United States
Environmental Protection
Agency

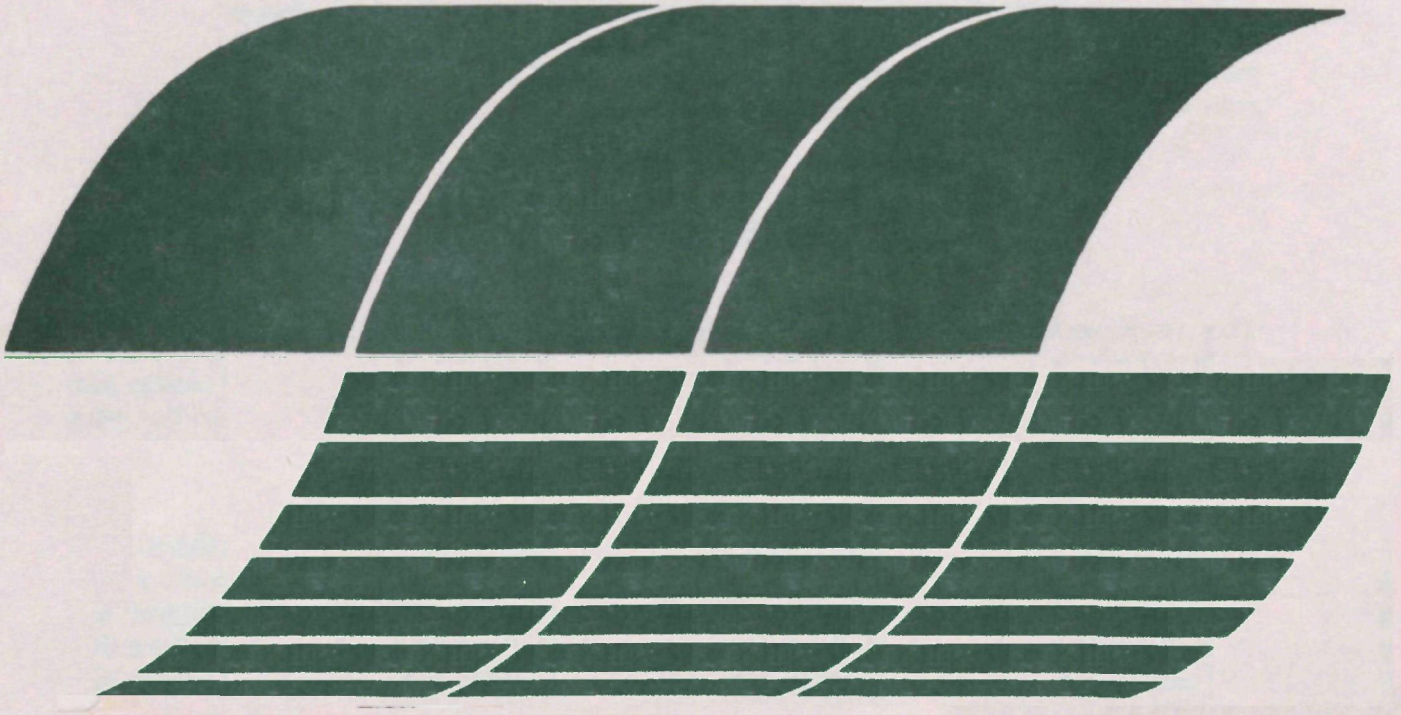
Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

EPA-600/7-79-246
November 1979

EPA

Ceilcote Ionizing Wet Scrubber Evaluation

Interagency Energy/Environment R&D Program Report



RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally-compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

EPA REVIEW NOTICE

This report has been reviewed by the participating Federal Agencies, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EPA-600/7-79-246

November 1979

Ceilcote Ionizing Wet Scrubber Evaluation

by

David S. Ensor

Meteorology Research, Inc.
464 West Woodbury Road
Altadena,California 91001

Contract No. 68-02-2125
Program Element No. EHE624A

EPA Project Officer: Dale L. Harmon

Industrial Environmental Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, NC 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

ABSTRACT

The Ceilcote ionizing wet scrubber installed on a refractory brick kiln was evaluated with tests involving particulate mass emission, particle size distribution, and opacity. The overall efficiency was 93 percent with an average outlet opacity determined with a heated plant process visiometer (PPV) of 8 percent over a 1.68 m (5.5 ft) path length. The average particle cut diameter of the scrubber system was 0.5 micron. The estimated theoretical power requirement for the ionizing wet scrubber was 41 watts/am^3 (1.54 hp/1000 ACFM). However, the scrubber system developed for the kiln included a cooling tower to provide chilled water for the prescrubber to condense volatile emissions which required 26 watts/am^3 (2.5 hp/1000 ACFM). The performance of the ionizing wet scrubber, based on theoretical power input, exceeds that of a venturi scrubber. It is recommended that the ionizing wet scrubber be considered in applications where practical for the removal of fine particulate matter.

CONTENTS

FIGURES

TABLES

SECTION 1

INTRODUCTION AND SUMMARY

The Ceilcote ionizing wet scrubber (IWS) was evaluated with field measurements of particle collection efficiency and an analysis of power consumption.

This evaluation was one of a series of such evaluations being conducted by the Industrial Environmental Research Laboratory of the United States Environmental Protection Agency (EPA) to identify and test novel devices which are capable of high efficiency collection of fine particles. 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 electrical aerosol size analyzers (EASA).

The IWS consists of a wetted plate, vertical plate ionizer followed by an irrigated bed of plastic packing. The particulate matter is charged by the ionizer and is collected in the irrigated packing. The subject equipment was installed on a refractory brick kiln and controlled a submicron fume. The scrubber consisted of a cold water quench followed by two IWS units. The pressure drop was typically 7.6 to 13 cm H_2O(3-5 in. H_2O). The theoretical power required was typically 67 watts/(am^3/min) [2.5 hp/ 1000 ACFM] for the scrubber system, including the IWS and cooling tower.

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

- In stack filter inlet and outlet
- Cascade impactor tests at the inlet and outlet
- Extractive sampling and subsequent measurement of submicron particles at the inlet and outlet with a Thermosystems EASA
- Opacity measurement with a Meteorology Research, Inc., plant process visiometer (PPV) at the inlet and outlet

The collection efficiency of the scrubber was 93 percent across the scrubber. Additionally, it was found that cooling the flue gas caused the formation of submicron particulate matter. Taking particle formation into account the collection efficiency was 98 percent. The outlet opacity, measured under dry conditions with a PPV, was from 3.7 to 11 percent based on a 1.68 m (5.5 ft) path length.

SECTION 2

CONCLUSION AND RECOMMENDATIONS

The following conclusions were made from the study:

1. The emission from the refractory kiln was a submicron fume formed by condensation of volatile material baked from the raw clay. The aerosol had a mean diameter of 0.6 micron and a geometric standard deviation of 5 as determined with a cascade impactor, assuming a particle specific gravity of 1.8 g/cm^3. The cooling of the flue gas from 150° to 50°C 300° to 120°F) doubled the concentration of particulate matter entering the ionizers and increased the mean diameter considerably.

2. The average overall mass collection efficiency was 93 percent for three days of testing. The average inlet concentration was 0.25 g/dsm^3 (0.109 $gr/dsft^3$) and the average outlet concentration was 0.017 g/dsm^3 (0.0076 $gr/dsft^3$). The average outlet opacity was 8 percent over a 1.68 m (5.5 ft) path length as measured with a Plant Process Visiometer at about 99°C (210°F).

3. The particle cut diameter (the particle diameter collected with a 50 percent efficiency) was 0.4 to 0.6 micron. The total theoretical power regained by the scrubber system including cooling tower for chilled water in the quench section was 67 watts/(am^3/min) (2.5 hp/1000 ACFM). The ionizers required the greatest percentage of the power input at 48.4 percent and the cooling tower required 38.4 percent. The use of energy to remove particulate matter in the scrubber is better than a theoretical high-pressure drop venturi scrubber.

It is recommended that the Ceilcote ionizing wet scrubber be considered in applications where scrubbers are practical for the removal of fine or submicron particulate matter.

SECTION 3

SITE DESCRIPTION

PROCESS

Globe Refractories, Inc., located at Newell, West Virginia, makes bloating-type refractories. These refractory products are used in the steel industry to line ladles. The term "bloating" means that the refractory brick expands permenantly when reheated, sealing the lining of the ladle.

The raw material is a local clay called Lower Kittanning clay composed mainly of Kaolinite, Quartz, Illite and Pyrite. Minor constituents are organic matter, micas, and ammonium chlorides or fluorides. The clay is formed into the required shapes including bricks, sleeves, nozzles and pocket blocks and fired to about 1100°C (2,000°F) in a tunnel kiln under a controlled temperature profile over 4 to 6 days' cycle. The formed clay is loaded on tunnel kiln cars which are slowly pushed through the kiln.

The chemical reaction during firing includes oxidation of organic matter to carbon dioxide and water, oxidation of pyrite to iron oxide and sulfur oxides, decomposition of Kaolinite and Illite to release chemically combined water, decomposition of ammonium chloride or fluoride to form ammonia and gaseous chlorides and fluorides. The fluxing of alkalis forms a glass that bonds the brick.

The major emissions problem from the kilns is believed to be a $NH_4 HSO_4$ smoke from reaction of ammonia gas and sulfur oxides.

The scrubber controlled emission from kilns 4 and 5B. The No. 4 kiln contributed about 20 percent of the flue gas. The production rate during the time of the test is shown in Table 3-1. The No. 4 kiln was inoperable during part of the test due to a car wreck in the kiln.

Compounds which are hypothesized to be found in the emission are summarized in Table 3-2. The chemical characterization of the emissions was beyond the scope of this effort. These materials were used as a guide to the selection of physical constants during the data reduction. The emission is highly corrosive when dissolved in water. It was noticed that 304 stainless steel probes installed for the test were severely corroded from continuous exposure to the scrubber liquid over a two-week period.

TABLE 3-1. PRODUCTION SCHEDULE

Date	Cars per 24-hour Day (6 am to 6 am) Kiln 4 (5.4 Ton/car)	Kiln 5B (21.5 Ton/car)	Comments
10/30/78	18	15	
31	18	15	
11/1/78	18	15	
2	18	16	
3	18	16	
4	18	16	
5	18	16	
6	18	16	Phase I test
7	18	16	Phase I test
8	17	17	Phase I test
9	18	16	Pump Repaired
10	18	17	Phase I test
11	18	17	
12	0	16	Kiln 4 shutoff
13	0	16	due to mechanical problem
14	0	15	
15	0	14	
16	0	17	
17	0	16	
18	Lit Kiln	16	Phase II test
19	0	16	
20	0	16	Phase II test
21	2	16	Phase II test

TABLE 3-2. POTENTIAL MATERIALS IN THE KILN EMISSIONS

Material	Density (g/cc)	Refractive Index	Comments
$NH_4 H F_2$	1.315		Deliquescence
$(NH_4)_2 SO_4$	1.769	1.521, 1.523, 1.533	
$NH_4 H SO_4$	1.78		
$(NH_4)_2 SO_3 \cdot H_2O$	1.41		
$NH_4 Cl$	1.527	1.642	
$NH_4 F$	--	1.315	

Source: Handbook of Chemistry and Physics (1959)

CONTROL DEVICE

General

The Ceilcote ionizing wet scrubber consists of five sections:

- Quench unit
- Prescrubber (with cooling tower)
- First ionizing wet scrubber
- Second ionizing wet scrubber
- Induced draft fans and stack

About 28.3 am^3/sec (60,000 ACFM) of flue gas at 150° C (300° F) is piped to the scrubber through a 1.5 m (5 ft) diameter 30 m (100 ft) long duct constructed of fiberglass reinforced plastic. A diagram of the scrubber is shown in Figure 3-1.

Quench Section

In the quench section, the flue gas is reduced from 150°C (300°F) to 60°C (140°F) by evaporative cooling. The quench water is supplied at 7.6 ℓ/sec (120 gpm) at a 3.6 x 105 n/m^3 (52 psig) pressure. The unit is 2.1 m (7 ft) in diameter and 2.7 m (9 ft) long.

Prescrubber and Cooler

The gas temperature is reduced to 46° C (115° F) in the prescrubber. The prescrubber has a gas flow area 3 m by 3 m (10 ft by 10 ft) with an overall length of 5.5 m (18 ft). It is of cross-flow design with a series of inlet baffles and a 1.8m (6 ft) deep bed of Tellerette packing. There are continuous water sprays on the inlet baffles, front of the packing, and above the packed bed. Outlet baffles are sprayed on a periodic basis. Most of the water for the sprays is cooled in the cooling tower. The cooling tower reduces the temperature of the prescrubber water from 49°C (120°F) to 29°C (85°F) with a flow of 54 ℓ/sec (860 gpm) and a heat transfer rate of 3.78 x 10^9Cal/hr (15 x 10^6 Btu/hr).

The cooling tower is 3.8 m (12.5 ft) in diameter and about 6.6 m (21.5 ft) high. The tower has a stack extension for a total height of 11 m (36 ft). It has 5 cm (2 in.) Tellerette Type-R packing and the entrainment separator is 0.3 m of 5 cm (2 in.) Tellerette Type-R packing. A fan rated at 27.3 am^3/sec (58,000 ACFM) at 10 cm H_2O) supplies cooling air at the bottom of the tower. The cooled water is pumped to the prescrubber at 52.4 ℓ/sec (832 gpm) at a 1.8 x 10^5 n/m^2 (26 psig) pressure.

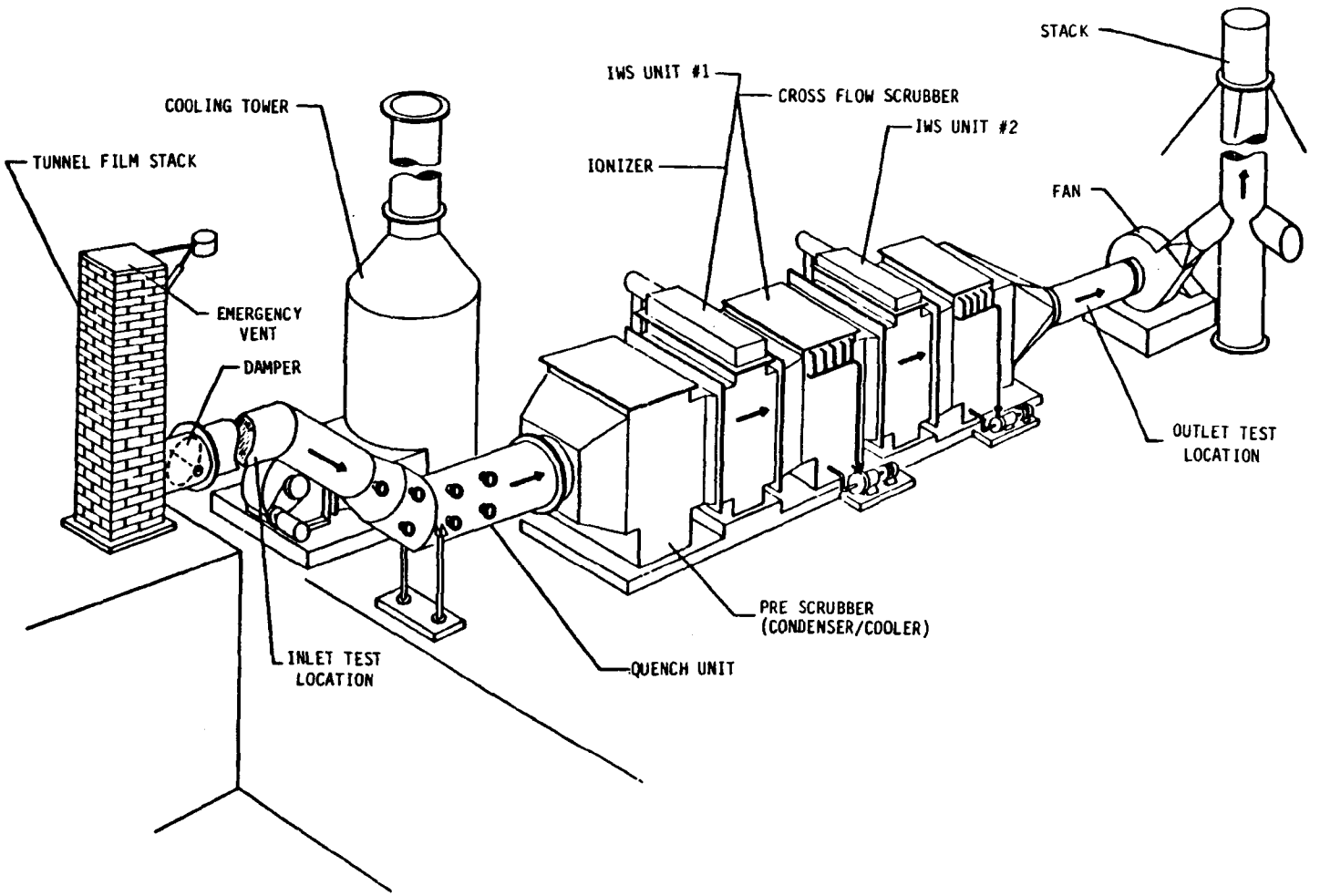


Figure 3-1. Overview of Ceilcote ionizing wet scrubber.

Ionizing Wet Scrubber (IWS)

The ionizing wet scrubber consists of two sections: an ionizer or charger and a cross-flow scrubber. The ionizer consists of charging wires suspended between irrigated grounding plates. The first ionizer operates at 30 kV with a current of 100 to 110 ma and the second operates at 31.5 kV with a current of 210 to 225 ma. The scrubber contains 1.2 m (4 ft) of irrigated 5 cm (2 in.) Tellerette Type-R packing and 0.3 m (1 ft) of unirrigated packing for entrainment separation. The irrigated packing is sprayed from the front and the top. The entrainment separator is flushed periodically. The recirculation pump is rated at 36.3 ℓ/sec (575 gpm) at a pressure of 1.8×10^5 n/m^2 (26 psig).

Fan and Stack

The fiberglass reinforced polyester fan is rated at 20 am^3/sec (42,000 ACFM) at 46° C (115° F) water saturated and 28 cm WC (11 in. WC) static pressure. The fiberglass reinforced plastic stack is 1.67 m (66 in.) diameter and 46 m (150 ft) in height.

Test Locations

The test locations are indicated on Figure 3-1. Both the inlet and the outlet were located on circular ducts with sufficient length before and after the test port for smooth flow.

SECTION 4

TEST METHODS

TECHNICAL APPROACH

Measurements were conducted in three areas: aerosol characterization, gas composition and process streams. The aerosol characterization included scrubber inlet and outlet measurements as follows:

- Cascade impactors for particles between 0.4 to 10 microns
- Extractive sampling systems with a Thermosystems Model 3030 Electrical Aerosol Size Analyzer and diffusion battery for particles 0.01 to 1 micron
- An MRI PPV to measure plume opacity (0.1 to 1 micron diameter particles)
- Mass concentration with in-stack filters

The gas composition measurements included:

- Orsat measurement of CO_2, O_2, CO
- Water content

The process measurements of interest included:

- Pressure drop through the scrubber
- Gas flow rate determined from velocity and temperature traverses
- Water flow rate estimate
- Analysis of scrubber water for total dissolved and suspended solids

SIZE DISTRIBUTION MEASUREMENT

Cascade Impactor

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 quick connect rings supporting jet plates, collection discs and a built-in filter holder. The design permits flexibility to various sampling situations.

The tests were conducted with procedures described by Harris, 1977. The particles were collected on Apiezon grease coated on 304 stainless steel foil collection discs. The discs were weighed to 0.01 mg on a Cahn electrobalance.

The sample train used for the impactor tests consisted of:

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

The inlet impactors were operated at duct temperature. The outlet impactors were heated to 121° C (250° F) with electrical heating jackets. The nozzles on the outlet impactors were also extended by 46 cm (18 in.) tubes which were also heated to 121°C (250°F) to dry the aerosol before entering the impactor.

Blank tests consisting of exposing the impactor substrates with filtered stack gas were conducted and the results are reported in Table 4-1. The inconsistent blank values are believed to be due to the volatile nature of the emission aerosol.

The impactor data were reduced with a procedure described by Markowski and Ensor, 1977, which is similar to the method described by McCain et al., 1979.

Fine Particles

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

1. The aerosol sample was diluted with clean, dry air
2. The particulate matter in the diluted aerosol was then measured with a Thermosystems Model 3030 Electrical Aerosol Size Analyzer

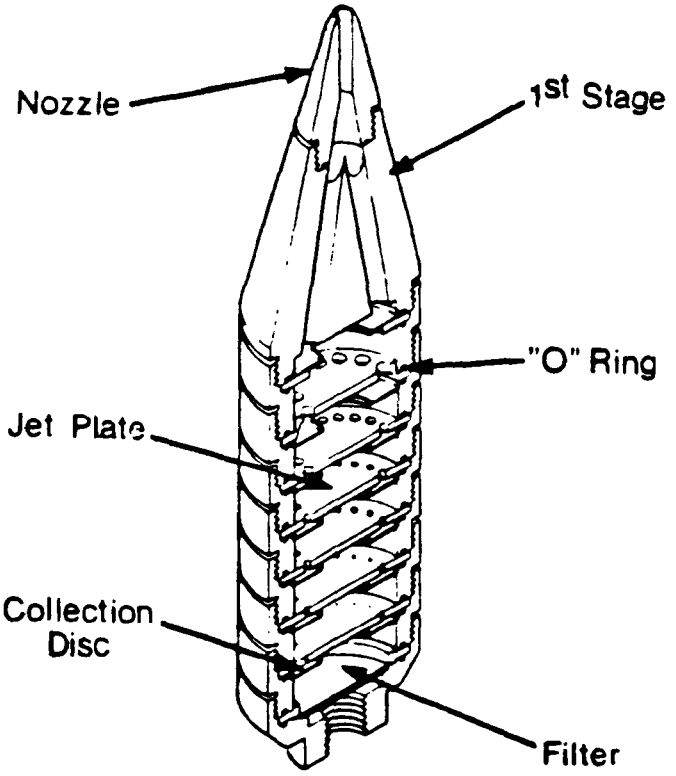


Figure 4-1. Assembly drawing of Model 1502 inertial cascade impactor.

TABLE 4-1. SUMMARY OF BLANK TESTS

Date	11/10/78	11/20/78	11/21/78	11/20/78
Stage	Outlet	Inlet	Inlet	Outlet
1	2.38	0.66	0.74	0.00
2	0.83	0.55	0.89	0.03
3	4.94	0.49	0.76	-0.03
4	3.59	0.41	0.66	-0.01
5	0.23	0.33	2.74	-0.02
6	0.01(a)	0.02(a)	0.03(a)	+0.07
7	0.02(a)	0.00(a)	-0.01(a)	0.00(a)
Filter	-0.06	-0.19	--	-2.02
Temp (°F)	250	281	287	250
Time (min)	30	30	45	89.0
Flow rate (ft^3/m)	0.87	0.54	0.49	1.40
Total Volume (m^3)	0.509	0.311	0.136	2.50

(a) Control disc not exposed to flue gas

Two separate dilution systems were used. The inlet dilution system consisted of a sampling probe with a cascade impactor precutter to remove particles greater than 2.5 microns followed by an out-of-stack, three-stage quantitative dilution system. The sample can be diluted with filtered dry air from 3:1 to 1000:1 by adjustment of control valves. The outlet dilution system was a single stage in-stack mixing tee. In both systems, the clean air flows are measured with orifices and the sample flows with venturis.

The TSI Model 3030 Electrical Aerosol Size Analyzer (EASA) was used at both the inlet and outlet. The EASA consists of a charger, where a known charge is placed on the particles, and a mobility analyzer, where the charged particles are attached to a central collecting rod. The size of particles collected in the mobility analyzer depends on the applied voltage on the collecting rod. The aerosol passing through the mobility analyzer is detected by measuring the current transferred by the particles. The aerosol distribution in 11 logarithmic steps from 0.003 to 1 micron is measured.

OPACITY MEASUREMENT

The opacity at the inlet and outlet of the scrubber was measured with an MRI PPV. The instrument was installed on a three-inch port and the sample was heated to reduce relative humidity. A diagram of the instrument is shown in Figure 4-2. The aerosol particles in the chamber were illuminated by a flash lamp with an opal glass filter. The scattered light was detected by a photomultiplier tube at approximately right angles to the 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:

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

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 Bouger Law.

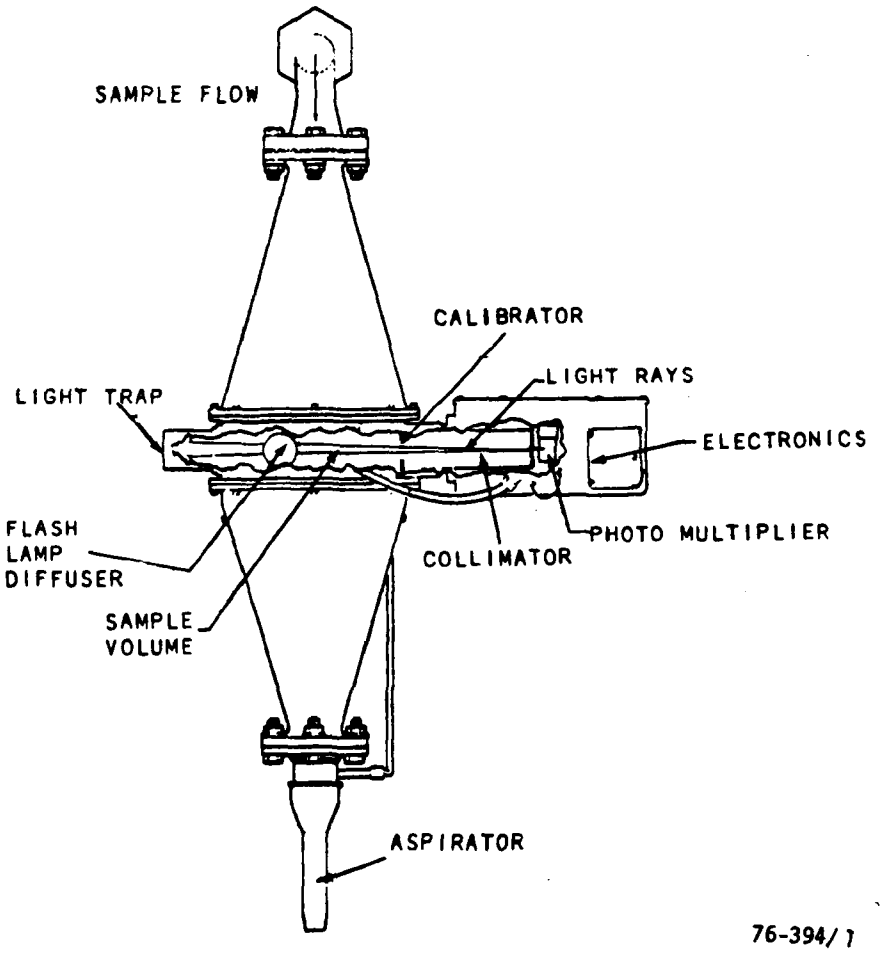


Figure 4-2. Diagram of the plant process visiometer.

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

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 was 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 integrating nephelometer and a transmissometer. The PPV was described in detail by Ensor, et al., 1974.

The PPV at the inlet was mounted with the 3/4 inch probe positioned in the center of the duct. The probe was insulated and the chamber electronically heated. The PPV at the outlet was placed on the ground and a 3 m (9 ft) probe extended into the duct from the bottom. The probe and chambers were electrically heated to about 93° C (200° F) to ensure that the gas was above the water dew point.

GAS COMPOSITION

The concentration of O_2, CO, 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.

PROCESS VARIABLES

The process variables were obtained as follows:

- The velocity was determined with an S type pilot probe following EPA Methods 1 and 2
- Pressure drop across the scrubber and pressure at the draft fan was measured using pressure transducers and recorded on a strip chart
- Samples of water were obtained for determinations of dissolved solids
- The water flow rates, pressure, and power required were estimated from the design specifications.

SECTION 5

FIELD TEST RESULTS

CALCULATION OF SCRUBBER PERFORMANCE

The performance of this scrubber was evaluated with the following procedure:

- The theoretical power required for the scrubber was computed from both the gas and water pressure drop and the transformer-rectifier output
- The scrubber aerodynamic cut diameter was computed from the cascade impactor and EASA 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, 1971, and adapted by Cooper and Anderson, 1975, the performance of the scrubber was compared to the theoretical performance of other common types of scrubbers

The overall particulate collection efficiency and opacity were also determined to indicate the ability to meet air pollution regulations.

MASS COLLECTION EFFICIENCY

The overall performance from cascade impactors and in-stack filters is shown in Table 5-1. The Phase I tests were taken under "as found" conditions. As the Phase I test work proceeded, it was obvious several mechanical problems existed in the scrubber. Due to settling of the water intake at the pond, gravel was introduced into the water system requiring the replacement of two pumps and unplugging the spray nozzles. After the scrubber was taken off line and inspected, it was also found that a high voltage cable was misplaced and was shorting in the No. 2 Ionizer.

The Phase II tests were conducted with the scrubber in good mechanical and electrical condition.

A second difference between Phase I and Phase II tests was in the volumetric flow of flue gas treated. Gas is treated from the No. 4 kiln and 58 kiln. A production problem caused shutting down No. 4 kiln during

TABLE 5-1. SUMMARY OF OVERALL MASS COLLECTION EFFICIENCY

Date (1978)		Inlet Run	Inlet Conc. mg/m^3(a) (gr/ft^3)	Outlet Run	Outlet Conc. mg/m^3(a) (gr/ft^3)(a)	Penetration (%)	Efficiency (%)	Opacity(b) (%)	Comments
11/6		10	230	5	104				
		11	229	6	126				
	(c)	1a	252	1b	96.6				
	Avg		237 (0.103)		108.9 (0.0475)	45.9	54.1	34	Phase I tests
11/7		21	371	7	104				
		22	279	12	74.5				
	(c)	2a	287	2b	100.4				
			312 (0.136)		92.96 (0.0405)	29.8	70.2	34	
11/8		23	248	13	73.7				
		24	254	14	112				
	(c)	3c	224	3b	48.2				
			242 (0.106)		78.0 (0.0340)	32.2	67.8	27	
11/10		25	259	16	756				
		26	256	17	471				
	(c)	4a	271	4b	360				IWS Power shutoff
			262 (0.114)		529 (0.231)	201.9	-101.9	81	
11/18		27	349	18	16.9				Phase II tests after completion of repairs
		28	318	19	34.8				
			333 (0.145)		25.9 (0.0123)	7.77	92.2	11	

TABLE 5-1. SUMMARY OF OVERALL MASS COLLECTION EFFICIENCY (Continued)

Date (1978)	Run	Inlet Conc. mg/m^3(a) (gr/ft^3)	Run	Outlet Conc. mg/m^3(a) (gr/ft^3)(a)	Penetration (%)	Efficiency (%)	Opacity(b) (%)	Comments
11/20	29	186	36	6.84				
	30	185	37	15.10				
(c)	5a	226	5c	7.41				
		199		9.78	4.91	95.1	3.7	
		(0.0831)		(0.00426)				
11/21	32	198	38	19.7				
	33	218	39	21.1				
(c)	6b	311	6a	9.38				
		242		16.7	6.90	93.1	6.8	
		(0.106)		(0.00728)				

Note: Both impactors and in-stack filters were heated to 121° C (250° F) at the outlet.

(a) 21.1°C, 76 cm, dry
(b) 1.676 meter (5 1/2 ft) path length
(c) In-stack filter samples - the other mass concentration results were computed from the cascade impactor tests.

the Phase II tests. The gas volume treated during Phase II was about 80 percent of that in Phase I.

The Phase II tests were analyzed in detail because the performance is more representative of the unit performing as designed. The Phase I results are included only for completeness.

The overall average efficiency of the scrubber as a unit for the Phase II tests was 93.5 percent. The "ionizer off" test conducted on November 10 may be used as an indication of the concentration of particulate matter entering the IWS units. If it is assumed no particulate matter was removed by the IWS packing, the IWS efficiency was 98.2 percent.

ESTIMATION OF POWER REQUIREMENT

Process Diagram

The scrubber is a multistage process. A diagram of the flows is shown in Figure 5-1. Measured values are used for the gas flows. However, only design water flow rates and pressures were available. Many of the flow meters and pressure gauges were malfunctioning due to the corrosive nature of the scrubber water. Using a combination of estimated process streams, measured gas flows, and transformer-rectifier readings, an accounting was made of the power required for the scrubber.

Gas Measurements

The gas flows were measured with an S-type pitot probe. A 12-point equal area tranverse was conducted at both the inlet and outlet of the scrubber. The results are summarized in Table 5-2. The theoretical power was computed using the equation reported by Strauss, 1974.

The results of the orsat analysis are summarized in Table 5-3. The average water concentration was obtained from the impactor tests.

Water Flows

The water flows and power required were estimated from the design value and are shown in Table 5-4.

Transformer-Rectifier Power

The corona power was computed from the secondary voltage and current of the transformer-rectifier units (TR) observed during the test. An average power input was computed for the days of November 18, 20, and 21. The results are shown in Table 5-5.

Total Power Input

The total theoretical power input to the scrubber is summarized in Table 5-6. The electrical power to the cooling tower for air circulation

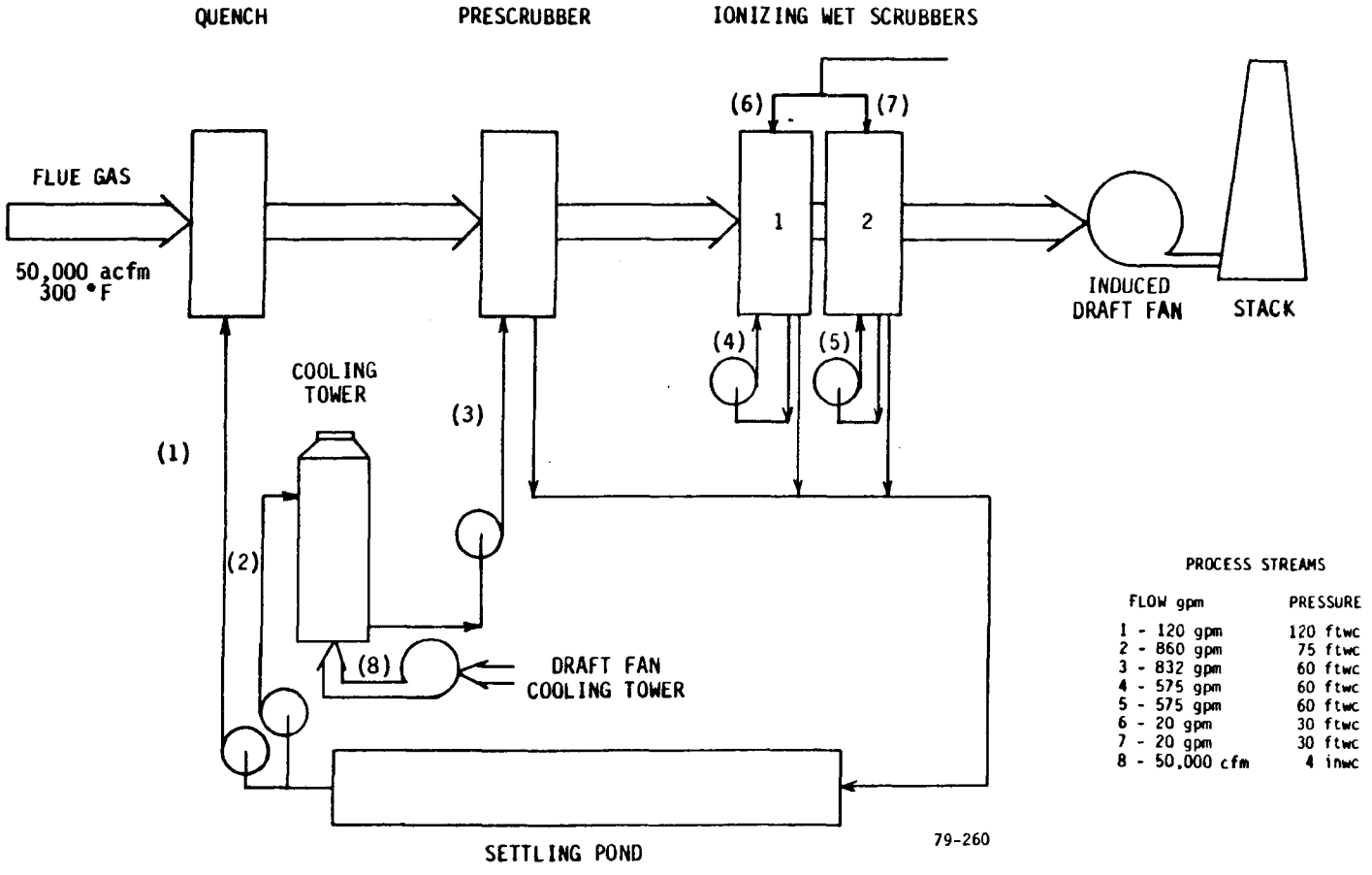


Figure 5-1. Scrubber process diagram.

TABLE 5-2. GAS FLOW RATES AND THEORETICAL POWER

Date (1978)	Stream	Pressure cmHg (in.Hg)	Pressure Drop[a] cmH_2O ($in.H_2O$)	Avg Velocity m/sec (ft/sec)	Avg Temp. ° C (° F)	Actual Vol Rate m^3/sec (acfm)	Std Vol Rate[b] m^3/sec (dscfm)	Water by Vol %	Power[c] watt/m^3/min (hp/1000acfm)
11/10	In	73.66 (29.00)		16.1 (52.7)	174 (345)	29.32 (62132)	17.27 (36600)	7.69	
			12.75 (5.02)						21.0 (0.788)
	Out	72.75 (28.64)		16.9 (55.6)	25.5 (78.0)	19.80 (41959)	18.00 (38142)	3.60	
11/18	In	74.55 (29.35)		12.5 (40.9)	156 (313)	22.72 (48148)	14.73 (31216)	3.63	
			7.82 (3.08)						12.9 (0.484)
	Out	73.96 (29.12)		12.9 (42.2)	19.7 (67.5)	15.02 (31826)	14.16 (29999)	2.69	
11/20	In	75.01 (29.53)		14.0 (45.8)	135 (275)	25.48 (53980)	17.47 (37022)	3.63	
			11.58 (4.56)						19.1 (0.716)
	Out	74.17 (29.20)		13.9 (45.7)	17.5 (63.5)	16.25 (34434)	16.06 (34022)	2.69	
11/21	In	75.01 (29.53)		11.9 (38.9)	138 (281)	21.63 (45828)	14.45 (30627)	5.33	
			11.43 (4.50)						18.8 (0.707)
	Out	74.14 (29.19)		(46.6)	15.7 (60.3)	16.59 (35158)	16.16 (34237)	2.01	
Average 11/13/20,21			10.26 (4.04)		Average Inlet 11/18/20,21	23.28 (49318)		Average 11/18,20,21	16.9 (0.6345)

(a) Flange to flange
(b) 21.1° C, 76 cm Hg, Dry - Inlet Area: 1.824 m^2 (19.635 ft^2); Outlet Area: 1.167m^2 (12.566 ft^2)
(c) Computed with Power = 0.157 ΔP_s where ΔP_s pressure drop in H_2O

TABLE 5-3. SUMMARY OF ORSAT TESTS

Date (1978)	Location	CO_2 (Vol %)	O_2 (Vol %)	N_2 (Vol %)	Dry Molecular Weight (g/g mole)	Average	Water (Vol %)	Molecular Weight with Water (g/g mole)
11/18	Outlet	2.4	14.6	83	28.97			
	Outlet	2.2	14.8	83	28.94	28.96	2.69	28.66
	Inlet	2.0	15.4	82.6	28.94			
	Inlet	2.2	15.6	82.2	28.98	28.96	3.63	28.56
11/20	Outlet	1.8	15.8	82.6	28.92			
	Outlet	1.4	16.0	82.6	28.86	28.89	1.58	28.72
	Inlet	2.0	15.6	82.4	28.94			
	Inlet	2.0	16.6	81.4	28.98	28.96	3.53	28.57
11/21	Inlet	2.1	15.0	82.9	28.94			
	Inlet	2.0	15.6	82.4	28.94	28.94	5.33	28.36

TABLE 5-4. ESTIMATION OF WATER SIDE THEORETICAL POWER

Stream From Fig 5-1	Flow ℓ/sec (gpm)	Pressure n/m^2 (psig)	Q_L/Q_G [b] ℓ/m^3 (gal./1000 acf)	Theoretical Power[c] Watts/(am^3/min) (hp/1000 acfm)
1	7.57 (120)	3.6×10^5 (52)	0.33 (2.43)	1.97 (0.074)
2	54.3 (860)	2.2×10^5 (32.5)	2.35 (17.4)	8.79 (0.330)
3	54.3 (832)	1.8×10^5 (26)	2.28 (16.9)	6.82 (0.256)
4	36.3 (575)	1.8×10^5 (26)	1.58 (11.7)	4.72 (0.177)
5	36.3 (575)	1.8×10^5 (26)	1.58 (11.7)	4.72 (0.177)
6	1.3 (20)	0.89×10^5[a] (13)	0.055 (0.41)	0.083 (0.0031)
7	1.3 (20)	0.89×10^5[a] (13)	0.055 (0.41)	0.083 (0.0031)

(a) Assumed for line pressure
(b) 23.28 am^3/sec (49.318 acfm) based on inlet gas flow
(c) $P_L = 0.583\ \Delta P_L\ (Q_L/Q_G)$ (hp/1000 acfm)
ΔP_L = psig
Q_L = gpm; Q_G = acfm

TABLE 5-5. SUMMARY OF TRANSFORMER-RECTIFIER POWER

Date 1978)	Flue Gas Treated am^3/min (acfm)	Unit 1[a] Avg Corona Power (watts)	Unit 2[a] Avg Corona Power (watts)	Unit 1 Power watts/am^3 (hp/1000 acf)	Unit 2 Power watts/am^3 (hp/1000 acf)
11/18	1511 (53,980)	1581	3372	1.05 (0.039)	2.23 (0.084)
11/20	1322 (47,218)	3080	6620	2.33 (0.087)	5.01 (0.19)
11/21	1250 (44,650)	2609	5448	2.09 (0.078)	4.44 (0.17)
			Average	1.82 (0.068)	3.89 (0.146)

(a) The product of the secondary voltage and current supplied to the ionizers by the transformer rectifier units.

TABLE 5-6. ESTIMATION OF THEORETICAL POWER REQUIREMENTS

Scrubber Stage	Gas watts/am^3/min (hp/1000 acfm)	Water watts/am^3/min (hp/1000 acfm)	Corona watts/am^3/min (hp/1000 acfm)	% of Total
Quench		1.97 (0.074)		3.0
Prescrubber		6.82 (0.256)		10.3
IWS 1[a]	8.47 (0.318)	4.80 (0.180)	1.82 (0.068)	22.7
IWS 2[a]	8.47 (0.318)	4.80 (0.180)	3.89 (0.146)	25.7
Cooling Tower[b]	16.7 (0.628)	8.79 (0.330)		38.4
Total	33.6 (1.264)	27.2 (1.02)	5.71 (0.214)	66.6 (2.50)[c]
Percent of Total	50.6	40.8	8.5	

(a) The gas pressure drop was divided between the two units
(b) Includes an estimate of the fan and the pump power requirements
(c) Note the total power on 11/21/78 measured with a Volt-amp meter was 149 hp or 3.02 hp/1000 acfm (80.5 watts/am^3/min)

and water circulation referenced to the volumetric flow of flue gas processed was considered as the energy input to the scrubber. Also, the gas side pressure drop was assumed to result only from the IWS units. The greatest single power input is from the gas side pressure drops. (It should be noted that this input includes the cooling tower air flow.) The major power input from these estimations is in the cooling tower; thus, the need to condense components of the flue gas stream in order to control the emission from the kiln results in an additional energy requirement when compared to a process which emits only solid particles. Also, the tests were conducted under atmospheric temperatures of about 4°C (40°F) which leads to efficient cooling of the water streams.

Under summer conditions, the scrubber temperature, efficiencies, and power requirements may be different than observed during the test.

Particulate Matter Formed in the Scrubber

An aspect of the process affecting scrubber performance is the formation of particulate matter during cooling of the flue gas. The two mechanisms which could contribute to the formation of particles are evaporation of water containing dissolved solids and condensation of volatile matter in the flue gas. Analysis of the water streams is reported in Table 5-7.

Using the water analysis and the gas stream properties, the increase in particulate matter concentration by evaporation is shown in Table 5-8. It was assumed that the gas stream was initially cooled by evaporation under conditions of constant enthalpy to saturation, then cooled by sensible heat transfer to the observed quench temperature. It was assumed that cooling of the gas from the saturation temperature did not cause the removal of particulate matter.

The fraction of particulate matter formed by evaporation of the scrubber water is estimated by considering the test day of November 10 when the ionizers were shut off. Particulate matter formation from water evaporation accounts for about 30 percent, and about 70 percent results from condensation directly from gas phase for the particulate matter formed in the scrubber. The influence of the particulate matter formed by the evaporation of water is shown in Figure 5-2 with an analysis of Phase II tests. The outlet concentration and scrubber penetration were directly related to the quantity of water evaporated in the quench section and estimated particulate matter. Thus, additional improvement in efficiency may be realized by reducing the dissolved solids in the quench water. However, the emissions were below any applicable regulation and cost of providing fresh water for cooling the flue gas may not be warranted at the present time.

PARTICLE COLLECTION EFFICIENCY

Mean Particle Diameter

Size distribution statistics computed for the cascade impactor tests are summarized in Table 5-9. The geometric mass mean diameter and geometric

TABLE 5-7. TOTAL SOLIDS IN WATER STREAMS

Date (1978)	Sample	Total Solids[a] (mg/liter)
11/10	Inlet	2606
	IWS Sump	1633
11/18	Inlet	2600
	Sump	2580
11/20	Inlet	2830
	Sump	2950
11/21	Inlet	2960
	Sump	3160

(a) The sample contained negligible amounts of suspended solids

The inlet sampling location was the water intake at pond.

The outlet sampling location was the sump of the scrubber. This location was the site of discharge of several discharge lines which were poorly mixed in the sample area.

TABLE 5-8. ESTIMATION OF AEROSOL FORMATION IN QUENCH SECTION

Date (1978)	Volumetric Gas Flow Inlet Cond. m^3/sec (acfm)	Temp. Inlet °C (°F)	Water Conc. by Volume Inlet Percent	Specific Humidity Inlet g/g (lb/lb)	Solids in Water mg/liter	T After Quench °C (°F)	Specific Humidity After Quench g/g (lb/lb)	Humidity at Saturation g/g[a] (lb/lb)	T at Saturation °C[a] (°F)	Increase in Specific Humidity g/g (lb/lb)	Increase in Particulate Matter mg/m^3[b][c] (gr/ft^3)	Particulate Matter from Evaporation Compared to Inlet Percent[d]	Particulate Matter from Evaporation Compared to Total Generated Percent[e]
11/10	29.32 (62132)	174 (345)	7.69	0.1342 (0.1342)	2606	48 (118)	0.0755 (0.0755)	0.190 (0.190)	63 (145)	0.0558 (0.0558)	163.5 (0.0713)	63	32
11/18	22.72 (48148)	156 (313)	3.63	0.067 (0.067)	2600	43 (110)	0.06 (0.06)	0.119 (0.119)	55 (131)	0.052 (0.052)	147.0 (0.0641)	44	
11/20	25.48 (53980)	135 (275)	3.53	0.05895 (0.05895)	2830	41 (106)	0.053 (0.053)	0.095 (0.095)	52 (125)	0.0361 (0.361)	115 (0.0501)	60	
11/21	21.63 (45828)	138 (281)	5.33	0.0907 (0.0907)	2960	41 (106)	0.053 (0.053)	0.130 (0.130)	56 (132)	0.0393 (0.0393)	131 (0.0571)	54	

(a) It is assumed that the inlet gas is cooled by evaporation as a constant enthalpy process and then the gas is cooled by sensible heat transfer

(b) Obtained by the product of the water solids concentration and increase in specific humidity, it is assumed after formation, the particulate matter is not removedd by condensation in the quench section

(c) Standard conditions 21.1° C, 76 cm Hg, Dry

(d) Ratio of the increase in particulate matter formed from evaporation to that measured during the inlet tests

(e) Computed by dividing the increase in particulate matter from evaporation by the outlet of 11/10 from the average outlet concentrations from 11/18, 20, and 21. Assumes negligible removal of particulate matter in the prescrubber and deenergized IWS.

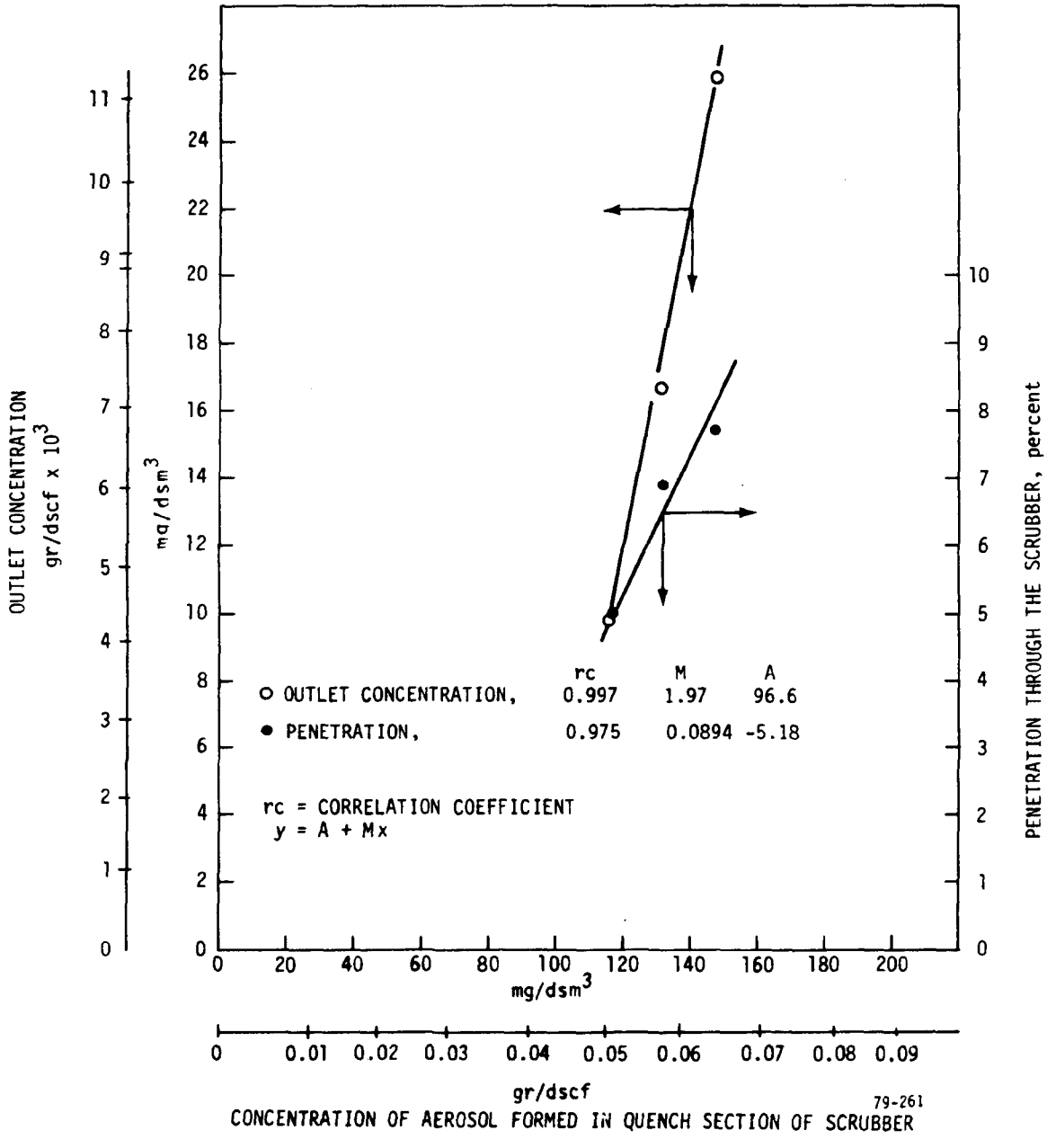


Figure 5-2. Scrubber performance as a function of scrubber-generated aerosol.

TABLE 5-9. SIZE DISTRIBUTION GEOMETRIC MEAN DIAMETER AND STANDARD DEVIATION

	Inlet				Outlet			
Date (1978)	Run No.	Dg (micron)	σ_g	r_c	Run No.	Dg (micron)	σ_g	r_c
11/10	25	0.468	3.57	0.876	16	1.27	4.15	0.983
	26	0.509	3.73	0.909	17	1.62	3.83	0.973
Avg		0.489	3.65	0.893		1.45	3.99	0.978
Standard Deviation		0.029	0.115	0.0233		0.247	0.226	0.007
11/18	27	1.443	7.95	0.761	18	0.181	4.82	0.939
	28	0.182	4.16	0.869	19	0.359	2.53	0.866
11/20	29	0.494	3.95	0.889	36	0.240	4.42	0.873
	30	0.564	3.90	0.905	37	0.183	2.92	0.857
11/21	32	0.363	5.44	0.889	38	0.305	2.99	0.862
	33	0.356	6.17	0.919	39	0.271	2.89	0.898
Avg		0.567	5.26	0.872		0.256	3.43	0.883
Standard Deviation		0.449	1.60	0.057		0.070	0.945	0.0312

Dg - Geometric mean diameter
σ_g - Geometric standard deviation
r_c - Least square correlation coefficient for fit to a log normal size distribution

Particle specific gravity = 1.8 g/cm^3

standard deviation were determined with a least square fit to a lognormal size distribution. The aerosol is submicron in size with a geometric mean diameter of 0.6 micron entering the scrubber and 0.3 micron in the exhaust gas.

The outlet size distribution obtained during the tests with the IWS shut off had a geometric mass mean diameter of 1.5 microns. Thus, the formation and growth of particles in the quench and prescrubber increases the mean diameter considerably. The growth mechanisms are suspected to be coagulation and humidification.

The differential size distribution (incremental mass concentration per incremental logarithmatic particle diameter as a function of particle diameter) dm/d log D vs D is shown for the cascade impactor results in Figure 5-3. The change in particle size distribution from the removal in the scrubber is shown for average results on November 18, 20, and 21.

In addition, the growth in aerosol size distribution from cooling and humidification of the flue gas is shown to be primarily in the 1 to 10 micron particle diameter range, thus indicating the reason for an increase in mean particle diameter indicated in Table 5-9.

The impactor and EASA results were combined to obtain particle size distributions and fraction penetration curves. The last day of testing, November 21, 1978, was selected for analysis in detail. All measurements exhibited very good precision.

The differential size distribution is shown in Figure 5-4. The figure illustrates many of the problems experienced with obtaining fine particle data. It was noticed that the size distribution measured at the inlet was related to the life of the silica gel used to dry the dilution air. The size distribution obtained under conditions of fresh silica gel was bimodal. However, as the silica gel was depleted, the distribution grew to a single mode at 0.4 microns and appeared to match the impactor results rather than the bimodal case. It is believed that the emission was very reactive with water. The dilution system was operated with dilutions of up to 1000:1; therefore, with fresh silica gel the aerosol would be measured with insignificant relative humidities (absolute humidity of 10^{-4}g h_2O/g air). The cascade impactor measured the particle size distribution under flue gas conditions of about 3 percent relative humidity. The single mode distribution is the one most likely to be present at the inlet of the scrubber. The size distributions measured by the EASA were repeatable and the humidity phenomena was observed on other test days.

A second uncertainty is related to the data reduction procedures. The EASA has cross sensitivity errors in the last four size channels (a particle will be sensed in more than one channel). A computational procedure reported by Twomey, 1975, was used to reduce the data to correct for cross sensitivity; the instruction manual method which does not correct for cross sensitivity was also used. The size distribution reported for the EASA depends on the data reduction technique.

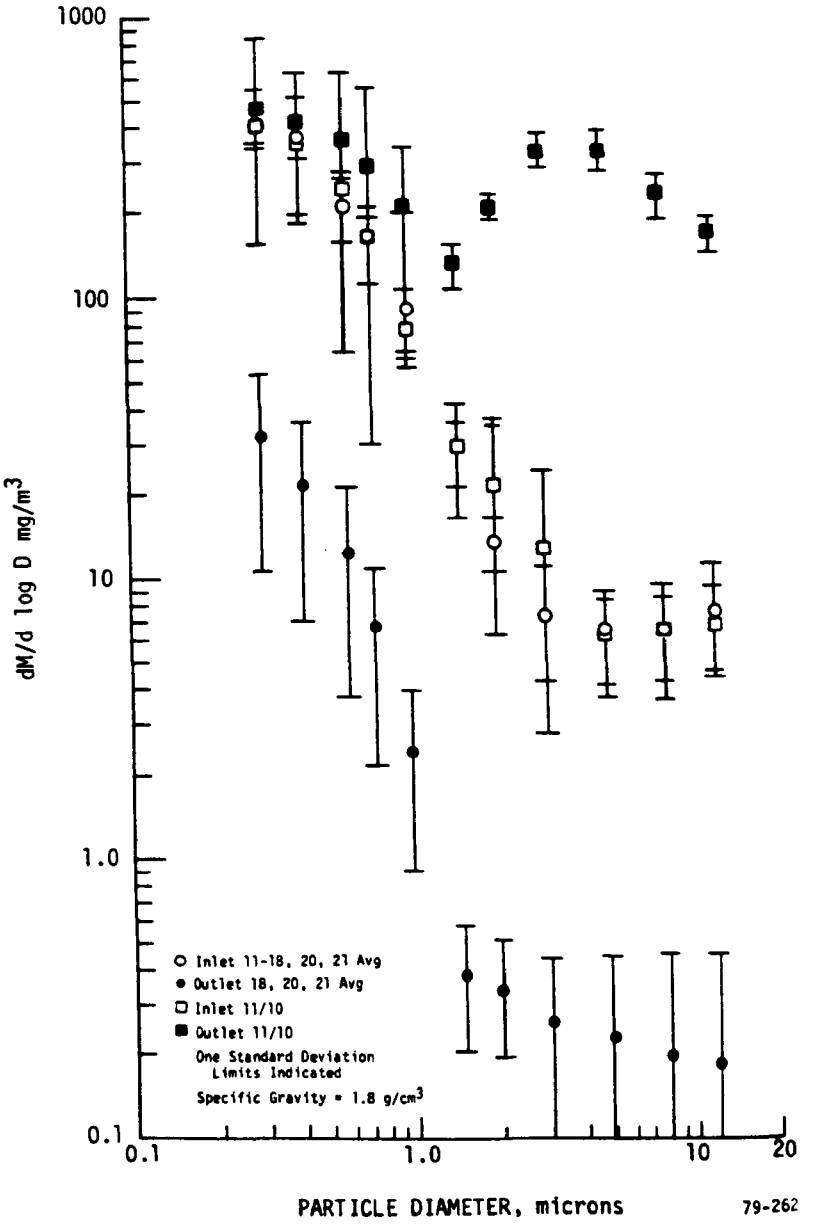


Figure 5-3. Differential size distribution for inlet and outlet of scrubber taken with cascade impactors.

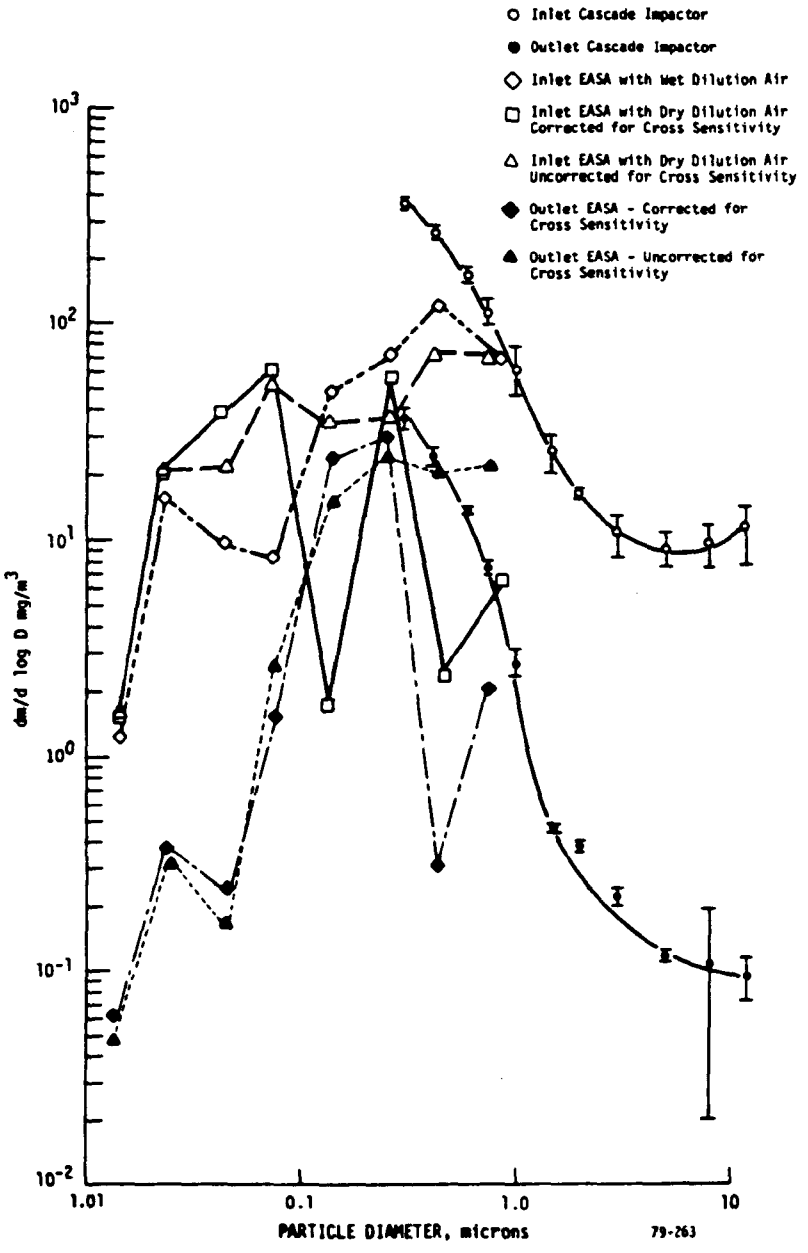


Figure 5-4. Impactor and EASA differential size distributions for 11/21/78.

In these tests, the instruction manual method agrees better with cascade impactor size distribution than the results corrected for cross sensitivity. However, the cascade impactors also have cross sensitivity and the reduction technique used does not correct for nonideal behavior in the impactor. Therefore, agreement of EASA and impactor size distributions does not mean any particular size distribution is correct. For this reason, results from different approaches are reported. The ambiguity in reported size distribution indicates the difficulty of obtaining this information for a reactive condensible aerosol even when state-of-the-art experimental techniques are used.

Particle Size Dependent Penetration

The penetration of the particulate matter is a preferred way of reporting performance rather than efficiency. The significant figures of the measurement can be preserved, and particle generation can be easily computed. The penetration is obtained by dividing the outlet differential size distribution curve by the inlet curve.

The average penetration for November 18, 20 and 21, as a function of particle diameter obtained with the cascade impactors, is shown in Figure 5-5. In addition, a penetration curve computed with the outlet deenergized, divided into the average size distribution for November 18, 20, and 21 is shown in Figure 5-5. This curve may be a more realistic measure of the IWS performance than the inlet/outlet tests because of particle formation in the quench and prescrubber.

In Figure 5-6, the combined impactor and EASA penetration curves are shown for November 21, 1978. The interpretation of the EASA results is an important consideration in computation of the penetration. The data obtained with partially spent silica gel at the inlet (diamond) is the most believable in the 0.1 to 0.3 micron range.

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

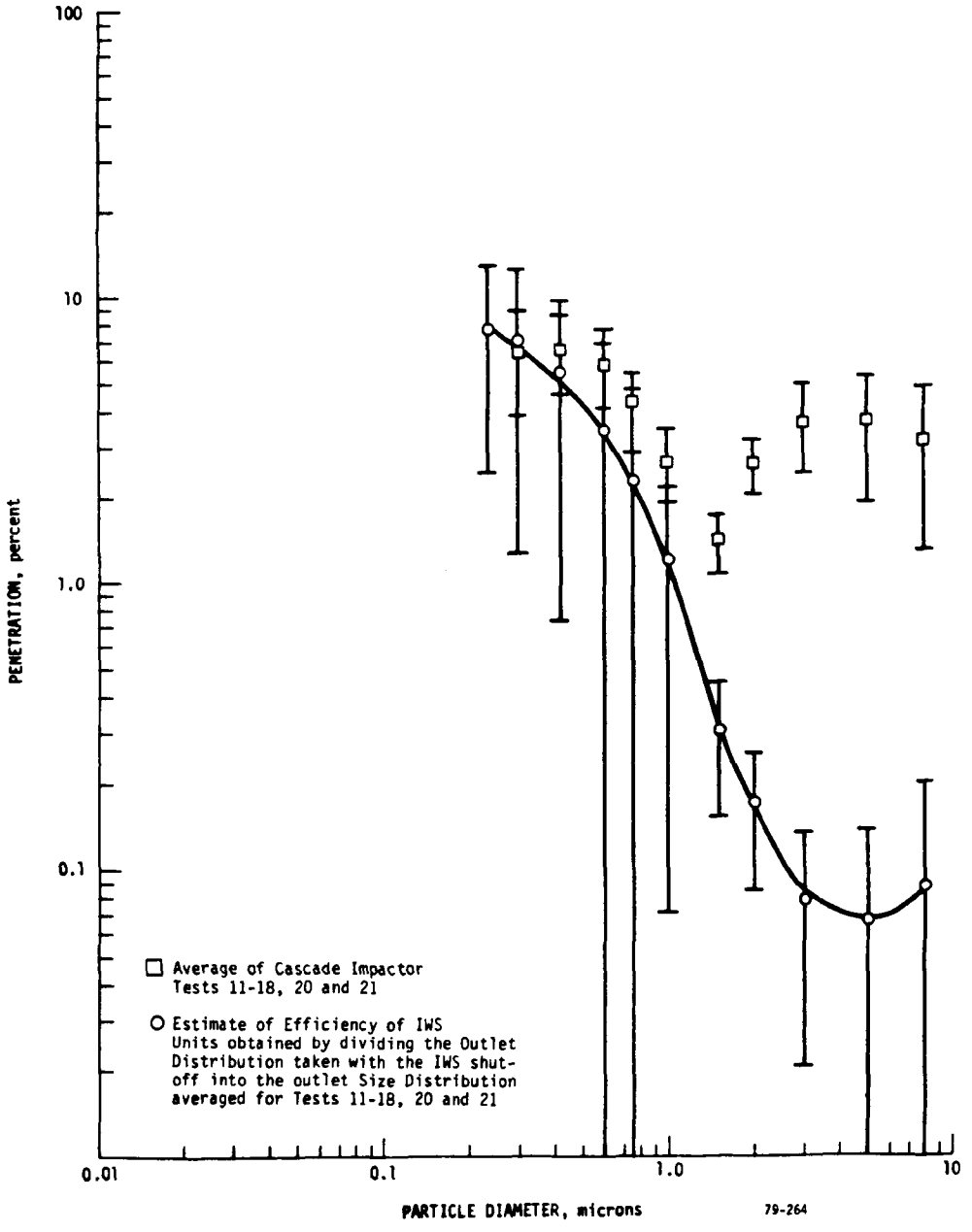


Figure 5-5. Particle size dependent penetration for the IWS units.

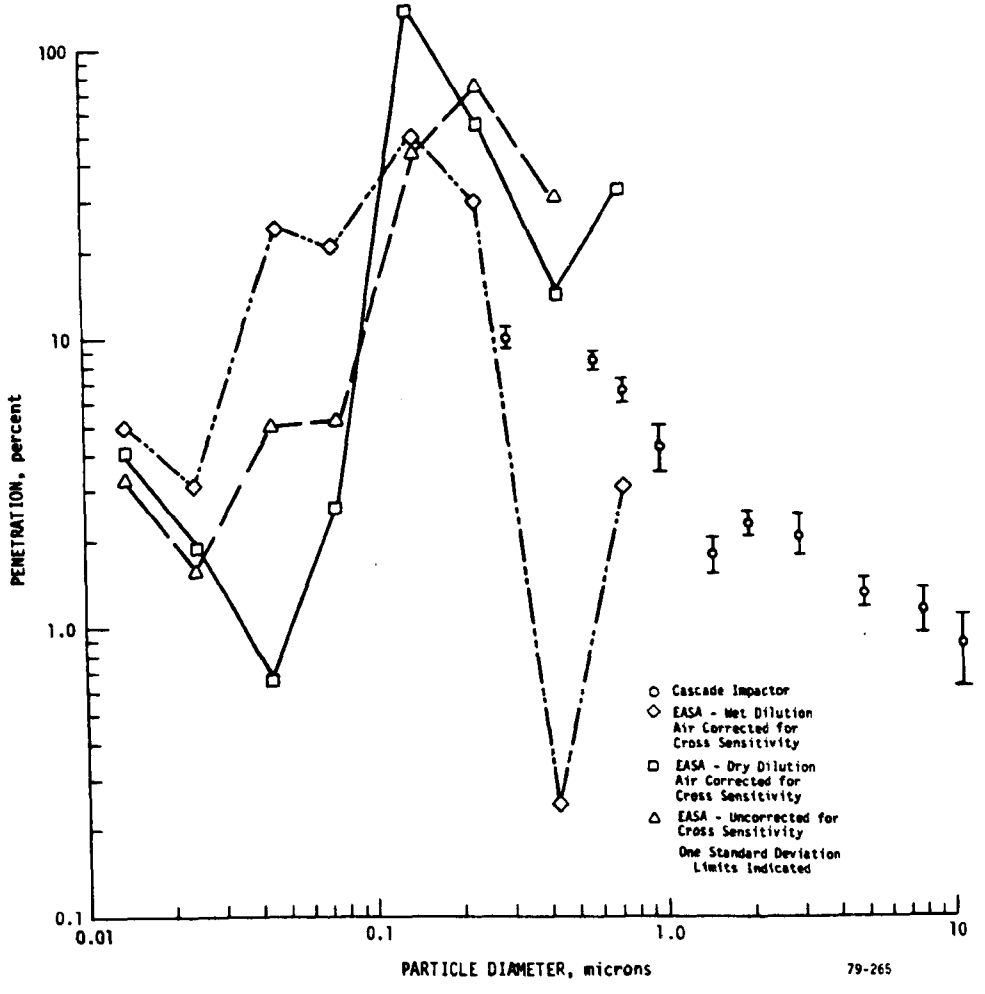


Figure 5-6. Particle size dependent penetration for cascade impactor and EASA results.

The actual diameter with 50 percent penetration was from Figure 5-6. The aerodynamic cut diameters were then computed from the actual diameter. The EASA size distribution was used because the cut diameter was below the the resolution of the impactor.

The square root of the Cunningham correction factor and density $\sqrt{C\rho}$ was computed for the size range of interest in Figure 5-7. The actual size cut diameters were taken from Figure 5-6 and reported in Table 5-10. Depending on the measurement and data inversion technique, the aerodynamic cut diameter was from 0.4 to 0.6 micron.

Comparison to Other Types of Scrubbers

The aerodynamic cut diameter from Table 5-10 and theoretical power from Table 5-6 are shown in Figure 5-8. This figure has theoretical performance curves for a number of different scrubber types for comparison. These results suggest that the IWS is more efficient than a theoretical venturi scrubber.

The aerodynamic cut diameter obtained for the whole scrubber on November 21 is believed to be valid for the IWS units including the aerosol generated in the quench and prescrubber section. As shown in Figure 5-5, the generated particles are captured in the IWS in the 1 to 10 micron diameter range. The penetration in the fine particle range, less than 1 micron, appears to be unaffected by particle generation. Thus, the aerodynamic cut diameter is unaffected by this phenomenon.

OPACITY

The PPV was a useful monitor of process variation. An example is shown in Figure 5-9 showing a trace of the inlet opacity. The drop in opacity every 1-1/3 hours is caused by the opening of doors to allow the entry of formed bricks into the kiln on tunnel kiln cars. An example of the outlet opacity is shown in Figure 5-10. The upsets on the chart were due to the "tripping" of TR sets on Ionizer 2 and resetting by an operator.

Another physical property of the emission was the sensitivity of opacity to measurement temperature and, presumably, relative humidity as shown in Figure 5-11. This behavior is similar to that observed during the measurement of the inlet size distribution when the size distribution changed as the silica gel in the dilution system was depleted. The phenomenon was repeatable but the magnitude of the change in opacity with chamber temperatures varied.

The wide ranges of concentration and opacity between inlet and outlet conditions allowed the correlation of mass concentration and opacity as shown in Figure 5-12. The correlation coefficient of 0.96 suggests that the size distribution was fairly consistent (within a factor of 3 in mean diameter) between the inlet and outlet of the scrubber as indicated in Table 5-1.

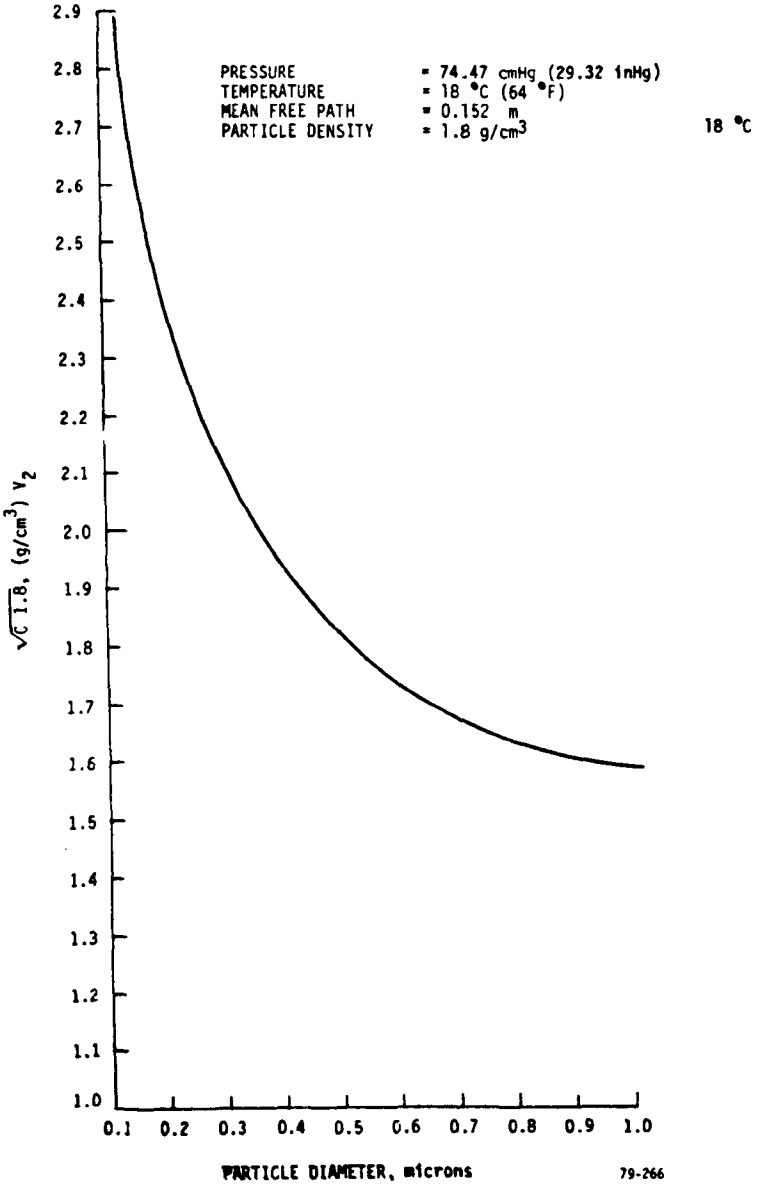


Figure 5-7. Conversion factor real to aerodynamic diameter.

TABLE 5-10. SUMMARY OF CUT DIAMETERS

Technique	Actual Diameter at 50% Penetration (micron)	$\sqrt{C\rho}$ $(g/cm^3)^{1/2}$	Aerodynamic Cut Diameter (micron)
EASA uncorrected for channel cross sensitivity	0.28	2.16	0.60
EASA inlet size distribution dry dilution air	0.24	2.28	0.55
EASA inlet size distribution water in dilution air	0.14	2.75	0.38

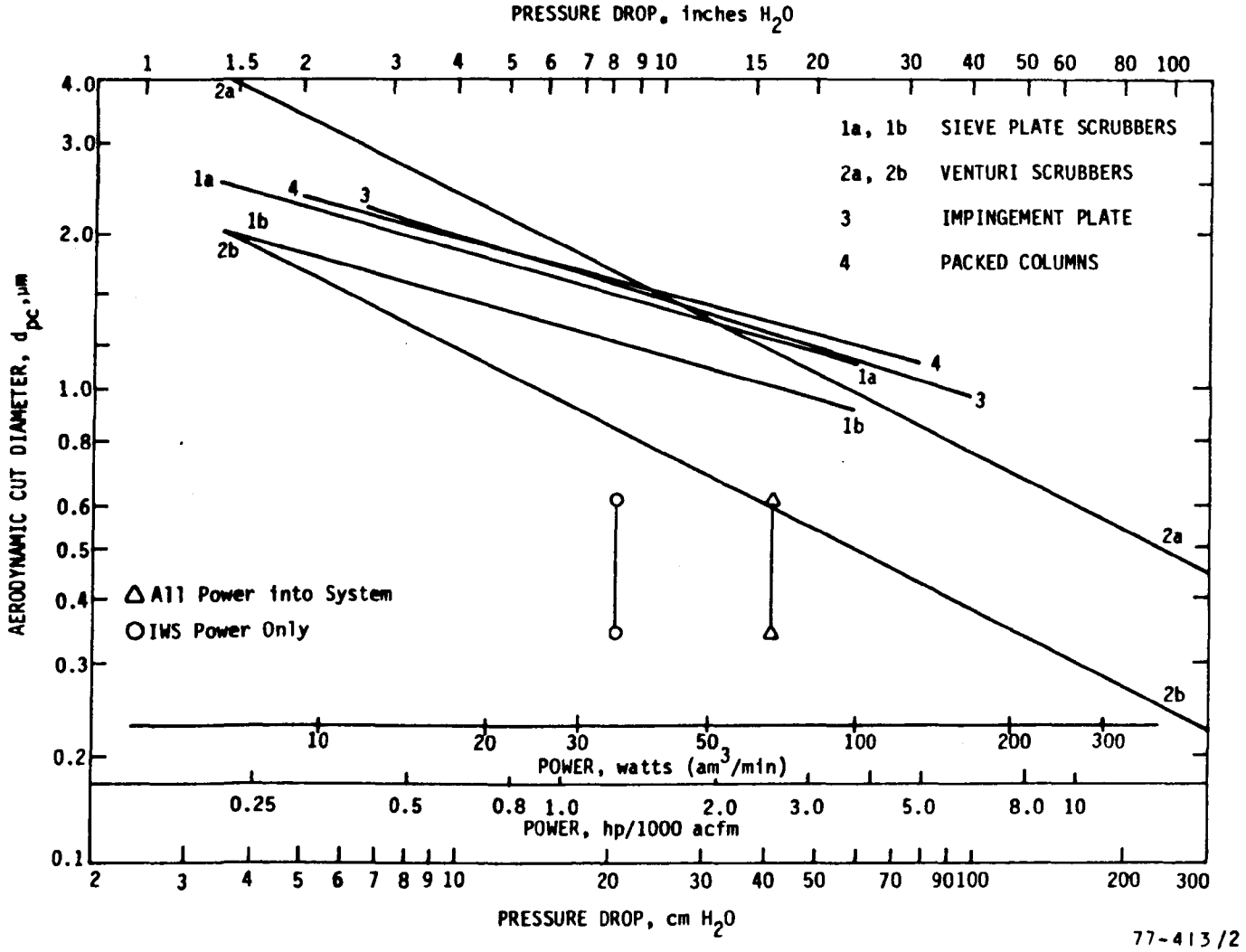


Figure 5-8. Aerodynamic cut-diameters of the Ceilcote ionizing wet scrubber compared to the theoretical performance of other scrubber types (after Cooper and Anderson, 1975, adapted from Calvert, 1974).

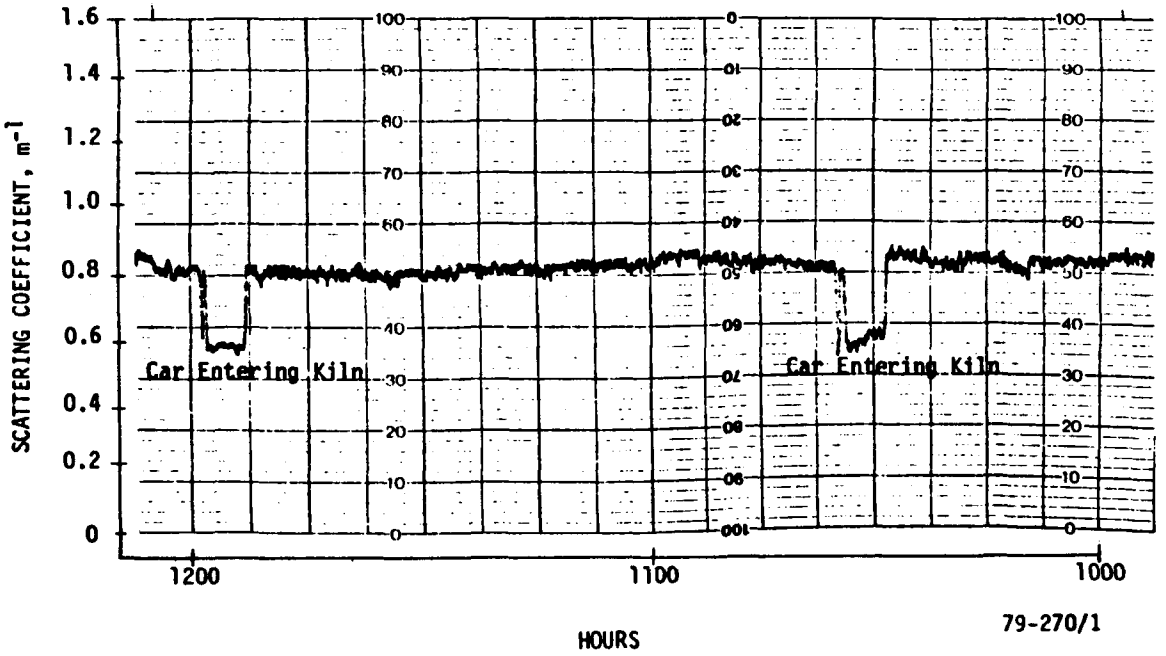


Figure 5-9. Example of plant process visiometer monitoring of inlet.

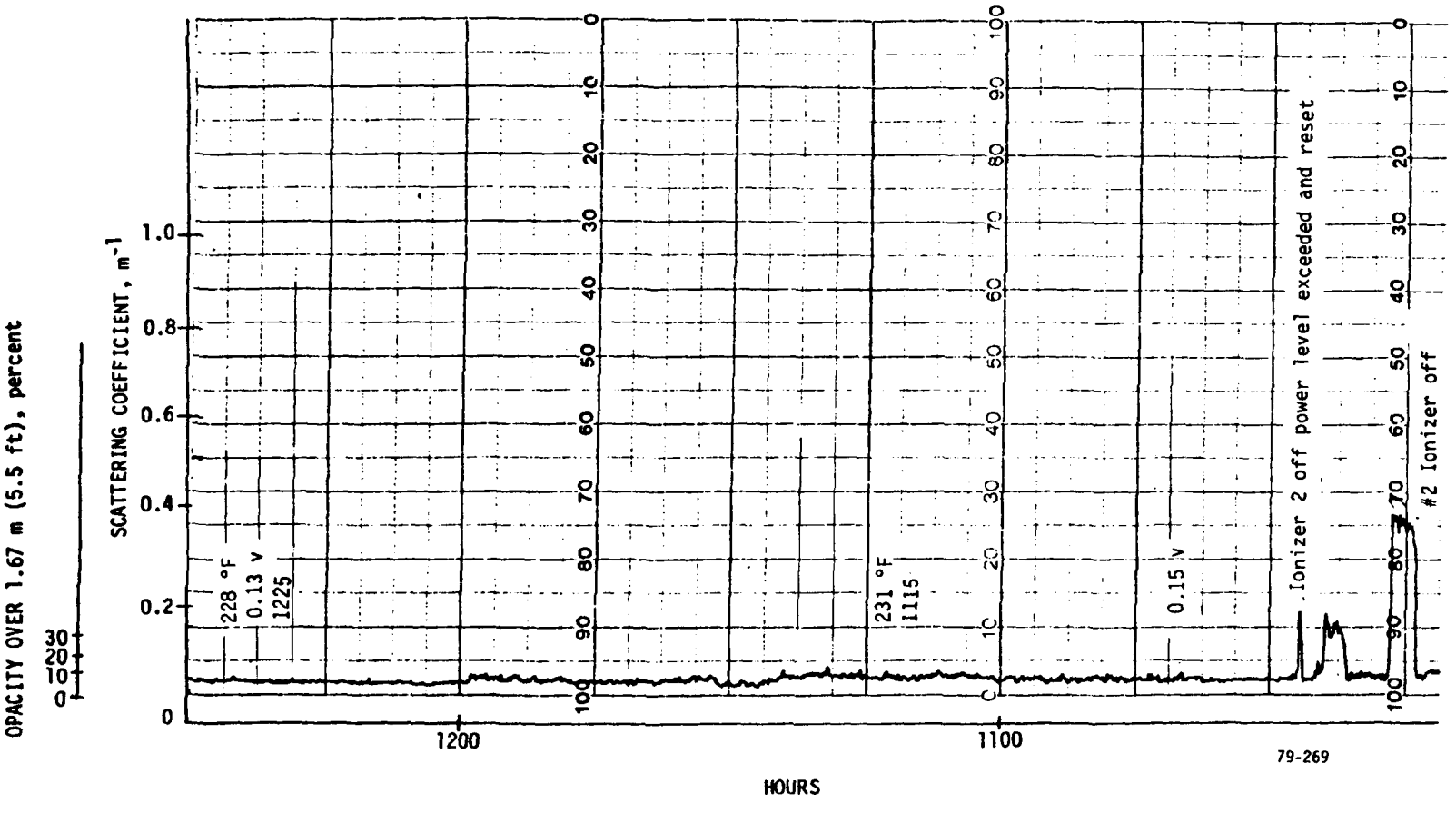


Figure 5-10. Example of plant process visiometer monitoring of outlet.

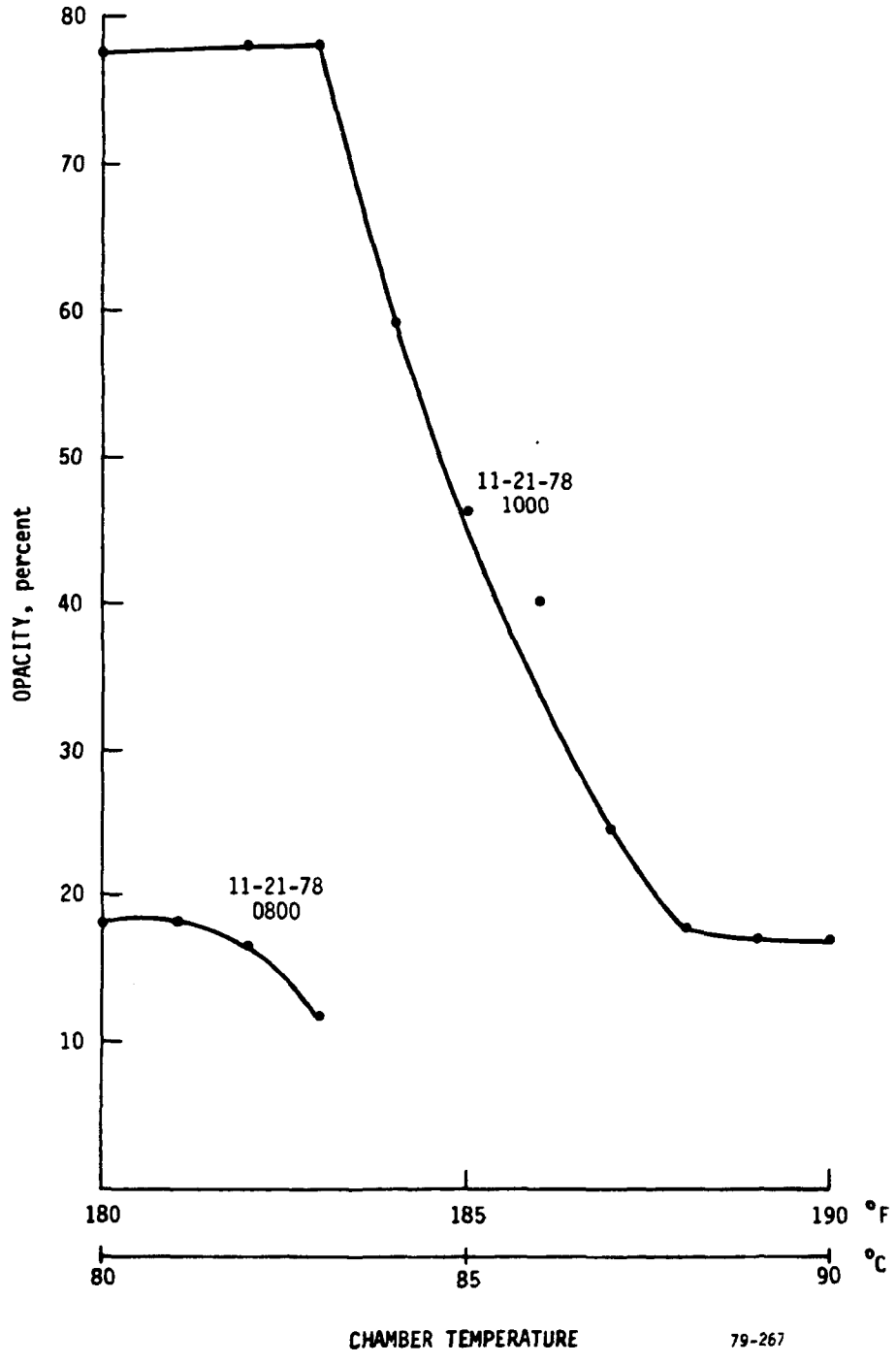


Figure 5-11. Outlet opacity as a function of plant process visiometer chamber temperature.

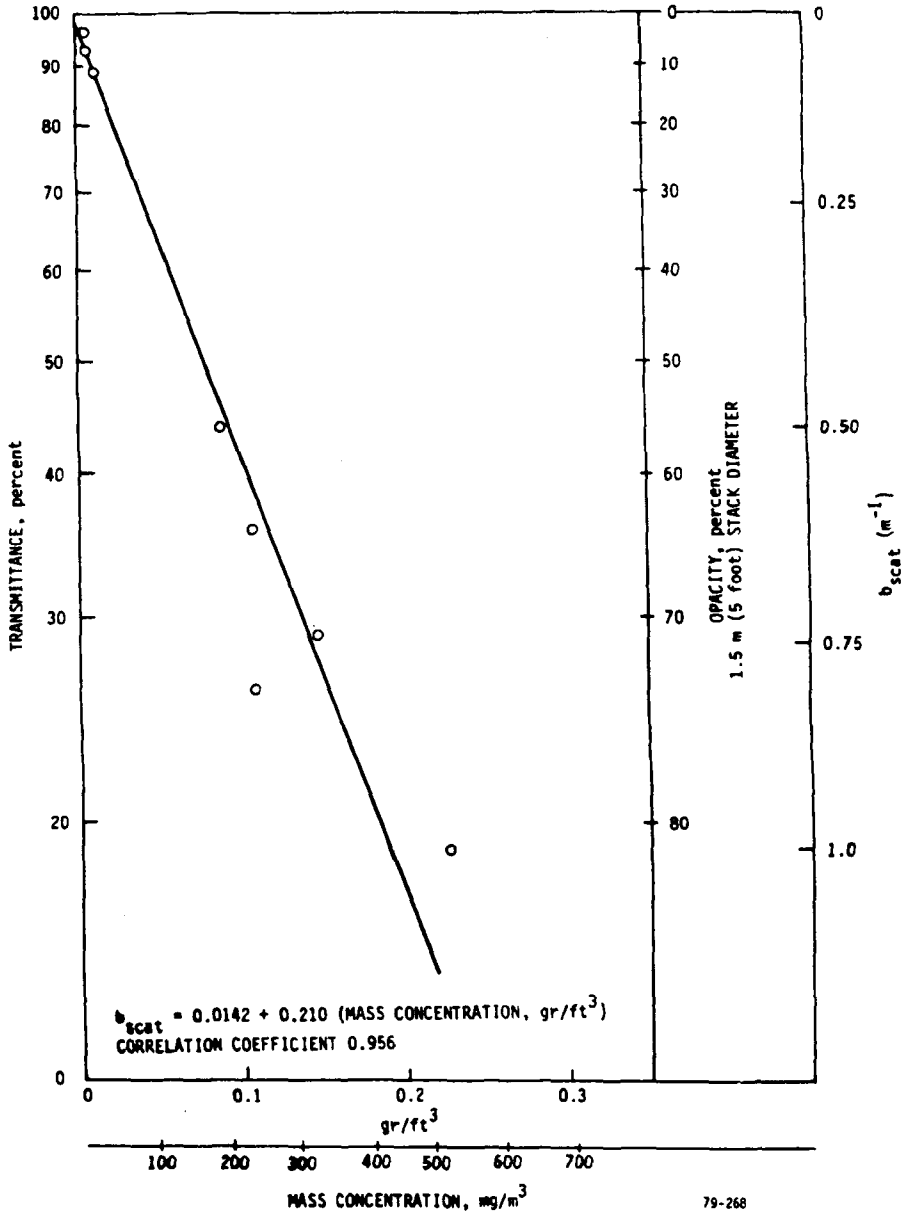


Figure 5-12. Correlation of opacity with mass concentration.

SECTION 6

BIBLIOGRAPHY

Calvert, S. 1974. Engineering Design of Fine Particle Scrubbers. J. Air Poll. Cont. Assoc. 24:929-934.

Calvert, S., J. Goldshmid, D. Leith, and D. Mehta. 1972. Scrubber Handbook. EPA Contract No. CAP-70-95, PB-213-06.

Cohen, J.J., and D.M. Montan. 1967. Theoretical Considerations, Designs, and Evaluation of a Cascade Impactor. Am. Ind. Hyg. Assn. J. 28:95-104.

Cooper, D.W., and D.P. Anderson. 1975. Dynactor Scrubber Evaluation. EPA-60/2-74-083-a, U.S. Environmental Protection Agency.

Ensor, D.S., L.D. Bevan, and G. Markowski. 1974. "Application of Nephelometry to the Monitoring of Air Pollution Sources." 67th Annual Meeting of the Air Pollution Control Assoc., Denver, Colorado, Paper No. 74-110.

Globe Refractories, Inc. 1978. "Stack Emissions from Plants Which Produce Bloating Ladle Refractory Products," January 13.

Handbook of Chemistry and Physics. 1959. Chemical Rubber Publishing Company, Cleveland, Ohio.

Harris, D.B. 1977. Procedures for Cascade Impactor Calibration and Operation in Process Streams. EPA-600/2-77-004.

Klugman, W.L., and S.V. Sheppard. 1975. "The Ceilcote Ionizing Wet Scrubber." Presented at the 68th Annual Meeting of the Air Pollution Control Assoc., Boston, Massachusetts, June 15-20.

Markowski, G.R., and D.S. Ensor. 1977. "A Procedure for Computing Particle Size Dependent Efficiency for Control Devices from Cascade Impactor Data." 70th Annual Meeting of the Air Pollution Control Assoc., Toronto, Canada, June.

McCain, J.D., G. Clinord, L.G. Felix, and J. Johnson. 1979. A Data Reduction System for Cascade Impactors. Proceedings: Advances in Particle Sampling and Measurement. EPA-600/7-79-065.

Mogul Corporation. 1977. Emission Evaluation Test Report: Globe Refractories, Inc., Newell, West Virginia, December 16.

Moore, R.F. "Globe Refractories, Inc., Air Pollution Control System"

Perry, J.H. 1963. Chemical Engineer's Handbook. McGraw-Hill Book Company, Inc., New York, New York. 15-5.

Strauss, W. 1974. Industrial Gas Cleaning. Pergamon Press, New York, New York. 333-334.

Twomey, S. 1975. Comparison of Constrained Linear Inversion and an Iterative Nonlinear Algorithm Applied to the Indirect Estimation of Particle Size Distributions. J. of Computational Physics. 18:188-200.

APPENDIX A

MANUFACTURER'S DESCRIPTION

IONIZING WET SCRUBBER*

Ceilcote's Ionizing Wet Scrubber (IWS) was developed to remove fine solid and/or liquid particulate down to 0.05 microns and less at low energy levels and high collection efficiencies. The IWS simultaneously removes corrosive, noxious and odoriferous gases from the process stream as well as coarse particulates.

The IWS incorporates advantages of electrostatic precipitators and wet scrubbers within one device by combining the principles of electrostatic particle charging, image force attraction, agglomeration and inertial impaction to increase particulate collection efficiencies in the submicron range.

Low operating/installation costs, simplified design and construction minimal maintenance/service requirements, high collection efficiencies irrespective of load, nonsensitivity to particle size/composition and high operating reliability are characteristics of the IWS.

A high voltage Ionizer section is utilized to charge particles in the gas stream before entering a Tellerette (R) packed charged particle scrubbing section.

Particulate is removed by conventional inertial impaction or by the newly applied principle of Image Force Attraction whereby charged particulate is attracted to neutral packing surfaces within the wet scrubber section of the IWS. The collected particulate and gases are removed continually from the stream by a liquid scrubbing medium which flows vertically down through the packing.

Extensive use of plastic in IWS construction makes it extremely attractive for use in corrosive environments. However, the IWS can be constructed of metal if desired.

For applications with particularly difficultl emission removal problems, the IWS can be employed as a multi-stage unit to increase collection efficiency. Actual field, laboratory, and operating experience indicate that two stages linked in series can solve most problems associated with troublesome submicron particulates requiring high collection efficiency.

Compliance with stringent environmental regulations and codes governing output emission and opacity are possible with the IWS. And, IWS systems can be continually upgraded by installing additional units.

*Ceilcote Technical Bulletin 1255, July, 1976

Appendix B. Cascade Impactor Results

TITLE: OUTLET RUN 39 11/21/78 1545 IMPTR 131/126 6 STAGES 24 HOLES LAST STAGE N

TEST DATA

TEST DURATION =	120.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	40.	DEGS. F	TEMP ATMOS. =	40.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	47.04	FT/SEC
BARO. PRES =	29.60	INCH HG	SAMPLE RATE =	1.56	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	165.84	CF(STACK COND.)
VOL. METER =	112.73	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.16	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	47.8	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	2.01	
VOLUME GAS STD. DRY =	.554E+01	CUBIC METER
PERCENT ISOKINETIC =	143.70	
CONCENTRATION =	.211E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM CUM	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.	.965E+00	.165E+02	.111E+03	.900E-01	.269E-01	.211E+02	.715E-01	.38
2	1.03	12.	.476E+00	.693E+01	.305E+03	.120E+00	.359E-01	.210E+02	.953E-01	.38
3	1.09	24.	.198E+00	.256E+01	.879E+03	.230E+00	.688E-01	.210E+02	.159E+00	.38
4	1.21	24.	.119E+00	.113E+01	.244E+04	.530E+00	.158E+00	.209E+02	.447E+00	.38
5	1.38	24.	.858E-01	.626E+00	.493E+04	.779E+01	.233E+01	.208E+02	.903E+01	.38
6	1.95	24.	.533E-01	.268E+00	.122E+05	.384E+02	.115E+02	.184E+02	.311E+02	.38
				FILTER WEIGHT		.233E+02	.695E+01	.695E+01		
				TOTAL WEIGHT		.704E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.271 MICRONS
STD. GEOMETRIC DEVIATION =	2.889
CORRELATION COEFFICIENT =	.898

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9987	3.017	16.494	6.643	1.344 TO	32.821
2	.9970	2.750	6.934	5.005	1.198 TO	20.913
3	.9938	2.498	2.565	3.831	1.045 TO	14.044
4	.9862	2.204	1.134	2.804	.852 TO	9.234
5	.8756	1.153	.626	.920	.242 TO	3.497
6	.3504	-.459	.268	.170	.014 TO	2.074
7	.0000					

ABEND IMPCT ABORTED
JOB NEAL ABORTED
JOB NEAL OFF AT 15:04:06.36 ON 06 APR 1979
EXECUTION TIME: 00:01:42.71

TITLE: OUTLET RUN 38 11/21/78 1235 IMPTR 109/102 6 STAGES 24 HOLES LAST STAGE\

TEST DATA

TEST DURATION =	130.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	43.	DEGS. F	TEMP ATMOS. =	43.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	47.04	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	1.23	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	160.53	CF(STACK COND.)
VOL. METER =	109.76	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.96	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	46.3	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	2.02	
VOLUME GAS STD. DRY =	.322E+01	CUBIC METER
PERCENT ISOKINETIC =	128.41	
CONCENTRATION =	.197E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VEL CM/SEC	MASS FRACT MGRAMS	CUNC MG/CUBIC M	CUM CONC MG/CUBIC M	DM/DLOGD MG/CUBIC M	SQRT PS150
1	1.01	8.	.965E+00	.175E+02	.996E+02	.220E+00	.684E-01	.197E+02	.182E+00	.38
2	1.03	12.	.476E+00	.734E+01	.273E+03	.140E+00	.435E-01	.197E+02	.116E+00	.38
3	1.09	24.	.198E+00	.272E+01	.786E+03	.210E+00	.653E-01	.196E+02	.151E+00	.38
4	1.20	24.	.119E+00	.121E+01	.218E+04	.510E+00	.159E+00	.196E+02	.449E+00	.38
5	1.36	24.	.838E-01	.668E+00	.440E+04	.537E+01	.167E+01	.194E+02	.651E+01	.38
6	1.88	24.	.533E-01	.288E+00	.109E+05	.369E+02	.115E+02	.177E+02	.315E+02	.38
				FILTER WEIGHT		.201E+02	.625E+01	.625E+01		
				TOTAL WEIGHT		.635E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.305	MICRONS
STD. GEOMETRIC DEVIATION =	2.992	
CORRELATION COEFFICIENT =	.862	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9965	2.700	17.455	5.878	1.029 TO	33.559
2	.9943	2.532	7.341	4.889	.970 TO	24.636
3	.9910	2.367	2.719	4.078	.900 TO	19.474
4	.9830	2.120	1.206	3.112	.775 TO	12.496
5	.8984	1.272	.668	1.229	.292 TO	5.182
6	.5164	-.477	.288	.181	.009 TO	3.577
7	.0000					

TITLE: INLET RUN 53 11/21/78 1425 IMPTR 116/106 7 STAGES 12 HOLES LAST STAGE%

TEST DATA

TEST DURATION =	15.0	MINUTES	TEMP IMPACTOR =	287.	DEGS. F
METER TEMP. =	46.	DEGS. F	TEMP ATMOS. =	46.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.97	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	.46	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	6.89	CF(STACK COND.)
VOL. METER =	4.41	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.35	INCH HG	STACK SUCTION =	-.482E-01	INCH HG
COND. WATER =	5.1	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	5.37	
VOLUME GAS STD. DRY =	.128E+00	CUBIC METER
PERCENT ISOKINETIC =	92.97	
CONCENTRATION =	.218E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM CUM	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.	.965E+00	.292E+02	.370E+02	.610E+00	.475E+01	.218E+03	.127E+02	.38
2	1.02	12.	.476E+00	.123E+02	.101E+03	.740E+00	.576E+01	.213E+03	.154E+02	.38
3	1.05	24.	.198E+00	.461E+01	.292E+03	.590E+00	.459E+01	.208E+03	.108E+02	.38
4	1.12	24.	.119E+00	.208E+01	.811E+03	.600E+00	.467E+01	.203E+03	.135E+02	.38
5	1.21	24.	.838E-01	.118E+01	.164E+04	.110E+01	.857E+01	.198E+03	.348E+02	.38
6	1.47	24.	.553E-01	.545E+00	.404E+04	.640E+01	.498E+02	.190E+03	.148E+03	.38
7	1.74	12.	.533E-01	.354E+00	.809E+04	.778E+01	.606E+02	.140E+03	.323E+03	.38
				FILTER WEIGHT		.102E+02	.793E+02	.793E+02		
				TOTAL WEIGHT		.240E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.556 MICRONS
STD. GEOMETRIC DEVIATION =	6.169
CORRELATION COEFFICIENT =	.919

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9782	2.019	29.219	14.010	5.380 TO	58.079
2	.9518	1.663	12.332	7.333	2.377 TO	22.620
3	.9307	1.482	4.612	5.272	1.918 TO	14.493
4	.9093	1.337	2.082	4.051	1.575 TO	10.420
5	.8700	1.127	1.181	2.764	1.124 TO	6.796
6	.6416	.362	.545	.688	.197 TO	2.397
7	.3658	-.348	.354	.189	.027 TO	1.305
8	.0000					

TITLE: INLET RUN 52 11/21/78 1335 IMPTR 117/101 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	15.0	MINUTES	TEMP IMPACTOR =	287.	DEGS. F
METER TEMP. =	44.	DEGS. F	TEMP ATMOS. =	44.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.97	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	.51	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	7.66	CF(STACK COND.)
VOL. METER =	4.89	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.55	INCH HG	STACK SUCTION =	-.47E-01	INCH HG
COND. WATER =	5.6	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	5.29	
VOLUME GAS STD. DRY =	.143E+00	CUBIC METER
PERCENT ISOKINETIC =	103.42	
CONCENTRATION =	.198E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.277E+02	.412E+02	.700E+00	.490E+01	.198E+03	.131E+02	.38
2	1.02	12.	.476E+00	.117E+02	.113E+03	.470E+00	.329E+01	.193E+03	.877E+01	.38
3	1.06	24.	.198E+00	.437E+01	.325E+03	.490E+00	.343E+01	.190E+03	.802E+01	.38
4	1.13	24.	.119E+00	.197E+01	.902E+03	.500E+00	.350E+01	.187E+03	.101E+02	.38
5	1.23	24.	.838E-01	.111E+01	.182E+04	.900E+00	.630E+01	.183E+03	.255E+02	.38
6	1.50	24.	.533E-01	.511E+00	.450E+04	.690E+01	.483E+02	.177E+03	.143E+03	.38
7	1.80	12.	.333E-01	.330E+00	.899E+04	.895E+01	.626E+02	.129E+03	.329E+03	.38
					FILTER WEIGHT	.943E+01	.660E+02	.660E+02		
					TOTAL WEIGHT	.283E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.363	MICRONS
STD. GEOMETRIC DEVIATION =	5.436	
CORRELATION COEFFICIENT =	.889	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9755	1.966	27.698	10.117	2.199 TO	46.551
2	.9587	1.736	11.686	6.864	1.831 TO	25.733
3	.9414	1.567	4.367	5.154	1.556 TO	17.074
4	.9238	1.431	1.968	4.095	1.335 TO	12.562
5	.8920	1.238	1.114	2.950	1.026 TO	8.481
6	.6486	.381	.511	.692	.164 TO	2.917
7	.3327	-.432	.330	.175	.017 TO	1.769
8	.0000					

TITLE: OUTLET RUN 37 11/20/78 1623 IMPTR 131/126 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	117.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	47.	DEGS. F	TEMP ATMOS. =	47.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	47.33	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	1.44	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	168.46	CF(STACK COND.)
VOL. METER =	116.62	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.96	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	37.9	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	1.58	
VOLUME GAS STD. DRY =	.339E+01	CUBIC METER
PERCENT ISOKINETIC =	148.81	
CONCENTRATION =	.151E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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.	.965E+00	.162E+02	.116E+03	.500E-01	.148E-01	.151E+02	.392E-01	.38
2	1.04	12.	.476E+00	.679E+01	.318E+03	.200E-01	.590E-02	.151E+02	.157E-01	.38
3	1.10	24.	.198E+00	.251E+01	.916E+03	.200E-01	.590E-02	.151E+02	.137E-01	.38
4	1.22	24.	.119E+00	.111E+01	.254E+04	.120E+00	.354E-01	.151E+02	.998E-01	.38
5	1.40	24.	.838E-01	.611E+00	.513E+04	.322E+01	.950E+00	.151E+02	.367E+01	.38
6	1.99	24.	.533E-01	.260E+00	.127E+05	.226E+02	.666E+01	.141E+02	.179E+02	.38
					FILTER WEIGHT	.253E+02	.746E+01	.746E+01		
					TOTAL WEIGHT	.513E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.183	MICRONS
STD. GEOMETRIC DEVIATION =	2.920	
CORRELATION COEFFICIENT =	.857	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9990	3.098	16.156	5.050	.894 TO	28.520
2	.9986	2.997	6.790	4.532	.864 TO	23.778
3	.9982	2.920	2.510	4.171	.838 TO	20.766
4	.9959	2.645	1.108	3.107	.727 TO	13.273
5	.9331	1.500	.611	.911	.188 TO	4.425
6	.4952	-.017	.260	.179	.009 TO	3.494
7	.0000					

TITLE: OUTLET RUN 36 11/29/78 1240 IMPTR 109/102 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	60.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	47.	DEGS. F	TEMP ATMOS. =	47.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	47.33	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	1.34	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	80.33	CF(STACK COND.)
VOL. METER =	55.61	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.96	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	18.1	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	1.58	
VOLUME GAS STD. DRY =	.162E+01	CUBIC METER
PERCENT ISOKINETIC =	138.37	
CONCENTRATION =	.684E+01	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.168E+02	.108E+03	.160E+00	.990E-01	.684E+01	.263E+00	.38
2	1.05	12.	.476E+00	.705E+01	.296E+03	.500E-01	.309E-01	.674E+01	.822E-01	.38
3	1.09	24.	.198E+00	.261E+01	.852E+03	.250E+00	.155E+00	.671E+01	.358E+00	.38
4	1.21	24.	.119E+00	.115E+01	.236E+04	.140E+00	.866E-01	.655E+01	.245E+00	.38
5	1.38	24.	.838E-01	.637E+00	.477E+04	.620E+00	.384E+00	.647E+01	.149E+01	.38
6	1.95	24.	.533E-01	.273E+00	.118E+05	.551E+01	.341E+01	.608E+01	.927E+01	.38
				FILTER WEIGHT		.432E+01	.267E+01	.267E+01		
				TOTAL WEIGHT		.111E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.240	MICRONS
STD. GEOMETRIC DEVIATION =	4.416	
CORRELATION COEFFICIENT =	.875	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9855	2.184	16.759	6.151	1.091 TO	34.677
2	.9810	2.075	7.046	5.229	1.035 TO	26.417
3	.9584	1.732	2.607	3.143	.810 TO	12.203
4	.9457	1.605	1.154	2.600	.708 TO	9.546
5	.8896	1.225	.637	1.478	.400 TO	5.462
6	.3910	-.276	.273	.159	.009 TO	2.939
7	.0000					

TITLE: INLET RUN 50 11/20/78 1737 IMPTR 116/106 7 STAGES 12 HOLES LAST STAGE N

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	281.	DEGS. F
METER TEMP. =	52.	DEGS. F	TEMP ATMOS. =	52.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	46.70	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	.52	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	15.58	CF(STACK COND.)
VOL. METER =	10.27	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.35	INCH HG	STACK SUCTION =	-.478E-01	INCH HG
COND. WATER =	9.6	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	4.45	
VOLUME GAS STD. DRY =	.296E+00	CUBIC METER
PERCENT ISOKINETIC =	96.72	
CONCENTRATION =	.185E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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 PS150
1	1.01	8.	.965E+00	.274E+02	.419E+02	.490E+00	.301E+01	.185E+03	.803E+01	.38
2	1.02	12.	.476E+00	.116E+02	.115E+03	.850E+00	.288E+01	.182E+03	.767E+01	.38
3	1.06	24.	.198E+00	.432E+01	.330E+03	.740E+00	.250E+01	.179E+03	.586E+01	.38
4	1.13	24.	.119E+00	.195E+01	.916E+03	.730E+00	.247E+01	.177E+03	.713E+01	.38
5	1.23	24.	.858E-01	.110E+01	.185E+04	.502E+01	.170E+02	.174E+03	.687E+02	.38
6	1.50	24.	.533E-01	.505E+00	.457E+04	.201E+02	.679E+02	.157E+03	.201E+03	.38
7	1.80	12.	.553E-01	.326E+00	.914E+04	.143E+02	.483E+02	.895E+02	.254E+03	.38
				FILTER WEIGHT		.122E+02	.412E+02	.412E+02		
				TOTAL WEIGHT		.547E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.564 MICRONS
STD. GEOMETRIC DEVIATION =	5.900
CORRELATION COEFFICIENT =	.905

	P(COM) PERCENT	/	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9857	2.138	27.393	10.366	2.499 TO	42.996
2	.9682	1.856	11.557	7.054	2.049 TO	24.279
3	.9547	1.693	4.318	5.650	1.798 TO	17.753
4	.9414	1.567	1.946	4.760	1.608 TO	14.088
5	.8497	1.035	1.102	2.309	.875 TO	6.101
6	.4832	-.042	.505	.533	.125 TO	2.278
7	.2225	-.764	.326	.200	.026 TO	1.518
8	.0000					

TITLE: INLET RUN 29 11/20/78 1640 IMPTR 117/101 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	281.	DEGS. F
METER TEMP. =	55.	DEGS. F	TEMP ATMOS. =	53.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	46.70	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	.56	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	16.85	CF(STACK COND.)
VOL. METER =	11.34	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.35	INCH HG	STACK SUCTION =	-.478E-01	INCH HG
COND. WATER =	6.1	CC	VISCOSITY =	.23E-05	POISE

TEST RESULTS

PERCENT MOISTURE =	2.61	
VOLUME GAS STD. DRY =	.326E+00	CUBIC METER
PERCENT ISOKINETIC =	104.57	
CONCENTRATION =	.186E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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 PS150
1	1.01	8.	.965E+00	.263E+02	.453E+02	.112E+01	.344E+01	.186E+03	.917E+01	.38
2	1.02	12.	.476E+00	.111E+02	.124E+03	.570E+00	.175E+01	.183E+03	.467E+01	.38
3	1.06	24.	.198E+00	.415E+01	.357E+03	.840E+00	.258E+01	.181E+03	.603E+01	.38
4	1.13	24.	.119E+00	.187E+01	.991E+03	.820E+00	.252E+01	.179E+03	.726E+01	.38
5	1.24	24.	.838E-01	.106E+01	.200E+04	.422E+01	.130E+02	.176E+03	.523E+02	.38
6	1.53	24.	.533E-01	.482E+00	.494E+04	.195E+02	.597E+02	.163E+03	.175E+03	.38
7	1.85	12.	.533E-01	.310E+00	.988E+04	.200E+02	.615E+02	.103E+03	.321E+03	.38
					FILTER WEIGHT	.137E+02	.419E+02	.419E+02		
					TOTAL WEIGHT	.607E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.494 MICRONS				
STD. GEOMETRIC DEVIATION =	3.953				
CORRELATION COEFFICIENT =	.889				
	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)
1	.9816	2.087	26.340	8.709	1.993 TO 38.054
2	.9722	1.914	11.110	6.863	1.779 TO 26.474
3	.9583	1.732	4.148	5.344	1.552 TO 18.395
4	.9448	1.597	1.867	4.438	1.383 TO 14.240
5	.8753	1.152	1.055	2.408	.843 TO 6.874
6	.5550	.138	.482	.598	.134 TO 2.655
7	.2250	-.755	.310	.175	.018 TO 1.707
8	.0000				

TITLE: INLET RUN 2R 11/18/78 1857 IMPR 116/106 7 STAGES 12 HOLES LAST STAGE N

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	318.	DEGS. F
METER TEMP. =	51.	DEGS. F	TEMP ATMOS. =	51.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.46	FT/SEC
BARO. PRES =	29.20	INCH HG	SAMPLE RATE =	.51	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	15.42	CF(STACK COND.)
VOL. METER =	9.75	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.17	INCH HG	STACK SUCTION =	-.272E-01	INCH HG
COND. WATER =	7.4	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.64	
VOLUME GAS STD. DRY =	.279E+00	CUBIC METER
PERCENT ISOKINETIC =	105.27	
CONCENTRATION =	.629E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUN COR	HOLE NUMBER	HOLE DIAMETER	D50 (MICRONS)	VE. 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.	.965E+00	.280E+02	.414E+02	.620E+00	.222E+01	.629E+03	.592E+01	.38
2	1.02	12.	.476E+00	.118E+02	.113E+03	.310E+00	.111E+01	.626E+03	.296E+01	.38
3	1.06	24.	.198E+00	.441E+01	.327E+03	.630E+00	.226E+01	.625E+03	.527E+01	.38
4	1.13	24.	.119E+00	.199E+01	.907E+03	.510E+00	.183E+01	.623E+03	.527E+01	.38
5	1.24	24.	.838E-01	.112E+01	.183E+04	.217E+01	.777E+01	.621E+03	.313E+02	.38
6	1.53	24.	.533E-01	.512E+00	.452E+04	.261E+02	.934E+02	.613E+03	.274E+03	.38
7	1.85	12.	.533E-01	.529E+00	.905E+04	.575E+02	.206E+03	.520E+03	.107E+04	.38
					FILTER WEIGHT	.878E+02	.314E+03	.314E+03		
					TOTAL WEIGHT	.176E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.182 MICRONS
STD. GEOMETRIC DEVIATION =	4.158
CORRELATION COEFFICIENT =	.869

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9965	2.694	28.025	8.449	1.779 TO	40.131
2	.9947	2.556	11.821	6.940	1.633 TO	29.487
3	.9911	2.371	4.413	5.329	1.428 TO	19.885
4	.9882	2.264	1.986	4.579	1.305 TO	16.065
5	.9754	1.975	1.122	3.032	.961 TO	9.564
6	.8273	.943	.512	.697	.144 TO	3.369
7	.5000	-.000	.529	.182	.015 TO	2.274
8	.0000					

TITLE: INLET RUN 27 11/18/78 1734 IMPTR 109/126 7 STAGES 12 HOLES LAST STAGEY

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	318.	DEGS. F
METER TEMP. =	50.	DEGS. F	TEMP ATMOS. =	50.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.46	FT/SEC
BARO. PRES =	29.20	INCH HG	SAMPLE RATE =	.52	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	15.67	CF(STACK COND.)
VOL. METER =	9.89	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.17	INCH HG	STACK SUCTION =	-.272E-01	INCH HG
COND. WATER =	7.4	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.63	
VOLUME GAS STD. DRY =	.284E+00	CUBIC METER
PERCENT ISOKINETIC =	106.98	
CONCENTRATION =	.349E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.278E+02	.421E+02	.261E+02	.918E+02	.349E+03	.245E+03	.38
2	1.02	12.	.476E+00	.117E+02	.115E+03	.146E+01	.514E+01	.257E+03	.137E+02	.38
3	1.06	24.	.198E+00	.438E+01	.332E+03	.220E+00	.775E+00	.252E+03	.181E+01	.38
4	1.13	24.	.119E+00	.197E+01	.922E+03	.310E+00	.109E+01	.251E+03	.315E+01	.38
5	1.24	24.	.838E-01	.111E+01	.186E+04	.254E+01	.895E+01	.250E+03	.361E+02	.38
6	1.54	24.	.533E-01	.507E+00	.460E+04	.250E+02	.880E+02	.241E+03	.258E+03	.38
7	1.86	12.	.533E-01	.326E+00	.919E+04	.266E+02	.938E+02	.153E+03	.487E+03	.38
				FILTER WEIGHT		.169E+02	.596E+02	.596E+02		
				TOTAL WEIGHT		.991E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	1.443	MICRONS
STD. GEOMETRIC DEVIATION =	7.950	
CORRELATION COEFFICIENT =	.761	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.7370	.634	27.799	5.370	.883 TO	32.655
2	.7223	.589	11.725	4.896	.859 TO	27.899
3	.7201	.583	4.377	4.830	.855 TO	27.269
4	.7170	.573	1.969	4.738	.850 TO	26.414
5	.6913	.499	1.112	4.062	.798 TO	20.683
6	.4394	-.152	.507	1.052	.166 TO	6.657
7	.1706	-.952	.326	.201	.006 TO	7.084
8	.0000					

TITLE: OUTLET RUN 19 11/18/78 1820 IMPTR 131/102 6 STAGES 24 HOLES LAST STAGE N

TEST DATA

TEST DURATION =	60.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	40.	DEGS. F	TEMP ATMOS. =	40.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	44.86	FT/SEC
BARO. PRES =	29.20	INCH HG	SAMPLE RATE =	1.30	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	77.82	CF(STACK COND.)
VOL. METER =	52.53	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.76	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	29.5	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	2.68	
VOLUME GAS STD. DRY =	.154E+01	CUBIC METER
PERCENT ISOKINETIC =	141.43	
CONCENTRATION =	.348E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.170E+02	.105E+03	.800E-01	.520E-01	.348E+02	.138E+00	.38
2	1.03	12.	.476E+00	.716E+01	.286E+03	.500E-01	.325E-01	.347E+02	.864E-01	.38
3	1.09	24.	.198E+00	.265E+01	.825E+03	.900E-01	.585E-01	.347E+02	.156E+00	.38
4	1.21	24.	.119E+00	.117E+01	.229E+04	.340E+00	.221E+00	.347E+02	.625E+00	.38
5	1.57	24.	.838E-01	.648E+00	.462E+04	.573E+01	.373E+01	.344E+02	.145E+02	.38
6	1.92	24.	.533E-01	.278E+00	.114E+05	.350E+02	.228E+02	.307E+02	.621E+02	.38
				FILTER WEIGHT		.122E+02	.792E+01	.792E+01		
				TOTAL WEIGHT		.535E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.359 MICRONS
STD. GEOMETRIC DEVIATION =	2.530
CORRELATION COEFFICIENT =	.866

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9985	2.969	17.028	5.644	1.021 TO	31.209
2	.9976	2.817	7.160	4.899	.974 TO	24.650
3	.9959	2.645	2.650	4.171	.912 TO	19.066
4	.9895	2.310	1.173	3.060	.771 TO	12.149
5	.8824	1.187	.648	1.080	.249 TO	4.693
6	.2277	-.746	.278	.179	.010 TO	3.320
7	.0000					

TITLE: OUTLET RUN 18 11/18/78 1640 IMPTR 117/101 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	60.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	42.	DEGS. F	TEMP ATMOS. =	42.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	44.86	FT/SEC
BARO. PRES =	29.20	INCH HG	SAMPLE RATE =	1.25	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	75.21	CF(STACK COND.)
VOL. METER =	50.97	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.76	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	28.6	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	2.69	
VOLUME GAS STD. DRY =	.149E+01	CUBIC METER
PERCENT ISOKINETIC =	136.69	
CONCENTRATION =	.169E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.173E+02	.101E+03	.100E+00	.673E-01	.169E+02	.179E+00	.38
2	1.03	12.	.476E+00	.728E+01	.277E+03	.420E+00	.283E+00	.169E+02	.751E+00	.38
3	1.09	24.	.198E+00	.270E+01	.798E+03	.400E+00	.269E+00	.166E+02	.624E+00	.38
4	1.20	24.	.119E+00	.119E+01	.221E+04	.250E+00	.168E+00	.163E+02	.476E+00	.38
5	1.37	24.	.838E-01	.661E+00	.447E+04	.221E+01	.149E+01	.162E+02	.579E+01	.38
6	1.90	24.	.533E-01	.285E+00	.110E+05	.931E+01	.627E+01	.147E+02	.171E+02	.38
				FILTER WEIGHT		.125E+02	.841E+01	.841E+01		
				TOTAL WEIGHT		.252E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.181	MICRONS
STD. GEOMETRIC DEVIATION =	4.823	
CORRELATION COEFFICIENT =	.939	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9960	2.655	17.322	11.828	2.660 TO	52.598
2	.9793	2.041	7.285	4.502	1.587 TO	12.770
3	.9635	1.793	2.697	3.047	1.197 TO	7.758
4	.9535	1.681	1.195	2.553	1.030 TO	6.328
5	.8658	1.107	.661	1.035	.376 TO	2.847
6	.4960	-.010	.285	.179	.027 TO	1.189
7	.0000					

TITLE: INLET RUN 24 11/ 8/78 1710 IMPTR 116/101 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	32.0	MINUTES	TEMP IMPACTOR =	517.	DEGS. F
METER TEMP. =	54.	DEGS. F	TEMP ATMOS. =	54.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	48.21	FT/SEC
BARO. PRES =	29.06	INCH HG	SAMPLE RATE =	.53	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	17.12	CF(STACK COND.)
VOL. METER =	10.47	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.97	INCH HG	STACK SUCTION =	-.882E-01	INCH HG
COND. WATER =	16.2	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.26	
VOLUME GAS STD. DRY =	.297E+00	CUBIC METER
PERCENT ISOKINETIC =	96.50	
CONCENTRATION =	.254E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.275E+02	.431E+02	.630E+00	.212E+01	.254E+03	.566E+01	.38
2	1.02	12.	.476E+00	.116E+02	.118E+03	.770E+00	.260E+01	.252E+03	.692E+01	.38
3	1.06	24.	.198E+00	.432E+01	.340E+03	.870E+00	.293E+01	.249E+03	.685E+01	.38
4	1.14	24.	.119E+00	.194E+01	.944E+03	.780E+00	.263E+01	.246E+03	.757E+01	.38
5	1.24	24.	.838E-01	.110E+01	.191E+04	.199E+01	.671E+01	.243E+03	.270E+02	.38
6	1.55	24.	.533E-01	.499E+00	.471E+04	.250E+02	.841E+02	.237E+03	.246E+03	.38
7	1.89	12.	.533E-01	.320E+00	.942E+04	.283E+02	.954E+02	.153E+03	.493E+03	.38
				FILTER WEIGHT		.169E+02	.571E+02	.571E+02		
				TOTAL WEIGHT		.753E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.462	MICRONS
STD. GEOMETRIC DEVIATION =	3.561	
CORRELATION COEFFICIENT =	.882	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9916	2.393	27.453	9.635	2.016 TO	46.053
2	.9814	2.084	11.578	6.509	1.683 TO	25.168
3	.9698	1.879	4.321	5.016	1.456 TO	17.285
4	.9595	1.745	1.943	4.232	1.305 TO	13.726
5	.9330	1.499	1.096	3.097	1.028 TO	9.326
6	.6013	.256	.499	.639	.139 TO	2.947
7	.2251	-.755	.320	.177	.016 TO	1.919
8	.0000					

TITLE: INLET RUN 23 11/ 8/78 1623 IMPTR 120/106 7 STAGES 12 HOLES LAST STAGE=N

TEST DATA

TEST DURATION =	32.0	MINUTES	TEMP IMPACTOR =	517.	DEGS. F
METER TEMP. =	56.	DEGS. F	TEMP ATMOS. =	56.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	48.21	FT/SEC
BARO. PRES =	29.06	INCH HG	SAMPLE RATE =	.55	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	16.84	CF(STACK COND.)
VOL. METER =	10.34	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.97	INCH HG	STACK SUCTION =	-.882E-01	INCH HG
COND. WATER =	16.0	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.28	
VOLUME GAS STD. DRY =	.292E+00	CUBIC METER
PERCENT ISOKINETIC =	94.95	
CONCENTRATION =	.248E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.277E+02	.424E+02	.620E+00	.212E+01	.248E+03	.567E+01	.38
2	1.02	12.	.476E+00	.117E+02	.116E+03	.610E+00	.209E+01	.245E+03	.557E+01	.38
3	1.06	24.	.198E+00	.436E+01	.335E+03	.600E+00	.206E+01	.243E+03	.480E+01	.38
4	1.14	24.	.119E+00	.196E+01	.929E+03	.670E+00	.230E+01	.241E+03	.661E+01	.38
5	1.24	24.	.838E-01	.111E+01	.188E+04	.294E+01	.101E+02	.239E+03	.406E+02	.38
6	1.54	24.	.533E-01	.504E+00	.463E+04	.239E+02	.820E+02	.229E+03	.240E+03	.38
7	1.88	12.	.533E-01	.323E+00	.927E+04	.238E+02	.814E+02	.147E+03	.422E+03	.38
				FILTER WEIGHT		.191E+02	.656E+02	.656E+02		
				TOTAL WEIGHT		.725E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.428 MICRONS
STD. GEOMETRIC DEVIATION =	3.681
CORRELATION COEFFICIENT =	.888

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9914	2.384	27.677	9.562	2.117 TO	43.187
2	.9830	2.120	11.673	6.781	1.797 TO	25.589
3	.9747	1.955	4.357	5.468	1.594 TO	18.753
4	.9654	1.818	1.959	4.572	1.425 TO	14.669
5	.9247	1.438	1.106	2.787	.966 TO	8.043
6	.5936	.236	.504	.582	.125 TO	2.716
7	.2648	-.628	.323	.189	.020 TO	1.824
8	.0000					

TITLE: OUTLET RUN 14 11/ 8/78 1915 IMPTR 119/106 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	38.	DEGS. F	TEMP ATMOS. =	38.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	52.44	FT/SEC
BARO. PRES =	29.06	INCH HG	SAMPLE RATE =	1.47	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	44.08	CF(STACK COND.)
VOL. METER =	29.78	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.66	INCH HG	STACK SUCTION =	-.404E+00	INCH HG
COND. WATER =	14.4	CC	VISCOSITY =	.22E-05	POISE

TEST RESULTS

PERCENT MOISTURE =	2.32	
VOLUME GAS STD. DRY =	.871E+00	CUBIC METER
PERCENT ISOKINETIC =	157.05	
CONCENTRATION =	.112E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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 PS150
1	1.02	M.	.965E+00	.160E+02	.118E+03	.000E+00	.000E+00	.112E+03	.000E+00	.38
2	1.04	12.	.476E+00	.672E+01	.324E+03	.800E-01	.919E-01	.112E+03	.244E+00	.38
3	1.10	24.	.198E+00	.248E+01	.935E+03	.100E+00	.115E+00	.112E+03	.265E+00	.38
4	1.22	24.	.119E+00	.110E+01	.259E+04	.202E+01	.232E+01	.112E+03	.653E+01	.38
5	1.41	24.	.858E-01	.602E+00	.524E+04	.246E+02	.283E+02	.110E+03	.109E+03	.38
6	2.02	24.	.553E-01	.255E+00	.129E+05	.506E+02	.581E+02	.815E+02	.156E+03	.38
				FILTER WEIGHT		.204E+02	.234E+02	.234E+02		
				TOTAL WEIGHT		.978E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.584	MICRONS
STD. GEOMETRIC DEVIATION =	1.516	
CORRELATION COEFFICIENT =	.918	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	1.0000	9.042	15.991	25.183	2.435 TO	260.404
2	.9992	3.150	6.719	2.168	.761 TO	6.174
3	.9982	2.905	2.482	1.957	.691 TO	5.544
4	.9775	2.005	1.095	1.346	.459 TO	3.947
5	.7256	.599	.602	.750	.209 TO	2.695
6	.2081	-.813	.255	.417	.084 TO	2.068
7	.0000					

TITLE: OUTLET RUN 13 11/ 8/78 1645 IMPTR 109/102 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	50.	DEGS. F	TEMP ATMOS. =	50.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	52.44	FT/SEC
BARO. PRES =	29.06	INCH HG	SAMPLE RATE =	1.75	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	52.58	CF(STACK COND.)
VOL. METER =	36.36	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.66	INCH HG	STACK SUCTION =	-.404E+00	INCH HG
COND. WATER =	17.6	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	2.37	
VOLUME GAS STD. DRY =	.104E+01	CUBIC METER
PERCENT ISOKINETIC =	163.49	
CONCENTRATION =	.737E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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	1.02	8.	.965E+00	.146E+02	.141E+03	.210E+00	.202E+00	.737E+02	.537E+00	.38
2	1.04	12.	.476E+00	.614E+01	.387E+03	.520E+00	.308E+00	.735E+02	.818E+00	.38
3	1.11	24.	.198E+00	.226E+01	.112E+04	.360E+00	.347E+00	.731E+02	.799E+00	.38
4	1.24	24.	.119E+00	.993E+00	.309E+04	.194E+01	.187E+01	.728E+02	.523E+01	.38
5	1.45	24.	.838E-01	.543E+00	.625E+04	.177E+02	.170E+02	.709E+02	.649E+02	.38
6	2.17	24.	.533E-01	.226E+00	.154E+05	.417E+02	.401E+02	.539E+02	.105E+03	.38
				FILTER WEIGHT		.143E+02	.138E+02	.138E+02		
				TOTAL WEIGHT		.765E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.370	MICRONS
STD. GEOMETRIC DEVIATION =	2.765	
CORRELATION COEFFICIENT =	.914	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9973	2.777	14.651	6.233	1.369 TO	28.367
2	.9951	2.461	6.142	4.520	1.183 TO	17.275
3	.9884	2.269	2.263	3.719	1.065 TO	12.982
4	.9630	1.787	.993	2.277	.760 TO	6.822
5	.7316	.617	.543	.693	.188 TO	2.556
6	.1870	-.889	.226	.150	.015 TO	1.466
7	.0000					

TITLE: INLET RUN 22 11/ 7/78 1656 IMPTR 120/106 7 STAGES 12 HOLES LAST STAGE\

TEST DATA

TEST DURATION =	32.0	MINUTES	TEMP IMPACTOR =	514.	DEGS. F
METER TEMP. =	52.	DEGS. F	TEMP ATMOS. =	52.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	48.17	FT/SEC
BARO. PRES =	29.01	INCH HG	SAMPLE RATE =	.60	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	19.21	CF(STACK COND.)
VOL. METER =	10.47	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.91	INCH HG	STACK SUCTION =	-.955E-01	INCH HG
COND. WATER =	43.5	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	17.34	
VOLUME GAS STD. DRY =	.297E+00	CUBIC METER
PERCENT ISOKINETIC =	108.39	
CONCENTRATION =	.279E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.259E+02	.484E+02	.800E+00	.269E+01	.279E+03	.717E+01	.38
2	1.02	12.	.476E+00	.109E+02	.133E+03	.810E+00	.272E+01	.276E+03	.726E+01	.38
3	1.07	24.	.198E+00	.407E+01	.382E+03	.960E+00	.323E+01	.273E+03	.753E+01	.38
4	1.15	24.	.119E+00	.182E+01	.105E+04	.940E+00	.316E+01	.270E+03	.908E+01	.38
5	1.26	24.	.838E-01	.103E+01	.214E+04	.811E+01	.273E+02	.267E+03	.109E+03	.38
6	1.59	24.	.533E-01	.464E+00	.528E+04	.288E+02	.968E+02	.259E+03	.280E+03	.38
7	1.96	12.	.533E-01	.295E+00	.106E+05	.106E+02	.355E+02	.143E+03	.181E+03	.38
				FILTER WEIGHT		.319E+02	.107E+03	.107E+03		
				TOTAL WEIGHT		.828E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.549 MICRONS
STD. GEOMETRIC DEVIATION =	4.396
CORRELATION COEFFICIENT =	.931

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9903	2.340	25.871	11.160	5.113 TO	40.009
2	.9806	2.066	10.906	7.440	2.461 TO	22.494
3	.9690	1.866	4.066	5.536	2.034 TO	15.066
4	.9576	1.724	1.824	4.485	1.753 TO	11.476
5	.8597	1.079	1.027	1.726	.731 TO	4.075
6	.5123	.031	.464	.365	.092 TO	1.449
7	.3847	-.293	.295	.226	.045 TO	1.137
8	.0000					

TITLE: INLET RUN 21 11/ 7/78 1558 IMPTR 104/103 7 STAGES 12 HOLES LAST STAGE N

TEST DATA

TEST DURATION =	32.0	MINUTES	TEMP IMPACTOR =	314.	DEGS. F
METER TEMP. =	51.	DEGS. F	TEMP ATMOS. =	51.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	48.17	FT/SEC
BARO. PRES =	29.01	INCH HG	SAMPLE RATE =	.59	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	18.95	CF(STACK COND.)
VOL. METER =	10.31	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.91	INCH HG	STACK SUCTION =	-.955E-01	INCH HG
COND. WATER =	42.9	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	17.32	
VOLUME GAS STD. DRY =	.293E+00	CUBIC METER
PERCENT ISOKINETIC =	106.91	
CONCENTRATION =	.371E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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 PSISO
1	1.01	8.	.965E+00	.261E+02	.477E+02	.512E+02	.174E+03	.371E+03	.465E+03	.38
2	1.02	12.	.476E+00	.110E+02	.131E+03	.331E+01	.113E+02	.196E+03	.301E+02	.38
3	1.07	24.	.198E+00	.409E+01	.377E+03	.670E+00	.228E+01	.185E+03	.533E+01	.38
4	1.14	24.	.119E+00	.184E+01	.104E+04	.870E+00	.297E+01	.183E+03	.852E+01	.38
5	1.26	24.	.858E-01	.103E+01	.211E+04	.103E+01	.351E+01	.180E+03	.141E+02	.38
6	1.58	24.	.533E-01	.466E+00	.521E+04	.124E+02	.424E+02	.176E+03	.123E+03	.38
7	1.95	12.	.533E-01	.298E+00	.104E+05	.165E+02	.562E+02	.134E+03	.287E+03	.38
				FILTER WEIGHT		.228E+02	.778E+02	.778E+02		
				TOTAL WEIGHT		.109E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	4.658 MICRONS
STD. GEOMETRIC DEVIATION =	64.716
CORRELATION COEFFICIENT =	.793

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.5296	.074	26.050	6.343	.999 TO	40.258
2	.4992	-.002	10.982	4.618	.903 TO	23.601
3	.4930	-.017	4.094	4.331	.879 TO	21.332
4	.4850	-.037	1.858	3.984	.845 TO	18.785
5	.4756	-.061	1.055	3.609	.801 TO	16.263
6	.3612	-.355	.468	1.061	.201 TO	5.593
7	.2096	-.808	.298	.161	.005 TO	4.812
8	.0000					

TITLE: INLET RUN 20 11/ 7/78 1558 IMPTR 104/105 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	32.0	MINUTES	TEMP IMPACTOR =	314.	DEGS. F
METER TEMP. =	51.	DEGS. F	TEMP ATMOS. =	51.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	48.17	FT/SEC
BARO. PRES =	29.01	INCH HG	SAMPLE RATE =	.59	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	18.95	CF(STACK COND.)
VOL. METER =	10.31	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.91	INCH HG	STACK SUCTION =	-.955E-01	INCH HG
COND. WATER =	42.9	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	17.32	
VOLUME GAS STD. DRY =	.293E+00	CUBIC METER
PERCENT ISOKINETIC =	106.91	
CONCENTRATION =	.585E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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.	.965E+00	.261E+02	.477E+02	.115E+01	.392E+01	.585E+02	.105E+02	.38
2	1.02	12.	.476E+00	.110E+02	.131E+03	.550E+00	.187E+01	.546E+02	.500E+01	.38
3	1.07	24.	.198E+00	.409E+01	.377E+03	.500E+00	.170E+01	.527E+02	.396E+01	.38
4	1.14	24.	.119E+00	.184E+01	.104E+04	.410E+00	.140E+01	.510E+02	.402E+01	.38
5	1.26	24.	.838E-01	.103E+01	.211E+04	.576E+01	.196E+02	.496E+02	.787E+02	.38
6	1.58	24.	.533E-01	.468E+00	.521E+04	.600E-01	.205E+00	.300E+02	.593E+00	.38
7	1.95	12.	.533E-01	.298E+00	.104E+05	.400E-01	.136E+00	.298E+02	.696E+00	.38
					FILTER WEIGHT	.870E+01	.297E+02	.297E+02		
					TOTAL WEIGHT	.172E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.442 MICRONS
STD. GEOMETRIC DEVIATION =	9.779
CORRELATION COEFFICIENT =	.926

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9330	1.499	26.050	13.498	5.314 TO	34.273
2	.9010	1.287	10.982	8.332	2.550 TO	27.227
3	.8719	1.135	4.094	5.891	2.061 TO	16.836
4	.8480	1.028	1.838	4.610	1.742 TO	12.198
5	.5125	.031	1.035	.475	.129 TO	1.745
6	.5090	.023	.468	.466	.126 TO	1.726
7	.5067	.017	.298	.460	.125 TO	1.714
8	.0000					

TITLE: OUTLET RUN 12 11/ 7/78 1910 IMPTR 119/126 6 STAGES 24 HOLES LAST STAGE=N

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	42.	DEGS. F	TEMP ATMOS. =	42.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	55.45	FT/SEC
BARO. PRES =	29.01	INCH HG	SAMPLE RATE =	1.62	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	48.74	CF(STACK COND.)
VOL. METER =	31.49	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.58	INCH HG	STACK SUCTION =	-.434E+00	INCH HG
COND. WATER =	49.6	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.23	
VOLUME GAS STD. DRY =	.912E+00	CUBIC METER
PERCENT ISOKINETIC =	143.32	
CONCENTRATION =	.745E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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	1.02	8.	.965E+00	.152E+02	.131E+03	1.000E-02	.110E-01	.745E+02	.291E-01	.38
2	1.04	12.	.476E+00	.638E+01	.359E+03	.200E-01	.219E-01	.745E+02	.582E-01	.38
3	1.10	24.	.198E+00	.235E+01	.103E+04	.200E+00	.219E+00	.744E+02	.506E+00	.38
4	1.23	24.	.119E+00	.104E+01	.287E+04	.165E+01	.181E+01	.742E+02	.507E+01	.38
5	1.43	24.	.838E-01	.567E+00	.579E+04	.195E+02	.214E+02	.724E+02	.819E+02	.38
6	2.10	24.	.533E-01	.238E+00	.145E+05	.328E+02	.359E+02	.510E+02	.951E+02	.38
				FILTER WEIGHT		.138E+02	.151E+02	.151E+02		
				TOTAL WEIGHT		.679E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.363	MICRONS
STD. GEOMETRIC DEVIATION =	2.340	
CORRELATION COEFFICIENT =	.956	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9999	3.620	15.201	7.886	2.486 TO	25.015
2	.9996	3.325	6.384	6.138	2.143 TO	17.578
3	.9966	2.708	2.354	3.632	1.511 TO	8.729
4	.9723	1.916	1.036	1.853	.853 TO	4.025
5	.6851	.482	.567	.547	.195 TO	1.533
6	.2027	-.832	.238	.179	.039 TO	.828
7	.0000					

TITLE: OUTLET RUN 7 11/ 7/78 1605 IMPTR 109/102 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	42.	DEGS. F	TEMP ATMOS. =	42.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	55.45	FT/SEC
BARO. PRES =	29.01	INCH HG	SAMPLE RATE =	1.42	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	42.62	CF(STACK COND.)
VOL. METER =	27.54	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.58	INCH HG	STACK SUCTION =	-.434E+00	INCH HG
COND. WATER =	43.4	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.23	
VOLUME GAS STD. DRY =	.794E+00	CUBIC METER
PERCENT ISOKINETIC =	125.34	
CONCENTRATION =	.104E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.163E+02	.115E+03	.140E+00	.176E+00	.104E+03	.466E+00	.38
2	1.04	12.	.476E+00	.683E+01	.314E+03	.260E+00	.326E+00	.104E+03	.866E+00	.38
3	1.10	24.	.198E+00	.253E+01	.904E+03	.107E+02	.134E+02	.104E+03	.310E+02	.38
4	1.22	24.	.119E+00	.112E+01	.251E+04	.702E+01	.880E+01	.902E+02	.248E+02	.38
5	1.40	24.	.838E-01	.614E+00	.506E+04	.140E+02	.176E+02	.814E+02	.678E+02	.38
6	2.00	24.	.533E-01	.261E+00	.125E+05	.406E+02	.509E+02	.639E+02	.137E+03	.38
				FILTER WEIGHT		.103E+02	.129E+02	.129E+02		
				TOTAL WEIGHT		.831E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.646 MICRONS
STD. GEOMETRIC DEVIATION =	2.716
CORRELATION COEFFICIENT =	.982

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9983	2.932	16.263	12.089	5.245 TO	27.862
2	.9952	2.589	6.835	8.583	4.098 TO	17.975
3	.8665	1.110	2.526	1.958	1.187 TO	3.231
4	.7820	.779	1.115	1.406	.842 TO	2.350
5	.6132	.287	.614	.861	.482 TO	1.536
6	.1242	-1.154	.261	.204	.078 TO	.531
7	.0000					

TITLE: INLET RUN 11 11/ 6/78 1757 IMPTR 120/106 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	32.0	MINUTES	TEMP IMPACTOR =	519.	DEGS. F
METER TEMP. =	65.	DEGS. F	TEMP ATMOS. =	65.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	44.69	FT/SEC
BARO. PRES =	29.45	INCH HG	SAMPLE RATE =	.50	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	15.96	CF(STACK COND.)
VOL. METER =	10.33	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.36	INCH HG	STACK SUCTION =	-.882E-01	INCH HG
COND. WATER =	7.7	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.66	
VOLUME GAS STD. DRY =	.290E+00	CUBIC METER
PERCENT ISOKINETIC =	97.04	
CONCENTRATION =	.229E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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 PSISO
1	1.01	8.	.965E+00	.285E+02	.402E+02	.550E+00	.189E+01	.229E+03	.505E+01	.38
2	1.02	12.	.476E+00	.120E+02	.110E+03	.580E+00	.200E+01	.227E+03	.533E+01	.38
3	1.06	24.	.198E+00	.449E+01	.317E+03	.690E+00	.238E+01	.225E+03	.555E+01	.38
4	1.13	24.	.119E+00	.202E+01	.880E+03	.770E+00	.265E+01	.223E+03	.765E+01	.38
5	1.23	24.	.838E-01	.114E+01	.178E+04	.267E+01	.919E+01	.220E+03	.371E+02	.38
6	1.52	24.	.533E-01	.523E+00	.439E+04	.218E+02	.750E+02	.211E+03	.221E+03	.38
7	1.83	12.	.533E-01	.337E+00	.878E+04	.205E+02	.707E+02	.136E+03	.370E+03	.38
				FILTER WEIGHT		.190E+02	.654E+02	.654E+02		
				TOTAL WEIGHT		.666E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.422	MICRONS
STD. GEOMETRIC DEVIATION =	3.833	
CORRELATION COEFFICIENT =	.899	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9917	2.397	28.467	10.568	2.450 TO	45.594
2	.9830	2.121	12.009	7.289	2.035 TO	26.102
3	.9727	1.922	4.485	5.577	1.742 TO	17.849
4	.9611	1.764	2.020	4.510	1.514 TO	13.440
5	.9210	1.412	1.142	2.811	1.029 TO	7.680
6	.5948	.237	.523	.580	.133 TO	2.536
7	.2855	-.566	.337	.197	.023 TO	1.662
8	.0000					

TITLE: INLET RUN 10 11/ 6/78 1655 IMPTR 108/101 7 STAGES 12 HOLES LAST STAGEV

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	519.	DEGS. F
METER TEMP. =	72.	DEGS. F	TEMP ATMOS. =	72.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	44.69	FT/SEC
BARO. PRES =	29.45	INCH HG	SAMPLE RATE =	.40	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	11.88	CF(STACK COND.)
VOL. METER =	7.79	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.36	INCH HG	STACK SUCTION =	-.882E-01	INCH HG
COND. WATER =	5.8	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.70	
VOLUME GAS STD. DRY =	.216E+00	CUBIC METER
PERCENT ISOKINETIC =	77.06	
CONCENTRATION =	.230E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.320E+02	.319E+02	.117E+01	.541E+01	.230E+03	.145E+02	.38
2	1.02	12.	.476E+00	.135E+02	.874E+02	.820E+00	.379E+01	.224E+03	.101E+02	.38
3	1.05	24.	.198E+00	.505E+01	.252E+03	.530E+00	.245E+01	.221E+03	.574E+01	.38
4	1.12	24.	.119E+00	.228E+01	.699E+03	.640E+00	.296E+01	.218E+03	.858E+01	.38
5	1.20	24.	.838E-01	.130E+01	.141E+04	.160E+01	.740E+01	.215E+03	.302E+02	.38
6	1.45	24.	.533E-01	.601E+00	.349E+04	.170E+02	.784E+02	.208E+03	.235E+03	.38
7	1.70	12.	.533E-01	.391E+00	.697E+04	.164E+02	.759E+02	.129E+03	.406E+03	.38
					FILTER WEIGHT	.116E+02	.536E+02	.536E+02		
					TOTAL WEIGHT	.497E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.621 MICRONS
STD. GEOMETRIC DEVIATION =	4.034
CORRELATION COEFFICIENT =	.861

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9765	1.986	31.961	9.918	1.977 TO	49.748
2	.9600	1.751	15.492	7.143	1.722 TO	29.630
3	.9493	1.638	5.049	6.108	1.590 TO	23.459
4	.9364	1.526	2.282	5.219	1.452 TO	18.757
5	.9042	1.306	1.296	3.843	1.171 TO	12.608
6	.5631	.158	.601	.775	.150 TO	4.019
7	.2330	-.729	.391	.225	.017 TO	2.909
8	.0000					

TITLE: INLET RUN 09 11/ 6/78 1655 IMPTR 104/103 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	319.	DEGS. F
METER TEMP. =	72.	DEGS. F	TEMP ATMOS. =	72.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	44.69	FT/SEC
BARO. PRES =	29.45	INCH HG	SAMPLE RATE =	.40	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	11.88	CF(STACK COND.)
VOL. METER =	7.79	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.36	INCH HG	STACK SUCTION =	-.882E-01	INCH HG
COND. WATER =	5.8	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.70	
VOLUME GAS STD. DRY =	.216E+00	CUBIC METER
PERCENT ISOKINETIC =	77.06	
CONCENTRATION =	.148E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.320E+02	.319E+02	.450E+00	.208E+01	.148E+02	.556E+01	.38
2	1.02	12.	.476E+00	.135E+02	.874E+02	.590E+00	.273E+01	.127E+02	.729E+01	.38
3	1.05	24.	.198E+00	.505E+01	.252E+03	.460E+00	.213E+01	.995E+01	.499E+01	.38
4	1.12	24.	.119E+00	.228E+01	.699E+03	.410E+00	.190E+01	.782E+01	.550E+01	.38
5	1.20	24.	.838E-01	.130E+01	.141E+04	.380E+00	.176E+01	.592E+01	.716E+01	.38
6	1.45	24.	.533E-01	.601E+00	.349E+04	.300E-01	.139E+00	.416E+01	.415E+00	.38
7	1.70	12.	.533E-01	.391E+00	.697E+04	1.000E-02	.463E-01	.403E+01	.249E+00	.38
				FILTER WEIGHT		.860E+00	.398E+01	.398E+01		
				TOTAL WEIGHT		.319E+01				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	3.320	MICRONS
STD. GEOMETRIC DEVIATION =	11.364	
CORRELATION COEFFICIENT =	.967	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)
1	.8589	1.076	31.961	45.330	12.955 TO 158.614
2	.6740	.451	15.492	9.922	4.612 TO 21.345
3	.5298	.075	5.049	5.979	2.195 TO 7.213
4	.4013	-.250	2.282	1.809	.986 TO 3.321
5	.2821	-.576	1.296	.818	.381 TO 1.759
6	.2727	-.604	.601	.764	.349 TO 1.673
7	.2696	-.614	.391	.747	.339 TO 1.646
8	.0000				

TITLE: OUTLET RUN 6 11/ 6/78 1948 IMPTR 119/126 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	60.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	52.	DEGS. F	TEMP ATMOS. =	52.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	49.59	FT/SEC
BARO. PRES =	29.45	INCH HG	SAMPLE RATE =	1.50	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	89.89	CF(STACK COND.)
VOL. METER =	60.37	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.02	INCH HG	STACK SUCTION =	-.426E+00	INCH HG
COND. WATER =	70.6	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	5.50	
VOLUME GAS STD. DRY =	.174E+01	CUBIC METER
PERCENT ISOKINETIC =	147.78	
CONCENTRATION =	.126E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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	1.02	8.	.965E+00	.158E+02	.121E+03	.140E+00	.804E-01	.126E+03	.214E+00	.38
2	1.04	12.	.476E+00	.665E+01	.351E+03	.280E+00	.161E+00	.126E+03	.427E+00	.38
3	1.10	24.	.198E+00	.246E+01	.953E+03	.340E+00	.195E+00	.126E+03	.452E+00	.38
4	1.22	24.	.119E+00	.108E+01	.264E+04	.562E+01	.323E+01	.125E+03	.909E+01	.38
5	1.40	24.	.838E-01	.597E+00	.534E+04	.568E+02	.326E+02	.122E+03	.126E+03	.38
6	2.01	24.	.535E-01	.253E+00	.132E+05	.100E+03	.576E+02	.895E+02	.155E+03	.38
					FILTER WEIGHT	.556E+02	.319E+02	.319E+02		
					TOTAL WEIGHT	.219E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.353	MICRONS
STD. GEOMETRIC DEVIATION =	2.566	
CORRELATION COEFFICIENT =	.934	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9994	3.221	15.836	7.351	1.892 TO	28.555
2	.9981	2.892	6.655	5.390	1.613 TO	18.013
3	.9965	2.700	2.458	4.500	1.454 TO	13.926
4	.9709	1.894	1.085	2.106	.821 TO	5.403
5	.7114	.557	.597	.597	.172 TO	2.071
6	.2537	-.663	.253	.189	.029 TO	1.250
7	.0000					

TITLE: OUTLET RUN 5 11/ 6/78 1735 IMPTR 109/102 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	50.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	54.	DEGS. F	TEMP ATMOS. =	54.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	49.59	FT/SEC
BARO. PRES =	29.45	INCH HG	SAMPLE RATE =	.88	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	43.94	CF(STACK COND.)
VOL. METER =	29.62	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.02	INCH HG	STACK SUCTION =	-.426E+00	INCH HG
COND. WATER =	34.6	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	5.51	
VOLUME GAS STD. DRY =	.851E+00	CUBIC METER
PERCENT ISOKINETIC =	96.68	
CONCENTRATION =	.104E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.207E+02	.709E+02	.500E-01	.588E-01	.104E+03	.157E+00	.38
2	1.03	12.	.476E+00	.872E+01	.194E+03	.200E-01	.235E-01	.104E+03	.626E-01	.38
3	1.07	24.	.198E+00	.324E+01	.559E+03	.120E+00	.141E+00	.104E+03	.328E+00	.38
4	1.16	24.	.119E+00	.145E+01	.155E+04	.670E+00	.788E+00	.104E+03	.225E+01	.38
5	1.29	24.	.838E-01	.811E+00	.313E+04	.165E+02	.194E+02	.103E+03	.769E+02	.38
6	1.69	24.	.533E-01	.361E+00	.773E+04	.576E+02	.677E+02	.835E+02	.192E+03	.38
				FILTER WEIGHT		.135E+02	.158E+02	.158E+02		
				TOTAL WEIGHT		.884E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.550	MICRONS
STD. GEOMETRIC DEVIATION =	2.217	
CORRELATION COEFFICIENT =	.888	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9994	3.256	20.713	7.346	1.521 TO	35.473
2	.9992	3.159	8.725	6.801	1.478 TO	31.301
3	.9978	2.856	3.245	5.342	1.329 TO	21.465
4	.9903	2.337	1.450	3.535	1.034 TO	12.082
5	.8036	.855	.811	1.086	.259 TO	4.555
6	.1522	-1.027	.361	.243	.019 TO	3.106
7	.0000					

TITLE: INLET RUN 26 11/10/78 1650 IMPTR 120/106 7 STAGES 12 HOLES LAST STAGE N

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	347.	DEGS. F
METER TEMP. =	61.	DEGS. F	TEMP ATMOS. =	61.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	55.98	FT/SEC
BARO. PRES =	29.12	INCH HG	SAMPLE RATE =	.65	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	19.60	CF(STACK COND.)
VOL. METER =	11.64	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.02	INCH HG	STACK SUCTION =	-.103E+00	INCH HG
COND. WATER =	19.0	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.69	
VOLUME GAS STD. DRY =	.320E+00	CUBIC METER
PERCENT ISOKINETIC =	101.50	
CONCENTRATION =	.256E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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.	.965E+00	.252E+02	.527E+02	.126E+01	.386E+01	.256E+03	.103E+02	.38
2	1.03	12.	.476E+00	.106E+02	.144E+03	.670E+00	.205E+01	.252E+03	.547E+01	.38
3	1.07	24.	.198E+00	.395E+01	.416E+03	.650E+00	.199E+01	.250E+03	.464E+01	.38
4	1.16	24.	.119E+00	.177E+01	.115E+04	.366E+01	.112E+02	.248E+03	.321E+02	.38
5	1.28	24.	.838E-01	.991E+00	.233E+04	.457E+01	.140E+02	.237E+03	.558E+02	.38
6	1.65	24.	.533E-01	.443E+00	.575E+04	.318E+02	.975E+02	.223E+03	.279E+03	.38
7	2.08	12.	.533E-01	.279E+00	.115E+05	.247E+02	.758E+02	.126E+03	.378E+03	.38
					FILTER WEIGHT	.163E+02	.498E+02	.498E+02		
					TOTAL WEIGHT	.836E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.509 MICRONS
STD. GEOMETRIC DEVIATION =	3.728
CORRELATION COEFFICIENT =	.909

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9849	2.168	25.173	8.834	2.228 TO	35.020
2	.9769	1.994	10.606	7.022	1.975 TO	24.962
3	.9691	1.868	3.948	5.953	1.798 TO	19.704
4	.9253	1.442	1.766	3.397	1.228 TO	9.391
5	.8706	1.129	.991	2.251	.855 TO	5.927
6	.4901	-.025	.443	.493	.119 TO	2.035
7	.1945	-.861	.279	.164	.021 TO	1.271
8	.0000					

TITLE: INLET RUN 25 11/10/78 1558 IMPTR 116/101 7 STAGES 12 HOLES LAST STAGE=N

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	347.	DEGS. F
METER TEMP. =	62.	DEGS. F	TEMP ATMOS. =	62.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	55.98	FT/SEC
BARO. PRES =	29.12	INCH HG	SAMPLE RATE =	.64	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	19.19	CF(STACK COND.)
VOL. METER =	11.42	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.02	INCH HG	STACK SUCTION =	-.103E+00	INCH HG
COND. WATER =	18.6	CC	VISCOSITY =	.24E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.69	
VOLUME GAS STD. DRY =	.319E+00	CUBIC METER
PERCENT ISOKINETIC =	99.39	
CONCENTRATION =	.259E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.254E+02	.516E+02	.910E+00	.285E+01	.259E+03	.754E+01	.38
2	1.03	12.	.476E+00	.107E+02	.141E+03	.105E+01	.329E+01	.256E+03	.876E+01	.38
3	1.07	24.	.198E+00	.599E+01	.407E+03	.105E+01	.329E+01	.253E+03	.766E+01	.38
4	1.16	24.	.119E+00	.179E+01	.113E+04	.820E+00	.257E+01	.249E+03	.736E+01	.38
5	1.28	24.	.838E-01	.100E+01	.228E+04	.223E+01	.698E+01	.247E+03	.278E+02	.38
6	1.64	24.	.535E-01	.449E+00	.563E+04	.298E+02	.934E+02	.240E+03	.268E+03	.38
7	2.06	12.	.535E-01	.285E+00	.113E+05	.304E+02	.952E+02	.147E+03	.476E+03	.38
				FILTER WEIGHT		.164E+02	.513E+02	.513E+02		
				TOTAL WEIGHT		.827E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.468	MICRONS
STD. GEOMETRIC DEVIATION =	5.566	
CORRELATION COEFFICIENT =	.876	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9890	2.291	25.440	8.606	1.740 TO	42.557
2	.9763	1.985	10.720	5.821	1.459 TO	23.214
3	.9636	1.794	5.991	4.579	1.279 TO	16.394
4	.9537	1.682	1.786	3.969	1.169 TO	13.474
5	.9267	1.452	1.002	2.963	.943 TO	9.311
6	.5060	.166	.449	.577	.119 TO	2.808
7	.1985	-.848	.283	.159	.014 TO	1.874
8	.0000					

TITLE: OUTLET RUN 17 11/10/78 1711 IMPTR 119/126 6 STAGES 24 HOLES LAST STAGE=N

TEST DATA

TEST DURATION =	8.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	48.	DEGS. F	TEMP ATMOS. =	48.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	57.02	FT/SEC
BARO. PRES =	29.12	INCH HG	SAMPLE RATE =	1.53	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	12.27	CF(STACK COND.)
VOL. METER =	8.34	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.66	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	6.2	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.57	
VOLUME GAS STD. DRY =	.240E+00	CUBIC METER
PERCENT ISOKINETIC =	131.62	
CONCENTRATION =	.471E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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	1.02	8.	.965E+00	.156E+02	.124E+03	.455E+01	.190E+02	.471E+03	.504E+02	.38
2	1.04	12.	.476E+00	.657E+01	.339E+03	.170E+02	.711E+02	.452E+03	.189E+03	.38
3	1.10	24.	.198E+00	.245E+01	.976E+03	.321E+02	.134E+03	.381E+03	.310E+03	.38
4	1.23	24.	.119E+00	.107E+01	.271E+04	.114E+02	.477E+02	.246E+03	.134E+03	.38
5	1.42	24.	.838E-01	.587E+00	.547E+04	.744E+01	.311E+02	.199E+03	.119E+03	.38
6	2.05	24.	.533E-01	.248E+00	.135E+05	.353E+02	.139E+03	.168E+03	.371E+03	.38
					FILTER WEIGHT	.691E+01	.288E+02	.288E+02		
					TOTAL WEIGHT	.113E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	1.619 MICRONS
STD. GEOMETRIC DEVIATION =	5.830
CORRELATION COEFFICIENT =	.979

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9596	1.747	15.646	16.913	6.126 TO	46.697
2	.8086	.873	6.573	5.227	2.668 TO	10.240
3	.5238	.059	2.427	1.754	1.026 TO	2.999
4	.4224	-.195	1.069	1.246	.714 TO	2.174
5	.3564	-.368	.587	.988	.549 TO	1.779
6	.0613	-1.544	.248	.203	.074 TO	.559
7	.0000					

TITLE: OUTLET RUN 16 11/10/78 1551 IMPTR 109/102 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	7.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	57.	DEGS. F	TEMP ATMOS. =	57.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	57.02	FT/SEC
BARO. PRES =	29.12	INCH HG	SAMPLE RATE =	1.44	CF(STACK COND.)
NOZZLE DIA. =	.2500	INCHES	TOTAL VOLUME(STACK) =	10.06	CF(STACK COND.)
VOL. METER =	6.95	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.68	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	5.2	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.63	
VOLUME GAS STD. DRY =	.196E+00	CUBIC METER
PERCENT ISOKINETIC =	123.24	
CONCENTRATION =	.756E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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 PSIS0
1	1.01	A.	.965E+00	.162E+02	.116E+03	.555E+01	.283E+02	.756E+03	.751E+02	.38
2	1.04	12.	.476E+00	.680E+01	.317E+03	.169E+02	.860E+02	.727E+03	.228E+03	.38
3	1.10	24.	.198E+00	.251E+01	.914E+03	.324E+02	.165E+03	.641E+03	.382E+03	.38
4	1.22	24.	.119E+00	.111E+01	.253E+04	.885E+01	.451E+02	.476E+03	.127E+03	.38
5	1.40	24.	.838E-01	.611E+00	.512E+04	.283E+02	.144E+03	.431E+03	.556E+03	.38
6	2.00	24.	.533E-01	.259E+00	.126E+05	.417E+02	.213E+03	.287E+03	.572E+03	.38
				FILTER WEIGHT		.145E+02	.740E+02	.740E+02		
				TOTAL WEIGHT		.148E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	1.270	MICRONS
STD. GEOMETRIC DEVIATION =	4.149	
CORRELATION COEFFICIENT =	.983	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9626	1.782	16.173	16.021	6.701 TO	38.307
2	.8487	1.031	6.797	5.507	3.028 TO	10.017
3	.6299	.331	2.512	2.034	1.265 TO	3.272
4	.5702	.177	1.109	1.632	1.012 TO	2.632
5	.3794	-.307	.611	.821	.471 TO	1.432
6	.0960	-1.295	.259	.202	.091 TO	.499
7	.0000					

TITLE: INLET RUN 8 11/ 5/78 1757 IMPTR 120/106 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	31.0	MINUTES	TEMP IMPACTOR =	314.	DEGS. F
METER TEMP. =	62.	DEGS. F	TEMP ATMOS. =	62.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.93	FT/SEC
BARO. PRES =	29.10	INCH HG	SAMPLE RATE =	.95	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	29.50	CF(STACK COND.)
VOL. METER =	18.57	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.04	INCH HG	STACK SUCTION =	-.588E-01	INCH HG
COND. WATER =	25.0	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	6.47	
VOLUME GAS STD. DRY =	.519E+00	CUBIC METER
PERCENT ISOKINETIC =	192.76	
CONCENTRATION =	.276E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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	S2RT PSI50
1	1.01	8.	.965E+00	.205E+02	.767E+02	.102E+01	.197E+01	.276E+03	.523E+01	.38
2	1.03	12.	.476E+00	.864E+01	.210E+03	.960E+00	.185E+01	.274E+03	.492E+01	.38
3	1.08	24.	.198E+00	.320E+01	.606E+03	.102E+01	.197E+01	.272E+03	.456E+01	.38
4	1.19	24.	.119E+00	.142E+01	.168E+04	.169E+01	.326E+01	.270E+03	.925E+01	.38
5	1.54	24.	.838E-01	.792E+00	.339E+04	.340E+02	.655E+02	.267E+03	.257E+03	.38
6	1.81	24.	.535E-01	.346E+00	.837E+04	.537E+02	.104E+03	.201E+03	.288E+03	.38
7	2.37	12.	.533E-01	.213E+00	.167E+05	.361E+02	.696E+02	.978E+02	.332E+03	.38
				FILTER WEIGHT		.146E+02	.282E+02	.282E+02		
				TOTAL WEIGHT		.143E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.556 MICRONS
STD. GEOMETRIC DEVIATION =	2.893
CORRELATION COEFFICIENT =	.918

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9929	2.451	20.522	7.512	1.970 TO	28.649
2	.9862	2.202	8.636	5.767	1.703 TO	19.534
3	.9790	2.035	3.203	4.826	1.531 TO	15.210
4	.9672	1.842	1.424	3.933	1.342 TO	11.521
5	.7297	.612	.792	1.065	.398 TO	2.849
6	.3544	-.373	.346	.374	.095 TO	1.474
7	.1022	-1.270	.213	.144	.022 TO	.945
8	.0000					

TITLE: INLET RUN 4 11/ 3/78 1912 IMPTR 108/101 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	45.0	MINUTES	TEMP IMPACTOR =	314.	DEGS. F
METER TEMP. =	59.	DEGS. F	TEMP AIMOS. =	59.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.93	FT/SEC
BARO. PRES =	29.10	INCH HG	SAMPLE RATE =	.82	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	37.05	CF(STACK COND.)
VOL. METER =	25.20	CUBIC FEET	PARTICLE DENSITY =	1.60	GRAM/CC
STACK PRESSURE =	29.04	INCH HG	STACK SUCTION =	-.588E-01	INCH HG
COND. WATER =	31.3	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	6.43	
VOLUME GAS STD. DRY =	.652E+00	CUBIC METER
PERCENT ISOKINETIC =	166.79	
CONCENTRATION =	.201E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.221E+02	.664E+02	.791E+01	.121E+02	.201E+03	.323E+02	.38
2	1.03	12.	.476E+00	.929E+01	.182E+03	.730E+00	.112E+01	.189E+03	.298E+01	.38
3	1.08	24.	.198E+00	.345E+01	.524E+03	.710E+00	.109E+01	.188E+03	.253E+01	.38
4	1.17	24.	.119E+00	.154E+01	.145E+04	.156E+01	.239E+01	.187E+03	.682E+01	.38
5	1.31	24.	.838E-01	.860E+00	.293E+04	.190E+02	.291E+02	.185E+03	.115E+03	.38
6	1.73	24.	.533E-01	.380E+00	.725E+04	.472E+02	.723E+02	.155E+03	.204E+03	.38
7	2.22	12.	.533E-01	.237E+00	.145E+05	.450E+02	.691E+02	.831E+02	.337E+03	.38
				FILTER WEIGHT		.917E+01	.141E+02	.141E+02		
				TOTAL WEIGHT		.131E+03				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.803 MICRONS
STD. GEOMETRIC DEVIATION =	3.335
CORRELATION COEFFICIENT =	.840

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9397	1.553	22.072	5.209	1.039 TO	26.125
2	.9342	1.508	9.294	4.934	1.016 TO	23.960
3	.9287	1.467	5.453	4.697	.995 TO	22.164
4	.9169	1.384	1.540	4.253	.951 TO	19.014
5	.7723	.746	.860	1.972	.555 TO	7.003
6	.4130	-.219	.380	.616	.115 TO	3.293
7	.0699	-1.477	.237	.135	.008 TO	2.411
8	.0000					

TITLE: INLET RUN 5 11/ 5/78 1912 IMPTR 104/103 7 STAGES 12 HOLES LAST STAGE

TEST DATA

TEST DURATION =	45.0	MINUTES	TEMP IMPACTOR =	314.	DEGS. F
METER TEMP. =	59.	DEGS. F	TEMP ATMOS. =	59.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.93	FT/SEC
BARO. PRES =	29.10	INCH HG	SAMPLE RATE =	.82	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	37.05	CF(STACK COND.)
VOL. METER =	23.20	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.04	INCH HG	STACK SUCTION =	-.588E-01	INCH HG
COND. WATER =	31.3	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	6.43	
VOLUME GAS STD. DRY =	.652E+00	CUBIC METER
PERCENT ISOKINETIC =	166.79	
CONCENTRATION =	.342E+01	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.221E+02	.664E+02	.400E+00	.614E+00	.342E+01	.163E+01	.38
2	1.03	12.	.476E+00	.929E+01	.182E+03	.440E+00	.675E+00	.291E+01	.180E+01	.38
3	1.08	24.	.198E+00	.345E+01	.524E+03	.470E+00	.721E+00	.213E+01	.168E+01	.38
4	1.17	24.	.119E+00	.154E+01	.145E+04	.360E+00	.552E+00	.141E+01	.157E+01	.38
5	1.31	24.	.838E-01	.860E+00	.293E+04	.370E+00	.568E+00	.859E+00	.224E+01	.38
6	1.73	24.	.533E-01	.380E+00	.725E+04	1.000E-02	.153E-01	.291E+00	.432E-01	.38
7	2.22	12.	.533E-01	.237E+00	.145E+05	.500E-01	.767E-01	.276E+00	.374E+00	.38
					FILTER WEIGHT	.130E+00	.199E+00	.199E+00		
					TOTAL WEIGHT	.223E+01				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	5.010 MICRONS
STD. GEOMETRIC DEVIATION =	5.531
CORRELATION COEFFICIENT =	.984

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.8206	.918	22.072	24.069	10.646 TO	54.417
2	.6233	.314	9.294	8.569	4.754 TO	15.444
3	.4126	-.221	3.453	3.436	2.196 TO	5.376
4	.2511	-.671	1.540	1.591	1.047 TO	2.418
5	.0852	-1.371	.860	.480	.274 TO	.842
6	.0807	-1.401	.380	.457	.258 TO	.808
7	.0583	-1.570	.237	.342	.185 TO	.641
8	.0000					

TITLE: OUTLET RUN 2 11/ 3/78 1912 IMPTR 117/126 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	45.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	48.	DEGS. F	TEMP ATMOS. =	48.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	53.29	FT/SEC
BARO. PRES =	29.10	INCH HG	SAMPLE RATE =	.87	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	39.26	CF(STACK COND.)
VOL. METER =	25.56	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.67	INCH HG	STACK SUCTION =	-.426E+00	INCH H3
COND. WATER =	42.4	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	7.65	
VOLUME GAS STD. DRY =	.734E+00	CUBIC METER
PERCENT ISOKINETIC =	142.36	
CONCENTRATION =	.565E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.208E+02	.703E+02	.120E+00	.164E+00	.565E+02	.435E+00	.38
2	1.03	12.	.476E+00	.876E+01	.193E+03	.700E-01	.954E-01	.563E+02	.254E+00	.38
3	1.07	24.	.198E+00	.326E+01	.555E+03	.430E+00	.586E+00	.563E+02	.136E+01	.38
4	1.17	24.	.119E+00	.145E+01	.154E+04	.230E+00	.313E+00	.557E+02	.895E+00	.38
5	1.30	24.	.838E-01	.814E+00	.311E+04	.863E+01	.118E+02	.554E+02	.466E+02	.38
6	1.70	24.	.533E-01	.361E+00	.769E+04	.520E+02	.436E+02	.436E+02	.124E+03	.38
				FILTER WEIGHT		.000E+00	.000E+00	.000E+00		
				TOTAL WEIGHT		.415E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	2.390 MICRONS
STD. GEOMETRIC DEVIATION =	1.271
CORRELATION COEFFICIENT =	.727

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9971	2.760	20.788	4.628	.587 TO	36.468
2	.9954	2.606	8.756	4.461	.585 TO	34.015
3	.9850	2.172	5.256	4.020	.574 TO	28.178
4	.9795	2.044	1.454	3.699	.569 TO	26.730
5	.7714	.743	.814	2.855	.482 TO	16.901
6	.0000	-9.042	.361	.274	.004 TO	19.760
7	.0000					

TITLE: INLET RUN 1 11/ 2/78 2026 IMPTR 107/103 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	34.0	MINUTES	TEMP IMPACTOR =	314.	DEGS. F
METER TEMP. =	56.	DEGS. F	TEMP ATMOS. =	56.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.93	FT/SEC
BARO. PRES =	29.15	INCH HG	SAMPLE RATE =	.65	CF(STACK COND.)
NOZZLE DIA. =	.1875	INCHES	TOTAL VOLUME(STACK) =	22.07	CF(STACK COND.)
VOL. METER =	12.60	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.09	INCH HG	STACK SUCTION =	-.588E-01	INCH HG
COND. WATER =	41.2	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	14.20	
VOLUME GAS STD. DRY =	.357E+00	CUBIC METER
PERCENT ISOKINETIC =	131.51	
CONCENTRATION =	.195E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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.	.965E+00	.249E+02	.523E+02	.310E+00	.869E+00	.195E+02	.232E+01	.38
2	1.03	12.	.476E+00	.105E+02	.143E+03	.590E+00	.165E+01	.186E+02	.441E+01	.38
3	1.07	24.	.198E+00	.391E+01	.413E+03	.510E+00	.143E+01	.169E+02	.333E+01	.38
4	1.15	24.	.119E+00	.175E+01	.115E+04	.540E+00	.151E+01	.155E+02	.434E+01	.38
5	1.27	24.	.838E-01	.984E+00	.231E+04	.000E+00	.000E+00	.140E+02	.000E+00	.38
6	1.62	24.	.553E-01	.443E+00	.571E+04	.000E+00	.000E+00	.140E+02	.000E+00	.38
7	2.01	12.	.533E-01	.280E+00	.114E+05	.000E+00	.000E+00	.140E+02	.000E+00	.38
				FILTER WEIGHT		.499E+01	.140E+02	.140E+02		
				TOTAL WEIGHT		.694E+01				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.115	MICRONS
STD. GEOMETRIC DEVIATION =	31.155	
CORRELATION COEFFICIENT =	.894	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9555	1.699	24.874	39.527	3.402 TO	459.320
2	.8705	1.128	10.483	5.541	1.566 TO	19.605
3	.7968	.830	3.905	1.990	.704 TO	5.628
4	.7190	.580	1.750	.841	.238 TO	2.973
5	.7190	.580	.984	.841	.238 TO	2.973
6	.7190	.580	.443	.841	.238 TO	2.973
7	.7190	.580	.280	.841	.238 TO	2.973
8	.0000					

TITLE: INLET RUN 54 11/21/78 1400 IMPIR 120/104 7 STAGES 12 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	15.0	MINUTES	TEMP IMPACTOR =	287.	DEGS. F
METER TEMP. =	45.	DEGS. F	TEMP ATMOS. =	45.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	42.97	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	.49	CF(STACK COND.)
NOZZLE DIA. =	.0000	INCHES	TOTAL VOLUME(STACK) =	7.28	CF(STACK COND.)
VOL. METER =	4.65	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.35	INCH HG	STACK SUCTION =	-.482E-01	INCH HG
COND. WATER =	5.3	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	5.33	
VOLUME GAS STD. DRY =	.136E+00	CUBIC METER
PERCENT ISOKINETIC =	$$$$$$$$$$	
CONCENTRATION =	.397E+03	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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.	.965E+00	.284E+02	.391E+02	.740E+00	.545E+01	.397E+03	.146E+02	.38
2	1.02	12.	.476E+00	.120E+02	.107E+03	.890E+00	.656E+01	.392E+03	.175E+02	.38
3	1.06	24.	.198E+00	.448E+01	.309E+03	.760E+00	.560E+01	.385E+03	.131E+02	.38
4	1.12	24.	.119E+00	.202E+01	.856E+03	.660E+00	.486E+01	.379E+03	.141E+02	.38
5	1.22	24.	.838E-01	.115E+01	.173E+04	.274E+01	.202E+02	.375E+03	.819E+02	.38
6	1.48	24.	.533E-01	.527E+00	.427E+04	.000E+00	.000E+00	.354E+03	.000E+00	.38
7	1.77	12.	.533E-01	.341E+00	.854E+04	.000E+00	.000E+00	.354E+03	.000E+00	.38
				FILTER WEIGHT		.481E+02	.354E+03	.354E+03		
				TOTAL WEIGHT		.539E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	.003 MICRONS
STD. GEOMETRIC DEVIATION =	66.425
CORRELATION COEFFICIENT =	.969

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.9863	2.205	28.429	34.055	10.778 TO	107.601
2	.9697	1.878	11.996	8.609	4.151 TO	17.944
3	.9556	1.703	4.484	4.132	2.285 TO	7.473
4	.9434	1.584	2.023	2.515	1.436 TO	4.406
5	.8925	1.240	1.146	.594	.270 TO	1.309
6	.8925	1.240	.527	.594	.270 TO	1.309
7	.8925	1.240	.341	.594	.270 TO	1.309
8	.0000					

TITLE: OUTLET RUN 40 11/20/78 1430 IMPTR 118/105 6 STAGES 24 HOLES LAST STAGEN

TEST DATA

TEST DURATION =	89.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	47.	DEGS. F	TEMP ATMOS. =	47.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	47.33	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	1.40	CF(STACK COND.)
NOZZLE DIA. =	.0000	INCHES	TOTAL VOLUME(STACK) =	124.40	CF(STACK COND.)
VOL. METER =	86.12	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.96	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	28.0	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	1.58	
VOLUME GAS STD. DRY =	.250E+01	CUBIC METER
PERCENT ISOKINETIC =	$$$$$$$$$$	
CONCENTRATION =	.000E+00	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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 PSISO
1	1.01	8.	.965E+00	.164E+02	.115E+03	.000E+00	.000E+00	.000E+00	.000E+00	.38
2	1.03	12.	.476E+00	.689E+01	.309E+03	.000E+00	.000E+00	.000E+00	.000E+00	.38
3	1.09	24.	.198E+00	.255E+01	.889E+03	.000E+00	.000E+00	.000E+00	.000E+00	.38
4	1.21	24.	.119E+00	.113E+01	.247E+04	.000E+00	.000E+00	.000E+00	.000E+00	.38
5	1.39	24.	.838E-01	.621E+00	.498E+04	.000E+00	.000E+00	.000E+00	.000E+00	.38
6	1.96	24.	.533E-01	.265E+00	.125E+05	.000E+00	.000E+00	.000E+00	.000E+00	.38
				FILTER WEIGHT		.000E+00	.000E+00	.000E+00		
				TOTAL WEIGHT		.000E+00				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	1.778 MICRONS
STD. GEOMETRIC DEVIATION =	1.035
CORRELATION COEFFICIENT =	$$$$$$$$$$

P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1$$$$$$$$$$	2.516	16.399	1.941	.143 TO	26.427
2$$$$$$$$$$	2.516	6.893	1.941	.143 TO	26.427
3$$$$$$$$$$	2.516	2.549	1.941	.143 TO	26.427
4$$$$$$$$$$	2.516	1.127	1.941	.143 TO	26.427
5$$$$$$$$$$	2.516	.621	1.941	.143 TO	26.427
6$$$$$$$$$$	2.516	.265	1.941	.143 TO	26.427
7$$$$$$$$$$					

```
/IMPCT : 03   UN Ø32650H
/IMPCT : 03   UN Ø32650H
/IMPCT : 03   UN Ø32076H
```

TITLE: INLET RUN 51 11/20/78 1710 IMPTR 120/104 7 STAGES 12 HOLES LAST STAGE=N

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	281.	DEGS. F
METER TEMP. =	52.	DEGS. F	TEMP ATMOS. =	52.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	46.70	FT/SEC
BARO. PRES =	29.40	INCH HG	SAMPLE RATE =	.54	CF(STACK COND.)
NOZZLE DIA. =	.0000	INCHES	TOTAL VOLUME(STACK) =	16.24	CF(STACK COND.)
VOL. METER =	10.81	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	29.35	INCH HG	STACK SUCTION =	-.478E-01	INCH HG
COND. WATER =	7.9	CC	VISCOSITY =	.23E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.49	
VOLUME GAS STD. DRY =	.311E+00	CUBIC METER
PERCENT ISOKINETIC =	$$$$$$$$$$	
CONCENTRATION =	.781E+01	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

SIZE DISTRIBUTION RESULTS

PLATE	CUM 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.	.965E+00	.268E+02	.436E+02	.650E+00	.209E+01	.781E+01	.557E+01	.38
2	1.02	12.	.476E+00	.113E+02	.120E+03	.550E+00	.177E+01	.572E+01	.472E+01	.38
3	1.06	24.	.198E+00	.423E+01	.344E+03	.490E+00	.158E+01	.395E+01	.368E+01	.38
4	1.13	24.	.119E+00	.190E+01	.955E+03	.410E+00	.132E+01	.238E+01	.380E+01	.38
5	1.23	24.	.838E-01	.108E+01	.193E+04	.330E+00	.106E+01	.106E+01	.429E+01	.38
6	1.51	24.	.533E-01	.493E+00	.476E+04	.000E+00	.000E+00	.000E+00	.000E+00	.38
7	1.83	12.	.533E-01	.317E+00	.955E+04	.000E+00	.000E+00	.000E+00	.000E+00	.38
				FILTER WEIGHT		.000E+00	.000E+00	.000E+00		
				TOTAL WEIGHT		.243E+01				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	8.026 MICRONS
STD. GEOMETRIC DEVIATION =	1.356
CORRELATION COEFFICIENT =	.887

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.7325	.620	26.832	9.694	2.075 TO	45.292
2	.5062	.015	11.319	8.064	1.913 TO	33.997
3	.3045	-.511	4.228	6.869	1.770 TO	26.656
4	.1358	-1.099	1.904	5.742	1.609 TO	20.488
5	.0000	-9.042	1.077	.511	.102 TO	2.562
6	.0000	-9.042	.493	.511	.102 TO	2.562
7	.0000	-9.042	.317	.511	.102 TO	2.562
8	.0000					

/IMPCT : 03 ON @32650M
/IMPCT : 03 ON @32650M
/IMPCT : 03 ON @32650M
/IMPCT : 03 ON @32650M

TITLE: OUTLET RUN 15 11/10/78 1350 IMPI[illegible] 6 STAGES 24 HOLES LAST STAGE

TEST DATA

TEST DURATION =	30.0	MINUTES	TEMP IMPACTOR =	250.	DEGS. F
METER TEMP. =	53.	DEGS. F	TEMP AMBS. =	53.	DEGS. F
METER PRES =	.00	IN.	VELOCITY =	57.02	FT/SEC
BARO. PRES =	29.16	INCH HG	SAMPLE RATE =	.87	CF(STACK COND.)
NOZZLE DIA. =	.0000	INCHES	TOTAL VOLUME(STACK) =	26.07	CF(STACK COND.)
VOL. METER =	17.88	CUBIC FEET	PARTICLE DENSITY =	1.80	GRAM/CC
STACK PRESSURE =	28.72	INCH HG	STACK SUCTION =	-.441E+00	INCH HG
COND. WATER =	13.3	CC	VISCOSITY =	.22E-03	POISE

TEST RESULTS

PERCENT MOISTURE =	3.60	
VOLUME GAS STD. DRY =	.509E+00	CUBIC METER
PERCENT ISOKINETIC =	$$$$$$$$$$	
CONCENTRATION =	.240E+02	MGRAM/CUBIC METER(DRY, 21.1 DEG C, 760 MM HG)

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	SART PSISO
1	1.01	8.	.965E+00	.208E+02	.701E+02	.238E+01	.467E+01	.240E+02	.124E+02	.38
2	1.03	12.	.476E+00	.877E+01	.192E+03	.830E+00	.163E+01	.194E+02	.434E+01	.38
3	1.07	24.	.198E+00	.326E+01	.553E+03	.494E+01	.970E+01	.177E+02	.226E+02	.38
4	1.17	24.	.119E+00	.146E+01	.153E+04	.359E+01	.705E+01	.803E+01	.201E+02	.38
5	1.30	24.	.838E-01	.816E+00	.310E+04	.430E+00	.844E+00	.982E+00	.335E+01	.38
6	1.69	24.	.533E-01	.362E+00	.765E+04	1.000E-02	.196E-01	.137E+00	.557E-01	.38
				FILTER WEIGHT		.600E-01	.118E+00	.118E+00		
				TOTAL WEIGHT		.122E+02				

LINEAR REGRESSION RESULTS

GEOMETRIC MEAN DIAMETER =	6.330	MICRONS
STD. GEOMETRIC DEVIATION =	2.598	
CORRELATION COEFFICIENT =	.973	

	P(CUM) PERCENT	Z	ACTUAL D (MICRON)	CALC. D (MICRON)	95 PERCENT LIMITS (MICRON)	
1	.8056	.861	20.831	14.411	5.462 TO	38.027
2	.7377	.636	8.774	11.621	4.739 TO	28.495
3	.3342	-.428	3.263	4.206	2.232 TO	7.926
4	.0408	-1.741	1.457	1.200	.610 TO	2.361
5	.0057	-2.529	.816	.566	.233 TO	1.372
6	.0049	-2.583	.362	.537	.218 TO	1.325
7	.0000					

TECHNICAL REPORT DATA *(Please read Instructions on the reverse before completing)*		
1. REPORT NO. EPA-600/7-79-246	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Ceilcote Ionizing Wet Scrubber Evaluation		5. REPORT DATE November 1979 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) David S. Ensor		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Meteorology Research, Inc. 464 West Woodbury Road Altadena, California 91001		10. PROGRAM ELEMENT NO. EHE624A 11. CONTRACT/GRANT NO. 68-02-2125
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Final; 9/78 - 9/79 14. SPONSORING AGENCY CODE EPA/600/13
15. SUPPLEMENTARY NOTES IERL-RTP project officer is Dale L. Harmon, Mail Drop 61, 919/541-2925.		

16. ABSTRACT The report gives results of an evaluation of a Ceilcote ionizing wet scrubber installed on a refractory brick kiln. Tests involved particulate mass emission, particle size distribution, and opacity. Overall efficiency was 93% with an average outlet opacity determined with a heated plant process visiometer (PPV) of 8% over a 1.68 m (5.5 ft) path length. The average particle cut diameter of the scrubber system was 0.5 micrometer. The estimated theoretical power requirement for the ionizing wet scrubber was 41 W/actual cu m (1.54 hp/1000 actual cu m. The scrubber system developed for the kiln included a cooling tower to provide chilled water for the prescrubber to condense volatile emissions which required 26 W/actual cu m (2.5 hp/1000 acfm). The performance of the ionizing wet scrubber, based on theoretical power input, exceeds that of a venturi scrubber.

17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Pollution Control	13B
Scrubbers	Stationary Sources	07A,13I
Ionization	Ceilcote Ionizing Wet Scrubber	07B,07C
Kilns		13A
Refractories	Particulate	11B
Dust		11G
18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 94
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE