1200 0068

309

Item 91

Z-(11) X 0

ARIZONA COMSTOCK CORPORATION

DETAILS OF OPERATION COVERING PERIOD OF THREE YEARS AND FOUR MONTHS

by

W. J. Loring, President and Managing Director

and

A. F. McFarland, Mill Superintendent

-o-

DETAILS OF METALLURGICAL PLANT & RESULTS

When Arizona Comstock started in February, 1933, the flow-sheet was as follows:

One 20x10 Blake-type jaw crusher, followed by one #25 Kennedy gyratory crusher. This crusher was later replaced by a Kennedy #57 gyratory.

The ore after leaving the gyratory about 1¼" size, goes to the fine ore bin and then to a #64½ Marcy ball mill in closed circuit with a Dorr duplex classifier size 4½' by 18' and was ground to about 5% on a sixty-mesh screen, thence to a 6' x 9' conditioner and to an eight-cell Fahrenwald flotation machine at a density of about three to one.

The fine ore bin has never been enlarged, which is a bottle-neck in this flow-sheet, capacity 280 tons.

The concentrate from the first two cells was pumped to a 10' x 14' thickener tank, then filtered on a 4' x 5' Oliver filter, and shipped to the smelter at Selby, California.

It was found that the concentrate made from the ore treated to date cannot be filtered on an Oliver filter or any filter for that matter. The moisture is driven off by placing the concentrate in drying trays, heated by oil burners.

During the first few months, the mill operated only intermittently. In September, 1933, it started operating 24 hours per day. From September to December, 1933, inclusive the tonnage averaged 3,004 tons per month.

Milling conditions and results for this period:

Density of pulp	Grind	Reagents - Lbs. Per Ton				
		"501"	"208"	"Aero.15"	Creosote	F. Oil
3 to 1	5% on 60 M.	.15	.017	.08	.08	.17

Recovery	
Gold.....	81.04 %
Silver....	69.52 %
Total.....	77.12 %

Ratio of Concentration

78 : 1

The ore milled during the above period was sulphide ore and old gobs from stopes underground. On clean sulphide ore the extraction was as high as 92% of the gold and 70% of the silver. This condition existed for only a few hours at a time, as there was not enough sulphide ore to keep the mill supplied.

During the next seven months, from January to July, 1934, a fourteen foot Deister sand table was installed and operated between the ball mill and classifier to remove concentrate and free gold. The ore during this period was slightly more oxidized and contained considerable old gobs from the stopes underground. During the last three months of this period the ore came mostly from the open cut on the surface and contained very little sulphide.

During the last three months there was a sharp decrease in recovery.

A Hardinge 8' x 56" conical ball mill in closed circuit with a 6' x 28' Dorr duplex classifier, was added to the mill in June, 1934. The Marcy was closed down for the time being. The Deister table apparently made no difference in the recovery and was taken out of the circuit.

Milling Conditions and Results for the First Four Months of Above Period

Density of Pulp	Grind	REAGENTS - LBS. PER TON OF ORE				
		"301"	"308"	"Aero 15"	Barrett 4	P. Oil
3 to 1	5% on 60 M.	.15	.014	.05	.04	.12

Last Three Months of Above Period

Density of Pulp	Grind	REAGENTS - LBS. PER TON OF ORE				
		"Z-8"	"208"	"Aero 15"	Barrett 4	P. Oil
3 to 1	5% on 60 M.	.15	.01	.04	.05	.09

First Four Months Period

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 75.26%, Silver 65.07% Total 69.30 %	78 : 1	2,907

Last Three Months of Above Period

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 65.2 %, Silver 52.05%, Total 58.9%	115 : 1	5,132

The lower recovery during the last three months was due to higher tonnage without increasing flotation capacity and also to the open cut ore which is highly oxidized.

From August, 1934, to October, 1935, a Simpson flotation machine was installed and in use in the circuit. The tailings from the Fahrenwald flotation machine was pumped to the Simpson machine and an average of twenty-five cents per ton was taken out of the Fahrenwald tailing.

Hydraulic traps were also installed between the mill discharges and the classifiers during this period. The traps apparently made no difference in the extraction, but they produced some gold which was amalgamated in the cleanup barrel. The gold being coated with an oxide film, would not amalgamate without the use of acid to remove this film. About a quart of nitric acid is used to each charge in the cleanup barrel, or for about four or five hundred pounds of material from the traps.

During this time most of the ore came from the surface cut and was badly oxidized. A small part of the ore was from underground and dumps on the surface. The dump ore contains some sulphide. Both the Hardinge and the Marcy mill ran during all but the first two months of this period.

The flotation capacity was very low. The time of contact being not more than three minutes. In July, 1935, about three pounds of soft coal were fed into the ball mills, per ton of ore milled. This was added to build up the froth. After the coal had been used for about one month it was discarded and seven sacks of pine sawdust were used per

day in place of coal. It was thought the coal would give trouble later in the Cyanide Plant. Both the coal and the sawdust help to build up toe froth in the oxidized ore, and the sawdust is still being used for that purpose.

Milling Conditions and Results for Above Period

Density of Pulp	Grind	REAGENTS - LBS. PER TON OF ORE "Z-8"	"208"	"Aero 15"	Tarol	P.Oil
2½ : 1	5% on 60M.	.13	.01	.06	.045	.08

Recovery	Ratio of Concentration	Tons Ore per Mo.
Gold 66.27 %, Silver 51.95 %, Total 59.72 %	94 : 1	8,901

During the above period sodium sulphide was used part of the time, first in the secondary unit and later in the primary unit.

From November, 1935, to March, 1936, or during the next five months twelve Kraut rougher cells and four Kraut cleaner cells were added to the mill circuit. The pulp was split, half going to the Fahrenwald cells and half to the twelve Kraut rougher cells replacing the Simpson machine. This raised the time of contact to 5" in the flotation cells and raised the recovery of gold and silver. The rougher concentrate was pumped to the four Kraut cleaner cells. The ore was mostly oxidized from the surface open cut, a small tonnage coming from underground and dumps on the surface. The ratio of concentration was raised considerably by these cleaner cells.

Milling Conditions and Results for Above Period

Density of Pulp	Grind	REAGENTS - LBS PER TON OF ORE "Z-8"	"208"	"Aero 51"	P.Oil	MC111
2½ : 1	5% on 60 M.	.12	.01	.05	.14	.02

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 75.8%, Silver 58.2% Total 67.5%	188 : 1	10,143

From April, 1936 to August, 1936, or during the next five months, twelve more Kraut rougher cells were added to the circuit, making 7½" contact in the flotation cells. Reagent "X-1" was added to improve the froth conditions, there being an oily condition in the cells at times which has a tendency to flatten the froth. The "X-1" maintains a uniform froth.

Density of Pulp	Grind	REAGENTS-LBS.PER TON OF ORE "Z-4"	"Z-6"	"208"	"Aero 51"	P.Oil	MC111	X-1
2½ : 1	5% on 60 M.	.07	.07	.01	.035	.11	.03	.008

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 79.2%, Silver 58.7% Total 71.2%	301 : 1	10,158

The cleaner tailing up to this time have been turned back to the conditioner tank and was higher in value than the heads to the mill. It is believed that this product gave little or no extraction. In July the cleaner tailings were diverted to

day in place of coal. It was thought the coal would give trouble later in the Cyanide Plant. Both the coal and the sawdust help to build up toe froth in the oxidized ore, and the sawdust is still being used for that purpose.

Milling Conditions and Results for Above Period

Density of Pulp	Grind	REAGENTS - LBS. PER TON OF ORE "Z-8"	"208"	"Aero 15"	Tarol	P.Oil
2½ : 1	5% on 60M.	.13	.01	.06	.045	.08

Recovery	Ratio of Concentration	Tons Ore per Mo.
Gold 66.27 %, Silver 51.95 %, Total 59.72 %	94 : 1	8,901

During the above period sodium sulphide was used part of the time, first in the secondary unit and later in the primary unit.

From November, 1935, to March, 1936, or during the next five months twelve Kraut rougher cells and four Kraut cleaner cells were added to the mill circuit. The pulp was split, half going to the Fahrenwald cells and half to the twelve Kraut rougher cells replacing the Simpson machine. This raised the time of contact to 5" in the flotation cells and raised the recovery of gold and silver. The rougher concentrate was pumped to the four Kraut cleaner cells. The ore was mostly oxidized from the surface open cut, a small tonnage coming from underground and dumps on the surface. The ratio of concentration was raised considerably by these cleaner cells.

Milling Conditions and Results for Above Period

Density of Pulp	Grind	REAGENTS - LBS PER TON OF ORE "Z-6"	"208"	"Aero 51"	P.Oil	MCIII
2½ : 1	5% on 60 M.	.12	.01	.05	.14	.02

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 73.8%, Silver 58.2% Total 67.5%	188 : 1	10,145

From April, 1936 to August, 1936, or during the next five months, twelve more Kraut rougher cells were added to the circuit, making 7½" contact in the flotation cells. Reagent "X-1" was added to improve the froth conditions, there being an oily condition in the cells at times which has a tendency to flatten the froth. The "X-1" maintains a uniform froth.

Density of Pulp	Grind	REAGENTS-LBS.PER TON OF ORE "Z-4"	"Z-6"	"208"	"Aero 51"	P.Oil	MCIII	X-1
2½ : 1	5% on 60 M.	.07	.07	.01	.035	.11	.03	.008

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 79.2%, Silver 58.7% Total 71.2%	301 : 1	10,158

The cleaner tailing up to this time have been turned back to the conditioner tank and was higher in value than the heads to the mill. It is believed that this product gave little or no extraction. In July the cleaner tailings were diverted to

storage tanks at the cyanide plant until that plant was ready to operate. It was then treated in three Dorr agitators 16' x 28'. The air lift in the Dorr agitators produced a very heavy froth which made it difficult to get the washes off the charge. This froth was in some cases five or six feet in depth and cut down the amount of wash solution that could be used.

After substituting Devereaus agitators for the Dorr agitators no more trouble was encountered from froth.

The batch system is used. At first settling was very slow, but after heating the pulp with steam to about 80 degrees fahrenheit the settling rate was increased so that a wash could be taken off every twenty-four hours. The pulp is heated by introducing dry steam into the charge while agitating.

From September, 1936, to October, 1937, -- at the start of this period twelve Kraut rougher cells were added to the circuit, making four separate flotation circuits and increasing the contact time to ten minutes in the cells. The hydraulic traps were taken out of the mill and classifier circuits. A 16" x 24" Denver Equipment jig was installed in the Hardinge circuit and an 18" x 18" Pan American jig installed in the Marcy circuit.

These jigs were much more efficient than the traps that were taken out. They remove all of the free gold from the grinding circuit.

The ore during this period was mostly oxidized from the surface cut.

Milling Conditions & Results

Density of pulp	Grind	REAGENTS - LBS. PER TON OF ORE						
		A-4	Z-6	"208"	Aero 31	P.Oil	Minerac	X-1
2½ : 1	5% on 60 M.	.075	.075	.01	.09	.145	.008	.008

Recovery	Ratio of Concentration	Tons Ore Per Mo.
Gold 81.24%, Silver 56.56% Total 70.35 %	204 : 1	11,562

During the past four years, many reagents and combinations of reagents have been tried both in the laboratory and in the mill circuit but the above combination seems to give the most consistent results. Sulphidizing reagents and dispersing reagents do not seem to help. The circuit is about neutral normally, but the PH has been varied over a wide range, from five to nine without making any change in extraction.

The best ratio of water to solids is from 2½ to 3 : 1. The economic grind is about 5% on a 60 mesh screen. A finer grind gives a little better recovery but with the present equipment cuts the tonnage below the economic point. A coarser grind raises the tailings value above the economic point. With another grinding unit it might be possible to improve the results, by grinding the sands. The tailings loss being in the coarse sand and the fine slimes.

The gold recovery since getting into the oxidized ores from the surface cut seems to have improved in direct ratio to the time of contact in the flotation cells. The silver recovery, however, is subject to a change in the ore and the silver minerals contained, silver chlorite as carargyrite being hard to float, also where the silver is closely associated with manganese in the ore the recovery is low. Jarosite was encountered in a certain section of the open cut and silver from this area is very hard to float

Stephanite was encountered in the open cut and the recovery of both silver and gold from this section of the mine is better than any thus far milled from the open cut to date, the gold recovery being about 90% and the silver about 70%.

The ratio of silver to gold in the ore varies considerably from month to month, it being as high as 42 : 1 and as low as 18 : 1. The less silver, of course, the better the total extraction. Laboratory tests show that by removing the primary slimes from the ore before going to the ball mill a ten percent better recovery is made on the balance of the ore by flotation. Also, less reagents are needed. The primary slime constitutes about 14% of the ore and contains about 8% of the value. This slime when floated gives 62% recovery.

TONNAGES MILLED AND COSTS

Year			
1935	Tons Milled		115,910
	Total Cost per Ton (Before Depreciation and Depletion)	$	3.41
1936	Tons Milled		124,179
	Total Cost Per Ton (Before Depreciation and Depletion)	$	3.08
1937 to 9/30/37	Tons Milled		104,193
	Total Cost Per Ton (Before Depreciation and Depletion	$	3.02

Note: The above costs cover the following:
(Period 1/1/37 to 9/30/37 as example)

Mining, Underground and Open Cut Surface	$		1.14
#Milling: Crushing	$	.26	
Grinding		.43	
Flotation and Amalgamation		.45	
Cyaniding Concentrate		.20	1.34
##Marketing			.11
##Price Differential			.10
General & Administration & Miscellaneous			.33
Total			$3.02

#Attention is called to the items indicated due to obsolete crushing plant. The cost here is sixteen cents higher than it should be.

##Marketing and Price Differential are entirely due to shortage of funds to install a concentrate treatment plant and produce bullion in place of drying and shipping concentrate.

For the years 1935-36 and the first nine months of 1937 the following figures are shown: Tons ore treated 344,282; excessive cost due to incomplete and obsolete plant, $127,396.00, or 37¢ per ton.

It will be seen how wasteful it is to depend upon plant of the kind that is incomplete and out-of-date for low costs and metallurgical standard recoveries.

There has been no comparison shown between the actual results obtained with a complete up-to-date plant.

First: The same effort would have treated a greater tonnage.

Second: The cost would have been 37¢ per ton less than it actually was.

In any event, the operation has continued to function under the above conditions.

There are three tailing dams, as follows:

Dams #1 & 2	235,466 tons	@	$ 2.11.....	$ 497,496.00
Dam #3	109,391 "	@	1.17.....	127,833.00
Total to 10/31/37	344,857 tons	@	$ 1.81.....	$ 625,329.00
Production to 10/31/37,	438,139 tons	$5.52		$2,331,678.00
Total sales of Production to 10/31/37				$1,532,215.00

The difference, as shown above, is due to no tailing dams in the early operation of this property and to a cloud-burst that washed the first dam out.

The average extraction from the beginning of operations to date of gold and silver is 64.2%, although the average is above 70% at present.

As to the probable life of the property, it is safe to say that there is in excess of ten year's ore and perhaps much more in the great Comstock Lode of which this property consists of 2,571 feet along the Lode. The average value is far above the results so far obtained because nearly all ore has been mined from the surface, while the ore from underground is at least $3.50 per ton higher in value.

CONCLUSION

Taking only the years 1935p36 and nine months of 1937 as the actual tonnage treated and average value of same, the following is shown: Tons treated 344,282.

Ore values used in this paper are based upon gold at $35.00 and silver at 77½¢ per ounce for the past two and one-half years.

The reduction in cost of 37¢ per ton is offset by a cost of 50¢ per ton for treating tails by cyanide making an increase in total cost of 13¢ per ton when the complete plant would be in operation including the cyanide plant for the tails.

This complete plant would have added 22% to the recovery, therefore, the

total values recovered would have increased by	$371,000.00
Less increase in costs @ 12¢ per ton	44,000.00
Net increase in Operating Profit	$327,000.00

It will be noted that the foregoing shows that the cost to treat the entire tailing will be accomplished at a total of thirteen cents per ton. In other words, when the metallurgical plant is complete, and general improvements have been made, a saving will be effected of thirty-seven cents per ton based upon the present setup, but when the tailings are cyanided at an additional cost of fifty-cents per ton, the actual added cost compared to present cost will be thirteen cents per ton.

It is proposed to cyanide all of the concentrates, as many tests show that by grinding the flotation concentrate to minus 600 mesh that ninety-nine percent plus of the gold and ninety-eight and one-half per cent of the silver is recovered.