TACOMA PLANT

AMERICAN SMELTING AND REFINING COMPANY

This plant operates on a custom basis, handling ores, concentrates and scrap from Canada, South America and domestic sources, containing gold, silver, copper and arsenic.

Because of the prevalence of small tonnage lots, sampling and rehandling costs are high. At the time of writing a new system of ore handling is in process of construction which should alleviate much of the present necessity of rehandling.

This report, however, will be confined to roasting, smelting and converting.

The roaster equipment consists of six 24' diameter Herreschoffs with a total hearth area of 1,345 sq. ft. each, in six hearths, and four 24' Herreschoffs, known as the Tacoma Type, with eight hearths, of total area 1,817 sq. ft. The essential difference in these two types of roasters, other than in number of hearths, is the feeding mechanism.

The former type having two cutting blades at 180° to each other at the center of the rabble arms and attached to the column, at the upper deck, which cut into the feed hopper and drag roaster feed onto the hearth just ahead of the rabble blades, which then transport it across the hearth to the drop-holes at the periphery of the deck.

The latter type or Tacoma type have two feed hoppers equipped with chain conveyors which feed continuously together or individually to the center of the upper deck, which is in this case, closed. Originally one hopper was designed for fast speed and the other slow speed, with this slow speed feed joining the fast speed on the fifth deck of the roaster.

Both types have variable speed motors controlling rabble speed, with 10 and 15 h.p. motors respectively. The larger motor on the Tacoma type. The average consumption of power is 8640 K W hours per roaster month and average tonnage capacity is 6,300 tons per roaster month.

On the upper or "wet", Tacoma Plant uses 20° rabbles with 1½" spacers between each head. On the lower decks usually #3 down, 30° rabbles with 4" spacers on alternate arms. This spacing is extremely important on the fire deck (#5 and #7 decks for standard and Tacoma types respectively) where any ridges have a tendency to sinter to the hearth and build up until rabbles break on attempting to pass over them.

These roasters being oil-fired and Tacoma Plant handling large quantity of high copper, low sulphur materials, with a maximum allowable elimination of 4.5 units sulphur, the roasting has to be closely watched to produce a calcine temperature of 900° F or better with the low elimination. The oil flame has a very decided influence on these factors and the type in use at present is produced by a nozzle, manufactured in the shops, from a 1½" pipe coupling pressed at the outlet end into a ¼" opening, which gives at an oil pressure of 60 psi and air 10 psi, controlled with gate values, a long, lazy luminous flat flame which is not as corrosive on the arch above the fire deck as a short flame from a burner giving better combustion - yet gives desired calcine temperature and elimination with a fuel ratio of .6 - .7 M Btu. per ton new feed at 7 - 9% moisture.

Rabbles and rabble arms are of cast iron with replacements high on the hotter decks especially if the operators fail to clean accretions from the decks and blades at least once per shift.

Fire brick arches and linings last three to five months depending on care in cleaning and the flame effect - longer campaigns are experienced of course on the colder decks. Patching a burnt-out section of a deck seems rather fruitless; sometimes only a few days of operation pass before it falls out again. High As_2O_3 on the charge seems to help buckle arches especially noticeable when figure rises of 7%.

Each roaster has two calcine hoppers, each with two doors which are now equipped with hydraulically operated slides and a ventilation system with outlet into roaster flue.

Conditions are relatively clean in the roaster building but this is entirely up to the foreman in keeping his section clean.

The larry car load to the reverb is approximately 5½ short tons, and are weighed out on track scales en route. The hopper discharge has a ring to drop down over the top of the Wagstaff gun hole, so as to give a dust free transfer of calcines. This does not operate unless the gun is in the hole. The reverb in operation is approximately 116' X 24' inside, and is a deep-bath, gun-fed, oil-fired operation.

The arch on this furnace (Tacoma #2) was originally sprung silica brick as on #1, now idle, but was changed to a magnesite suspended arch in the combustion zone. This type of arch proved unsatisfactory and was disappointing in tonnage expectancy and is gradually being replaced with fire-brick suspension and maintained with silica slurry. The remaining places of magnesite do not take slurry very well and large "floaters" often appear on the bath of the furnace. However, the arch seems reasonably satisfactory if oil consumption is held to give a below maximum of 2975° F in the combustion zone. Over 3000° F the arch drips rapidly and soon deteriorates. Tonnage rate is in the range 850 - 950 Tons calcine per day at a fuel ratio of 3.0 - 3.7 M. BTU per ton charged.

The four Wagstaff guns are placed at 32° angle to the bath with the first guns on either side approximately 12' from the bridge-wall and #2 gun on the south side 12' from #1 gun. On the north side the #2 gun is approximately 15' from #1 gun. On the south side, approximately 25 feet from #2 gun, provision has been made for another gun similar to a Wagstaff except that it cannot be withdrawn from the furnace. It is in fact an 8" pipe into the furnace. The operators claim this is extremely useful when calcine refuses to spread and the bay end or skimming zone becomes overheated.

The crucible of the furnace is 18" magnesite with 18" silica brick on the outside extending the first 56' when the magnesite thins to 13" and the silica to 15". The first 40' (approximately) of the sidewalls are water jacketed with 8" copper jackets setting on the magnesite.

The bottom of this furnace is poured slag with a natural build-up of magnetite. The furnace is sounded once a month to determine this increase in bottom and from previous samples, metal tie-up is calculated. It averages from

1.0 to 4.0" magnetite build up.

The arch is sprung silica brick (15") beyond the part magnesite, part fire-brick suspension in the combustion zone. Both arches and sidewalls are maintained by three shifts of a slurry operator and helper.

Slurry make-up is:
200 lbs. silica 60 - 65% - 200#, 2 - 3% fire clay
1 gal. (U.S.) water-glass
and sufficient water to give a Sp. Gr. 1.6.

The "Floaters" mentioned previously will probably disappear when the suspended arch is all fire-brick as adhesion to this by slurry is very good. The worst features of the "floater" is loss in smelting rate and high slag losses when caught over the skimming block.

The matte launders, matte tapping blocks, converter slag launder (water cooled tip) and slag skimming blocks are of local fine-cast copper and when beyond further use are returned to the converter aisle as scrap. This use of copper castings under corrosive conditions has greatly reduced operating costs by elimination of cast-iron counter parts. The slag launder is the only large cast-iron equipment used for handling molten material, other than ladles, and with a 39% silica slag corrosion is negligible.

Instrumentation appears to be beneficial in controlling the many variables of the operation and Tacoma Plant has automatic equipment for oil and combustion air and furnace draft with the necessary recording apparatus. Another instrument of promise is the oxygen recorder, however, at present it is not equipped with suitable filters to handle reverberatory gases and is continually fouling up.

The forced combustion air is in the vicinity of 54%, calculated from fan capacity and outputs, the remainder being drawn into the furnace through the various spy-holes, gun holes and burner parts.

Draft is held to 0.06" water while smelting and is as high as 0.30" while dropping charge. The high draft is necessary to overcome the slack effect in the wasteheat boilers on low draft and enable the four men per shift to carry out their tube lancing. The lancers use 90 psi air and a trickle of water which keeps the tubes relatively clear. The draft is held low of ½ hour and then high for the following ½ hour.

The two Erie City boilers on this #2 furnace are 1,000 H. P. each and evaporate 1,035,000 pounds of water per 24 hours at steam pressure 175 psi at 520°F, giving a heat recovery of 46 - 49% of heat value of fuel used. Soot blowers are on order which, when installed, should alleviate the high labor cost of hand-lancing.

The reverberatory slag is transferred to the dump by electric motor in pots holding six tons in strings of six ladles, and then dumped into the bay. There is a small market for granulated slag and pot shells and, as required, a granulator is operated using sea water.

The converter equipment at Tacoma consists of two 13' X 30' Pierce-Smiths and an 11' X 26' P. S. with riding rings back from the ends. The smaller converter is used for a standby when one of the larger ones has to go down for relining or when all three are necessary during a two reverb furnace campaign.

All converters are lined with 18" magnesite brick and maintained by magnetiting when necessary. Occasional "bare" spots are covered by transferring magnetite slag from an operating converter and freezing in place. Local conditions of high lead mattes, necessitating over-blows, and large quantity of cold scrap to be used, are not condusive to long campaigns on linings. However, the two larger converters usually make 25,000 - 29,000 tons blister per run.

Another bad feature at Tacoma is the necessity for making big charges so as to fit in with hot transfer of blister to the anode department early in the morning. The Garr guns in use are 8" diameter and are a little small. When worn down a small hand ladle of blister is poured into the base.

Tuyeres are 1½" diameter and are punched with 1-1/8" diameter rod or with 3/4" rod with 1-1/8" diameter knob, fitted with hand shields. Punching is easy and before finish and each over-blow the holes are cleaned while the converter is out of the stack. The punchers platform can be raised or lowered hydraulically.

The air pressure is recorded and is maintained at 13 - 14 psi on the larger converters and 11 - 12 psi on the smaller, 11' X 26' P. S. A flow meter on the line in c.f.m. would be beneficial for the puncher's observation.

The old 10' X 26' converter has been converted into a matte and copper wire melting furnace. It is oil fired at one end with a stack outlet into a brick flue to the atmosphere or the regular converter flue which is used when leady mattes are being melted.

The converter mouth has been replaced with a cylindrical stack to give a more or less air-tight joint with a lid lined with fire-resisting cement and raised and lowered hydraulically. Average daily capacity is in vicinity of sixty tons. The hot transfers are to the converters or if high grade copper wire and scrap is being handled to the anode furnaces direct.

The aisle cranes are two Shaw Electric Company cranes 75 feet span with a sixty ton main hoist, but at present are capable of forty-two tons. Auxiliary lift is eighteen tons. Main hoist motor is 120 H.P., two auxiliaries and bridge motors 78 H.P. and carriage motor 25 H. P.

The crane bales are annealed at 1100° F every 3 - 5 months. Ladles are repaired by welding with Stoody self-hardening welding rods.

Copper ladles 100 cu. ft. capacity holding 18 tons blister
Mattle ladles 150 cu. ft. capacity holding 19 tons 40% matte.

Empty ladle weights are:

Copper: 14,650 lbs.; matte: 15,500 lbs.

Use of lime spray for ladles gives easy shell removal.

The ladle bumper at Tacoma has an 8" cast copper plate over the reinforced concrete base.

Shell slag is loaded out on railroad cars by clamshell to the crushing mill for transfer to the fine ore bin where it is reburned on the roaster charge.

The copper skulls are loaded onto a "boat" for transfer to the converter, usually prior to the "finish" blow.

R. J. Turney