PRINTED: 01/27/2003

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: DOUGLAS SMELTER

ALTERNATE NAMES:

COCHISE COUNTY MILS NUMBER: 562

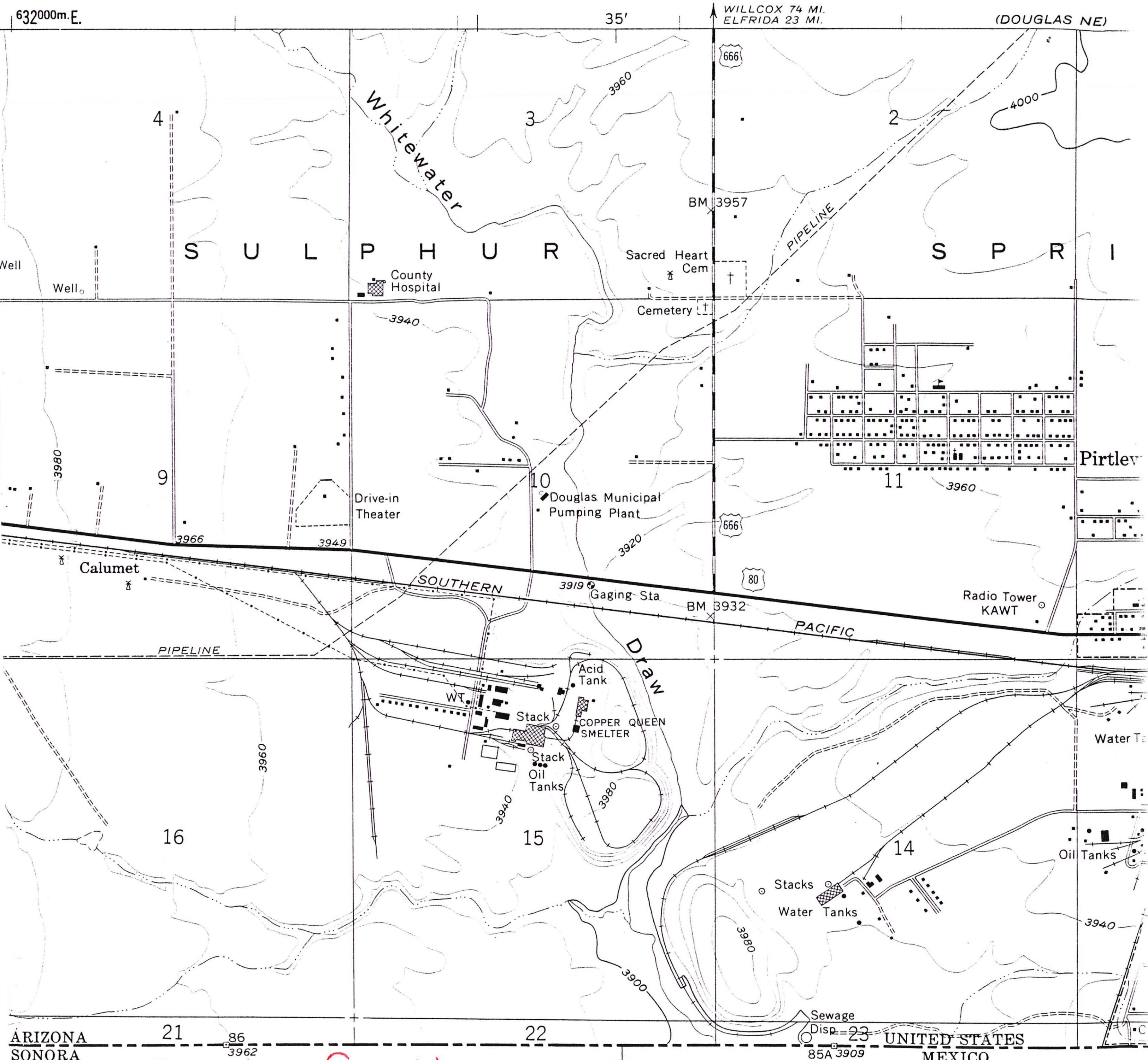
LOCATION: TOWNSHIP 24 S RANGE 27 E SECTION 15 QUARTER C
LATITUDE: N 31DEG 20MIN 51SEC LONGITUDE: W 109DEG 35MIN 21SEC
TOPO MAP NAME: DOUGLAS - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
MILL CU SMELTER

BIBLIOGRAPHY:
ADMMR DOUGLAS SMELTER FILE
US MSHA 1978 METAL-NONMETAL MINE INFO. SUPP.
US MSHA 1978 METAL-NONMETAL MINE FILE REF.
SMELTER DISMANTLED ABOUT 1990

ES
INTERIOR
RVEY



Douglas Smelter
T24S R27E Sec. 15

Douglas 7.5′

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

COCHISE CO.

Douglas

Smelter

MILS # 562 (F)
O-AKA'n

MM-7172	Copper
7173	Copper
7175	Copper Bar

PHELPS DODGE DOUGLAS SMELTER

JHJ MEMO FOR FILE 6/18/85: A visit to the smelter in Douglas revealed no new information. The smelter superintendent, Walter Gage is very pessimistic about continuing operation in 1988. He believes the coalition formed by the union members and environmentalists will force the smelter shut-down. However, I understand (not verified) that top management does not accept that line of thought. At his time there is considerable custom smelting being done on ores from Mexico.

PD DOU ms smelter (A)

NEWS RELEASE

phelps dodge Corporation Western General Offices, Office of the General Manager
Phelps Dodge Tower, 2600 N. Central Avenue, Phoenix, AZ 85004-3015 • (602) 234-8100

FOR IMMEDIATE RELEASE

CONTACT: M. P. Scanlon
(602) 234-8113

PHOENIX, ARIZONA, July 29, 1986 -- Phelps Dodge Corporation today announced the resumption of smelting operations at its copper smelter at Douglas, Arizona following the lodging of a consent agreement among the Company, the federal Environmental Protection Agency and the Arizona Department of Health Services. The consent agreement, lodged in federal District Court in Tucson today, requires the termination of smelting operations no later than January 15, 1987.

Smelting had been suspended on July 9 until negotiations on the consent agreement were completed. The approximately 280 workers laid off on July 9 will be returning to their jobs over the next several days.

###

DOUGLAS SMELTER (F)

NEWS RELEASE

phelps dodge Corporation Western General Offices, Office of the General Manager
Phelps Dodge Tower, 2600 N. Central Avenue, Phoenix, AZ 85004-3015 • (602) 234-8100

FOR IMMEDIATE RELEASE

CONTACT: M. P. Scanlon
(602) 234-8113

PHOENIX, ARIZONA, July 9, 1986 -- Phelps Dodge Corporation today announced that its Douglas, Arizona, smelter will suspend smelting copper concentrate at midnight tonight for what the company hopes will be a relatively brief period until Phelps Dodge and the federal Environmental Protection Agency can complete work on a consent decree to enable the smelter to continue operating until its scheduled final closure at December 31, 1987. The smelter has been operating under an EPA suspension of applicable sulfur dioxide emissions regulations during negotiations on the decree, but the suspension expires today.

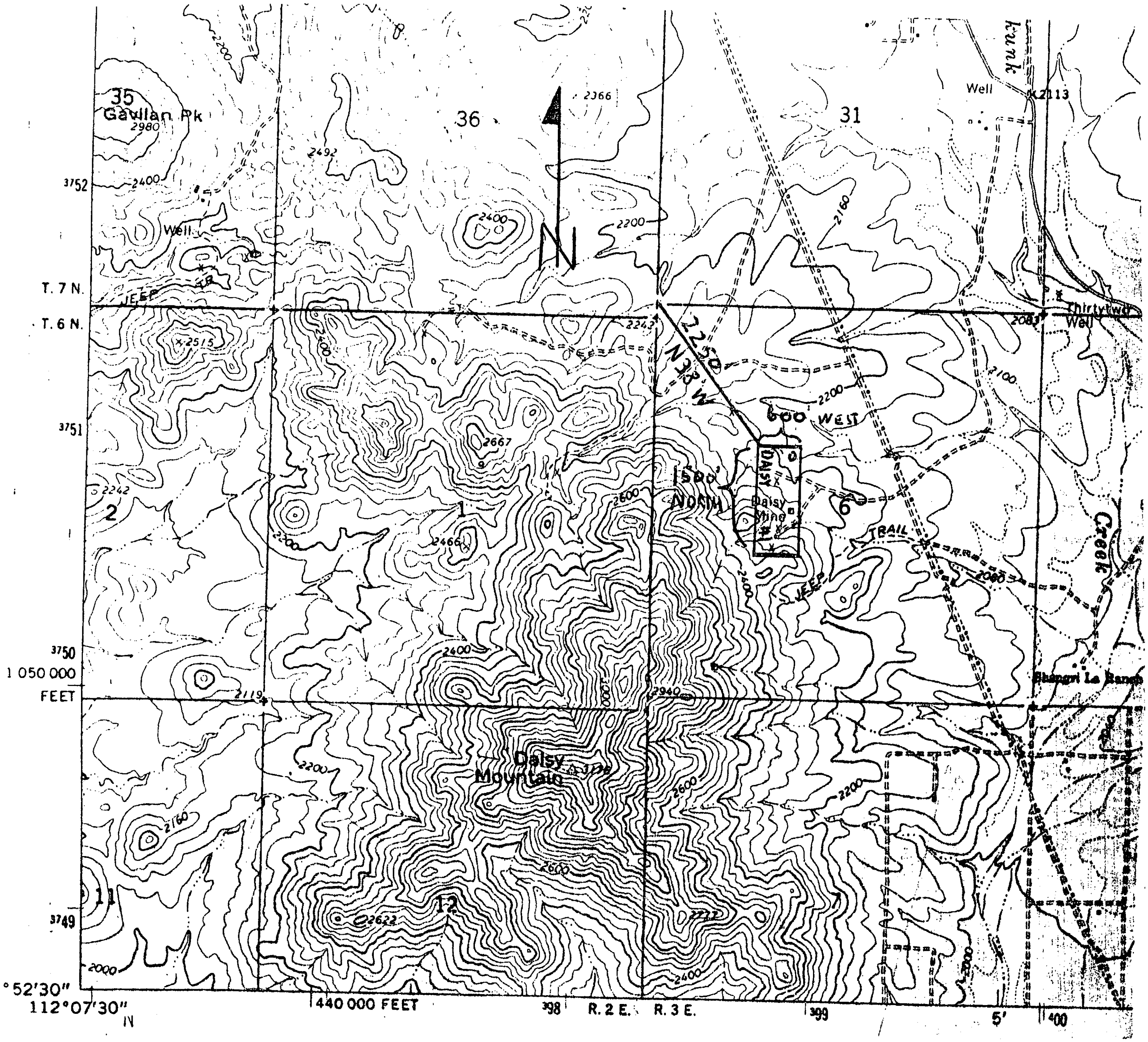
"Both EPA and Phelps Dodge have been working nights and weekends to finalize this decree, but we can't get it done before the suspension expires," said A. E. Himebaugh, Phelps Dodge Vice President and General Manager, Western Operations. "I still believe we can reach agreement within a few more days and resume smelting, but until then to continue to operate would violate the law, which we will not do."

Until operations can resume, the smelter's furnaces will be kept warm, but no concentrate will be charged. Approximately 300 workers will be affected, and customers have been advised to hold back scheduled shipments to the smelter.

* * * * *

CLAIM MAP

Lode (X)
Placer ( )



O IS THE LOCATION MONUMENT

Scale: 1" = 2000 ft.

1. The above map depicts the DAISY #1 mining claim, which is located in Section(s) 6 , Township(s) 6N , Range(s) 3E ,G&SRM, MARICOPA County, Arizona.

2. Type of corner and location monuments used are as follows: 2" x 2" x 5' WOODEN POSTS .

3. The bearings and distances between claim corners are as depicted on the above map.

FLOW SHEET OF COPPER SMELTING
DOUGLAS REDUCTION WORKS
DOUGLAS, ARIZONA

Delivered before Copper Queen Smelter Club by

R. H. Mills

September 20, 1929.

The ore receipts at the Douglas Smelter fall into six general classifications; concentrates, oxide ore, sulphide ore, silicious ore, precipitates and miscellaneous Custom ores. For our purposes tonight, the latter may be disregarded, as it represents only a small fraction of the total.

Some typical assays of the remaining five classes, taken at random but being fairly representative, show about as follows:

Class	Cu	SiO2	Al2O3	Fe	CaO	S
C. Q. Flotation Conct.	13.40	8.2	2.9	32.6	0.4	40.1
C. Q. Sand Concentrates	9.35	6.8	1.8	36.8	0.4	44.6
Moctezuma Concentrates	23.62	10.8	4.0	26.9	1.0	29.8
Sulphide Ore	4.13	25.7	9.3	24.2	1.9	21.0
Oxide Ore	5.93	20.6	7.0	24.8	8.2	1.8
Silicious Ore	3.63	64.6	8.3	8.6	0.4	9.6
Precipitates	63.12	1.8	4.0	8.6	0.2	1.7

As given above the ores and concentrates contain copper, silica, alumina, iron, lime and sulphur. They also contain many other elements such as gold, silver, lead, manganese, zinc, etc., but which are in such small quantities that they do not need to be considered. Of course, the gold and silver are valuable and must be recovered, but they follow the copper and appear in the bullion along with it. The rest of the elements are not recovered and when we get to the smelting proper, we shall see how they are eliminated.

When the ore arrives at Douglas it is, more or less, wet. Therefore a careful sample is taken, weighed and dried and from the loss in weight the percentage of moisture is determined. The cars are weighed as they come in, the percentage of moisture is applied to the wet weight, and the dry weight is determined. From then on, only the dry weight is considered for any purpose.

For obvious reasons a sample, other than moisture, must be taken to determine the contents of each lot of ore arriving at the smelter. This is done in two ways -

First - Concentrates are sampled by the auger method, whereby a quantity of the concentrate is removed by literally boring holes in the concentrate and removing the displaced material in a can provided for that purpose.

Second - The ore is sampled while being unloaded (which is done by contract labor by hand shoveling). Every tenth shovelful is kept for a sample.

These samples are taken to the Sample Mill where they are crushed and divided until we get the assay pulp of about 16 ounces. These are sent to the assay laboratory where the contents are accurately determined.

Now in order to smelt this ore economically it must be mixed thoroughly in such proportions as will give the desired metallurgical result. To do this the ore is unloaded into beds of which we have six. Two of these beds have a capacity of 30,000 tons each, and four have a capacity of 20,000 tons each.

A typical bed analysis shows:

Cu. 9.07; SiO_2 22.0; Al_2O_3 7.2; Fe 25.4; CaO 1.9; S. 24.5.

When a bed is ready to be smelted the ore is picked up by steam shovels and loaded into dump cars in which it is transported to the crushing plant where it is dumped into an unloading pocket. From there it is delivered via an apron conveyor and a belt conveyor to the gyratory crusher where it is crushed to a 3 inch maximum. From the gyratory it is taken on another belt conveyor, under an electro magnet to remove tramp iron, to the primary rolls where it is crushed to a 1-1/4 inch maximum. From these rolls via another belt conveyor to the secondary rolls where it is crushed to a 1/4 inch maximum and delivered on another conveyor belt to Western dump cars. These are hauled to the unloading bins and taken up an incline conveyor belt to the storage bins, one of which is above each roaster. These bins have a capacity of approximately 150 tons each.

Our new superimposed roaster-reverb. plant is more or less of an innovation in copper smelting. The ore is first hoisted to the top of the building as described above. From there it descends through the roasters to the reverbs. entirely by gravity without handling or haulage. This reduces labor and power costs and by taking calcines directly from the roasters, a much hotter calcine is obtained for the reverb and a heat loss is thereby avoided thus increasing reverb capacity, and cutting fuel cost per ton of charge smelted.

Our new plant has two reverberatory furnaces, each 96 feet by 23 feet 6 inches, above which are superimposed twelve Herreshoff roasters, somewhat modified by Colonel Stout, Mr. Samuel and Mr. Robinson to fit local conditions.

Each roaster consists of one outside drying hearth followed by eleven interior hearths over which the ore travels alternately towards the center and towards the outside. The ore is moved in this fashion by rabble teeth on an air cooled arm which is revolved by an air cooled center column.

The ore is fed from the storage bins to the outside drying hearth by an apron feeder actuated by a lever arm from the revolving wenter column.

Now the purpose of a roaster is threefold, to eliminate sulphur, to dry the ore and to preheat the ore. The average bed mix as fed to the roasters will contain from 4% to 8% moisture. In traversing the outside drying hearth a part of this moisture is driven off. Then in the top hearths of the roaster the balance is eliminated and the ore is gradually getting hotter and hotter until the sulphur ignites and begins to burn. Combustion continues until by the time the 11th hearth is reached the temperature has reached 1100° F or more, depending on conditions. On the 9th, 10th and 11th hearths are two air arms in addition to the two rabble arms which are slotted and allow the air to escape which has been previously used to cool the rabble arms and column. This furnishes the preheated air to support the combustion of the sulphur. The hot gases ascend through the roaster and transfer their heat to the descending ore and the cycle is complete. Once started the roaster is self-sustaining, the sulphur in the ore being all the fuel required for normal operations. Occasionally it is necessary to burn some oil, as in starting up after a protracted shutdown or due to excessive moisture such as we had following the heavy rains in July and August.

The ascending gases pass up a 4 ft. diameter circular uptake into a bustle line which connects all roasters together. From this bustle line the gases, which contain some dust, pass into the Cottrell plant.

This dust is valuable in that it contains copper and steps must be taken to recover it. An analysis of Cottrell dust shows: Cu. 15,35; SiO2 7.2; Al2O3 3.7; Fe 25.3; CaO .04 and S. 19.7. For this purpose we have the Cottrell plant. It consists essentially of 8 units, 4 above each set of 6 roasters (corresponding to one reverb). Each of these units contain 138 eight inch pipes and 2 ten inch pipes, arranged vertically and through which the gases must pass in order to get to the stack. Through the center of each of these pipes is suspended a wire carrying approximately 50,000 volts of electricity and entirely insulated from any ground. The flow of current from the wire to the grounded pipe carries the dust to the pipe where it is deposited. From time to time the pipes are rapped with pneumatic hammers which jar loose the dust and it falls into hoppers below and is carried by pipes to screw feeders on the reverberatories below. The ascending gas, having been cleaned of the dust, is conducted through a balloon flue to the 351 ft. 17 ft. diameter stack and thence to the atmosphere.

When the calcines arrive on the 11th hearth of the roaster we find they analyze as follows:

Cu. 9.48; SiO_2 23.8; Al_2O_3 7.1; Fe 28.9; CaO 2.1; S 13.3

This constitutes the bulk of the charge to the reverb furnaces. The 11th hearth is provided with a number of drop holes through which the calcine falls thence through pipes into the calcine hoppers immediately over the reverberatories.

These hoppers are 65 feet in length and are arranged one on each side and extending from the firing end toward the skimming end. On the bottom of these hoppers are 26 charge pipes 6 inches in diameter spaced at intervals of 30 inches, leading down through a hole in the reverb arched roof. The calcines pass down these pipes and pile up along the sidewalls of the furnace, leaving a channel down the center.

At the firing end of the furnace are arranged ten oil burners burning approximately 425 barrels of fuel oil each 24 hours. Air for atomizing this oil is furnished by the old blast furnace blowers at 42 ounces pressure. Secondary air for combustion is admitted through the holes in which the burners are inserted, which are 9 by 15 inches.

The hot gases and products of combustion pass down the channel between the banks of calcine heating them to a temperature of approximately 2400° F. This is far above the smelting temperature and the charge readily smelts and runs down into the center as a liquid which consists of matte and slag. Matte is a combination of Cu., Fe and S in various proportions, depending on the amount of copper and sulphur present and is much heavier than the slag, which is mainly a silicate of iron.

The specific gravity of matte is about 5.0.

The specific gravity of slag is about 3.5.

Thus it is readily seen that in liquid form and given a certaim time the matte will settle to the bottom and slag come to the top, just as cream separates from milk.

The matte is tapped out from time to time through a small hole near the bottom of the furnaces.

A typical analysis of matte is as follows:

Cu. 30.24 Fe 39.6 S 25.7

The slag is skimmed off the top through a small door into launders which convey it to the slag pot in which it is hauled to the dump.

A typical slag analysis is as follows:

Cu 0.48; SiO_2 37.6; Al_2O_3 9.8; FeO 46.3; Cao 2.2; S 0.4.

Now the hot gases from the oil burners after passing between the charge banks and smelting them are carried by an uptake to 4 Erie City vertical tube type boilers. They are rated at 520 H.P. each. The gases enter the boilers at about 2000° F and emerge at about 650° F. Each boiler has an uptake up which the gases pass to a balloon flue and thence to the stack.

Draft is maintained at a low point at all times so that these gases do not contain a great amount of dust and no dust collecting apparatus is necessary. However, the dust coming down from the Cottrells in pipes is very fine and to avoid causing a great deal of dusting at the time of its dropping into the reverb it is fed into the furnace through a motor driven screw feeder, which pushes the dust through a small opening in the sidewalls of the furnace one on each side of each reverberatory.

When the matte is tapped from the reverb it flows down cast iron launders to a ladle which will hold about 14 tons. This ladle is provided with a bail and is picked up by an electric crane and taken to the converters.

The converters are eight in number and stand side by side on the opposite side of the crane aisle from the reverberatories. They are of the Great Falls or upright type and are 12 feet in diameter, lined with 15 inches of magnesite brick. The matte is poured into them from the ladle suspended from the crane. Now from the analysis of the matte we find that we have eliminated everything from the copper except iron and sulphur. These are eliminated in the converters in two stages. First the iron and some of the sulphur is removed. This is done by adding silica to the matte in the converter and blowing compressed air into the matte below the bath line. This serves to agitate the mixture and at the same time the oxygen in the air will combine with some of the sulphur and the iron from which the sulphur has been taken, and thus keep up the temperature during the reaction between the silica and the iron, which also evolves heat. This forms a slag and, being much lighter than the copper sulphide remaining, comes to the top in the same way that the slag comes to the surface in the reverberatory.

A typical analysis of converter slag is as follows:

Cu 2.76; SiO_2 19.4; Fe 54.7; S 1.5

When this reaction is complete the slag is skimmed off into a ladle, another ladle of matte is added, more silica, and the mixture is blown as before. The slag that has been skimmed off into the ladle is picked up by a crane and taken back to the reverberatories where it is poured back into the reverb down a launder ending in a well in the arch through which it drops into the molten bath below. The reason for returning this slag to the reverberatories is that it contains too much copper to throw away and if put into the reverb it mingles with the other slag at a temperature which keeps it molten and allows the copper to settle to the bottom and join the matte for a return trip to the converters

After the converter has received and formed slag from (usually) 4 ladles of matte and the last slag has been skimmed off we have sufficient copper sulphide remaining to make a charge of copper. This copper sulphide remaining is known as white metal. The converter is turned up and the air is blown through until all the sulphur has been eliminated. Now all we have left is copper. This is in the form of blister copper.

An analysis of a typical sample shows:

Au. 0.44 oz.; Ag. 18.06 oz.; Cu. 99.27; S 0.049; O2 0.30.

This copper is poured out of the converter into a ladle and taken by a crane to the holding furnace which is a brick lined oil fired vessel cylindrical in shape, but lying on its side. The purpose of this vessel is merely to keep the copper molten until ready to pour into the moulds and also as a vessel from which to pour.

The casting into blister bars is done on what is known as a Walker Casting Machine, which consists of 28 moulds mounted on radial arms forming a large wheel which is revolved so that each mould in turn comes under the spout of the holding furnace. As each mould is filled the wheel is revolved and another mould comes under the spout. The copper quickly solidifies and when a mould has arrived at a point about opposite the holding furnace the mould is automatically dumped into a water bath which further cools the bar. An inclined conveyor takes the bars from the water bath up to the loading platform where the bar is placed on a small truck and the rough edges are trimmed off. It is then trucked to the railroad car and loaded for shipment to the refinery. A bar of blister copper weighs on the average about 275 pounds.

Skull Breaker

In handling all this molten material in ladles, a great deal of shell forms in the ladles which are generally known as skulls. These must be knocked out occasionally or they would build up indefinitely until the ladle would hold no liquid. For this purpose we have a skull breaker, which is nothing but a large grating so mounted that small dump cars can be run beneath to receive the skulls. The ladles are shelled by bumping them (while held by a crane) against an old ladle placed on the grating. The shell easily falls out, since the ladle has previously been treated with a lime wash. An apparatus similar to a small pile driver running on a track above the grating is spotted over the dumped shells and breaks them up sufficiently so they will fall through the gratings into the cars below, which are hauled out as filled and returned to the system to recover the copper which is contained in them.

This completes the cycle from ore to blister copper as practised at Douglas at present. In the near future we shall place in operation our new Anode Plant for the further fire refining of blister copper, but that will no doubt form one of the early topics for discussion by this Club.

c