+02	.38
4	1.09	24.	.125E+00	.201E+01	.694E+03	.268E+01	.647E+02	.251E+03	.197E+03	.38
5	1.15	24.	.889E-01	.118E+01	.137E+04	.142E+01	.343E+02	.187E+03	.107E+03	.38
6	1.36	24.	.541E-01	.516E+00	.369E+04	.116E+01	.280E+02	.153E+03	.781E+02	.38
7	1.55	12.	.541E-01	.342E+00	.738E+04	.275E+01	.664E+02	.125E+03	.370E+03	.38
				FILTER WEIGHT		.241E+01	.582E+02	.582E+02		
				TOTAL WEIGHT		.131E+02				

INTERPOLATED SIZE DISTRIBUTION RESULTS

POINT	DIAMETER (MICRONS)	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M
1	.300	-99.00	-99.0
2	.420	95.75	351.
3	.600	133.7	168.
4	.750	144.0	85.3
5	1.00	151.3	70.2
6	1.50	166.6	152.
7	2.00	186.3	181.
8	4.00	246.1	146.
9	6.00	263.0	62.7
10	9.00	270.3	29.1
11	12.0	272.5	23.3
12	18.0	277.3	21.6

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/7-77-116	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Century Industrial Products FRP-100 Wet Scrubber Evaluation		5. REPORT DATE October 1977 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) D.S. Ensor and R.G. Hooper		8. PERFORMING ORGANIZATION REPORT NO. MRI 76-FR-1468
9. PERFORMING ORGANIZATION NAME AND ADDRESS Meteorology Research, Inc. Box 637 Altadena, California 91001		10. PROGRAM ELEMENT NO. EHE624 11. CONTRACT/GRANT NO. 68-02-2125
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15. SUPPLEMENTARY NOTES IERL-RTP project officer for this report is Dale L. Harmon, Mail Drop 61, 919/541-2925.

16. ABSTRACT The report gives results of a field test evaluation of the performance of the Century Industrial Products FRP-100 wet scrubber installed on a lightweight aggregate kiln. Inlet/outlet tests for particle size distribution with cascade impactors and extractive sampling with an electrical aerosol size analyzer, and plume opacity with a plant process visiometer were conducted. The scrubber, operating at 80% rated capacity, had an aerodynamic cut diameter (50% collection efficiency) of 0.8 microns at a theoretical hydraulic power of 15.8 watts/a cu m/min (0.6 hp/1000 acfm) The liquid-to-gas ratio was about 2.16 l/cu m (16 gal./1000 acf). The formation of submicron aerosol from the evaporation in the gas cooling section of water containing dissolved solids was observed during all tests. Also, the carryover of spray from the scrubber (there was no mist eliminator) was observed at flow rates greater than 23.7 cu m/sec (50,000 acfm).

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Evaluation Scrubbers Kilns	Air Pollution Control Stationary Sources FRP-100 Scrubber	13B 14B 07A

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