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

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

AP-42 Section 11.23
Reference 18
Report Sect. 4
Reference 18

Interpoll Inc.
2982 North Cleveland Avenue
St. Paul, Minnesota 55113

(612) 636-6866

RESULTS OF THE DECEMBER 13 & 14, 1979 PARTICULATE EMISSION COMPLIANCE TESTS ON THE KILN COOLER EXHAUST AND THE 2A WASTE GAS STACKS AT THE EVELETH EXPANSION COMPANY PLANT NEAR EVELETH, MINNESOTA

Submitted to:

EVELETH EXPANSION COMPANY
P. O. Box 180
Eveleth, Minnesota 55734

Attention: D.S. Coyle
Chief Metallurgist

Approved by:

Perry Lonnes

Perry Lonnes, Ph.D.
Director of Environmental
Measurements Section

Report Number 9-683
January 22, 1980
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SYMBOLS AND ABBREVIATIONS

ACFM	actual cubic feet per minute
DSCFM	standard cubic foot of dry gas per minute
DEG-F	degrees Fahrenheit
FT/SEC	feet per second
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g	gram
HRS	hours
IN.	inches
IN. H.G.	inches of mercury
IN. W.C.	inches of water
LB	pound
LB/HR	pounds per hour
LB/10^6BTU	million British Thermal Units heat input
microns (μm)	micrometer
MIN	minutes
SQ. FT.	square feet
v/v	percent by volume
mg/DSCM	milligrams per dry standard cubic meter
LB/DSCF	pounds per dry standard cubic foot
MWH	megawatt hours
ohm-cm	ohm-centimeter
HP	horsepower
PSI	pounds per square inch
w/w	percent by weight

Standard conditions are defined as 68 ^{o}F (20 ^{o}C) and 29.92 in. of mercury pressure.

1 INTRODUCTION

On December 13 and 14, 1979, Interpoll Inc. personnel conducted particulate emission compliance tests on the Kiln Cooler Exhaust and the 2A Waste Gas Stacks at the Eveleth Expansion Company Plant located near Eveleth, Minnesota. On-site testing was performed by Messrs. E. Trowbridge and P. Severson. Coordination between plant operation and testing activities was provided by Dan Jarvis of the Eveleth Expansion Company. The tests were not witnessed by a member of the Minnesota Pollution Control Agency (MPCA).

Particulate evaluations were performed in accordance with EPA Methods 1-5, CFR Title 40, Part 60, Appendix A, and the revisions to these methods, FR42(160). Preliminary determinations of the gas linear velocity profile were made on each source to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. Interpoll sampling trains which meet or exceed specifications in the above-cited references were used to extract representative particulate samples by means of a heated stainless steel-lined probe.

Testing on these two sources was conducted from existing test ports located on the stacks. Testing protocol on each source was based upon EPA Method 1 recommendations. A visible emission determination was performed on each source by a currently EPA-certified observer.

The important results of the tests are summarized in Section 2. Detailed results are presented in Section 3. Results of preliminary measurements, field data, and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The important results of the particulate emission compliance tests performed on the Kiln Cooler Exhaust Stack and the 2A Waste Gas Stack are presented in Tables 1 and 2, respectively. As will be noted, the particulate concentrations measured at the exhaust stack of the Kiln Cooler ranged from .069 to .13 GR/DSCF. In the case of the 2A Waste Gas Stack, the particulate concentrations ranged from .019 to .034 GR/DSCF. A particle size distribution determination was performed on the particulate sample collected during the first run on the Kiln Cooler Exhaust Stack. Examination of the results (Section 3.4), indicate that 75% of the particulate material was larger than ten microns in diameter which may indicate a malfunction in the operation of the dust control equipment on this source.

No difficulties were encountered in the field or in the laboratory evaluation of the particulate and Orsat samples. On the basis of this fact, and a complete review of the entire data and results, it is our opinion that the particulate concentrations reported herein are accurate and closely reflect the actual values which existed at the time the tests were conducted.

* PROBE WASH + FILTER CATCH.

Table 1. Summary of the Results of the December 13, 1979 Particulate Emission Compliance Test on the Kiln Cooler Exhaust Stack at the Eveleth Expansion Co.

ITEM	RUN 1	RUN 2	RUN 3
Date of Test	12-13-79	12-13-79	12-13-79
Time of Test (HRS)	1030-1202	1220-1350	1408-1542
Process Rate (TONS/HR)	np	np	np
Volumetric Flow			
ACTUAL (ACFM)	280000	283000	281000
STANDARD (DSCFM)	133000	133000	136000
Gas Temperature (DEG-F)	592	599	570
Gas Moisture Content (% v/v)	.88	1.01	.96
Gas Composition (% v/v, dry)*			
carbon dioxide	.03	.03	.03
oxygen	20.90	20.90	20.90
nitrogen	79.07	79.07	79.07
Particulate Concentration			
ACTUAL (GR/ACF)	.057	.033	.062
STANDARD (GR/DSCF)	.12	.069	.13
Isokinetic Variation (%)	100.2	97.7	100.2
Particulate Emission Rate (LB/HR)	137.6	77.8	149.5

* Composition of normal air (not analyzed)

np-not provided

Table 2. Summary of the results of the December 14, 1979 Particulate Emission Compliance Test on the 2A Waste Gas Stack at the Eveleth Expansion Company.

ITEM	RUN 1	RUN 2	RUN 3
Date of Test	12-14-79	12-14-79	12-14-79
Time of Test (HRS)	850-1005	1100-1218	1245-1400
Process Rate (TONS/HR)	500	600	600
Volumetric Flow			
ACTUAL (ACFM)	305000	317000	318000
STANDARD (DSCFM)	239000	249000	246000
Gas Temperature (DEG-F)	119	120	127
Gas Moisture Content (% v/v)	10.81	10.55	10.42
Gas Composition (% v/v, dry)			
carbon dioxide	1.11	1.21	1.21
oxygen	19.30	19.10	19.10
nitrogen	79.59	79.69	79.69
Time-averaged Velocity Weighted Oxygen (% v/v, dry)	19.24	18.95	19.06
Particulate Concentration			
ACTUAL (GR/ACF)	.027	.016	.015
STANDARD (GR/DSCF)	.034	.021	.019
Isokinetic Variation (%)	103.4	99.5	99.9
Particulate Emission Rate (LB/HR)	70.8	44.5	41.2

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition results for each source are presented first, followed by the particulate emission and opacity data for each source. Preliminary measurements including traverse point description are given in Appendix A and Appendix B.

The results have been calculated on a CDC 3300 computer using standard Fortran programs. EPA-published equations have been used as the basis of the calculation techniques in these programs. It should be noted in interpreting these results that the particulate emission rates have been calculated by both the "concentration x flow" and the "ratio of areas" methods and the average reported. The average is the best estimate of the true value, since the bias introduced by an isokinetic sampling is approximately equal but of opposite sign in the two calculation techniques and thus cancels in the average.

3.1 Results of Gas Analyses

JOB: EVELETH EXPANSION CO.

INTERPOLL REPORT NO. 9-683

3.1.1 TEST NO. 1 KILN COOLER EXHAUST

RESULTS OF GAS ANALYSES -- METHOD 3 (PERCENT BY VOLUME)

	RUN 1	RUN 2	RUN 3
DATE OF RUN	12/13/79	12/13/79	12/13/79
DRY BASIS (ORSAT)*			
CARBON DIOXIDE	.03	.03	.03
OXYGEN	20.90	20.90	20.90
CARBON MONOXIDE	0	0	0
NITROGEN	79.07	79.07	79.07
WET BASIS (ORSAT)			
CARBON DIOXIDE	.03	.03	.03
OXYGEN	20.72	20.69	20.70
CARBON MONOXIDE	0	0	0
NITROGEN	78.38	78.27	78.31
MOISTURE CONTENT	.88	1.01	.96
DRY MOLECULAR WEIGHT	28.84	28.84	28.84
WET MOLECULAR WEIGHT	28.75	28.73	28.74
SPECIFIC GRAVITY (RELATIVE TO AIR)	.9929	.9925	.9926

0.95 A.B.

*Not analyzed - composition is that of normal air

3.1.2 TEST NO. 2 2A WASTE GAS STACK

RESULTS OF GAS ANALYSES -- METHOD 3 (PERCENT BY VOLUME)

	RUN 1	RUN 2	RUN 3
DATE OF RUN	12/14/79	12/14/79	12/14/79
DRY BASIS (ORSAT)			
CARBON DIOXIDE	1.11	1.21	1.21
OXYGEN	19.30	19.10	19.10
CARBON MONOXIDE	0	0	0
NITROGEN	79.59	79.69	79.69
WET BASIS (ORSAT)			
CARBON DIOXIDE	.99	1.08	1.08
OXYGEN	17.21	17.09	17.11
CARBON MONOXIDE	0	0	0
NITROGEN	70.98	71.08	71.38
MOISTURE CONTENT	10.81	10.55	10.42
DRY MOLECULAR WEIGHT	28.95	28.94	28.96
WET MOLECULAR WEIGHT	27.77	27.80	27.82
SPECIFIC GRAVITY (RELATIVE TO AIR)	.9591	.9603	.9608
VELOCITY WEIGHTED AND TIME-AVERAGED OXYGEN DURING METHOD 5 RUNS	19.04	18.95	19.06

3.2 Results of Particle Concentration Determinations

JOB: EVELETH EXPANSION CO.

INTERPOLL REPORT NO. 9-683

3.2.1 TEST NO. 1 KILN COOLER EXHAUST

RESULTS OF PARTICLE CONCENTRATION DETERMINATION -- METHOD 5(BE)

	RUN 1	RUN 2	RUN 3
DATE OF RUN	12/13/79	12/13/79	12/13/79
TIME RUN START/END(HRS)	1030/1202	1220/1350	1408/1542
PITOT TUBE COEFFICIENT	.840	.840	.840
TOTAL MOISTURE IN GAS SAMPLE (GRAMS)	8.0	9.0	9.0
TOTAL PARTICULATE MATERIAL COLLECTED(GRAMS) *	.3332	.1861	.3621
VOLUME THROUGH GAS METER (CF AT METER COND.)	45.90	44.98	47.14
TOTAL SAMPLING TIME (MIN)	80.0	80.0	80.0
NOZZLE DIAMETER (IN)	.374	.374	.374
AVERAGE STACK GAS TEMPERATURE DURING DETERMINATION (DEG-F)	592.	599.	570.
VOLUMETRIC FLOW**			
ACTUAL ..... (ACFM)	280082	282836	280614
DRY STANDARD ... (DSCFM)	133141	133374	136147
ISOKINETIC VARIATION (%)	100.2	97.7	100.2
PARTICLE CONCENTRATION			
ACTUAL ..... (GR/ACF)	.0575	.0326	.0623
DRY STANDARD ... (GR/DSCF)	.1204	.0688	.1279
PARTICLE MASS FLOW (LB/HR)	137.61	77.81	149.50

* DRY CATCH ONLY
** CALCULATED ON THE BASIS OF VELOCITY PRESSURES MEASURED DURING THIS PARTICULATE DETERMINATION.

JOB: EVELETH EXPANSION CO.

INTERPOLL REPORT NO. 9-683

3.2.2 TEST NO. 2 2A WASTE GAS STACK

RESULTS OF PARTICLE CONCENTRATION DETERMINATION -- METHOD 5(BE)

	RUN 1	RUN 2	RUN 3
DATE OF RUN	12/14/79	12/14/79	12/14/79
TIME RUN START/END(HRS)	950/1005	1100/1218	1245/1400
PITOT TUBE COEFFICIENT	.854	.854	.854
TOTAL MOISTURE IN GAS SAMPLE (GRAMS)	115.0	112.0	110.0
TOTAL PARTICULATE MATERIAL COLLECTED(GRAMS) *	.0984	.0607	.0563
VOLUME THROUGH GAS METER (CF AT METER COND.)	47.77	47.99	47.71
TOTAL SAMPLING TIME (MIN)	64.0	64.0	64.0
NOZZLE DIAMETER (IN)	.242	.242	.242
AVERAGE STACK GAS TEMPERATURE DURING DETERMINATION (DEG-F)	119.	120.	127.
VOLUMETRIC FLOW**			
ACTUAL ..... (ACFM)	304579	316633	317617
DRY STANDARD ... (DSCFM)	238871	248633	246454
ISOKINETIC VARIATION (%)	103.4	99.5	99.9
PARTICLE CONCENTRATION			
ACTUAL ..... (GR/ACF)	.0267	.0165	.0152
DRY STANDARD ... (GR/DSCF)	.0340	.0209	.0195
PARTICLE MASS FLOW (LB/HR)	70.79	44.53	41.19

* DRY CATCH ONLY
** CALCULATED ON THE BASIS OF VELOCITY PRESSURES MEASURED DURING THIS PARTICULATE DETERMINATION.

3.3 Results of Opacity Observations

3.3.1 TEST NO. 1 SOURCE: KILN COOLER STACK

RESULTS OF OPACITY OBSERVATIONS - EPA METHOD 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0	100
5	.0223	0
10	.0458	0
15	.0706	0
20	.0969	0
25	.1249	0
30	.1549	0
35	.1871	0
40	.2219	0
45	.2596	0
50	.3010	0
55	.3468	0
60	.3979	0
65	.4559	0
70	.5229	0
75	.6021	0
80	.6990	0
85	.8239	0
90	1.000	0
95	1.301	0
100		0
		TIME AVERAGE

OBSERVER: E. Trowbridge

CERTIFICATION DATE: 11-6-79

DATE OF OBSERVATION: 12-13-79

TIME OF OBSERVATION: 1400-1500

3.3.2 TEST NO. 2 SOURCE: 2A WASTE GAS STACK

RESULTS OF OPACITY OBSERVATIONS - EPA METHOD 9

PERCENT OPACITY	OPTICAL DENSITY	RELATIVE FREQUENCY (%)
0	0	100
5	.0223	0
10	.0458	0
15	.0706	0
20	.0969	0
25	.1249	0
30	.1549	0
35	.1871	0
40	.2219	0
45	.2596	0
50	.3010	0
55	.3468	0
60	.3979	0
65	.4559	0
70	.5229	0
75	.6021	0
80	.6990	0
85	.8239	0
90	1.000	0
95	1.301	0
100		0
0	0	TIME AVERAGE

OBSERVER: E. Trowbridge
CERTIFICATION DATE: 11-6-79
DATE OF OBSERVATION: 12-14-79
TIME OF OBSERVATION: 1400-1500

3.4 Results of the Particle Size Distribution Analysis

(Kiln Cooler Exhaust Stack Test 1 Run 1)

3.4.1 RESULTS OF PARTICLE SIZE DISTRIBUTION DETERMINATION-METHOD MSA SEDIMENTATION-CENTRIFUGATION

SAMPLE: EVELETH TACONITE CO. TACONITE DUST FROM KILN COOLER EXHAUST STACK (TEST 1 RUN 3 12/13/79)

PARTICLE DIAMETER* (UM)	REL. CUM. FREQ. PERCENT BY MASS GREATER THAN
63.00	4.15
38.00	18.17
25.00	18.17
10.00	75.30
8.00	81.47
5.00	88.42
3.00	94.60
2.00	95.37
1.00	96.14
.80	96.14
.60	96.95

PARTICLE DIAMETER* (UM)	REL. TIVE FREQ. PERCENT BY MASS
> 63.00	4.15
63.00- 38.00	14.02
38.00- 25.00	0
25.00- 10.00	57.13
10.00- 8.00	6.17
8.00- 5.00	4.95
5.00- 3.00	4.18
3.00- 2.00	.77
2.00- 1.00	.77
1.00- .80	0
.80- .40	.81
< .60	3.05

*SPHERICAL PARTICLES AT A DENSITY OF 2.20 G/CC (ASSIGNED)

NOTE: MASS CONC: DISP. AGENT 4.0 %, PH 8.20%
COMP. COLOR : BLACK.

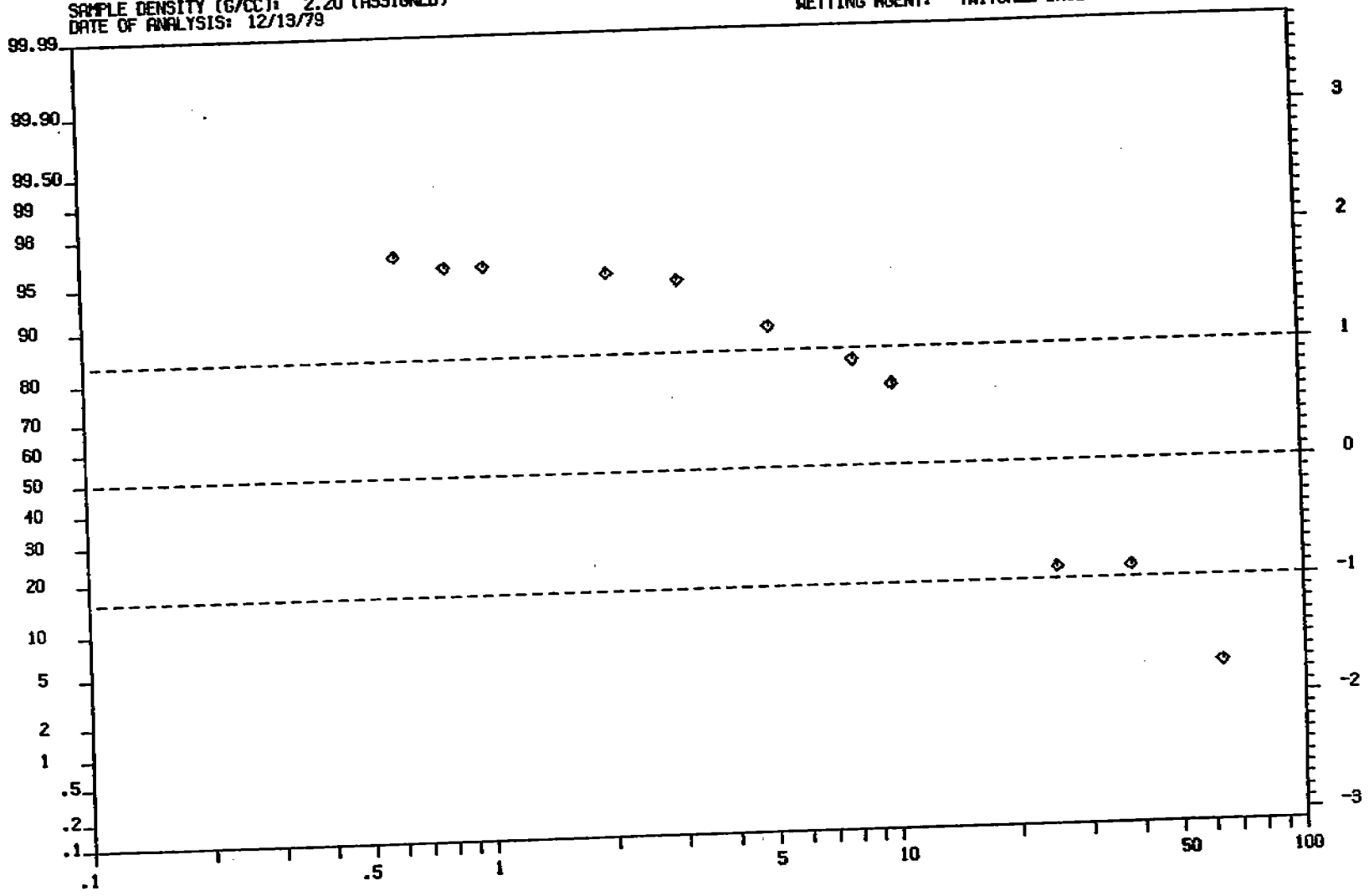
NOTE: Probe Wash & Filter Catch sized separately and mathematically combined.

INTERPOLL REPORT NO. 9-683

LOG-NORMAL PLOT OF THE CUMULATIVE WEIGHT-SIZE DISTRIBUTION
METHOD: MSA-WHITBY SEDIMENTATION CENTRIFUGATION

SAMPLE DESCRIPTION: EVELETH TACONITE CO. TACONITE DUST FROM KILN COOLER EXHAUST STACK (TEST 1 RUN 3 12/19/79)
SAMPLE DENSITY (G/CC): 2.20 (ASSIGNED)
DATE OF ANALYSIS: 12/13/79

FEEDING LIQUID: 50 PCT BENGENE + 50 PCT SKELLYS
DISPERING AGENT(S): TWITCHEL BASE 8262
SEDIMENTATION LIQUID: BENZENE
WETTING AGENT: TWITCHEL BASE 8262



PERCENT BY WEIGHT GREATER THAN

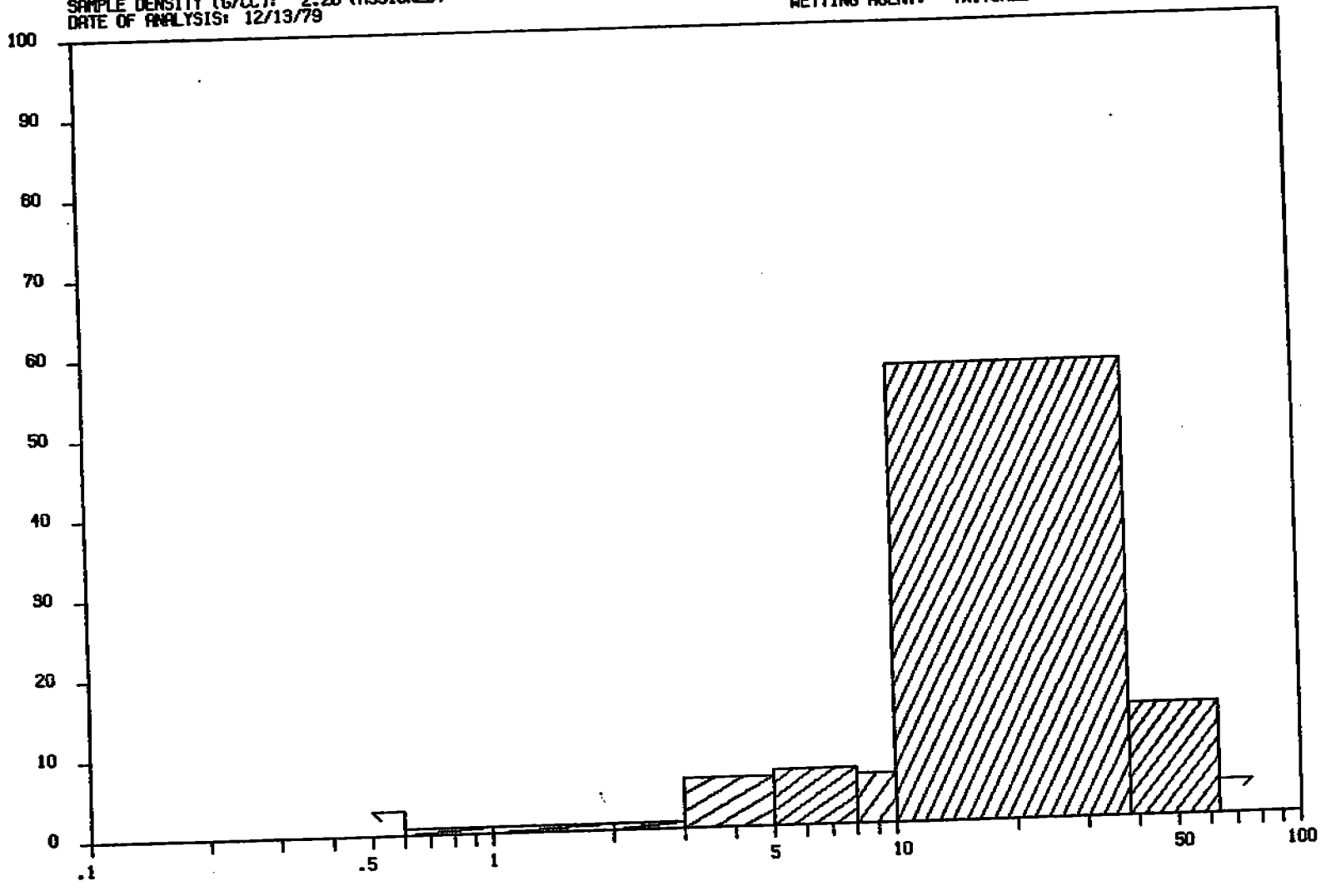
EQUIVALENT STOKE'S PARTICLE DIAMETER (MICRONS)

INTERPOLL REPORT NO. 9-683

SEMI-LOG PLOT OF THE WEIGHT-SIZE DISTRIBUTION
METHOD: MSA-WHITBY SEDIMENTATION CENTRIFUGATION

SAMPLE DESCRIPTION: EVELETH TACONITE CO. TACONITE DUST FROM KILN COOLER EXHAUST STACK (TEST 1 RUN 3 12/13/79)
SAMPLE DENSITY (G/CC): 2.20 (ASSIGNED)
DATE OF ANALYSIS: 12/13/79

FEEDING LIQUID: 50 PCT BENGENE + 50 PCT SKELLYS
DISPERING AGENT(S): TWITCHEL BASE 8262
SEDIMENTATION LIQUID: BENZENE
WETTING AGENT: TWITCHEL BASE 8262



TACON 21

Source category: Taconite ore processing
Plant name : Eveleth Mines
Test date : December 13-14, 1979
Process : Waste exhaust

Date:
Location:
Ref. No.: (18)

Basis for process rate :

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton
Waste gas ~~stack 2A~~ grate/kiln coal and fuel oil fired (TOTAL)	Wet scrubber system	filt. PM	1	141.58	500.00	0.14	0.28
		filt. PM	2	89.06	600.00	0.074	0.15
		filt. PM	3	82.38	600.00	0.069	0.14
				AVERAGE		0.095	0.19
		CO2	1	36419	500.00	36	73
		CO2	2	41361	600.00	34	69
		CO2	3	40863	600.00	34	68
				AVERAGE		35	70