ENVIRONMENTAL PROTECTION AGENC

OFFICE OF ENFORCEMENT

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INSPIRATION

NATIONAL ENFORCEMENT INVESTIGATION

DENVER, COLORADO

STATE IMPLEMENTATION PLAN
INSPECTION OF
INSPIRATION CONSOLIDATED COPPER COMPANY
INSPIRATION SMELTER
INSPIRATION, ARIZONA

SEPTEMBER 1976

ENVIRONMENTAL PROTECTION AGENCY

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
Denver

OFFICE OF AIR QUALITY PLANNING AND STANDARDS
Durham

REGION IX
San Francisco

INSPIRATION CONSOLIDATED COPPER COMPANY
Inspiration, Arizona

SUMMARY AND CONCLUSIONS

Inspiration Consolidated Copper Company operates an open pit mine, concentrator, oxide ore leach plant, smelter, and tank house for the production of cathode copper near Inspiration, Arizona. An inspection to acquire data with which to evaluate the design and operation of existing particulate matter air pollution control equipment at the smelter and to survey the suitability of the smelter to be emission tested was conducted by state and EPA personnel on January 26-27, 1976. Substantial amounts of process, control equipment, and stack sampling were requested of and received from the Company.

The following conclusions are based on the inspection and a review of the information obtained:

1. The Inspiration Smelter is the newest Arizona smelter and the only one which has an electric furnace instead of reverberatory furnaces. It is also one of the two smelters which reports, on the basis of stack testing results, that it is in compliance with the process weight regulation. However, as will be discussed below, those stack test results should be considered invalid.

2. This smelter uses cyclones as a pretreatment device preceding the electrostatic precipitators (ESP's). This arrangement reduces by 80% the particulate matter concentrations to be controlled by the ESP's. No test data are available with which to draw conclusions as to the appropriateness of such a control system.

3. The measured gas volumes produced by the individual process units are less than the design gas volume capacities of the control systems. This allows the control systems to operate at their design efficiencies.

4. The source tests conducted at the Inspiration Smelter did not determine whether the smelter was in compliance with the process weight regulation because both tests were performed at an unsuitable location. Upstream and downstream flow disturbances are in close proximity to the sampling station so that Method 1 criteria cannot be met. In addition, only one diameter could be traversed and only 12 points, instead of 48, were sampled. Isokinetic rates were not within tolerances.

5. The control system design of the entire smelter suggests the smelter is capable of complying with the process weight regulation. Continued performance of an acid plant requires a nearly particulate free inlet gas stream. Thus, the cyclones, ESP's, and cold gas cleaning system of scrubbers and mist ESP's must perform adequately and continuously. If the inlet particulate matter concentration to the acid plant is high, the catalyst beds in the acid plant conversion towers will soon clog, the plant will be shut down, and the bypass stack will have to be used.

INSPECTION OF
INSPIRATION CONSOLIDATED COPPER COMPANY
INSPIRATION SMELTER

Inspiration, Arizona
January 26-27, 1976
612/473-2411

INTRODUCTION

The Inspiration Consolidated Copper Company operates an open pit mine, concentrator, oxide ore leach plant, smelter, and tank house for the production of cathode copper near Inspiration, Arizona. Based on September 1975 data, the daily production was 350 m. tons (385 tons) of blister copper with an approximate assay of 98% copper.

On December 17, 1975, the Vice President and General Manager of the Inspiration Consolidated Copper Company was requested by letter to provide process and air pollution control information on the Inspiration Smelter, and informed of a planned plant inspection [Appendix A]. On January 26 and 27, 1976, the following EPA and State personnel conducted a process inspection: Mr. Meade Stirland, Arizona Department of Health; Mr. Larry Bowerman, EPA, Region IX; Mr. Gary D. Young, EPA, NEIC; Mr. Jim V. Rouse, EPA, NEIC. The data requested were furnished at the completion of the inspection [Appendix B].

The purpose of the inspection was to acquire data with which to evaluate the design and operation of existing particulate matter air pollution control equipment and to survey the suitability of the smelter to be emission tested. The inspection focused primarily on the smelter, although the oxide ore leach plant and tank house were also inspected. The process equipment, the particulate matter emission sources, and the air pollution control equipment were also examined. The inspection team surveyed the existing smelter source testing locations for accessibility and capability to perform source testing.

Company personnel were cooperative throughout the inspection. Company personnel participating included: Mr. D. W. Middleton, Vice President and General Manager; Mr. W. Pattullo, Director of Environmental Control; Mr. J. B. Holman, General Superintendent.

The applicable regulation contained in the Arizona State Implementation Plan (SIP) of specific interest for this inspection was the process weight regulation [Appendix C]. This regulation was promulgated as 40 CFR §52.126 on May 14, 1973, to replace the State's process weight regulation which was determined by EPA to be not sufficiently stringent. The regulation allows certain emission rates for each process unit based on the production feed rate.

PROCESS DESCRIPTION

Figure 1 is a simplified process flow diagram for the Inspiration Smelter. Table 1 is a list of the smelter process equipment and operating data.

Concentrates and precipitates are bedded in an enclosed building near the smelter building. Limestone flux is added to the bedded material. The mixture is reclaimed by front-end loaders which deliver it to a charge belt to the dryer. In the dryer the moisture content of 9 to 12% is reduced to less than 0.3%; a moisture-free condition in the furnace feed is necessary to prevent explosions. The dried material is discharged to a pair of 635 m. tons (700 tons) capacity furnace feed bins located above the slag tapping endwall of the furnace.

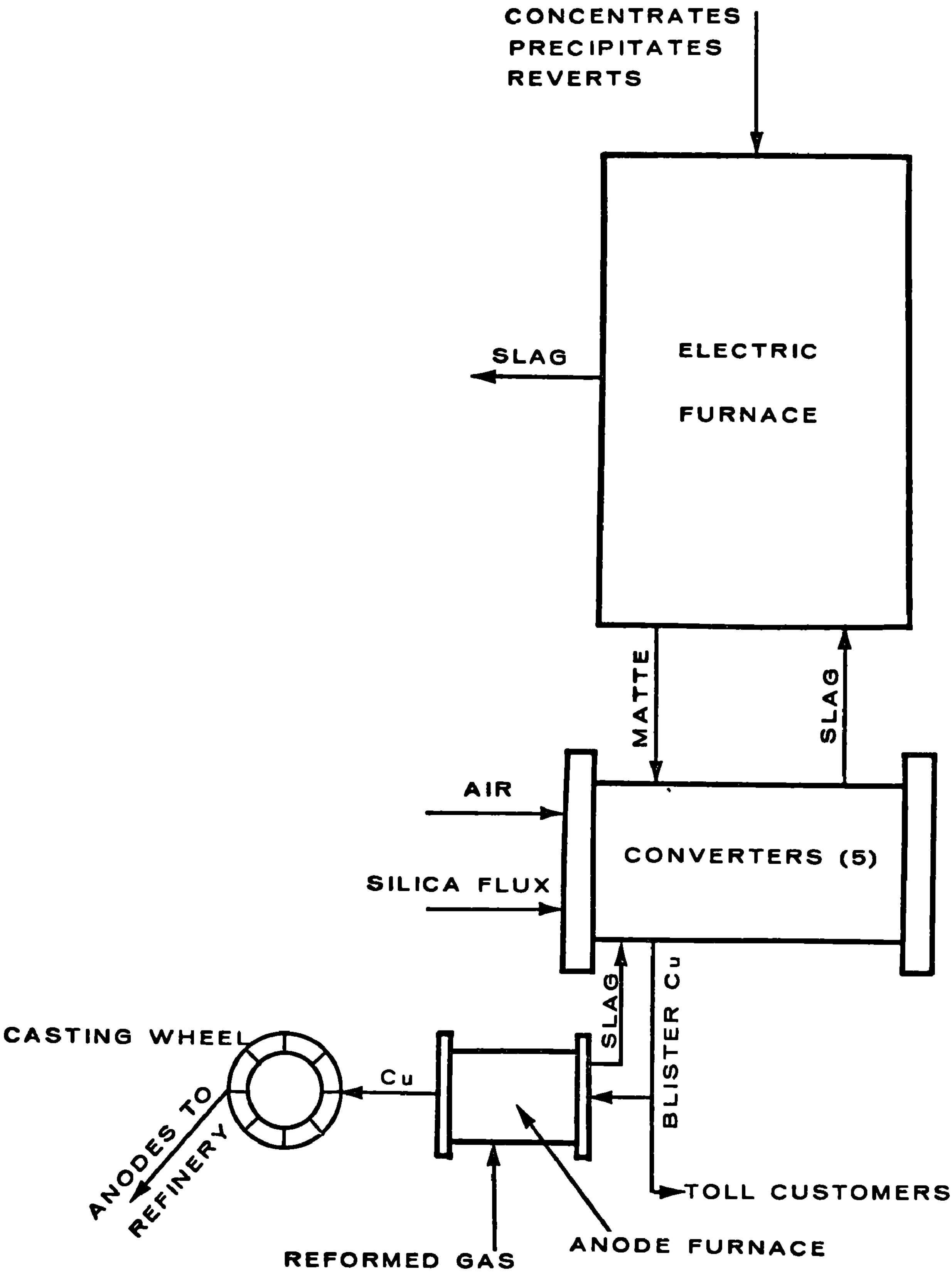

Figure 1. Inspiration, Inspiration Process Flow Diagram

Table 1

SMELTER PROCESS EQUIPMENT AND OPERATING DATA
INSPIRATION CONSOLIDATED COPPER COMPANY
Inspiration, Arizona

Parameter	Electric Furnace			Converters		
No. of Units		1			5	
Feed Constituents†		C/C, R, F, CS			M, F, CD	
Feed Rate		(m. tons/day)	(tons/day)		(m. tons/day)	(tons/day)
	C/C	1212	1335	M	803	885
	R	77	85	F	482††	531††
	F	109	120	CD	321	354
	CS	529	583			
	Total	1927	2123	Total	1606	1707
Size of Unit		(meters)	(feet)		(meters)	(feet)
	Width	10	34	Diam.	4†††	14†††
	Length	36	117	Length	12†††	38†††
Hrs. Operation/mo		720-744				720-744
Gas Volume Generated		(std m^3/min)	(scfm)††††		(std m^3/min)	(scfm)††††
		433-722	15,300-25,500		578-663	20,400-23,400
Exit Gas Temperature		°C	°F		°C	°F
		650-760	1,200-1,400		1,200	2,200

† *Concentrates/cements (C/C), Reverts (R), Flux (F), Converter Slag (CS), Cold Dope (CD)*
†† *Assume 0.6 ton flux/ton of matte*
††† *Siphon converters are considered to be the equivalent of 4 x 10 m (14 x 32 ft), Pierce-Smith converters*
†††† *Standard conditions are 760 mm Hg (29.92 in Hg or 14.7 psia) and 21°C (70°F)*

The Elkem electric furnace is the largest copper matting furnace in the world. The furnace's inside dimensions are 10 x 36 m (34 x 117 ft) in width and length, respectively. The furnace is equipped with six self-baking carbon electrodes, 180 cm (71 in) in diameter, that enter the furnace along the center line of the sprung arch roof. The electrodes can be raised or lowered, but when in operation dip into the molten slag above the matte layer. Heat for smelting is generated by resistance of the slag to the submerged arc between electrode pairs.

Dried feed is reclaimed from each feed bin by a variable speed screw feeder which augers the charges to a drag conveyor extending nearly the length of the electric furnace. Each bin features this arrangement, one serving the east and the other the west side of the electrode lines. Each totally enclosed drag conveyor delivers the charge to a series of fifteen feed spouts on the furnace roof. Seven spouts are near the line of electrodes; the other eight are near the furnace sidewall. The charge in the spout enters the furnace first through an arc gate and then through a weighted tilt gate, sequenced so that a seal is maintained on the furnace. Most of the charge is introduced nearest the electrodes; the remaining 10 to 20% enters through the spouts near the furnace sidewalls.

The inverted, double arch bottom of the furnace and the end- and sidewalls, to a point above the bath line, are of basic brick construction. Above the bath the upper side- and endwalls and the sprung arch roof contain fire brick. The furnace is supported on concrete piers. Vertical steel columns and tie rods clamp the sidewalls and provide additional structural support.

The endwalls of the furnace are water cooled. The sidewalls and bottom are air cooled from a set of three blowers rated at 3,340 std m^3/min (118,000 scfm) each, on each side of the furnace at ground level. Two blowers on each side normally operate at one time, with the air produced sweeping under the furnace, up the sidewalls and exhausting through the roof, changing the atmosphere once each minute.

The unit operates with 76 cm (30 in) of matte and a 152 cm (60 in) slag layer. Slag is skimmed from either of two tap holes in the endwall of the furnace into a launder. The launder delivers slag to 17 m^3 (600 ft^3) pots mounted on trucks which haul the slag to a dump. The matte endwall faces the converter aisle and contains four holes for drawing off matte into two pairs of launders. Two 8.5 m^3 (300 ft^3) ladles are positioned on either side of a swivel spoon at the end of the matte launder. As matte flows into the swivel spoon a ladle fills. Once it is filled, the swivel spoon tilts to a reverse slope and matte flows into the adjacent ladle.

Matte ladles are picked up by an overhead crane and matte is charged to one of the five Hoboken-Overpelts converters. These siphon converters are 4 x 12 m (14 x 38 ft) in diameter and length, respectively. Air is blown into the charge through tuyeres, flux is added, and slag produced is skimmed into a ladle. The converter slag is then returned to the electric furnace by overhead crane. Additional matte is added to the converter to produce finished blister copper. Of the five converters, four will be in service while one is down for repairs. The converters are cycled so that one hot converter is on standby and the other three are in operation and blowing a large percentage of the time. The three converters on blow are staggered so that one is on its "copper blow" while the other two are at differing stages of the "slag blow."

Finished blister copper is poured into ladles and carried by overhead crane to the one anode furnace or returned to toll customers. The anode grade molten copper is cast into molds on the casting wheels. The anodes are cooled, inspected, and transferred to the Inspiration tank house for production of cathode copper.

EMISSION SOURCES AND RELATED CONTROL EQUIPMENT

The primary particulate matter sources at the Inspiration Smelter are the electric furnace and the converters. The majority of the exhaust gas volumes produced by these sources is treated by control systems which are discussed below. Fugitive emissions from such sources as skimming and returning converter slag are neither collected nor treated, but are exhausted directly to the atmosphere through the smelter building roof vents. The anode furnace emits some untreated particulate matter directly to the atmosphere above the converter aisle; however, since this gas stream is not collected, the concentrations are indeterminate.

Figure 2 is a diagram of the Inspiration Smelter plant layout, the air pollution control system, and the exhaust gas flow. Table 2 summarizes certain design and operating data for the individual air pollution control systems. Appendix B contains more specific information on each control system.

Electric Furnace Control System

The principal electric furnace exhaust gases pass through a vertical radiation-type gas cooler. Heat recovered from the 590°C (1,100°F) exit gases is used for steam production. The gases then enter a convection type gas cooler, flowing outside a bundle of tubes through which cooling air is circulated by a fan. The furnace gas temperature has thus been reduced to 510°C (950°F). The first stage of hot cleaning of the electric furnace gases takes place in two parallel cyclones. The cyclones are designed to handle a maximum gas volume of 870 std m^3/min (30,000 scfm), but usually handle between 430 and 720 std m^3/min (15,300 and 25,500 scfm) [Appendix D]. Second stage hot cleaning of the furnace gases is performed by an electrostatic precipitator (ESP) with an operating temperature range between 315 and 400°C (600 and 750°F). With some air infiltration into the system, an estimated design volume of 1100 std m^3/min (38,700 scfm) of gas is delivered to the acid plant.

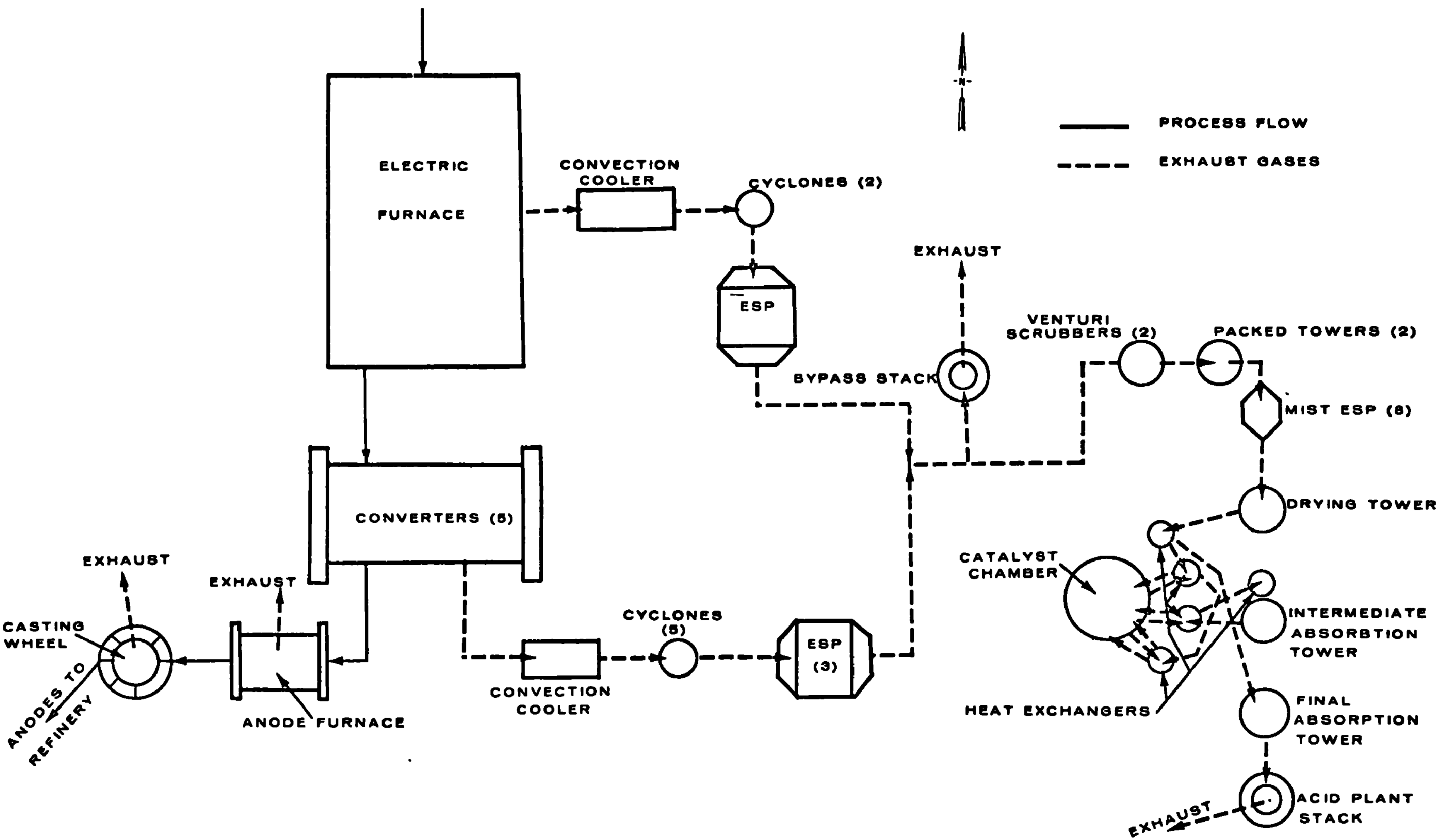

Figure 2. Inspiration, Inspiration Plant Layout, Process Exhaust Flow, and Air Pollution Control Systems

Table 2

SMELTER AIR POLLUTION CONTROL EQUIPMENT AND DATA
INSPIRATION CONSOLIDATED COPPER COMPANY
Inspiration, Arizona

Control Device	Manufacturer	Date of Installation/ Modification	No. of Units	Gas Flow Rate m^3/min	Gas Flow Rate scfm[a]	Operating Temp. °C	Operating Temp. °F	Pressure Drop H_2O cm	Pressure Drop H_2O in	Collection Area m^2	Collection Area ft^2	Velocity m/sec	Velocity ft/sec	Retention Time sec
Electric Furnace														
Cyclones	Ducon	NR[b]	2	866	30,600	455	850	NR		NA[c]		NR		NR
ESP	Research Cottrell[d]	1973	1	433-722	15,300-25,500	400	750	NR		NR		NR		NR
Scrubbers and Acid Plant	(see description under Converters)													
Converters														
Cyclones	Ducon	NR	5	663	23,400	480	900	NR		NA		NR		NR
ESP	Research Cottrell	1973	3	866	30,600	400	750	NR		NR		NR		NR
Scrubbers[e]	Cyprus Skele	1973	2	3030	107,000	290	550	5	2	NA		NR		NR
Acid Plant	Lurgi	1973[g]	1	3030	107,000[f]	105		NR		NA		NA		NA

[a] *Standard conditions are 760 mm Hg (29.92 in Hg or 14.7 psig) and 21°C (70°F)*
[b] *NR = Not reported*
[c] *NA = Not applicable*
[d] *Reference 2 reports this unit is a Western Precipitation ESP*
[e] *Venturi-type*
[f] *Design flow rate is 2770 std m^3/min (97,800 scfm) [Appendix D]*
[g] *Double absorption*

Converter Control System

The converter exhaust gases become laden with particulate matter when air is blown into a converter through tuyeres to oxidize the iron and copper sulfides. An estimated 660 std m^3/min (23,400 scfm) of gas is produced by one converter and is exhausted through a vertical waterwall radiation and convection cooler to cool the gases from 1,200 °C (2200 °F) to approximately 480 °C (900 °F). The exhaust gas then enters a cyclone (one per converter) and subsequently is delivered to a mixing plenum chamber which serves three ESP's in parallel. The cyclones are designed to remove 80% of the dust carried in the gas stream. The ESP's are each designed to handle 980 std m^3/min (34,700 scfm) of gas at a maximum temperature of 400 °C (750 °F). The gases cleaned in the ESP's are ducted to the acid plant.

The cleaned and cooled electric furnace and converter gases are combined and ducted to the cold gas cleaning system preceding the acid plant. Here the gas is split between a pair of venturi scrubbers, flowing concurrently with 20% sulphuric acid solution down through the units and then into the lower end of either of two packed washing and cooling towers. Cooled gases from the packed towers are combined and then split again before entering either of two pairs of mist ESP's. Upon exiting the first two pairs, the gas is again recombined and then split to pass through a second set of mist ESP pairs.

A gas volume of approximately 3720 std m^3/min (131,500 scfm) containing 7% SO_2 then enters the double absorption acid plant where it is dried, the SO_2 converted to SO_3, and the SO_3 absorbed in acid to form the final strength acid. Although designed to produce 1210 m. tons (1330 tons/day), approximately 910 m. tons (1000 tons)/day of 92 to 95% strength sulphuric acid is actually produced. The exit gas from the final absorption tower is exhausted from the 60 m (200 ft) acid plant tail gas stack.

EMISSIONS DATA

Three separate source tests were conducted at the Inspiration smelter during 1975 by Engineers Testing Laboratories (ETL), Phoenix. Only the two tests on the acid plant stack are of particular interest for this report. Both tests were believed to be compliance tests following the prescribed methods (Methods 1-5) in the EPA regulation [Appendix C].

The sampling location for both tests was the single horizontal port located on the breeching to the acid plant tail gas stack. At this location the duct is 2 m (6.4 ft) in diameter. Upstream of the port less than one-half duct diameter, the gas stream enters the stack. Less than one-half duct diameter downstream from the port is a flange in the duct. Only twelve sampling points were used on one diameter during both tests.

Individual hourly process weights were not determined for the first test, but were determined for the second test. For that test, the estimated charging rate to the electric furnace was summed with the estimated charging rate of cold dope and silica to the converters. The allowable process weight was then calculated by the formula contained in the applicable regulation [Appendix C], and the test results compared with the allowable results.

Following is a summary of both tests and comments regarding the methods, procedures, and results of each test.

May 8-9, 1975

The sampling train used was a Method 5 front-half with a 10% solution of hydrogen peroxide in the impingers. Moisture was measured as impinger weight gain corrected for sulfur compounds as SO_2 in the gas stream.

Only two runs were conducted. The minimum sampling time of 2 hours and the minimum sampling volume of 1.70 m^3 (60 ft^3) [Appendix C], were met for the first run but not the second; the second run was conducted just over 80 minutes at only 8 traverse points and only 1.5 m^3 (52 ft^3) of gas was collected. The isokinetic flow rates were not reported. The results of test runs 4 and 5 are presented in Table 3.

June 17, 1975

The sampling train arrangement was the same as that used in the May test. However, only a 5% solution of hydrogen peroxide was used in the impingers. Moisture content was assumed to be nil based on the results of the May test. Only two runs were conducted. The sampling time was 2 hours for each run and the sampling volumes were 1.78 and 1.66 m^3 (63.3 and 58.5 ft^3), respectively. The isokinetic rate was 111% for both runs. The results of both runs are presented in Table 3.

Table 3

PARTICULATE MATTER EMISSIONS TEST RESULTS
INSPIRATION CONSOLIDATED COPPER COMPANY
Inspiration, Arizona

Test Run	Date (1975)	Stack Temperature		Gas Volume		Moisture Content	Actual Emissions		Allowable Emissions	
		°F	°C	acfm	m^3/min	%	lb/hr	kg/hr	lb/hr	kg/hr
4	5-8	120	49	98,100	2,780	<0.1	5	2	ND†	
5	5-9	133	56	93,400	2,640	<0.1	7	3	ND	
1	6-17	131	55	83,500	2,360	<0.1††	11	5	38	17
2	6-17	128	53	78,900	2,230	<0.1††	11	5	38	17

† *ND = Not Determined*
†† *Assumed values from previous test results*

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2. Inspiration's Copper Smelter Facilities. Richard C. Cole, Vice President. Oct. 1974.

3. Particulate and Sulfur and Emissions Tests, Concentrate Dryer and Acid Plant, May 6, 7, 8 and 9, 1975. Inspiration, Arizona. Engineers Testing Laboratories, Inc., Phoenix. 1975.

4. Particulate Emissions Tests, Acid Plant, June 17, 1975. Inspiration, Arizona. Engineers Testing Laboratories, Inc., Phoenix. June 30, 1975.

APPENDIX A

NEIC INFORMATION REQUEST
LETTER TO INSPIRATION

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT
NATIONAL FIELD INVESTIGATIONS CENTER—DENVER
BUILDING 53, BOX 25227, DENVER FEDERAL CENTER
DENVER, COLORADO 80225
December 17, 1975

D. W. Middleton
Vice President and General Manager
Inspiration Consolidated Copper Company
Inspiration, Arizona 85537

Dear Mr. Middleton:

The Environmental Protection Agency has undertaken a program to evaluate the performance characteristics of particulate control facilities at the copper smelters in Arizona and Nevada. Representatives of EPA will observe each smelter's process operations and air pollution control facilities, review source test data, examine appropriate records, etc., during a site inspection of each smelter.

In anticipation of such a site inspection of your smelter, we have prepared the attached list of detailed information needs which we intend to use as a discussion outline during our inspection. We would appreciate it if you could inform the appropriate company personnel about the attached list and the forthcoming inspection of your facility so that the necessary information will be readily available and the inspections can be expedited.

We are conducting these inspections under the authority of Section 114(a)(ii) of the Clean Air Act, which authorizes representatives of EPA to enter facilities for the purpose of determining whether the facility is in violation of any requirement of a state implementation plan. At your facility, we anticipate that EPA or a contractor hired by EPA will be conducting an emissions source test for particulate matter within the next few months. Therefore, EPA will make a source test pre-survey, either separately or in conjunction with our site inspections, prior to performing such a source test.

If you have any questions concerning the purpose of these site inspections, please feel free to contact Mr. Gary D. Young of my staff (303/234-4658) or Mr. Larry Bowerman, EPA Region IX (415/556-6150). Mr. Young will be in contact with you within the next few weeks concerning a site inspecton of your smelter during January or early February.

Sincerely,

Thomas P. Gallagher

Thomas P. Gallagher
Director

Attachment

cc: Richard O'Connell
Bruce Scott

COPPER SMELTER INFORMATION NEEDS

A. GENERAL

1. Plant location

2. Person to contact regarding plant survey information needs, his telephone number and address

3. Simple block flow diagram showing smelter process equipment, air pollution control devices, and stack configuration

B. PROCESS

1. General

   a. Detailed description of the process, including flow diagrams, unique features, and how the process operates

   b. Definition of normal operation

   c. Actual production rate (lbs blister copper/hr and percent Cu)

   d. Type and quantity of fuel consumed

      Oil - i. Heating value (BTU's/gal)
      ii. Percent sulfur (by weight)
      iii. Percent ash (by weight)
      iv. Specific gravity
      v. Consumption (gals or bbls/yr)

      Gas - i. Type of gas (constituents in percent by weight)
      ii. Density (lbs/SCF)
      iii. Heating value (BTU's/SCF)
      iv. Percent sulfur (by volume and grains/SCF)
      v. Consumption (SCF/yr)

      Coal - i. Heating value (BTU's/T)
      ii. Percent sulfur (by weight)
      iii. Percent ash (by weight)
      iv. Consumption (lbs/unit/hr)

   e. Ore composition, including a typical percent and range of percentages for each chemical constituent

   f. Flux composition, including a typical percent and range of percentages for each chemical constituent

   g. Standard conditions - pressure (psi) and temperature (°F) - used to calculate SCFM

2. Concentrators

   a. Design process feed rate (lbs raw ore/hr)

   b. Actual process feed rate (lbs raw ore/hr), including method and estimated accuracy of measurement

   c. Average number of hours of operation per month

   d. Process instrumentation used, including data for a typical reading and range of readings

   e. Description of where and how samples of process material can be collected

   f. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results

   g. Expected life of process equipment (years)

   h. Plans to modify or expand process production rate

3. Roasters

   a. Design process feed rate (lbs concentrate/hr)

   b. Actual process feed rate (lbs concentrate/hr), including method and estimated accuracy of measurement

   c. Design process gas volumes (SCFM)

   d. Actual process gas volumes (SCFM), including method of determination, calculation, or measurement

   e. Actual process temperature (°F)

   f. Average number of hours of operation per month

   g. Process instrumentation used, including data for a typical reading and range of readings

   h. Description of where and how samples of process material can be collected

   i. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results

j. Expected life of process equipment (years)

k. Plans to modify or expand process production rate

4. Reverberatory furnaces

   a. Design process feed rate (lbs calcine/hr + lbs flux/hr + lbs converter slag/hr)

   b. Actual process feed rate (lbs calcine/hr + lbs flux/hr + lbs converter slag/hr), including method and estimated accuracy of measurement

   c. Design process gas volumes (SCFM)

   d. Actual process gas volumes (SCFM), including method of determination, calculation, or measurement

   e. Actual process temperature (°F)

   f. Average number of hours of operation per month

   g. Process instrumentation used, including data for a typical reading and range of readings

   h. Description of where and how samples of process material can be collected

   i. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results

   j. Expected life of process equipment (years)

   k. Plans to modify or expand process production rate

5. Converters

   a. Design process feed rate (lbs matte/hr + lbs slag/hr + lbs flux/hr)

   b. Actual process feed rate (lbs matte/hr + lbs slag/hr + lbs flux/hr), including method and estimated accuracy of measurement

   c. Design process gas volumes (SCFM)

   d. Actual process gas volumes (SCFM), including method of determination, calculation, or measurement

   e. Actual process temperature (°F)

f. Average number of hours of operation per month

g. Process instrumentation used, including data for a typical reading and range of readings

h. Description of where and how samples of process material can be collected

i. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results

j. Expected life of process equipment (years)

k. Plans to modify or expand process production rate

6. Refining Furnaces

a. Design process feed rate (lbs blister copper/hr)

b. Actual process feed rate (lbs blister copper/hr), including method and estimated accuracy of measurement

c. Design process gas volumes (SCFM)

d. Actual process gas volumes (SCFM), including method of determination, calculation, or measurement

e. Actual process temperature (°F)

f. Average number of hours of operation per month

g. Process instrumentation used, including data for a typical reading and range of readings

h. Description of where and how samples of process material can be collected

i. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results

j. Expected life of process equipment (years)

k. Plans to modify or expand process production rate

C. EMISSIONS

1. List of sources of particulate emissions in the plant (including fugitive emissions)

2. Level of uncontrolled particulate emissions by source (lbs/hr or T/yr)

3. Existing source test data employed for particulates by stack, process unit, or control device, including:

    a. Test method

    b. Data acquired

    c. Operating process weight rate

    d. Calculations

    e. Test results

4. Particle size and chemical composition of uncontrolled particulate emissions, including method of determination

5. Level of uncontrolled visible emissions by source (percent opacity) and method of determination

6. Extent of and reason for variance of particulate emissions with:

    a. Process design parameters

    b. Process operating parameters

    c. Raw material composition or type

    d. Product specifications or composition

    e. Production rate

    f. Season or climate

    g. Sulfur dioxide control

D. CONTROL SYSTEMS

1. Detailed description of the particulate and sulfur dioxide emissions control systems, including:

    a. Process treated

b. Type of fuel consumed per unit

c. Quantity of fuel consumed per unit

d. Method of determination of design parameters

e. Engineering drawings or block flow diagrams

f. Expected life of control system

g. Plans to upgrade existing system

2. Electrostatic precipitators

a. Manufacturer, type, model number

b. Manufacturer's guarantees, if any

c. Date of installation or last modification and a detailed description of the nature and extent of the modification

d. Description of cleaning and maintenance practices, including frequency and method

e. Design and actual values for the following variables:

i. Current (amperes)
ii. Voltage
iii. Rapping frequency (times/hr)
iv. Number of banks
v. Number of stages
vi. Particulate resistivity (ohm-centimeters)
vii. Quantity of ammonia injected (lbs/hr)
viii. Water injection flow fate (gals/min)
ix. Gas flow rate (SCFM)
x. Operating temperature (°F)
xi. Inlet particulate concentration (lbs/hr or grains/SCFM)
xii. Outlet particulate concentration (lbs/hr or grains/SCFM)
xiii. Pressure drop (inches of water)

3. Fabric filters

a. Manufacturer, type, model number

b. Manufacturer's guarantees, if any

c. Date of installation or last modification and a detailed description of the nature and extent of the modification

d. Description of cleaning and maintenance practices, including frequency and method

e. Filter material

f. Filter weave

g. Bag replacement frequency

h. Forced or induced draft

i. Design and actual values for the following variables:

    i. Bag area (ft^2)
    ii. Bag spacing (inches)
    iii. Number of bags
    iv. Gas flow rate (SCFM)
    v. Operating temperature (°F)
    vi. Inlet particulate concentration (lbs/hr or grains/SCF)
    vii. Outlet particulate concentration (lbs/hr or grains/SCF)
    viii. Pressure drop (inches of water)

4. Scrubbers

a. Manufacturer, type, model number

b. Manufacturer's guarantees, if any

c. Date of installation of last modification and a detailed description of the nature and extent of the modification

d. Description of cleaning and maintenance practices, including frequency and method

e. Scrubbing media

f. Design and actual values for the following variables:

    i. Scrubbing media flow rate (gals/min)
    ii. Pressure of scrubbing media (psi)
    iii. Gas flow rate (SCFM)
    iv. Operating temperature (°F)
    v. Inlet particulate concentration (lbs/hr or grains/SCF)
    vi. Outlet particulate concentration (lbs/hr or grains/SCF)
    vii. Pressure drop (inches of water)

5. Sulfuric acid plants

a. Manufacturer, type, model number

b. Manufacturer's guarantees, if any

c. Date of installation or last modification and a detailed description of the nature and extent of the modification

d. Description of cleaning and maintenance practices, including frequency and method

e. Frequency of catalyst screening

f. Type of demister

g. Design and actual values for the following variables:

   i. Production (T of acid/day)
   ii. Conversion rate (percent)
   iii. Acid strength (percent H_2SO_4)
   iv. Number of catalyst beds
   v. Gas flow rate (SCFM)
   vi. Operating temperature (°F)
   vii. Inlet SO_2 concentration (ppm)
   viii. Outlet SO_2 concentration (ppm)
   ix. Acid mist (lbs H_2SO_4/T of acid)
   x. Blower pressure (psi)

6. Liquid SO_2 plants

a. Manufacturer, type, model number

b. Manufacturer's guarantees, if any

c. Date of installation or last modification and a detailed description of the nature and extent of the modification

d. Description of cleaning and maintenance practices, including frequency and method

e. Absorbing media

f. Design and actual values for the following variables

   i. Production (T of SO_2/day)
   ii. Conversion rate (percent)
   iii. Gas flow rate (SCFM)
   iv. Operating temperature (°F)
   v. Inlet SO_2 concentration (ppm)
   vi. Outlet SO_2 concentration (ppm)
   vii. Acid mist (lbs H_2SO_4/T of SO_2)

7. Detailed description of how the particulate and sulfur dioxide emission control systems operate

8. Description of instrumentation (flow meters, continuous monitors, opacity meters, etc.) used, including manufacturer and model number, data for typical and range of readings, and identification of location by process unit, control system unit, or by stack

9. Description of typical types of control system malfunctions, including frequency of occurrence and anticipated emission results

E. STACKS

1. Detailed description of stack configuration, including process and/or control system units exhausted

2. Identification by stack of:

   a. Heights (ft above terrain)

   b. Elevation of discharge points (ft above sea level)

   c. Inside diameters (ft)

   d. Exit gas temperatures (°F)

   e. Exit gas velocities (ft/sec)

APPENDIX B

INSPIRATION RESPONSE TO NEIC INFORMATION REQUEST

COPPER SMELTER INFORMATION NEEDS

A. GENERAL

1. Plant Location - Inspiration, Arizona

2. Person to contact: D. W. Middleton, Vice President and General Manager
   Telephone: 612-473-2411, Ext. 201
   Address: Inspiration, Arizona 85537

3. Block flow diagram, etc. - See attached page 1(A)

B. PROCESS

1. General

a. & b. Detailed description of process, flow diagrams, unique features, how process operates:

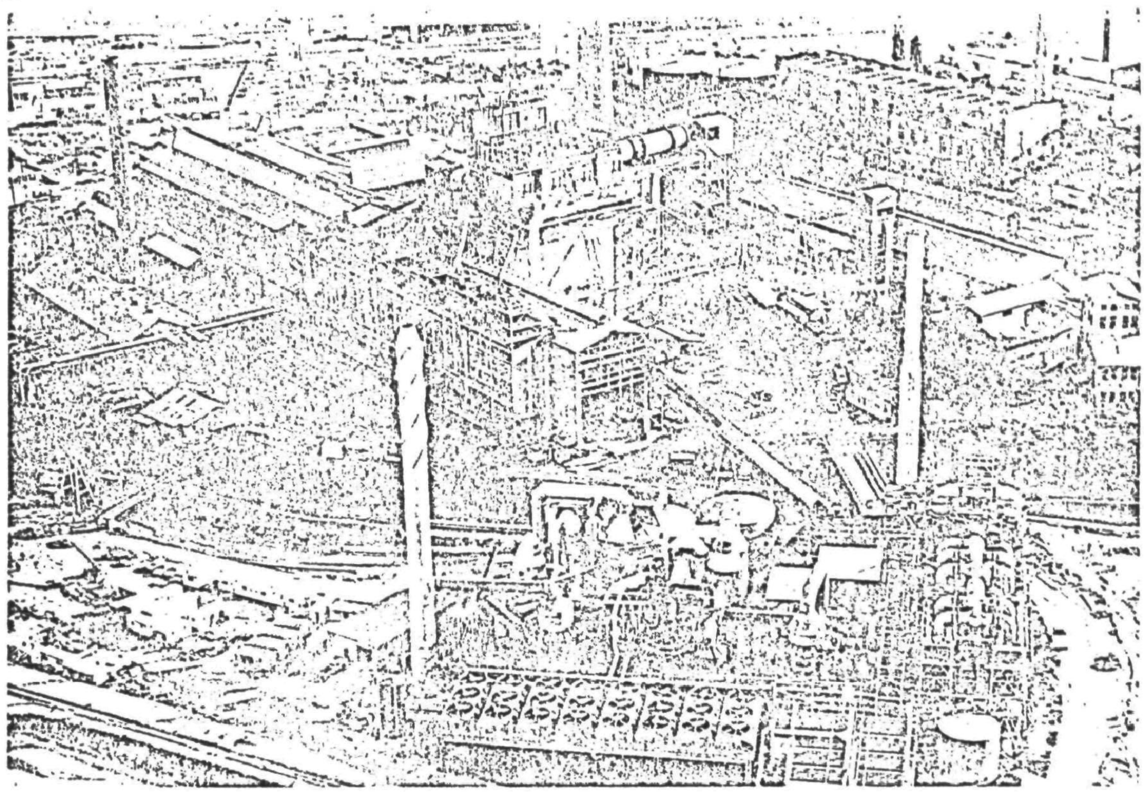
80-100 TPH off drier
80 TPH → furnace
so many tons of [illegible]
96,000 scfm → acid plt

The new plant will be operating about 40% on Inspiration feed and 60% on toll-processed material. The electric matte furnace is designed for a daily diet of 1,821 tons of feed composed about as follows: 1,500 tpd of concentrate, 148 tpd of cold dope, 123 tpd of silica flux, and 50 tpd of limestone.

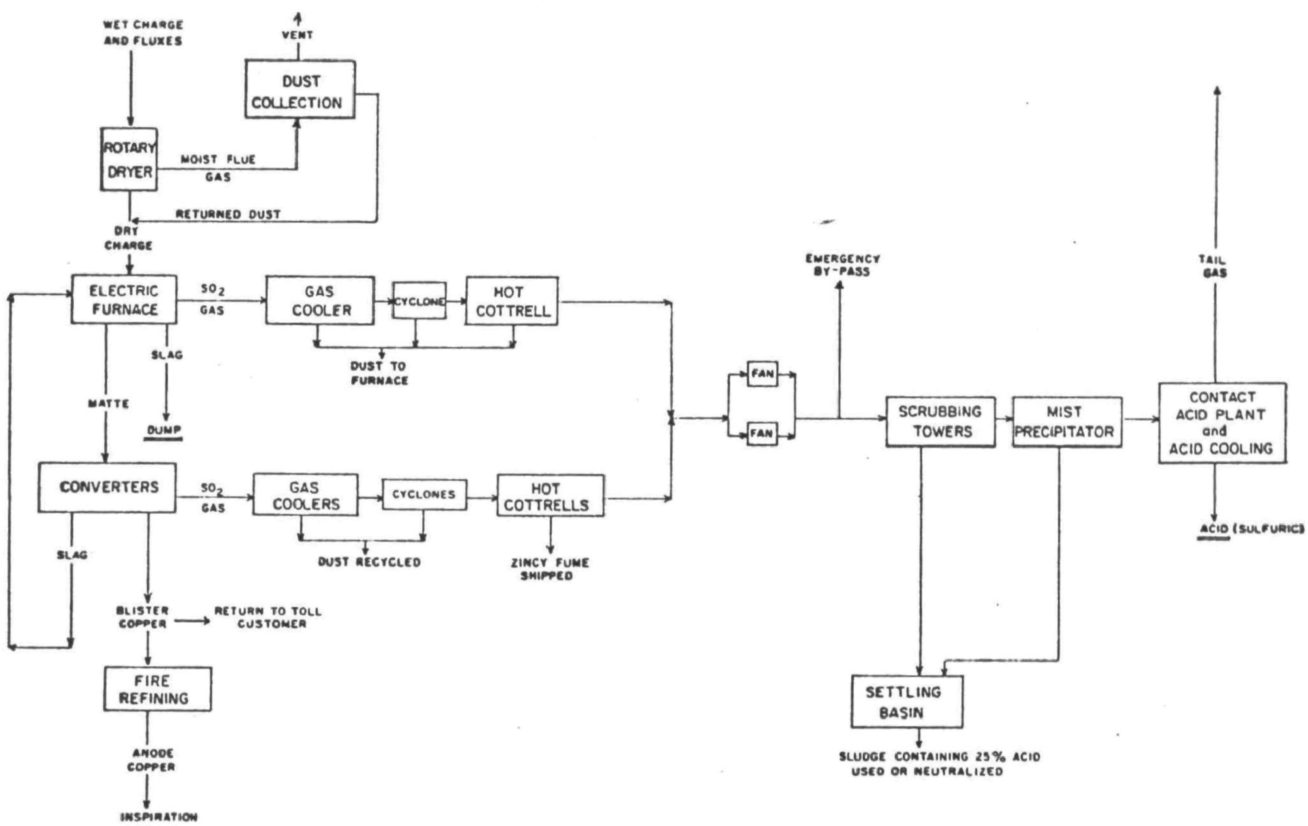
Inspiration feed and toll concentrate (with copper precipitates) are bedded in an eclosed building on a concrete slab in two parallel 6,000-ton piles by means of an overhead tripper conveyor system. Lime is needed for the electric furnace and is added as minus 1/4-in. material in the bedding plant. The bed mixture is reclaimed by front-end loaders which deliver it to a 24-in. wet charge belt equipped with a continuous weighing system. Wet concentrate with silica flux, as required, and reverts are conveyed to a 550-ton wet charge bin.

A screening installation is used to provide the converters with sized plus 1/4-in. minus 2-in. cold dope and silica. This system also handles and sizes matte smelter reverts to minus 1/4-in. for the electric furnace. The feed preparation used for the new plant varies somewhat from the mix blended for the reverberatory system. Formerly, flux, concentrates, and precipitates were interlayered in the bedding building, and the old furnace was fed a wet charge. Reverts were recycled directly to the converters.

The mix delivered to the wet charge bin in the new system has a moisture content of 9% to 12%. It must be taken to a bone-dry condition, largely to prevent explosions that may range from a mild bump to something of a damaging proportion. Experience elsewhere has shown that serious eruptions can occur in an electric



Overall view of smelter and pollution control facilities described in following schematic illustration, photographs and text. *(Photography by Dale R. Henderson, Inspiration Consolidated Copper Company)*



furnace when the charge contains free moisture. For efficient operation, electric matte furnaces run best with the bath completely covered with solid charge. If moist charge caves or sloughs into the bath, an eruption may follows.

Considered only from the aspects of the material and moisture load, Inspiration invested in a rather large 16-ft-dia by 80-ft-long Fuller rotary dryer with a fully insulated, but unlined, stainless 316L steel shell. It is designed to reduce the moisture content to 0.1% to 0.3%. Fired by either natural gas or heavy fuel oil, the dryer helps conserve power consumption in the electric furnace. However, the main factor considered in its sizing was relief from the dust load carryover.

Most materials handled by the smelter are finely divided and become very dusty when dried. They are easily swept by a fast-moving stream of gases. In order to hold the particulate load of dryer gases within reasonable limits, the unit was designed to keep gas velocities low while taking advantage of dryer residence time. It has been calculated that 20%, or less, of the solids will be entrained in the gas stream.

The dryer is concurrently fired from Peabody burners. The exit gas is maintained above the dew point for a cleaning system consisting of a pair of Dracco cyclones and a high-efficiency baghouse before it is vented to the atmosphere. The dried charge is a very abrasive mixture that can become aerated to form a fluid, free-flowing mass. To minimize problems in handling this difficult material, the dryer was elevated on a concrete pier to bring the discharge point as close as possible to a pair of 700-ton-capacity furnace feed bins, located on the charging floor above the slag tapping endwall of the furnace. Both are totally enclosed structures vented into the dryer dust collection system.

The Elkem electric furnace is the largest copper matting furnace in the world. Measuring 34 ft wide by 117 ft long (ID), the furnace is equipped with six in-line, self-baking carbon electrodes, 71 in. in dia, that enter the furnace along the centerline of the sprung arch roof. They dip into the molten slag layer. Heat for smelting is generated by resistance of the slag to the submerged arc between electrode pairs.

On the charging floor, a twin system is employed. Dried feed is reclaimed from each 700-ton bin by a 6-ft-long variable speed screw feeder which augers the charge to a 22-in.-wide, four-speed drag conveyor extending 114 ft, nearly the length of the furnace. Each bin features this arrangement, one serving the east and the other the west side of the electrode line. Each totally enclosed drag conveyor delivers the charge to a series of 15 feed spouts that enter the furnace roof. Seven of these spouts are near the line of electrodes, and the other eight are near the furnace sidewall. The charge in the spout enters the furnace through an arc gate and then a weighted tilt gate, sequenced so that a seal is maintained on the furnace. The end spout is open at all times. Most of the charge will be introduced in the line of spouts nearest the electrodes; the remaining 10% to 20% will enter the line near the furnace sidewalls.

The inverted, double-arch bottom of the furnace and the end and sidewalls, to a point above the bath line, are of basic brick construction. Above the bath, the upper-side and endwalls and the sprung arch roof contain firebrick. The furnace is supported on concrete piers. Vertical steel columns and tie rods clamp the sidewalls and provide additional structural support. The unit operates with 30 in. of matte and a 60-in. slag layer.

The endwalls of the furnace are water cooled. The sidewalls and bottom are air cooled from a set of three blowers, rated at 118,000 cfm each, on each side of the furnace at the ground level. Normally, two operate on each side and one is on standby. Air sweeps under the furnace, up the sidewalls and exhausts through the roof, changing the atmosphere once a minute.

Electric power is delivered to Inspiration at 115 kv and stepped down to 22.9 kv in a new substation rated at 56,000 kva. The transformer vault, located on the furnace charging floor, takes 22.9-kv power on the primary side of three single-phase transformers with a total rating of 51,000 kva.

The electric furnace transformers reduce the voltage to the operating level required for slag resistance operation. They are connected to the furnace electrodes by means of a bus bar and flexible cable arrangement leading to a copper contact shoe below the electrode slip ring. The slip ring permits automatic adjustment of the electrode position according to the desired power input. A full range of operating voltages is available, and the power input will not exceed 11.5 kw per sq. ft. of hearth area. The bus bars are contained in an enclosed duct, which is under pressure to maintain a dust free atmosphere. If the transformers should develop a leak, the oil is drained out of the building and away from the electrical atmosphere.

Electrode paste for the Soderberg self-baking electrodes is delivered to the smelter in 1-ton blocks having the following specifications: fixed carbon 75.4%, volatile matter 11-12%, and ash 7.6%. The blocks have a density of approximately 1.6 gm per cc, and become fluid at 80° to 100°C. The electrode clamps and slipping mechanisms, which act on the steel casing housing the carbon, are the reverse of the arrangement used elsewhere. At

Inspiration, the clamps are spring loaded in a closed position and can be opened only by the application of hydraulic power to 100-ton jacks for purposes ofpositioning. The slip rate, based on power input requirements, is normally handled automatically, but the system is equipped with a manual override from a remote station.

The upper floor of the furnace building is arranged for electrode paste handling and the assembly of steel casing for the carbon blocks. The floor is serviced from an elevator for delivery of carbon blocks and flat 12-gauge steel plates. New casing is assembled in sections standing 5 ft 11 in. in height by first punching the sides of 18 plates to shape fins pointing inward, then rolling them to the proper radius. The shaped and punched sections are then joined into a finished cylindrical section by an automatic welding machine. As casing and carbon are consumed, a new casing section is mounted and welded to the shortened assembly. A hoist then loads the carbon blocks into the empty casing.

Electric furnace matte smelting eliminates the dilution of reaction gases by the large volume of combustion products associated with fuel-fired furnaces. This makes it possible to pull a 4-6% SO_2 gas stream from the furnace into the uptake positioned in the furnace roof near the matte tap endwall--a marked contrast to the weak 0.5-0.8% SO_2 coming off the reverberatory furnace.

The furnace endwall panels, two slag tap blocks, four matte tap blocks, and six electrode contact clamps are water-cooled from a 1,200-gpm pumping, distribution, and return system. The six electrode compression rings are water cooled by a separate 300-gpm pumping and circulation network.

Slag is skimmed from one of two tap holes in the endwall of the furnace. A pair of launders, sloped close to 19%, delivers the slag to a set of 600-cu-ft pots, and at the rated capacity, the slag handling will amount to about 980 tpd. The pots will be hauled to the dump by trucks of special design. The slag end of the furnace is equipped with a Joy tapping machine with a mud gun assembly for opening and replugging the slag skimming hole.

The matte endwall faces the converter aisle, parallel to the longitudinal axis of the latter. This endwall contains four holes for drawing off matte into two pairs of launders that take a modified V-shape in plan.

At the two junctions, the matte flows into one of two swivel spoons. Four 300-cu-ft ladles are positioned in a sand pit at the matte end. As a ladle is filled, the swivel spoon is tilted to a slight reverse slope, accumulating matte in the spoon. It is then pivoted to a new position over an empty ladle and down-tilted. Rotation and tilt of the swivel spoon is handled by air-actuated cylinders.

The converter is equipped with two 75-ton, two-hook P&H overhead bridge cranes. A clever leap-frog winch arrangement, installed near the junction of the two buildings, allows the position of the new cranes to be interchanged on the same track connecting the two converter aisles. The converter aisleway serving the reverberatory furnace contains cranes with a 40-ton main hoist and two 20-ton auxiliary hoists for the 175-cu-ft ladles in use there.

At the nominal rated capacity of the new smelter, over 1,200 tpd of matte will be tapped through the endwall. Converter slag is returned through the matte tap endwall from ladles that empty into two launders entering the furnace on 10 ft 6 in. centers about 10 ft above the matte tap holes.

The siphon converters, 14 ft dia by 38 ft long, are considered the equivalent of 14 x 32-ft Peirce Smith converters. The five Hoboken-Overpelts are equipped with automatic draft control, 52 tuyeres on 6-in. centers, a tight converter flue and gas cleaning system, and a charge mouth of 20 to 25 sq. ft. This opening is small by comparison with standard converters. The reaction end of the vessel, measuring 32 ft. long, is extended by the siphon which is totally enclosed and dammed from the reaction zone to contain the bath. The casing for this extension contains a raised roof to siphon off the gases. It is also equipped with a counterweight to compensate for the asymmetry of the vessel.

A horizontal 9-ft-dia concentric cylinder taps the siphon on the rotary centerline of the converter unit, conducting the offgases to a dust settling chamber and the gas uptake. A proprietary gas-tight seal and joint links the rotating portion of the vessel assembly with a stationary section which enters the dust chamber. The entire converter assembly from endwall to the dust chamber and uptake measures about 75 ft. long.

It is anticipated that each siphon converter equipped with 1-1/2-in. tuyeres, will be unable to take an air blast in the bath much in excess of 20,000 scfm without tending to plug the siphon.

The Hoboken-Overpelt converters are installed on 55-ft centers in a unique "en echelon" pattern slanted at 37.5° from the converter aisle craneway. This arrangement places each converter mouth under the crane aisle for ladle servicing. The siphon end and gas uptake system of each converter extends outside the craneway in a lateral extension of the building. By freeing the exit gas handling system from the path of crane travel, it has been possible to use a simpler and more desirable design for the gas uptake and initial cooling system since it has unencumbered headroom. The converter platforms are equipped with Gaspe-type Heath & Sherwood tuyere punching machines.

Individual dampers installed in the flue system behind each converter are automatically controlled. Regulation of the dampers maintains an approximate zero pressure across the mouth of the converter. The Hobokens will, in fact, hardly tend to puff at the mouth, thus preventing gas escape and minimizing the intrusion of dilution air. The latter two effects are among the big advantages claimed for the siphon converter. Reduced gas escape will obviously improve in-plant working conditions, and SO_2, concentrated in a manageable gas stream, is a more desirable acid plant feed.

Each Inspiration converter is equipped with separate 80-ton capacity cold dope and silica bins. Both bins are equipped with variable-speed feeder belts which deliver sized, plus 1/4-in., minus 2-in. products to an adjustable downspout. This system is able to feed flus or cold dope to the converter while the tuyeres are submerged and the converter is blowing. Matte can also be ladled into the converter during a blow. Such flexibility assists in achieving an optimum gas grade for delivery to the acid plant.

Since the converters must now be geared to efficient acid making, as well as blister copper recovery, the operating strategy of Inspiration's seasoned converter crews will require some reorientation. A new objective is in effect at the operation--to maintain as smooth a gas flow as possible in a volume that has a concentrated SO_2 content for the acid plant. The latter will run more efficiently if surging volumes and SO_2 grades are reduced.

Of the five converters, four will be in service while one is down for repairs. The converters will be cycled so that one hot converter will be on standby, and the other three will be in operation and blowing a large percentage of the time. The three on blows are staggered so that one is on its copper or finishing blow while the other two are at differing stages of slag blowing. Matte is tapped from the electric furnace for the hot standby converter as the unit on the copper blow nears its end point. The fourth converter can then start a slag blow, and the finished converter can be down-turned for pouring blister copper. The hot blister can be transferred via the craneway to the existing anode refining furnace at the near end of the old converter aisle. Alternatively, the blister can be cast into 6,000-lb cakes.

The converters on slag blows are periodically turned down to skim slag for return to the electric furnace. When the smelter is at its nominal rated capacity, about 600 tpd of converter slag will be returned to the electric furnace. A fan of 40,000-cfm capacity ventilates the matte tap end of the furnace.

From a materials handling view, the converter aisleway, the reaction vessels and their work platforms, the associated gas handling equipment, and the feed arrangements for fluxing and reverts present a clean, uncluttered design which lends a feeling of spaciousness to the interior. The ground floor of the aisle is concreted, but contains appropriate gravel pits under splash areas, such as the converter mouths and the matte tap and slag return area of the electric furnace. The aisleway also contains a preheat station that can accommodate three ladles along the wall to the west of gravel pit at the matte tap section. Between the preheat and matte tap its, a ladle crust breaker ram has been mounted.

Electric furnace and converter gases are processed in separate hot cleaning systems designed for high-efficiency recovery of particulates. The final exhaust from the hot gas cleaning system is drawn through a 90-in.-dia flue to the acid plant where the stream enters a cold gas cleaning installation.

The electric furnace generates an approximate average of 30,000 scfm of gas at 1,300°F. It leaves the furnace through an uptake hood serving an American Schack Co. model, 14 ft sq by 65 ft high, vertical radiation and shot-cleaned convection cooler. The radiation section features water-wall construction. On leaving the convection cooler, the gas has a temperature of about 850°F. A coupled flue on the furnace building roof delivers the gas to one of two Ducon dust cyclones arranged in parallel. It is estimated that a peak of 6,700 lb. per hr. of particulates can reach the cylones, which are designed to drop 80% of the dust load. Cycloned gas enters a high-velocity flue linked with a Research Cottrell electrostatic precipitator, which has a design specification of 98% collection efficiency.

On entering the Cottrell, the gas has been cooled to about 750°F. With some air infiltration in the system up through the electrostatic precipitator, an estimated volume of 38,000 scfm of gas from the electric furnace hot gas cleaning system is delivered through a 48-in. flue to the insulated duct leading to the acid plant.

Converter gases are handled in much the same way. At peak volume, each converter will produce about 23,000 scfm of gas at 2,200°F, which is swept from the dust chamber to a vertical American Schack water-wall radiation and shot-cleaned convection cooler. The gas leaves the radiation section at about 1,200°F and exits the convection cooler at about 900°F. It is then cleaned in a Ducon cyclone (one per converter), and five 46-in. flues deliver the cycloned converter gases to a mixing plenum chamber which serves three Research Cottrell electrostatic precipitators in parallel.

The converter cyclones are also designed to separate 80% of the dust carryover in the gas stream. The electrostatic precipitators on the converter system are each designed to handle 34,000 scfm of gas with a maximum temperature of 750°F at 95% collection efficiency. All electrostatic precipitators for the furnace and converters are ganged on the roof of the furnace building. Electrostatic precipitator gases from the converter system are ducted in 48-in. insulated lines into the 90-in. main delivering gas to the acid plant.

Dust from the precipitators and plenum chamber is collected by screw conveyors and transported to a bin at ground level next to the furnace building or to the furnace feed bins.

The draft to pull electric furnace and converter gases through the hot cleaning system is created by two 1,250-hp hot gas fans, each rated for 70,000 scfm. A total of about 140,000 scfm of gas will be drawn to the acid plant from the hot gas cleaning system of the electric furnace and the three converters that are on-line. All flues in the hot gas handling installation are high-velocity ducts which convey gas at speeds of 4,000 to 7,000 fpm to minimize the settling of dust in the flues. The gas delivered to cold gas cleaning at the acid plant should be about 550°F.

The merged gas streams from the smelter are piped 430 ft. in the 90-in. main to the cold gas cleaning system at the acid plant. Here, the gas is split between a pair of venturi scrubbers, flowing concurrently with 25% sulphuric acid solution down through the units into the lower end of two packed washing and cooling towers.

A bleed stream from the acid wash solution goes through a set of settling tanks to remove sludge so that the circulating acid can be adjusted to about 0.5% solids content. Some of the acid is bled to SO_2 strippers. Stripper gas joins the smelter gas stream entering the packed towers. The 25% acid from the stripper is recovered for use in an agitation leach and CCD circuit for slimes at the Inspiration concentrator.

A 1% washing acid circulates through the packed towers countercurrently to the gas flow. This solution passes through graphite tube and shell coolers. The condensed water from the gases is ducted from the washing tower overflow to the sump of the venturi scrubber.

Cooled gases from the packed towers at about 104°F are combined and enter eight electrostatic mist precipitators, furnished by Plastic Design and Engineering. They are arranged in two stages, with four units in parallel composing each stage. This final gas cleaning renders an optically clear stream for the adjacent acid plant.

To attain the desired degree of SO_2 recovery, a more expensive double-absorption contact system, furnished by American Lurgi, was selected for acid making. Clean gas from the cold cleaning system contains about 7% SO_2. It is pulled through a drying tower countercurrently to a flow of 93-96% sulphuric acid by a pair of downstream, 5,000-hp Allis Chalmers blowers in parallel.

From the blowers, the gas enters the conversion and absorption system. The Lurgi plant is equipped with a total of four V_2O_5 catalyst beds for converting SO_2 to SO_3. Four Cyclotherm heat exchanger installations, two of them containing two vessels in series, maintain proper gas temperatures for conversion and absorption. Top bed gases from the catalytic converter are cooled in one heat exchanger. Gases leaving the second bed are cooled by two heat exchangers in series before going to the intermediate double venturi type absorber. With over 80% of the SO_2 converted to SO_3, the heat-exchanged, second-bed gases flow concurrently with acid from the top of the intermediate absorber down through the unit. This helps conserve heat required for the catalytic reaction in the third state of conversion.

The weak offgas from the absorber returns to the catalytic converter after it is further heated in the shell of the set of exchangers handling second-bed gases. Containing less than 2% SO_2, this weak gas passes through the third and fourth catalyst beds, with a single heat exchange taking place between them. The gas from the fourth bed enters two heat exchangers in series and then the final absorption tower. Off-gas from the final absorption tower goes to the 200-ft-high tail gas stack.

Nominal monohydrate acid production, without allowances for losses, will be 1,330 tpd in the plant, which has the capability of producing either 93% or 98% acid. The final product will be delivered to a 10,000-ton sotrage system.

An ingenious sytem recovers waste heat from furnace and converter gas cooling stages and utilizes it to generate steam in a plant designed by Treadwell Corp. as part of its overall engineering contract.

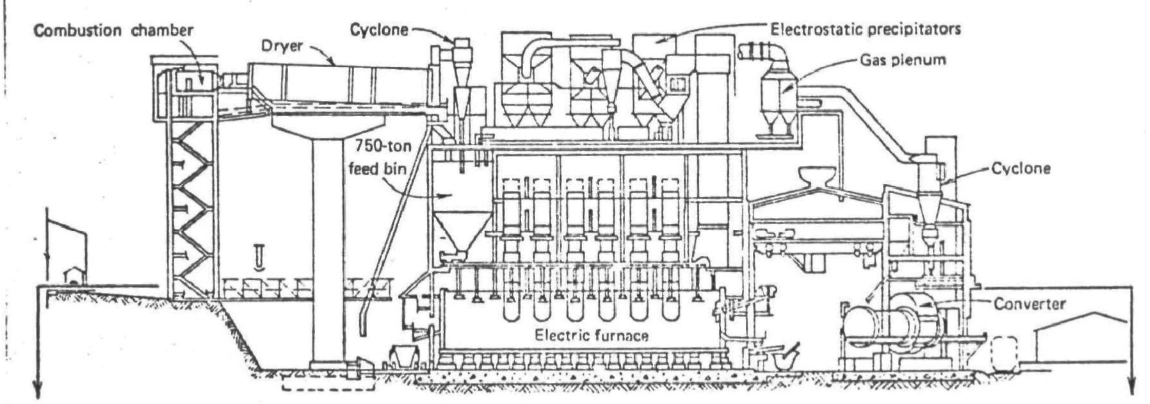
High pressure, high temperature water (500°F at 1,000 psi) circulates in a closed loop system through the water jackets on the American Schack radiation coolers handling electric furnace and converter offgases. Heat is removed from this closed recirculation system and converted to steam in steam generators. A peak total of 126,000 lb. per hr. of steam will be generated. The steam is used to drive turbines supplying blast air to the converters and to drive the pumps which recirculate the high pressure water through the radiation coolers. Any excess steam can be fed to the Inspiration power plant.

Maintaining the cooling water at 500°F will keep the offgases above the dew point and out of the corrosion range. The system includes water treatment facilities to supply treated water to the steam plant.

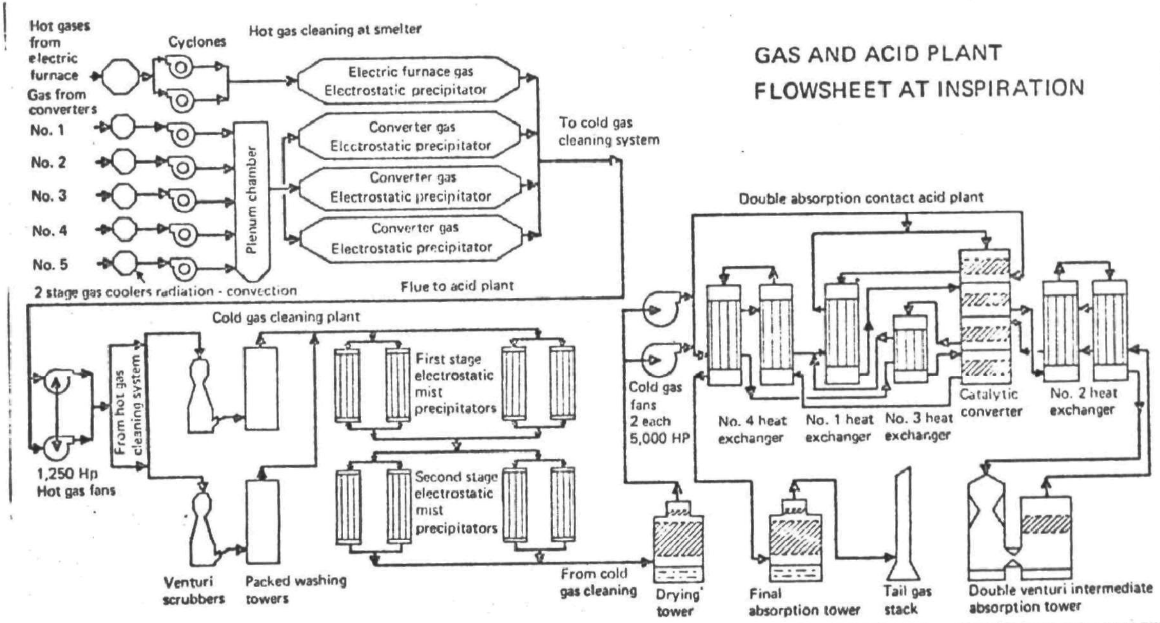
The new smelter-acid installation is a highly sophisticated system with two control centers. The nerve center for the smelter commands a sweeping view of the converters and furnace. This control room houses the instruments which monitor and control furnace and converter operating conditions. Temperature indicator and recorder panels track sensitive points in the system, including concentrate feed, hot gases, and cooling water. Functioning of equipment, which is operated either automatically or manually by local operators, is also monitored in the smelter control room.

A DuPont 460 photometric analyzer monitors the SO_2 content of effluent gases at seven locations. A paging system links the smelter control center, the acid plant control center, and the smelter cranemen for telephone communications.

ELECTRIC FURNACE AND DRYER



LONGITUDINAL SECTION A-A FROM PLOT PLAN



GAS AND ACID PLANT FLOWSHEET AT INSPIRATION like to operate it @ capacity

c. Actual Production Rate - For operating days in month of September 1975 was 385 tons/day of blister with approximate assay of 98% copper.

d. Type and Quantity of Fuel Consumed:

Diesel Oil	#2	#6
Heating Value (BTU's/Gal)	140,000	150,000
Percent Sulfur (by weight)	0.35	0.9
Percent Ash (by weight)	--	--
Specific Gravity	0.860	0.972
Consumption (Gals/yr) 1975	56,848	32,230

just process fuel - does not include that consumed in power house

Natural Gas

Specific Gravity	0.625
Heating Value (BTU's/Scf)	1091
% Sulfur (By Vo. & Grains/Scf)	0
Consumption (Scf/yr) 1975	1.171×10^9

Constituents in % By Wt.

Methane	CH_4	87.04
Ethane	C_2H_6	8.49
Nitrogen	N_2	2.47
Propane	C_3H_8	1.81
Carbon Dioxide	CO_2	0.07
N Butane	C_4H_{10}	0.05
Iso Butane	C_4H_{10}	0.04
Helium	HE	0.03

Coal (Not Used)

e. & f. Ore and Flux Composition------------Chemical Constituents

Composite (Sept.1975)	Cu	SiO_2	Al_2O_3	Fe	CaO	S
1. Concentrate	26.8	8.4	2.1	25.8	0.8	30.4
2. Cement Copper	76.7	3.0	2.2	4.0	0.1	1.3
3. Limestone	0	6.7	0.6	0.5	52.0	0.2
4. Silica	0.1	92.7	2.1	1.7	0.1	0.1

g. Standard Conditions - Psi - 14.7, Temp. °F - 60, used to calculate scfm.

2. Concentrators - We felt this was not applicable due to the fact that the smelter is a toll smelter receiving concentrates from various companies and we do not have information on other concentrators.

3. Roasters - N/A

4. Reverberatory furnaces - N/A We do not operate a reverberatory furnace, however, we do operate an electric furnace and the information received is as follows:

   a. Design process feed rate -
      Concentrates and cements - 1,500 TPD
      flux - 173 TPD
      reverts - 148 TPD
      converter slag - original design

   b. Actual process feed rate for September per operating day -
      Concentrates and cements - 1335 TPD
      flux - 120 TPD
      reverts - 85 TPD
      converter slag - 583 TPD
      Method of determining is based on scale weights and calculated volumes of ladles of converter slag.

   c. Design gas volumes - 30,000 scfm

   d. Actual process gas volumes - 15-25,000 scfm. Determined by measurement with annubar.

   e. Actual process temperature - between 12-1400°F

   f. Average number of hours of operation per month - plant is scheduled to operate every day throughout the month.

   g. Process instrumentation used - controlling instrumentation are flowmeters and thermocouples. The flowmeter measures from 0 to 45,000 scfm with a typical reading of 15-25,000 scfm. Thermocouples are recording various temperatures throughout the off gas system and ranges from 200-2000°F.
      1200-1400°F during normal operation

   h. Description of where and how samples of process material can be collected - the samples are taken by sampling the matte and slag molten streams leaving the furnace.

   i. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results - Will discuss.

   j. Expected life of process equipment - Should be indefinite if properly maintained.

   k. Plans to modify or expand process production rate - Unknown at this time.

5. Converters

a. Design process feed rate - designed for electric furnace feed rate of 1500 TPD.

b. Actual process feed rate - September 1975 -
matte grade - 43.5%
885 TPD of matte
flux - assume .6 tons silica flux/ton of matte = 885 x .6 = 531 TPD, cold dope approximately 354 TPD.

c. Design process gas volumes -

(1) slag blow - 21,000 scfm
(2) copper blow - 23,000 scfm

d. Actual process gas volumes - slag and copper blow - 20,000 scfm measured by converter - annubar (pitot tube).

e. Actual process temperature - molten material 2300°F. off gases @ 2200°F (see pg 7)

f. Average number of hours of operation per month - 24 hours, seven days/week.

g. Process instrumentation used, including data for a typical reading and range of readings - Process instrumentation used is blast air rate with volume ranging from 10-22,000 scfm.

h. Description of where and how samples of process material can be collected - Hand samples are taken by sampling the molten stream of the slag during the converter cycle.

i. Description of typical types of process fluctuations and/or malfunctions, including frequency of occurrence and anticipated emission results - Will discuss

j. Expected life of process equipment - Unknown if properly maintained.

k. Plans to modify or expand process production rate - unknown at present.

6. Refining Furnaces

a. Design process feed rate - Not known

b. Actual process feed rate, including method and estimated accuracy of measurement - Actual process feed rate approx. 250 TPD. Weigh anodes on railroad scales - process varies more than accuracy of scales.

c. Design process gas volumes - Not known

d. Actual process gas volumes, including method of determination, calculation, or measurement - Unknown

e. Actual process temperature - 2100°F

f. Average number of hours of operation per month - 24 Hrs./Day seven days per week.

g. Process instrumentation used, including data for a typical reading and range of readings - Not known

h. Description of where and how samples of process material can be collected - Samples of the molten copper are taken from the pouring spout.

i. Description of typical types of process fluctuations, malfunctions, frequency, and anticipated emission results - Will discuss.

j. Expected life of process equipment - Indefinite if properly maintained.

k. Plans to modify or expand process production rate - None definite at this time.

C. EMISSIONS

1. List of sources of particulate emissions in the plant:

   a. Rotary dryer baghouse

   b. Acid plant tail gas stack.

2. Level of uncontrolled particulate emissions by source - Not known

3. Existing source test data employed for particulates by stack, process unit, or control device, including:

   a. Test Method #5

   b. through e. - please refer to attachment

4. Particle size and chemical composition of uncontrolled particulate emissions, including method of determination - Unknown.

5. Level of uncontrolled visible emissions by source and method of determination - Unknown.

6. Extent of and reason for variance of particulate emissions with:

   a. through g. Unknown

D. CONTROL SYSTEMS

1. Detailed description of the particulate and sulfur dioxide emissions control systems, including:

ATTACHMENT FOR C-3

Inspiration Consolidated Copper Company

INSPIRATION, ARIZONA 85537

July 3, 1975

Bureau of Air Pollution Control
Division of Environmental Health Services
Arizona Department of Health Services
1740 West Adams Street
Phoenix, Arizona 85007

Attention: Mr. Carl Billings

Dear Sir:

Please find enclosed our application for an Operating Permit for our modified smelter facility.

Mass emission testing was performed at points in the process selected by the Bureau of Air Quality Control. Actual compliance testing was performed by Engineering Testing Laboratories, Inc. of Phoenix and witnessed by representatives of the State Bureau of Air Quality Control and EPA Region IX. All test data and results were submitted separately to the State Bureau of Air Quality Control by the Engineering Testing Laboratories, Inc.

The stack tests performed on the concentrate dryer baghouse and acid plant tail gas showed that particulate emissions were well within the process weight table requirements. SO_2 analyses were also made to complete sulfur balances. Enclosed are schematic illustrations of process and test resulting material balances for particulates and sulfur.

From the above results, it is shown that Inspiration's modified smelter facility is well within the allowable particulate emissions and has met the 90% sulfur removal requirement of the Conditional Permit. Therefore, Inspiration Consolidated Copper Company is requesting an Operating Permit.

If any additional information is required, please contact me.

Sincerely,

William E. Pattullo

William E. Pattullo
Director of Environmental Control

WEP:ma
Enclosure

Bureau of Air Pollution Control
Division of Environmental Health Services
ARIZONA DEPARTMENT OF HEALTH SERVICES
1740 West Adams Street
Phoenix, Arizona 85007
Phone. (602) 271-4540

APPLICATION FOR OPERATING PERMIT

(As required by Title 36, Chapter 14, Article 1, Section 36-1707.01, C., Arizona Revised Statutes)

1. Permit to be Issued to (Business License Name of Organization that is to Receive Permit) - Inspiration Consolidated Copper Company

2. Name (or names) of Owner or Principals doing business as the above organization - Same

3. Mailing Address — Inspiration, Arizona 85537
(Number / Street / City or Community / State / Zip)

4. Equipment Location — Same
(Number / Street / City or Community / Zip Code)

5. Type of Organization - X Corporation ☐ Partnership ☐ Individual Owner ☐ Government Agency

6. Permit Application Reason - ☐ Begin Operation of New Equipment X Continue Operation of Existing Equipment ☐ Transfer (change of location or owner)

7. General Nature of Business -

Mining, Milling, Smelting and Refining Copper

8. Equipment Description -

Smelter and Appurtenances

9. If this equipment had a previous written permit, state name of corporation, company or individual owner that operated this equipment and state previous Bureau of Air Pollution Control Permit Number.

Name Inspiration Consolidated Copper Company Permit Number Docket No. 70-10

10. If the organization is acquiring Air Pollution Control device(s) and wishes to apply for certification of the device(s) in accordance with sec. 43-123 02. (c), Arizona Revised Statutes, Check Here ( )

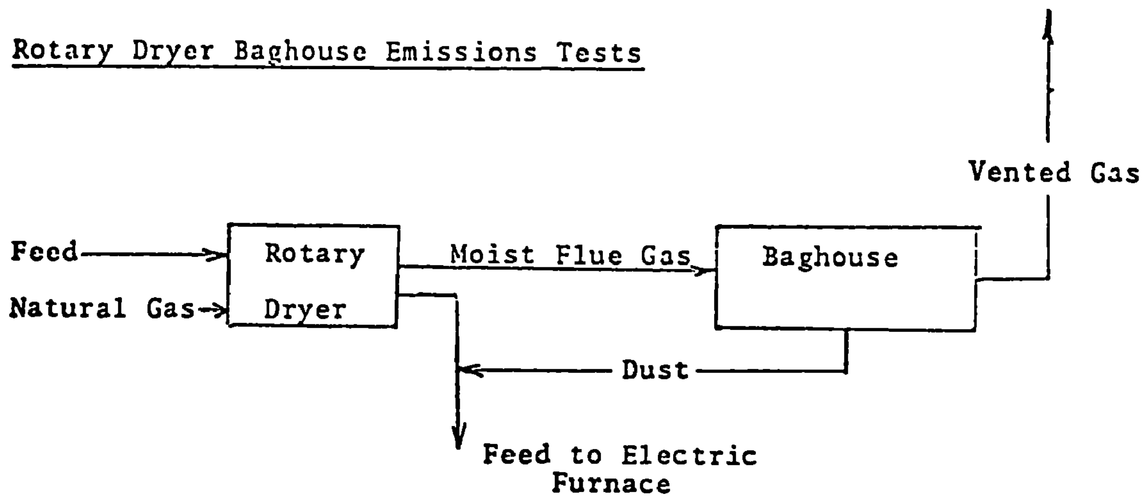
11. Signature of Responsible Member of Organization ____________

Official Title of Signer Vice President & General Manager

12. Typed or Printed Name of Signer D. W. Middleton

Date July 3, 1975 Telephone Number 473-2411, Extension 201

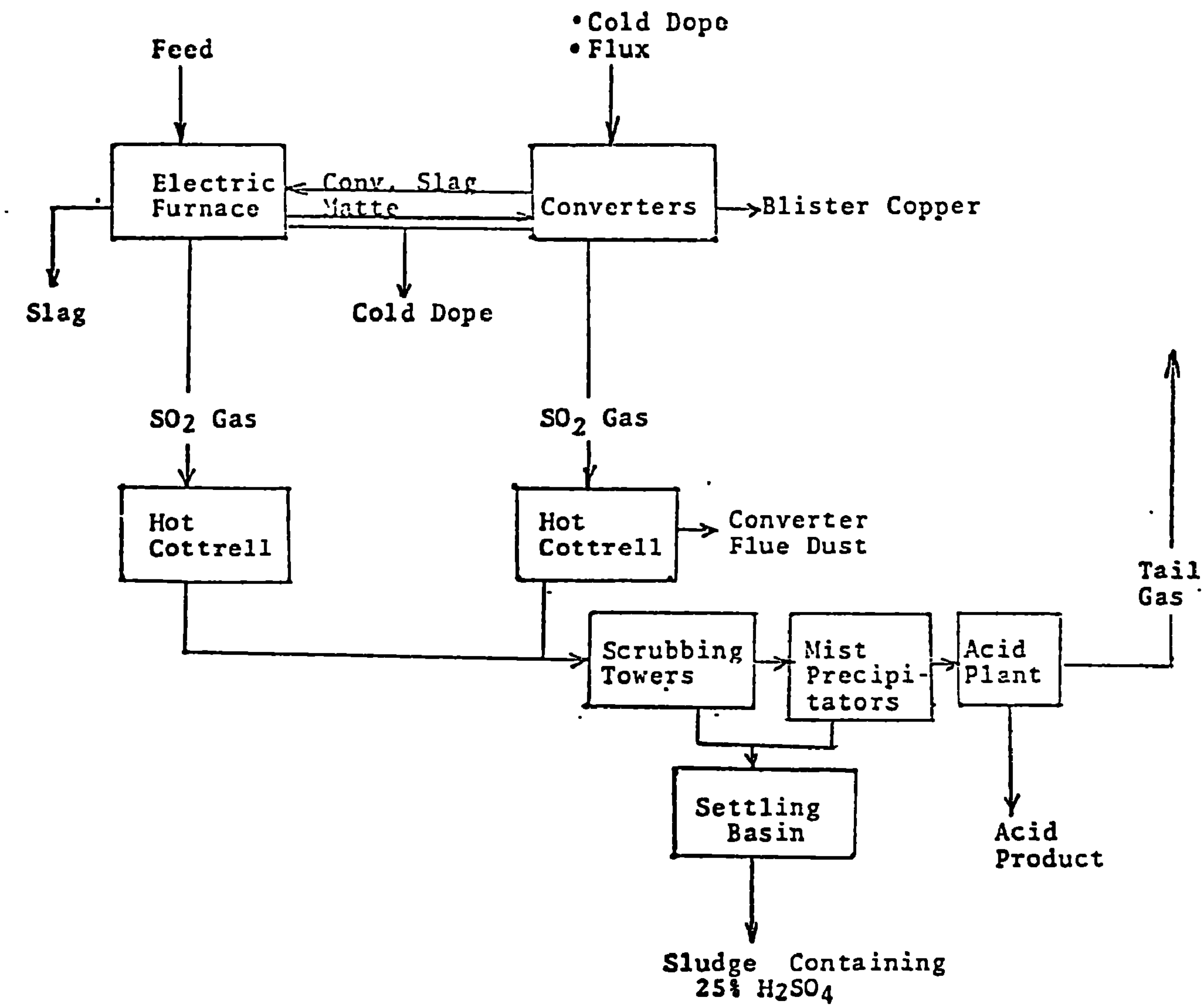
I. Rotary Dryer Baghouse Emissions Tests



Test No.	Date	Feed Rate To Dryer (T/Hr)	Emissions Particulate (#/Hr)	SO_2 (PPM)
1	5/29/75	70	18	79.5
2	5/30/75	70	18	99.3

Note: Conversion of SO_2 PPM to #/Hr sulfur is 13#/Hr and 16#/Hr respectively for Test #1 and #2.

II. Acid Plant Tail Gas Emission Tests



ACID PLANT TAIL GAS EMISSION TESTS (CONTINUED)

	TEST NO.	FEED T/HR	SLAG T/HR	COLD DOPE IN T/HR	COLD DOPE OUT T/HR	FLUX T/HR	CONV. FLUE DUST T/HR	SLUDGE (SOLIDS) T/HR	25% H_2SO_4 T/HR	ACID 92% T/HR	EMISSIONS PARTICULATES #/HR	EMISSIONS SO_2 PPM	TOTAL
	#1 (6-17-75)	80	40	37.50	37.50	37.50	1.25	0.014	0.699	58	10	135	
	#2 (6-17-75)	70	40	37.50	37.50	37.50	1.25	0.014	0.699	50	11	135	
[illegible]) Material In	#1	80		37.50		37.50							155 T/HR
	#2	70		37.50		37.50							145 T/HR
3) Sulfur Balance	#1												
In (Lbs/Hr)		40,320		6,547.5		75							46,942.5
Out (Lbs/Hr)			1,760		6,547.5		250	Trace	114	34,847	-	47	43,565.5
In (Lbs/Hr)	#2	35,280		6,547.5		75							41,902.5
Out (Lbs/Hr)			1,760		6,547.5		250	Trace	114	30,041	-	43	38,755.5
	Note: Assume remaining sulfur as fugitive losses												

a. Process treated - Refer to Part B - PROCESS

b. Type of fuel consumed per unit - The acid plant preheater consumes fuel during acid plant start-up, shutdown and during low strength SO_2 situations. Type of fuel - natural gas with alternate of #2 diesel.

c. Quantity of fuel consumed per unit - varies and is unpredictable.

d. Method of determination of design parameters - will discuss.

e. Engineering drawings or block flow diagrams - Refer to Part B - PROCESS

f. Expected life of control system - Unknown if properly maintained.

g. Plans to upgrade existing system - Unknown at present.

2. Electrostatic precipitators

a. Manufacturer, type, model number -

Research Cottrell
Electrostatic using Opzil type collecting plates
Model No. SI9ARC-20

b. Manufacturer's guarantee - outlet concentration of 0.02 grains per cubic foot (98% Recovery).

c. Date of installation or last modification and a detailed description of the nature and extent of the modification - 1973

d. Description of cleaning and maintenance practices, including frequency and method - when necessary due to malfunction.

e. Design and actual values for the following variables:

		DESIGN	ACTUAL
(1)	Current (amperes)	750 MA	750 MA
(2)	Voltage	70,000 volts	40,000
(3)	Rapping Freq. (Times/Hr.)	30 Times/Hr.	24/Hr.
(4)	No. of Banks	1 Unit	Same
(5)	No. of stages	3 sections ea. have 29 ducts	Same
(6)	N/A		
(7)	N/A		
(8)	N/A		
(9)	Gas flow rate scfm	38,000 scfm	15-25,000

	DESIGN	ACTUAL
(10) Operating Temp	750°F	460-750°F
(11) N/A		
(12) N/A		
(13) Pressure Drop (inches of water) -	10"- +5" N.G.	N/A

2. Electrostatic precipitators - Converters (3)

   a. Manufacturer - Research Cottrell
      Type - Electrostatic using Opzel type collecting plates
      Model No. - (S19ARC-20)

   b. Manufacturer's Guarantee - collection efficiency of 95% when treating gas capacity of 34,000 scfm per precipitator at a gas temperature of 750°F and at a negative pressure. Outlet concentration of 0.02 grains per cu. ft.

   c. Date of installation - 1973

   d. Description of cleaning and maintenance practices - As necessary.

   e. Design and actual values for the following variables:

	DESIGN	ACTUAL
(1) Current Amperes	750 MA	750 MA
(2) Voltage	70,000 Volts	40,000
(3) Rapping Freq.	30 times/Hr	30
(4) No. of banks	One unit each	Same
(5) No. of stages	Each unit has 4	Same
(6) N/A	Sections of 21 ducts	
(7) N/A		
(8) N/A		
(9) Gas flow rate	34,000 scfm	30.000
(10) Operating Temp.	750°F	600-758°F
(11) N/A		
(12) N/A		
(13) Pressure Drop	10"- +5 W.G.	N/A

3. Fabric Filters

   a. Manufacturer - Fuller Co.
      Type - 8 Zone No. 156 Plenum Pulse Collector
      Model No. - No. 156

   b. Manufacturer's guarantee - Efficiency of 97%.

   c. Date of installation - Mechanically accepted 12/73.

   d. Description of cleaning and maintenances practices - As Necessary

e. Filter media - 14-16 oz. Nomex FF80

f. Filter Weave - Needled fabric supported

g. Bag replacement frequency - as required.

h. Forced or induced draft - Induced draft.

i. Design and actual values for the following variables:

		DESIGN	ACTUAL
(1)	Bag area	13,000	11,700
(2)	Bag spacing	6"	7"
(3)	No. of bags	1248	1120
(4)	Gas Flow Rate scfm	78,000	36,300
(5)	Operating Temp	350°F	205°F
(6)	N/A	N/A	N/A
(7)	N/A	N/A	N/A
(8)	Pressure Drop	3-7"	3-7"

4. Scrubbers

a. Manufacturer, type, model number -
Cyprus Steele
Type - Venturi
Number - N/A

b. Manufacturer's guarantees - N/A

c. Date of installation of last modification and a detailed description of the nature and extent of the modification - 1972-1973

d. Description of cleaning and maintenance practices, including frequency and method - As required.

e. Scrubbing media - N/A

f. Design and actual values for the following variables:

		DESIGN	ACTUAL
(1)	Scrubbing media flow rate	4060 GPM	N/A
(2)	Pressure of scrubbing media	79 psi	65 psi
(3)	Gas Flow rate	96,000 scfm	105,000 scfm
(4)	Operating temp.	575°F	550°F
(5)	Inlet Part. Conc.	N/A	
(6)	Outlet Part. Conc.	N/A	N/A
(7)	Pressure drop	5"	2"

5. Sulfuric Acid Plants

a. Manufacturer - Designed by Lurgi

b. Manufacturer's guarantee - maximum flow rate - 129,000 scfm at 8.3% SO_2; 500 ppm SO_2 in tail stack; 100 mgr Nm^3 acid mist expressed as SO_3.

c. Date of installation or last modification and a detailed description of the nature and extent of the modification - 1972-73.

d. Description of cleaning and maintenance practices, including frequency and method - As required.

e. Frequency of catalyst screening - As required

f. Type of demister - Stainless steel with teflon fibers.

g. Design and actual values for the following variables:

		DESIGN	ACTUAL
(1)	Production	1330 T/D	1000
(2)	Conversion rate	99.5	99.6
(3)	Acid Strength	93-98%	92-95%
(4)	Number of catalyst beds	4	4
(5)	Gas flow rate	129,000	105,000
(6)	Operating Temperature	104°F	100-105°F
(7)	Inlet SO_2 concentration	7%	6.5%
(8)	Outlet SO_2 Concentration	less than 500ppm	300 ppm
(9)	Acid Mist	100 mgr Nm^3	29.4
(10)	Blower pressure	8 psig	4 psig

6. Liquid SO_2 Plants - Not applicable

7. Detailed description of how the particulate and sulfur dioxide emission control systems operate - Refer to Part B - PROCESS GENERAL

8. Description of instrumentation used, including manufacturer and model number, data for typical and range of readings, and identification of location by process unit, control system unit, or by stack - Will discuss lots

9. Description of typical types of control system malfunctions, including frequency of occurrence and anticipated emission results - Will Discuss

E. STACKS

1. Detailed description of stack configuration, including process and/or control system units exhausted - Refer to Part B - PROCESS GENERAL.

2. Identification by stack of:

	Dryer	ByPass	Acid Pl. Tail Gas
a. Height (Ft. above terrain)	143	200	200
b. Elevation of Discharge Point (Ft. above sea level)	3,690	3,759	3,759
c. Inside Diameter	4'-8"	7'-5"	6'-3"
d. Exit Gas Temp (^oF)	375^o	550^o	150^o
e. Exit Gas Velocities (Ft/Sec)	76	40.5	57.0

APPENDIX C

SIP REGULATION APPLICABLE TO INSPIRATION

Subpart D—Arizona

§ 52.124 [Revoked]

1. Section 52 124 is revoked.
2. Section 52.126 is amended by adding paragraph (b) as follows:

§ 52.126 Control strategy and regulations: Particulate matter.

* * * * *

(b) *Replacement regulation for Regulation 7–1–3 6 of the Arizona Rules and Regulations for Air Pollution Control, Rule 31(E) of Regulation III of the Maricopa County Air Pollution Control Rules and Regulations, and Rule 2(B) of Regulation II of the Rules and Regulations of Pima County Air Pollution Control District (Phoenix-Tucson Intrastate Region).*—(1) No owner or operator of any stationary process source in the Phoenix-Tucson Intrastate Region (§ 81 36 of this chapter) shall discharge or cause the discharge of particulate matter into the atmosphere in excess of the hourly rate shown in the following table for the process weight rate identified for such source:

Process weight rate (pounds per hour)	Emission rate (pounds per hour)	Process weight rate (pounds per hour)	Emission rate (pounds per hour)
50	0 36	60,000	29 60
100	0 55	80,000	31 19
500	1.53	120,000	33 28
1,000	2 25	160,000	34 85
5,000	6 34	200 000	36 11
10,000	9 73	400,000	40 35
20,000	14.99	1,000,000	46 72

(i) Interpolation of the data in the table for process weight rates up to 60,000 lbs/hr shall be accomplished by use of the equation:

$$E = 3.59\ P^{0.62} \quad P \leq 30 \text{ tons/h}$$

and interpolation and extrapolation of the data for process weight rates in excess of 60,000 lbs/hr shall be accomplished by use of the equation:

$$E = 17.31\ P^{0.16} \quad P > 30 \text{ tons/h}$$

Where: E=Emissions in pounds per hour
P=Process weight in tons per hour

(ii) Process weight is the total weight of all materials and solid fuels introduced into any specific process. Liquid and gaseous fuels and combustion air will not be considered as part of the process weight. For a cyclical or batch operation, the process weight per hour will be derived by dividing the total process weight by the number of hours in one complete operation from the beginning of the given process to the completion thereof, excluding any time during which the equipment is idle For a continuous operation, the process weight per hour will be derived by dividing the process weight for a given period of time by the number of hours in that period

(iii) For purposes of this regulation, the total process weight from all similar units employing a similar type process shall be used in determining the maximum allowable emission of particulate matter.

(2) Paragraph (b)(1) of this section shall not apply to incinerators, fuel burning installations, or Portland cement plants having a process weight rate in excess of 250,000 lb/h.

(3) No owner or operator of a Portland cement plant in the Phoenix-Tucson Intrastate Region (§ 81 36 of this chapter) with a process weight rate in excess of 250,000 lb/h shall discharge or cause the discharge of particulate matter into the atmosphere in excess of the amount specified in § 60 62 of this chapter.

(4) Compliance with this paragraph shall be in accordance with the provisions of § 52.134(a).

(5) The test methods and procedures used to determine compliance with this paragraph are set forth below. The methods referenced are contained in the appendix to part 60 of this chapter. Equivalent methods and procedures may be used if approved by the Administrator.

(i) For each sampling repetition, the average concentration of particulate matter shall be determined by using method 5. Traversing during sampling by method 5 shall be according to method 1. The minimum sampling time shall be 2 hours and the minimum sampling volume shall be 60 ft^3 (1 70 m^3), corrected to standard conditions on a dry basis.

(ii) The volumetric flow rate of the total effluent shall be determined by using method 2 and traversing according to method 1. Gas analysis shall be performed using the integrated sample technique of method 3, and moisture content shall be determined by the condenser technique of method 4.

(iii) All tests shall be conducted while the source is operating at the maximum production or combustion rate at which such source will be operated. During the tests, the source shall burn fuels or combinations of fuels, use raw materials, and maintain process conditions representative of normal operation, and shall operate under such other relevant conditions as the Administrator shall specify.

APPENDIX D

CALCULATIONS OF GAS FLOW RATES

FLOWRATE AT STANDARD CONDITIONS*

$$\frac{P_i V_i}{T_i} = \frac{P_s V_s}{T_s} \quad \text{or} \quad V_s = \frac{P_i}{P_s} \times \frac{T_s}{T_i} \times V_i$$

where: P_i = given pressure = 14.7 psi therefore $P_i = P_s$

V_i = given gas volume

T_i = given temperature in °R = 520 °R

P_s = pressure @ std condns (14.7 psi or 760 mm Hg)

V_s = gas volume @ std condns (in same units as V_i)

T_s = temperature @ std condns (530 °R)

Electric Furnace

$$V_s = \frac{15{,}000\ (530)}{520} = 15{,}288 \text{ scfm}$$

$$= \frac{25{,}000\ (530)}{520} = 25{,}481 \text{ scfm}$$

Converters

$$V_s = \frac{20{,}000\ (530)}{520} = 20{,}385 \text{ scfm}$$

$$= \frac{23{,}000\ (530)}{520} = 23{,}442 \text{ scfm (maximum)}$$

* *Reference 1 reports standard conditions as 760 mm Hg (14.7 psi) and 16 °C (60 °F). The calculations below are simple adjustments of reported values.*