AP42 Section:	12.2
Reference:	96
Title:	Republic Steel Corporation, Cleveland, Ohio, Particulate Emission Evaluation, Envirotech/Chemico No. 21 One Spot Quench Car at the Coke Oven Battery, Betz, Converse, Murdoch, Inc., Plymouth Meeting, PA, June 1981.

GSA

REPORT

AP-42 Section 12.2
Reference
Report Sect. 4
Reference 96

Republic Steel Corporation
Cleveland, Ohio

Particulate Emission Evaluation
Envirotech/Chemico
No. 21 One Spot Quench Car

BCM Betz·Converse·Murdoch·Inc.
Consulting Engineers, Planners and Computer Scientists

SOTDAT/STEEL LIBRARY SYSTEM

Report Title: see title page

Plant and Location: Republic Steel Corp., Cleveland, OH

SCC: 30300303

Testing Date(s): 4/7-9/81

By Whom: BCM

Stack Test Review Attached: No

Reviewed By:

Problems Seen by Reviewer:

Confidentiality Status: Unknown

If status is confidential, list confidential pages or sections:

Source of Determination of the Confidentiality Status:

Report Encoded By:

Date Encoded:

Form Numbers:

Comments:

PARTICULATE EMISSION EVALUATION OF THE ENVIROTECH/CHEMICO NO. 21 ONE SPOT QUENCH CAR

AT THE

COKE OVEN BATTERY
OF
REPUBLIC STEEL CORPORATION
CLEVELAND WORKS
CLEVELAND, OHIO

JUNE 1981

BCM PROJECT NO. 00-4178-12

PREPARED BY

ROBERT ALFRED, SCIENTIST II

APPROVED BY

PETER R. CHARRINGTON, P.E.
ASSISTANT VICE PRESIDENT

BETZ•CONVERSE•MURDOCH•INC.
ONE PLYMOUTH MEETING MALL
PLYMOUTH MEETING, PENNSYLVANIA 19462

CONTENTS

1.0 EXECUTIVE SUMMARY

Republic Steel Corporation (RSC) retained Betz•Converse•Murdoch•Inc. (BCM) to evaluate its No. 21 Envirotech/Chemico one spot quench car installed at the Coke Oven Batteries Nos. 6 and 7 at the Cleveland facility. The emission data were evaluated in accordance with the Envirotech/Chemico specifications and testing was performed as per the procedures established by the Environmental Protection Agency (EPA), the State of Ohio, and the City of Cleveland. Three 24 push tests, incorporating both push and travel modes, were performed by BCM. In addition, opacity observations were noted for each oven that was pushed during the particular testing program.

2.0 SCOPE AND OBJECTIVES

The scope of the project was outlined in BCM Proposal No. 00-4178-12 which is contained in Appendix 1. The following parameters were determined for each test:

- Gas flow - ACFM and SCFM
- Gas temperature - °F
- Moisture - % by volume
- Flue gas analysis - % by volume CO_2, O_2, CO + N_2 (by difference)
- Particulate emissions - grains/dry standard cubic feet (g/dscf), lbs/hr, lbs/ton of coke pushed, lbs/ton of coal charged
- Opacity - % Opaque

3.0 PROCEDURES

3.1 Field Work

Field testing was conducted April 7 through 9, 1981. The sampling team consisted of the following BCM personnel:

- Robert Alfred - Scientist II
- Nassar Oshkoohi - Scientist II
- Jeffrey P. Bishop - Technician IV

Mr. Gene John of Republic Steel acted as liaison between BCM and Republic Steel, and Mr. Bill Weiss of Chemico ensured that the scrubber car was operating normally during the test periods. Mr. Joe Bryant of Chemico observed the testing performed on the test car.

The following methods of sampling were employed in the test program:

1. Sampling and traverse locations were determined at a pre-test meeting on March 24, 1981, attended by personnel from the City of Cleveland DAPC and the EPA.

2. Gas flow, gas temperature and static pressure measurements were made per Method Two of the Federal Register, Volume 42, Number 160, August 18, 1977; the methodology is outlined in Appendix 2.

3. Particulate testing was conducted as per a modified Methods Five Federal Register, Volume 42, Number 160, August 18, 1977. These procedures are outlined in Appendix 2.

4. Fyrite oxygen (O_2) and carbon dioxide (CO_2) indicators (manufactured by the Bacharach Instrument Company) were used to determine the molecular weight of the flue gas. The Fyrite directly determines percent carbon dioxide and oxygen. The volume percent CO plus nitrogen was determined by difference. All of these parameters were used to calculate the molecular weight of the dry flue gas.

5. Moisture content sampling was conducted per Method Four of the Federal Register, Volume 42, Number 160, August 18, 1977; the methodology is outlined in Appendix 2.

3.2 Equipment Calibration

In accordance with the accepted procedures published by the EPA, all gas velocity measuring equipment, volume metering equipment, temperature measuring equipment, and flow rate metering equipment had been calibrated within 60 days of the actual test date. Calibration data are contained in Appendix 4.

TABLE 1

PARTICULATE EMISSIONS RESULTS

Run Number	Concentration (Grains/DSCF)	Particulate Emissions		
		Pounds/Hour	Lbs/Ton of Coke Pushed*	Lbs/Ton of Coal Charged**
1	.0139	7.81	0.026	0.020
2	.0188	9.31	0.032	0.024
3	.0169	8.97	0.028	0.021

* Based on 280.8 tons of coke pushed during each 24 oven tests; see Appendix 3 computation sheet

** Based on typical yield of 0.75 tons of coke pushed per ton of coal charged

5.2 Visible Emissions Procedure

The opacity was observed during all three testing programs. All observations were recorded in accordance with guidelines established in EPA Federal Method Nine of the Federal Register, with the exception of the guideline that the sun be located 140° to the observer's back. This guideline could not be met because of the location of the coke ovens; this is a well-established practice. All observations were recorded by a certified BCM observer.

Opacity readings were taken above the coke car with blue sky as background. Observations began at the start of the push cycle of the quench car and continued until the quench car cycle completed its run, which lasted two minutes. There were 24 pushes per test, each push occurring approximately eight minutes apart.

APPENDIX 1

BCM PROPOSAL

Betz·Converse·Murdoch·Inc.

PROPOSAL

TO

REPUBLIC STEEL CORPORATION
CLEVELAND DISTRICT
3100 E. 45th STREET
CLEVELAND, OH 44127

FOR

A SOURCE EMISSION TESTING OF THE
ENVIROTECH/CHEMICO
ENCLOSED QUENCH CAR SYSTEMS
AT THE
CLEVELAND MILL
OF
REPUBLIC STEEL CORPORATION

BCM PROJECT NO. 00-4178-12

MARCH 16, 1981

PREPARED BY:

PETER R. CHARRINGTON, P.E.
ASSISTANT VICE PRESIDENT, AIR QUALITY

BETZ·CONVERSE·MURDOCH·INC.
ONE PLYMOUTH MEETING MALL
PLYMOUTH MEETING, PENNSYLVANIA 19462

3.3 Analytical Methods

All samples generated during the sampling program were returned to the BCM Laboratory in Norristown, Pennsylvania. Laboratory data are contained in Appendix 3, Table 3-1.

3.4 Calculations

All particulate concentrations, moisture content, gas flow, and molecular weight calculations were accomplished through the use of a computer. Raw data generated from the field sampling program and the results of the laboratory analyses were introduced into equations presented in Methods Two, Three, Four, and Five of the Federal Register, Volume 42, No. 160, August 18, 1977. Computer input and all other data appear in Appendix 3.

4.0 SUMMARY

4.1 Particulate Emissions Results

The parameters evaluated using the EPA and State of Ohio testing methods are contained in the computer printout at the end of Appendix 3. Test results are listed in Table 1.

4.2 Visible Emissions

The opacity observations were performed in conjunction with Chemico, the City of Cleveland DAPC, and the EPA.. The readings are contained in Appendix 2.

5.0 DISCUSSION

5.1 Particulate Testing Results

The testing for the quench car particulate emissions was performed with minimal field difficulties. The starting time for Test Run No. 1 was delayed approximately four hours because of difficulties in hooking up electricity to the test car. After this problem was solved, testing went smoothly throughout the rest of the program. However, in Test Run No. 2, the hot coke began "sticking" in Oven No. 81. Therefore, the pushing machine was not able to push the coke out. The operator of the quench car who initiated the scrubbing cycle was unaware of this problem. After approximately 47 seconds, the scrubber was turned off. Because the scrubber was only scrubbing clean air, the cubic feet of gas samples and sampling time from this push were subtracted from the appropriate total. If they were to be included in the calculations, the gas flow (ACFM) and grains/dscf would drop in value and the isokinetics would rise approximately one percent.

TECHNICAL SCOPE

It is the desire of Republic Steel Corporation (Republic) to have the emissions from the ENVIROTECH/CHEMICO Enclosed Quench Car Systems located at the Cleveland plant of the Republic Steel Corporation evaluated and quantified. The intent of this proposal is to present Belt-Converse•Murdoch•Inc.'s (BCM) approach to fulfilling Republic's request for determining the above information.

The project will involve emission sampling from the outlet of two Quench Car Systems in order to generate compliance data for submission to the Ohio Environmental Protection Agency (EPA). A maximum of three runs will be performed during a four-day period at each location. The project is subdivided as noted below.

For ease of discussion and mutual understanding of the BCM services to be provided, the suggested scope is subdivided into the steps as noted below.

1.0 PROJECT PLANNING

Upon acceptance of the proposal, the Section Manager of the Air Quality Section or the Field Project Engineer will meet with Republic Steel to accomplish the following:

- Establish lines of communication for the testing
- Discuss the project scope to ensure Republic and BCM are in agreement
- Ensure that the sampling site is prepared for testing (see Client Responsibility Section)

2.0 SAMPLING AND ANALYSIS

2.1 Test Procedures

All particulate testing procedures to be followed during the three 24 push tests for each car are those prescribed by the Environmental Protection Agency (EPA) and the Ohio EPA. The procedures to be followed during testing are outlined below:

- Use an out-of-stack glass fiber filter, followed by a full impinger train (which consists of two distilled water filled impingers), followed by an empty impinger, and then a silica gel-filled final impinger. A glass lined probe heated to 250°F ± 25°F will be used for the testing.

- Sample point location and velocity traverses will consist of four six-point sampling traverses.

- EPA Method 5 sampling procedures will be followed for the particulate sampling with the following exceptions:

  (1) A sample rate of approximately 0.3 scfm will by used for each test

  (2) A back half particulate loading will be generated by evaporating all water washes at 105°C ± 5°C, and the residue weight determined

2.2 Parameters

The following parameters will be evaluated and reported for each of three test runs for each Quench Car.

- Gas flow - ACFM - ACFM and SCFM
- Gas temperature -°F
- Gas molecular weight - Orşat analysis - (CO_2, O_2, CO and N_2 by difference) - % by volume
- Moisture content - % by volume
- Particulate concentration -gr/dscf (front-half and back-half of sampling train reported separately)
- Particulate emission rate - lbs/hr (front-half and back-half of sampling train reported separately)
- Visible emissions - % opaque (optional)

2.3 For each car, BCM will provide two men on-site for four days with the necessary sampling equipment to complete the testing. If visible emissions are required, BCM will provide three men during the program.

3.0 ANALYTICAL

All samples will be returned to our laboratory in Pittsburgh, PA for analysis.

4.0 REPORT

Five copies of the reports (one report for each car) will be submitted within 30 working days of field testing completion. Preliminary data should be available within 15 working days of the completion of the sampling. The reports will include all field data sheets, analytical reports, and sampling methodologies from the testing of the cars.

BUSINESS SCOPE

COMPENSATION

It is proposed that the outlined project scope be performed on a Lump Sum basis. This fee is firm and cannot be changed unless it is mutually agreed that the scope of the work has changed from what is outlined in this project. Costs are based on 10 hour field days and hours in excess of 10 are considered as overtime.

LUMP SUM COSTS

Mobilization(1)
Report Preparation
Each 24-push test
Opacity Observer/10-hour day
Each Delay/OT Hour per 2-man crew
Each Delay/OT Hour per 3-man crew

---

(1)Include Pre-test Meeting, completion of Intent to test forms.

DELAYS/OVERTIME

Delays caused by conditions beyond BCM's control, such as partial or complete process shutdowns or irregularities, strikes, floods or fires which delay the project's completion, constitute a Change-of-Scope. Also, unfavorable weather conditions which BCM's Field Project Engineer considers a threat to crew safety and/or sample quality, constitute a Change-of-Scope and will be charged at the delay/overtime rate. In addition, the field work is based on a 10-hour day (excluding travel). Any hours necessary for the successful completion of the project in excess of 10 per day will be charged at the delay/overtime rate described in the compensation section. Any expenses incurred as a result of project delays/overtime will be billed at cost plus 10%. The BCM Field Project Engineer will notify you of such Changes of Scope. At your request, BCM will outline the type of shelter, as required, to minimize weather delays. If the project is postponed within 72 hours of the scheduled start date, you may be charged a fee (not to exceed the mobilization charge).

WORK SCHEDULE

Work on this project can be started within 10 calendar days of your authorization to proceed and can be completed within 30 working days of completion of the field work. This schedule is our best estimate based on our anticipated laboratory and engineering workload. At the time of

your authorization to proceed, it may be possible to improve this schedule if necessary. On the other hand, an unexpected increase in our laboratory and engineering workload may cause a few days' delay in starting the project.

INVOICES

Invoices will be submitted monthly for work completed, with terms net thirty (30) days with past-due balances subject to interest at the rate of one and one-quarter percent (1-1/4%) per month, effective forty-five (45) days after date of invoice. This represents an annual interest charge of fifteen percent (15%).

VALIDITY

This proposal is valid for 60 days. Subsequent to that date, BCM may review the basis of payment to allow for changing costs and adjust starting and completion dates to conform to our workload.

INSURANCE

BCM will maintain insurance coverage in the following amounts and, upon request of the client, will provide a Certificate of Insurance so indicating:

Type of Policy	Limits of Liability
(a) Standard Worker's Compensation and Employer's Liability	Statutory
(b) General Liability	
Bodily Injury	$500,000 Each Occurrence and Aggregate
Property Damage	$500,000 Each Occurrence and Aggregate
(c) Automobile Liability	
Combined Single Limit (Bodily Injury and Property Damage)	$1,000,000 Each Occurrence

SAFETY

BCM personnel always endeavor to conduct field activities in such a manner as to protect themselves and others from accidents and injury. When special safety equipment is required, the client should so specify. BCM personnel use their own safety equipment (hard hats, goggles) unless otherwise instructed.

PROJECT MANAGEMENT

BCM will assign key personnel who are fully qualified and experienced with similar studies. Their duties are briefly described below.

Section Manager - Air Quality

Mr. P. R. Charrington, P.E., will be responsible for all field studies and analytical determinations. Mr. Charrington has been involved in over four-hundred source emission programs.

Project Engineer - Air Quality

Mr. D. E. Seely will be assigned as the project engineer for the field sampling project. He will be responsible for the data evaluation and sampling system design. Mr. Seely has been involved in the J&L Pittsburgh Works Quench Car testing and several Bethlehem Steel Quench Car programs.

CLIENT RESPONSIBILITY

To successfully complete the field testing, it shall be the responsibility of Republic Steel to provide the following:

1. A plant liaison for the BCM field testing team during the field testing
2. Access to the sampling location
3. Electric power (110V and 20 amp service) to within 50' of the sampling location
4. All operating data of the coke oven battery during field testing

QUALIFICATIONS

BBN has performed over 40 tests on the ENVIROTECH/CHEMICO Quench Car during the past two years. Provided below are the locations of the projects with plant contacts and phone numbers which Republic should feel free to contact.

- Jones and Laughlin Steel Corporation - Pittsburgh Works

  May - July, 1979
  August - September, 1979
  Mr. S. W. Kretz - (412) 378-5447

- Bethlehem Steel Corporation - Bethlehem, PA

  February - March, 1979
  Mr. El Rekai and Mr. Robert Alpago - (215) 694-3878

- Bethlehem Steel Corporation - Sparrows Point, MD

  October, 1980
  Bill Bogart - (301) 477-7886

- Bethlehem Steel Corporation - Lackawanna, NY

  April, 1981 - Tentative Schedule
  Ron Riefler - (716) 821-2504

- Jones and Laughlin Steel Corporation - Indiana Harbor Works

  November, 1980
  Andrew Wichlinski - (219) 391-2818

- Shenango Coke Corporation

  March 1981
  Jim Zwikle - (412) 777-6654

- Republic Steel Corporation - Warren and Youngstown

  April, 1981
  Tom Kachur - (216) 841-8200

- United States Steel Corporation

  April, 1981
  Frank Bowiski - (412) 233-2594

APPENDIX 2

FIELD SAMPLING PROGRAM

APPENDIX 2

FIELD SAMPLING PROGRAM

1.0 SAMPLING PROCEDURES

1.1 Test Station and Traverse Locations

The locations of the sampling stations and traverse points are critical to the performance of the project. A description of the sampling location follows. The outlet duct of the scrubber measured 72 by 64 inches. Four test ports each contained 6 test points, for a total of 24 points.

1.2 Gas Flow and Gas Temperature Determinations

The gas flow rate and temperature profiles were measured by conducting a simultaneous velocity and temperature traverse in conjunction with the particulate testing program. Gas velocity heads were measured with a calibrated "S"-type Pitot tube which was connected to an inclined manometer. A Chromel-Alumel thermocouple connected to a potentiometer was used to determine the gas temperature.

1.3 Moisture Content

Sampling was conducted concurrently with particulate sampling using the principles presented in EPA Method Four. The following parameters were evaluated in order to determine the gas stream's moisture content: sample gas volume, sample gas temperature, sample gas pressure, impinger moisture gain, and silica gel moisture gain. Some minor modifications were made to the Method Four train to allow simultaneous particulate and moisture content sampling. These modifications did not deviate from established sampling principles.

The substitution of a glass fiber filter for Pyrex wool as a filtering medium and the substitution of a calibrated orifice for a rotameter as a flow metering device were the primary modifications.

1.4 Particulate Sampling

The sampling procedures and sampling equipment used are outlined in Method Five of the Federal Register, Volume 42, Number 160, August 18, 1977.

The size of the nozzle required to maintain isokinetic sampling was calculated from the results of a previously completed velocity and temperature traverse. The sampling train used a glass-lined probe, which was heated to 250°F by an internal heating element. A nozzle of the calculated size was attached to the end of the probe which was inserted into the stack. A calibrated "S"-type Pitot tube and a Chromel-Alumel thermocouple were attached to the probe and used to monitor the velocity head and the temperature at the traverse points during the sampling period. Sampled gas passed through the nozzle and the probe to a glass fiber filter for the removal of the suspended particulates. The filter was housed in a heated chamber whose temperature was maintained at 248°F ±25 degrees. From the filter, the stack gas passed to the impinger train. The first two impingers each contained 150 ml of deionized water. The third impinger contained no reagents and acted as a knockout impinger. The fourth impinger contained approximately 200 grams of coarse silica gel which collected any moisture and/or vapors which had not been captured in the preceding impingers.

The second impinger was a 500 ml Greenburg-Smith inpinger, while the first, third and fourth were 500 ml impingers of the Greenburg-Smith design, modified by replacing the tip with a 1/2-inch ID glass tube. Note that the impinger train was immersed in an ice bath for the entire test period so that the exist gas temperature would not exceed 68°F.

From the impinger train, the gas was conducted through an umbilical cord to the control console, a Model 2343 RAC Stak Samplr which contained the following pieces of equipment (listed in the order in which sampled gas passed through them): a main valve; a by-pass valve for flow adjustment; an airtight vacuum pump; a dry gas meter; and a calibrated orifice. The orifice was equipped with pressure taps which were connected across the inclined manometer used to ensure that isokinetic conditions were maintained. A schematic diagram of the sampling train is presented at the end of this appendix.

The sampling train was subjected to a leak check prior to and after each sample run. The inlet of the nozzle was plugged and the pump vacuum was held at the highest vacuum attained during that period of testing. In all cases, the leakage rate was minimal and did not exceed the maximum allowable leakage rate of 0.02 cfm.

Upon completion of a test, the soiled glass fiber filter was removed from its filter holder and placed in a petri dish which was subsequently sealed. The probe and nozzle were washed internally with acetone; the particulate matter remaining in the probe was removed with a nylon brush attached to a polyethylene line. The front half of the glass filter holder was also rinsed with acetone and the washings obtained were added

to those collected from the nozzle and the probe. All washings were stored in sealed polyethylene sample bottles for transfer to the laboratory. The silica gel used in the fourth impinger was removed and stored in a sealed sample bottle. The contents of the first, second and third impingers were combined and measured volumetrically.

1.5 Field Data Sheets

The flue gas velocity head, the flue gas temperature, the inlet and outlet dry gas meter temperatures, the orifice pressure differential, the sample volume, the sampling time, the pump vacuum, the filter temperature, and the impinger train outlet gas temperature were recorded during the sampling program. The field data sheets generated during the program follow.

Betz • Converse • Murdoch • Inc. BCM

NOMOGRAPH DATA

PLANT Republic Steel · Cleveland

DATE 7-6-81

SAMPLING LOCATION Chemico Q-CAR

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.78
AVERAGE METER TEMPERATURE (AMBIENT +20°F), °F	$T_{m\,avg.}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	25%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	140
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	1.1
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	3.0
C FACTOR		.67
CALCULATED NOZZLE DIAMETER, in.		.22
ACTUAL NOZZLE DIAMETER, in.		.195
REFERENCE Δp, in. H_2O		1.8

PLANT Republic Plant

DATE 4-7-81

SAMPLING LOCATION Q-CAR #2

SAMPLE TYPE Method 5

RUN NUMBER 1 OPERATOR BA

BAROMETRIC PRESSURE _____ STATIC PRESSURE _____

FILTER NUMBER(S) E587

GEL NUMBER(S) D703

THIMBLE NUMBER _____ PLATE NUMBER _____

H_2O PICKUP (ml) 180

BCM FIELD DATA SHEET

ORSAT:

CO_2 5

O_2 20

CO 0

PYROMETER NUMBER _____

THERMOCOUPLE NUMBER _____

PROBE NUMBER _____ TYPE _____

NOZZLE NUMBER _____ I.D. .195

METER BOX NUMBER 7 $\Delta H_@$ 1.28

PITOT NUMBER _____ C_p .84

SAMPLE BOX NUMBER(S) _____

ASSUMED MOISTURE (%) 25

ASSUMED METER TEMPERATURE 80

C FACTOR .67 REFERENCE Δp 1.8

Leak Check < .01 CFM AT 15" Hg READ AND RECORD ALL DATA EVERY _____ MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
	1319	179.215										
A-1	60		2.2	2.0	2.2							
	107	180.84	.70	.70	.70	120	68	68	7	255	56	126
	1326											
A-2	59		2.2	2.2	2.2							
	186	182.29	.64	.64	.64	125	69	68	7	270	60	
	1335											
A-3	63		1.5	1.5	1.5							
	77	183.64	.54	.54	.54	130	70	68	6	250	60	81
	1345											
A-4	61		1.1	1.1	1.1							
	94	185.02	.65	.65	.65	130	70	69	6	245	60	
	1353											
A-5	62		.94	.94	.94							
	123	186.58	.51	.51	.51	128	72	70	5	240	61	
	1405											
A-6	66		.26	.26	.26							
	78	187.23	.24	.24	.24	140	74	70	2	255	64	
	1412											
B-1	62		2.3	2.3	2.3							
	68	188.21	.85	.85	.85	135	74	70	7	255	67	

PLANT _____ DATE _____ RUN NUMBER _____

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY (Δp), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
B-2	66		2.8	2.8	2.8				1			
	60	190.28	.95	.95	.95	132	75	72	7	245	68	
	1433											
B-3	64		2.1	2.1	2.1							18
	53	191.54	.85	.85	.85	123	75	73	6	240	68	
	1450											
B-4	66		1.3	1.3	1.3				6			
	81	192.90	.57	.57	.57	120	78	74	6	245	70	111
	1525											
B-5	66		.56	.55	.55							
	103	194.4	.29	.29	.29	121	78	76	7	248	72	121
	1535											
B-6	62		.19	.19	.19							
	63	194.9	.18	.18	.18	140	78	76	2	238	72	
	1545											
C-1	78		3.1	3.1	3.1							
	100	197.06	.87	.87	.87	130	80	78	8	262	72	
	1556											
C-2	62		2.0	2.0	2.0							38
	64	198.48	.84	.84	2.0	121	80	78	8	248	70	
	1600											
C-3	62		1.1	1.1	1.1							
	88	199.61	.58	.58	.58	138	80	76	6	248	68	93
	1610											
C-4	51		.85	.85								
	17	200.4				ABORTED PUSH						48
C-4	63		.80	.80	.80							
	57	201.29	.40	.40	.40	138	80	78	4	253		
	1620											
C-5	60		.34	.34	.34							83
	83	202.08	.A	.19	.19	128	80	80	3	239	68	
	1625											
C-6	61		.09	.09								
	60	202.52	.09	.09		101	80	80	2	252	67	

C-4 aborted sample noted

PLANT Republic Steel Cleve

DATE 4-8-81

SAMPLING LOCATION Q-CAR #21

SAMPLE TYPE Method 5

RUN NUMBER 2 OPERATOR BA

BAROMETRIC PRESSURE 30.25 STATIC PRESSURE

FILTER NUMBER(S) E702

GEL NUMBER(S) D692

THIMBLE NUMBER PLATE NUMBER

H_2O PICKUP (ml) 177

BCM

FIELD DATA SHEET

ORSAT:

CO_2 1.5

O_2 20

CO 0

PYROMETER NUMBER

THERMOCOUPLE NUMBER

PROBE NUMBER TYPE

NOZZLE NUMBER I.D. .195

METER BOX NUMBER 7 $\Delta H_@$ 1.78

PITOT NUMBER C_p .84

SAMPLE BOX NUMBER(S)

ASSUMED MOISTURE (%) 25%

ASSUMED METER TEMPERATURE 80

C FACTOR .67 REFERENCE Δp 1.8

Leak Check 4.01CFM @ 15"Hg READ AND RECORD ALL DATA EVERY ____ MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
	0957	207.40										
A-1	60		2.0	2.0								6 VENS
	63	208.56	.45	.45		120	72	72	6	238	68	56
	1004											
A-2	63		1.6	1.6								
	95	209.86	.36	.36		120	76	76	5	234	70	118
	1013											
A-3	63		1.4	1.4								
	79	211.01	.39	.39		134	76	76	5	232	70	66
	1020											
A-4	63		.29	.29								
	107	212.19	.37	.37		135	78	78	3	244	76	8
	1030											
A-5	61		.45	.45								
	60	212.85	.26	.26		135	78	76	3	244	74	
	1038											
A-6	60		.28	.22								
	95	213.68	.19	.19		145	78	76	2	240	74	71
	1047											
B-1	65		2.0	2.0								18
	26	214.79	.72	.72		138	78	77	6	240	74	

PLANT DATE RUN NUMBER

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
D-1	63		1.9	1.9								
	73 1643	204.09	.65	.65		120	80	80	7	260	66	
D-2	67		.95	.95								
	58 1650	204.97	.28	.28		123	80	78	4	232	66	68
D-3	60		.31	.31								
	79 1658	205.69	.12	.12		115	80	80	2	232	66	103
D-4	62		.24	.24								
	46 1705	206.00	.10	.10		128	80	80	2	250	66	1
D-5	60		.10	.10								
	91 1713	206.67	.09	.09		125	79	80	2	250	64	113
D-6	60		.10	.10								
	47	207.015	.09	.09		125	78	80	2	220	64	
			LEAK Check 4.001 AT 10" Hg									
	3476	27.80	2756.89	2733.95		127.3	76.6	75.2				
	−68	−.79	.8089	.8022								
	3408 Total sec.	27.01 CF										
	56.8 min											

PLANT DATE RUN NUMBER

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
B-2	32	215.19	1.8			SCRUB	ABANDONED		DID NOT PUSH			81
	15	215.49				"	"					
	1108											
B-2	68		2.2	2.2								
	72	216.98	.64	.64		122	80	80	7	240	70	25
	1117											
B-3	63		1.7	1.7								
	92	218.49	.56	.56		189	81	81	6	248	72	91
	1128											
B-4	66		.82	.82								
	95	219.25	.47	.47		138	82	82	5	250	72	101
	1139											
B-5	67		.64	.64								
	98	220.83	.24	.24		138	84	84	4	248	70	111
	1207											
B-6	68		.20	.20								38
	64	221.42	.19	.19		148	84	81	3	240	72	
	1213											
C-1	63		2.4	2.4								
	84	222.96	.54	.54		124	81	81	7	238	72	121
	1222											
C-2	65		1.6	1.6								48
	65	224.27	.52	.52		116	82	82	6	234	74	
	1228											
C-3	60		.86	.86								131
	123	225.58	.35	.35		131	84	84	4	284	74	
	1236											
C-4	66		.38	.38								58
	68	226.34	.32	.32		125	84	84	3	250	74	
	1244											
C-5	63		.39	.39								73
	76	227.11	.20	.20		152	84	84	3	250	71	
	1253											
C-6	66		.27	.27								68
	71	227.74	.15	.15		148	84	84	2	251	71	

PLANT | DATE | RUN NUMBER

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
	1308											
D-1	61		2.8	2.8								1
	28	228.92	.89	.89		155	86	86	7	242	68	
	1816											
D-2	65		1.1	1.1								83
	90	230.19	.48	.48		149	86	87	5	242	72	
	1227											
D-3	67		.78	.78								
	59	231.11	.42	.42		142	88	87	4	261	74	11
	1328											
D-4	60		.22	.22								103
	78	231.69	.14	.14		145	88	88	2	260	76	
	1338											
D-5	68		.12	.12			89	89				21
	106	232.94	.11	.11		140			2	248	76	
	1345											
D-6	60		.12	.12								113
	84	232.724	.10	.10		160	89	89	2	248	76	
				cfm								
		LEAK Check	≤.005	AT 11" Hg								
	~~58.99 min.~~											
	56.98 min.											
		~~25.374~~				136.6	82.1	81.8				
		24.674	~~.2486~~	~~.6460~~			82.0					
			.7363	.6605								
	57.71	25.374	RepIA									

24.674

PLANT Republic Steel Cleve

DATE 4-9-81

SAMPLING LOCATION Q-CAR #21

SAMPLE TYPE Method 5

RUN NUMBER 3 OPERATOR BA

BAROMETRIC PRESSURE ____ STATIC PRESSURE ____

FILTER NUMBER(S) E 708

GEL NUMBER(S) D 700

THIMBLE NUMBER ____ PLATE NUMBER ____

H_2O PICKUP (ml) 147

BCM

FIELD DATA SHEET

ORSAT:

CO_2 .5

O_2 21

CO ____

PYROMETER NUMBER ____

THERMOCOUPLE NUMBER ____

PROBE NUMBER ____ TYPE ____

NOZZLE NUMBER ____ I.D. .195

METER BOX NUMBER ____ $\Delta H_@$ 1.78

PITOT NUMBER ____ C_p ____

SAMPLE BOX NUMBER(S) ____

ASSUMED MOISTURE (%) 25

ASSUMED METER TEMPERATURE 80

C FACTOR .67 REFERENCE Δp 1.8

READ AND RECORD ALL DATA EVERY ____ MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F				
	926	232.945										
A-1	66		2.2	2.2								
	70	234.28	.38	.38		110	54	54	7	276	52	73
	0934											
A-2	63		2.2	2.2								
	62	235.45	.38	.38		95	56	56	7	276	54	68
	0943											
A-3	61		1.5	1.5								
	38	236.39	.38	.38		110	58	56	6	240	56	~~85~~ 81
	0949											
A-4	62		1.1	1.1								
	22	237.44	.35	.35		115	58	56	5	256	56	83
	0957											
A-5	66		.38	.38								
	39	237.97	.22	.22		120	58	56	2	236	58	11
	1003											
A-6	62	238.616	.32	.32								93
	73		.15	.15		145	58	56	2			
	1013											
B-1	63		2.5	2.5								31
	50	239.97	.80	.80		110	58	58	8	250	58	

PLANT | DATE | RUN NUMBER

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr) CLOCK	GAS METER READING (V_m), ft³	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
	1020											
B-2	63		2.16	2.16	2.16							
	78	241.44	.52	.52	.52	116	58	58	8	254	58	103
	1027											
B-3	60		1.16	1.16	1							
	60	242.56	.42	.42		115	58	59	6	246	58	41
	1033											
B-4	63		.96	.96								
	71	243.63	.31	.31		114	60	59	4	240	56	13
	1040											
B-5	61		.73	.73								57
	60	244.33	.28	.28		119	60	59	4	240	58	
	1046											
B-6	64		.38	.38								123
	88	245.01	.19	.19		124	60	59	3	245	58	
		245.09	LEAK CHECK	LEAK CHECK	PROBE OK	4.001 AT 15" HG	BREAK	FOR LUNCH				
	1150		LEAK	CHECK								
C-1	64		2.8	2.8								75
	78	246.54	.65	.65		121	60	60	8	240	59	
	1159											
C-2	66		1.7	1.7								
	49	247.70	.53	.53		128	60	60	6	248	59	
	1207											13
C-3	68		.69	.69								
	62	248.54	.26	.26		126	60	60	4	255	60	
	1214											
C-4	64		.26	.26								85
	80	249.02	.21	.21		121	60	60	2	248	60	
	1222											
C-5	66		.30	.30								93
	43	249.54	.22	.22		120	60	60	2	240	60	
	1229											
C-6	64		.31	.31								95
	70	250.2	.20	.20		128	60	60	2	240	60	

PLANT DATE RUN NUMBER

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m, ft³)	VELOCITY HEAD (Δp_s, in. H_2O)	ORIFICE PRESSURE DIFFERENTIAL (ΔH, in. H_2O) DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH, in. H_2O) ACTUAL	STACK TEMPERATURE (T_s, °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$, °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$, °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F	
	1436											
D-1	66		2.4	2.4								
	44	251.47	.81	.81		110	60	60	8	250	60	33
	1242											
	69		.69	.69								105
D-2	83	252.28	.20	.20		110	60	60	4	240	59	
	1250											
	64		.48	.48								43
D-3	51	252.76	.18	.18		112	61	61	4	245	59	
	1255											
	63		.43	.43								115
D-4	87	253.54	.21	.21		128	62	61	4	240	58	
	1303											
	66		.22	.22								53
D-5	58	254.09	.19	.19		122	64	62	3	250	59	
	1910											
	66		.19	.19								125
D-6	98	255.69	.15	.15		145	64	62	2	255	60	
			Leak	check	0.001	cfm at	10" Hg					
						119.3	59.5	58.8				
	51.63 min	22.745										
			.7565	.7065			59.2					

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Consulting Engineers, Planners and Architects

Date 4-8-81 Location Name REPUBLIC STEEL

Observer J. P. BISHOP Address CLEVELAND, OHIO

Run #2

Comments

Comments

ervation Point R.R. TRACKS NORTH OF OVENS

k-Distance from 50' Height 20

l-Speed 5-10 Direction NW

pe of Installation COKE OVEN QUENCH CAR 1

bservation Began Ended

her: 50% CLOUD COVER

marks: X NOT VALID READINGS SUN OUT OF POSITION

ent (%) Smoke Density

OVEN #	0	15	30	45		0	15	30	45	
#1 0957										#14 1213
56 0	0	5	5	5	121 30	M	SS	ED		
1	5	0			31					
2					48 32 X	5	5	10	10	#15 1221
#2 1004 118 3	0	5	0	0	33	10	10	10	5	
4	0	0			34					
#3 1015 66 5	0	0	0	0	131 35 X	0	5	5	5	#16 1228
6	0	5	5		36	0	5	0		
#4 1020 123 7 X	0	5	5	5	58 37 X	5	5	0	0	#17 1236
8	10	5	5	0	38	5	5	0	0	
#5 1031 8 8 X	0	10	15	5	73 39	0	0	5	5	#18 1244
10	5	5	0		40	0				
#6 1038 71 11 X	5	5	5	5	68 41	0	0	5	0	#19 1253
12	5	0			42	0	0			
#7 1046 18 13 X	25	20	10	5	83 43 X	0	5	5	5	#20 1300
14	5	0	0		44	5	0			
#8 1055 81 15	5	5	5	0	1 45 X	25	20	10	5	#21 1308
16	0	5	10	10	46	5	0			
17	15	10	10	5	47					#22 1314
18	10	10	10		93 48 X	0	0	5	0	
#9 1108 98 19 X	0	5	5	10	49	0	0	0		
20	10	5	0		11 50 X	0	0	0	0	#23 1322
#10 1117 91 21 X	0	5	5	5	51	5	5	25	10	
22	0				52	5				
#11 1128 181 23	0	5	5	0	173 53 X	0	0	0	0	#24 1329
24	5	5			54	5	0			
#12 1138 111 25	0	0	0	0	21 55 X	0	5	5	25	#25 1338
26	5	5	5	0	56	10	5	5	0	
#13 1207 33 27 X	0	5	5	15	13 57	0	0	5	0	#26 1345
28	5	0			58	0				
29					69					

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Consulting Engineers, Planners and Architects

Date 4-8-81

Location Name REPUBLIC STEEL

Observer J. P. BISHOP

Address CLEVELAND, OHIO

Run #2

Comments

Comments

servation Point R.R. TRACKS NORTH OF OVENS

ck-Distance from 50' Height 20

d-Speed 5-10 Direction NW

ype of Installation COKE OVEN QUENCH CAR

1

bservation Began ____ Ended ____

her: 50% CLOUD COVER

emarks: X NOT VALID READINGS SUN OUT OF POSITION

ent (%) Smoke Density

OVEN #	0	15	30	45		0	15	30	45	
#1 0957	56 0	0	5	5	5	121 30	M	SSED		#14 1113
	1	5	0			31				
	2					48 32 X	5	5	10	10 #15 1221
#2 1004	118 3	0	5	0	0	33	10	10	10	5
	4	0	0			34				
#3 1015	66 5	0	0	0	0	131 35 X	0	5	5	5 #16 1228
	6	0	5	5		36	0	5	0	
#4 1020	128 7 X	0	5	5	5	58 37 X	5	5	0	0 #17 1236
	8	10	5	5	0	38	5	5	0	0
#5 1031	8 9 X	0	10	15	5	133 39	0	0	5	5 #18 1244
	10	5	5	0		40	0			
#6 1038	71 11 X	5	5	5	5	68 41	0	0	5	0 #19 1253
	12	5	0			42	0	0		
#7 1046	18 13 X	25	20	10	5	83 43 X	0	5	5	5 #20 1300
	14	5	0	0		44	5	0		
#8 1055	81 15	5	5	5	0	145 X	25	20	10	5 #21 1308
	16	0	5	10	10	46	5	0		
	17	15	10	10	5	47				#22 1314
	18	10	10	10		93 48 X	0	0	5	0
#9 1108	28 19 X	0	5	5	10	49	0	0	0	
	20	10	5	0		111 50 X	0	0	0	0 #23 1322
#10 1117	91 21 X	0	5	5	5	51	5	5	25	10
	22	0				52	5			#24 1329
#11 1128	181 23	0	5	5	0	173 53 X	0	0	0	0
	24	5	5			54	5	0		
#12 1138	111 25	0	0	0	0	21 55 X	0	5	5	25 #25 1338
	26	5	5	5	0	56	10	5	5	0
#13 1207	38 27 X	0	5	5	15	113 57	0	0	5	0 #26 1345
	28	5	0			58	0			
	29					59				

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Date [illegible] Location Name REPUBLIC STEEL

Observer J. E. BISHOP Address CLEVELAND, OHIO

RUN #3

rvation Point RR TRACKS

tack-Distance from ____ Height ____

d-Speed ____ Direction ____

e of Installation COKE OVEN

Q-CAR

1

ervation Began ____ Ended ____

her:

rks: I - STEAM INTERFERENCE

X - SUN OUT OF POSITION

cent (%) Smoke Density

Comments

		0	15	30	45		0	15	30	45	
0919	58 0	0	0	0	0	30	0	5	5	15	#14 1159
	1	0				31	10	10	5	0	
#1	73 2	0	0	I	I	32	0	0	0	0	#15 1207
0926	3	I				33	5	5			
#2	69 4	0	0	0	0	34 X	0	0	0	I	#16 1214
0933	5	0	0			35	5	0			
#3	6			0	5	36	0	0	0	0	#17 1222
0942	7	0	0	15	5	37	0				
	8	0				38 X	I	I	I	I	#18 1228
#4	83 8	I	I	I	I	39	I	0			
0948	10	I				40 X	0	0	0	0	#19 1236
#5	11	0	0	0	0	41	0	0			
0956	12	0	0			42 X	0	0	0	0	#20 1242
#6	93 13	I	I	I	I	43	0	0			
1003	14	I	I			44			X 0	0	#21 1249
#7	31 15	0	0	0	0	45	0	0	0	0	
1013	16	0	0			46 X	I	I	I	I	#22 1255
#8	103 17		I	I	I	47	0	I	0		
1019	18	I	I	I		48 X	0	0	0	0	#23 1303
#9	19					49	0				
1027	20	0	0	0	0	50 X	0	0	0	0	#24 1309
	21	0	0			51	0	0	0		
#10	113 22	0	0	0	0	52					
1033	23	0				53					
#11	24	0	0	0	0	54					
1040	25	0	0	0		55					
#12	123 26	0	0	0	0	56					
1046	27	0	0			57					
#13	75 28	0	0	5	0	58					
1150	29	0	0			59					

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Consulting Engineers, Planners and Architects

Date 04-07-81 Location Name REPUBLIC STEEL CORP

Observer J. P. BISHOP Address CLEVELAND, OHIO

Run #7

Comments

PUSH TRAVEL

	0	15	30	45		0	15	30	45	Comments
0	X	X	X	X⁰	30	X⁵	X⁵	X⁵	X⁰	#16 1649
1					31					
2	X	X	X	X⁰	32	X⁵	X⁵	X⁵	X⁵	#17 1619
3					33					
4	X	X	X	X⁰	34	5	5	0	0	#18 1627
5					35					
6	X	X	X	X⁰	36	X⁵	X¹⁰	X⁵	X⁰	#19 1636
7					37					
8	X	X¹⁰	X⁵	X⁵	38	X	X	X⁰	X⁰	#20 1644
9					39					
10	X	X¹⁰	X¹⁰	X⁵	40	X⁰	X⁰	X⁵	X⁰	#21 1650
11					41					
12	X	X¹⁰	X⁵	X⁰	42	5	0	0	0	#22 1658
13					43					
14	X⁵	X¹⁰	X⁵	X⁰	44	X	X⁵	X⁰	X⁰	#23 1705
15					45					
16	X⁵	X⁵	X⁵	X⁰	46	0	5	5	5	#24 1713
17					47					
18	X⁵	X⁵	X⁰	X⁰	48					
19					49					
20	X¹⁰	X¹⁰	X⁰	X⁰	50					
21					51					
22	X¹⁰	X¹⁰	X⁵	X⁰	52					
23					53					
24	X⁵	X⁵	X⁰	X⁰	54					
25					55					
26	X⁵	X¹⁵	X⁵	X⁰	56					
27					57					
28	X⁵	X⁵	X⁰	X⁰	58					
29					59					

#1 1321 #2 1328 #3 1336 #4 1345 #5 1353 #6 1405 #7 1412 #8 1424 #9 1434 #10 1451 #11 1528 #12 1531 #13 1545 #14 1653 #15 1601

Observation Point RR TRACKS NORTH OF COKE OVEN

Back-Distance from 40' Height 20'

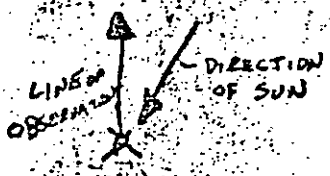
Wind-Speed 5-15 Direction NW

Type of Installation COKE OVEN QUENCH CAR

Observation Began Ended

Weather: CLEAR SKY

Remarks: X - INTERFERENCE SUN OUT OF POSITION MAX ESTIMATED READING IN UPPER CORNER



Percent (%) Smoke Density

Three Rivers Group

APPENDIX 3

LABORATORY ANALYSIS AND DATA REDUCTION

APPENDIX 3

LABORATORY ANALYSIS AND DATA REDUCTION

1.0 ANALYTICAL METHODS

All samples generated during the test program were analyzed at the BCM Laboratory in Norristown, Pennsylvania. The following discussions describe the analytical methods employed.

1.1 Particulate Samples

All glass fiber filters used in the sampling program had been tare-weighed following a 24-hour desiccation period prior to their use in the field. Upon their return to the laboratory, they were desiccated and reweighed. The weight difference was the amount of sample collected.

Nozzle, probe, and filter holder acetone washings were evaporated to dryness in separate tared beakers. The residue was desiccated and the beakers were reweighed to a constant weight. The weight difference was the amount of particulate matter collected at these locations in the sampling train.

Acetone blanks were evaporated to dryness in tared beakers, and were desiccated and reweighed. Any residue which remained was a contaminant in the reagent and was considered a blank weight used as a correction factor in subsequent calculations. The laboratory results of the particulate sampling program are listed in Table 3-1.

1.2 Moisture Content

Silica gel had been tare-weighed prior to its use in the field. Upon its return to the laboratory, the silica gel was reweighed. The entire weight gain was due to water vapor. The total volume of the impinger solutions, minus the original volume of water in the impingers, plus the volume of moisture and/or vapors collected by the silica gel, equaled the total moisture gain of the sampling train. This volume was used as the basis for percent moisture by volume calculations.

2.0 COMPUTER INPUT SHEET

The reduced data calculated from the field data sheets were combined with the laboratory results on the computer input data sheet to facilitate programming. The computer input data sheet follows Table 3-1.

3.0 EQUATIONS FOR THE CALCULATIONS OF TEST RESULTS

The equations following the data input sheets were programmed into the computer to facilitate the calculation of the test program results. The equations were prescribed in Methods 2, 3 and 5 of the Federal Register, Volume 42, Number 160, August 8, 1977, appropriately amended, and used to calculate the results of particulate testing and flow, temperature, and static pressure testing.

4.0 PARTICULATE TEST RESULTS

The complete results of the computer analyses of the data generated from the particulate test program are presented on the computer printout at the end of this appendix.

TABLE 3-1

LABORATORY RESULTS*

Run Number	Particulate Results		Total Catch (mg)
	Filter (mg)	P&C** (mg)	
1	8.8	14.8	23.6
2	10.5	18.3	28.8
3	10.9	14.0	24.9

* Blank corrected

** P&C = Probe and cyclone; includes acetone wash of nozzle, probe, cyclone, and front-half of filter holder

Rep 1A

10	Number of Tests	3															
20	Test Identification	"1"	"2"	"3"						2A							
30	Stack Area, IN^2	4608	4608	4608													
40	Stack Temperature, °F	127.3	136.6	179.3													
50	Sample Volume, Dry, CF	27.01	24.67	22.74						25.31							
60	Avg. Meter Temperature, °F	75.9	82.0	59.2													
70	Avg. Orifice (Δ H) IN H_2O	1.78	1.78	1.78	802	.660	.706										
80	Nozzle, Dia. IN	.195	.195	.195	/												
90	Duration of Test, Min.	56.80	56.98	51.63						57.21							
100	CO_2	.5	1.5	.5													
110	CO	00.0	0.0	0.0													
120	O_2	20.0	20.0	21.0													
130	N_2	79.5	78.5	78.5													
140	Stack Pressure, IN Hg	30.30	30.35	30.35													
150	Barometric Pressure, IN. Hg	30.24	30.29	30.25													
160	Pitot. Correction Factor	.84	.84	.84													
170	Pitot Traverse (Avg.$\sqrt{\Delta P}$) IN H_2O	.809	.736	.756													
180	Volume, H_2O Collected, ml	186.1	184.6	167.1													
190	Ml, SO_3	0	0	0													
200	Ml, SO_2	0	0	0													
210	Total Collected Weight, mg	23.6	28.8	24.9													
220	Normality of SO_3	0	0	0													
230	Normality of SO_2	0	0	0													
240	Meter Calibration Factor	.97	.97	.97													

CLIENT: Republic Steel
LOCATION: Cleveland, Ohio
JOB NO.: 00-4178-12

NAME OF FILE: REP1

J489

AIRPOL 1 INPUT DATA SHEET

BCM

COMPUTATION SHEET

Sheet Number _____ of _____
Date _____
J. O. Number 00 – 4178 – 12
Computed by BA
Checked by _____

Name of Client Republic Steel
Project _____
Description Quench Car

$$11.7 \frac{\text{TONS}}{\text{OVEN}} \times \frac{24 \text{ OVENS}}{\text{TEST}} = 280.8 \text{ TONS COKE/TEST}$$

$$\frac{280.8 \text{ TONS COKE}}{\text{TEST}} \times \frac{\text{TEST}}{\text{MIN}} \times \frac{60 \text{ min}}{\text{HR}} = \frac{\text{TONS COKE}}{\text{HR}}$$

$$\text{Lbs. PARTICULATE/hr} \times \frac{\text{HR}}{\text{TONS COKE}} = \frac{\text{Lbs PARTICULATE}}{\text{TON COKE}}$$

EXAMPLE: RUN 1

$$\frac{280.8 \text{ Tons Coke}}{\text{TEST}} \times \frac{\text{TEST}}{56.80 \text{ min}} \times \frac{60 \text{ min}}{\text{hR}} = 296.6 \frac{\text{Tons Coke}}{\text{hR}}$$

$$7.8 \text{ Lbs PARTICULATE/hR} \times \frac{\text{Hr}}{296.6 \text{ TONS COKE}} = .026 \frac{\text{Lbs PARTICULATE}}{\text{TON COKE}}$$

RUN	TONS/OVEN	OVENS/TEST	TONS COKE/TEST	TEST TIME MIN.	TONS COKE/HR	LBS PART/hr	LBS PART / TON COKE
1	11.7	24	280.8	56.80	296.6	7.8	.026
2	11.7	24	280.8	56.98	295.7	9.3	.031
3	11.7	24	280.8	51.63	326.3	9.0	.028

PARAMETERS		1	2	3
AREA OF BREECHING	(SQ IN)	4608.00	4608.00	4608.00
SAMPLE VOLUME(DRY)	(STD CU FT)	26.10	23.60	22.71
MOISTURE	(%)	25.1437	26.9252	24.5760
MOLECULAR WEIGHT	STACK GASES	26.14	26.07	26.24
GAS TEMPERATURE	(F)	127	137	119
GAS VELOCITY	(FPM)	3001	2754	2778
GAS VOLUME	(SCFM)(DRY)	65456	57810	61998
GAS VOLUME	(ACFM)	96043	88122	86908
PARTICULATE CONC :				
GRAINS/STD CU.	FOOT (DRY BASIS)	.0139	.0188	.0169
GRAINS/STD CU.	FOOT (WET BASIS)	.0104	.0137	.0127
GRAINS/STD CU.	FOOT 12% CO2	.3343	.1504	.4053
GRAINS/CU.	FOOT (STK COND)	.0095	.0123	.0118
POUNDS/HOUR		7.8126	9.3118	8.9718
ORSAT ANALYSIS :				
CARBON DIOXIDE	(VOL %)	.50	1.50	.50
CARBON MONOXIDE	(VOL %)	.00	.00	.00
OXYGEN	(VOL %)	20.00	20.00	21.00
NITROGEN	(VOL %)	79.50	78.50	78.50
EXCESS AIR	(%)	2024.29	2762.43	-7608.67
ISOKINETIC	(%)	108.36	110.60	109.53

APPENDIX 4

EQUIPMENT CALIBRATION

PITOT CALIBRATION

Pitot No. 4-1 STRAIGHT Date 11-17-80 Engineer JFA

Range	Run No.	ΔP_{std}	A SIDE ΔP	A SIDE C_p	A SIDE DEV.	B SIDE ΔP	B SIDE C_p	B SIDE DEV.	DIF.
1	1	.031	.045	.822	0	.044	.831	+.003	
	2	.031	.045	.822	0	.044	.831	+.003	
	3	.031	.045	.822	0	.045	.822	-.006	
	AVG.			.822			.828		.006
2	1	.19	.27	.830	0	.27	.830	0	
	2	.19	.27	.830	0	.27	.830	0	
	3	.19	.27	.830	0	.27	.830	0	
	AVG.			.830			.830		0
3	1	.45	.65	.824	+.002	.62	.843	-.002	
	2	.45	.65	.824	+.002	.62	.843	-.002	
	3	.45	.66	.817	-.005	.61	.850	+.005	
	AVG.			822			.845		.023
4	1	.62	.91	.817	+.003	.90	822	0	
	2	.62	.92	.813	-.001	.90	.822	0	
	3	.62	.92	.813	-.001	.90	.822	0	
	AVG.			.814			.820		.006
5	1	.85	1.35	.786	+.008	1.35	.786	+.004	
	2	.86	1.4	.776	-.002	1.35	.790	+.008	
	3	.85	1.4	.771	-.007	1.4	.771	-.011	
	AVG.			.778			.782		.004
6	1	1.25	1.75	.837	-.005	1.70	.849	-.006	
	2	1.3	1.75	.853	+.011	1.70	.866	+.011	
	3	1.25	1.75	.837	-.005	1.70	.849	-.006	
	AVG.			.842			.855		.013
7	1	1.45	1.95	.854	0	1.90	.865	0	
	2	1.45	1.95	.854	0	1.90	.865	0	
	3	1.45	1.95	.854	0	1.90	.865	0	
	AVG.			.854			.865		.011

$$C_p = 0.99\sqrt{\frac{\Delta P_{std}}{\Delta P_s}}$$

DEV. $= C_p - \overline{C_p}$

DEV. ≤ 0.01

DIF. $= \overline{C_{p(A)}} - \overline{C_{p(B)}}$

DIF. ≤ 0.01

BCM

METER BOX CALIBRATION SHEET

Date 2-5-81 Box No. 7 Inspector DM

Pump OK Oil OK Wick OK Pump Serial No. 0524

Manometers OK Knobs OK Oil OK Tubing OK

Quick Connects OK Vacuum Gage OK Valves OK

Dry Gas Meter OK Volume 20.8 ft^3 Serial No. 673629

Thermometers OK In 51 °F Out 51 °F Ambient 59 °F

Amphenol OK Lights OK Switches OK Variac OK

Leak Check - Max. Vacuum 25 in. Hg Leak Rate 000 CFM

Remarks

Man. Orifice	CF_w	CF_d	T_w	IT_d	OT_d	T_d	Time θ
0.5	5.000	5.150	58.5	58.0	54.0	56.0	12.800
1.0	5.000	5.212	58.5	65.0	59.5	62.3	9.029
2.0	10.253	10.713	58.5	73.7	64.7	69.2	13.408

Tolerances: $1.6 \leq \Delta H_@ \leq 2.1$

$\Delta H_@ =$	$\frac{(0.0317)(\Delta H)}{(P_b)(OT_d+460)}\left[\frac{(T_w+460)(\theta)}{(CF_w)}\right]^2$	$\gamma =$	$\frac{(CF_w)(P_b)(T_d+460)}{(CF_d)(P_b+\Delta H/13.6)(T_w+460)}$
1.806	$\frac{(0.0317)(0.5)}{(30.08)(54.0+460)}\left[\frac{(58.5+460)(12.806)}{(5)}\right]^2$	.965	$\frac{(5)(30.08)(57.0+460)}{(5.150)(30.08+0.0368)(58.5+460)}$
1.778	$\frac{(0.0317)(1.0)}{(30.08)(59.5+460)}\left[\frac{(58.5+460)(9.029)}{(5)}\right]^2$	.964	$\frac{(5)(30.08)(62.3+460)}{(5.212)(30.08+0.0737)(58.5+460)}$
1.847	$\frac{(0.0317)(2.0)}{(30.08)(64.7+460)}\left[\frac{(58.5+460)(13.408)}{(10.253)}\right]^2$	.972	$\frac{(10.253)(30.08)(69.2+460)}{(10.713)(30.08+0.147)(58.5+460)}$