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MSM
HISTORICAL
COLLECTION

THESIS

FOR THE DEGREE

OF

ENGINEER OF MINES

BY

LAMAR HORACIO HUNT.

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"DESIGN OF 300 TON CYANIDE TAILINGS PLANT AND OPERATION OF SAME".

June 1910

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MSM
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DESIGN OF 300 TON CYANIDE TAILINGS PLANT

AND

OPERATION OF SAME.

oOo

The plant in question was designed by the writer, to treat the immense tailings dumps of the Sacramento Gold Mining Company at Mercur, Utah, consisting of one-half million tons of old cyanide tailings.

The ore is porous and friable, causing much slime, which is impermeable to cyanide solution, by the old leaching system. Slime has always been troublesome, and the above plant was designed to overcome this difficulty.

The ore as originally treated, consisted of crushing in a Gates Crusher, then passed through rolls and finally leached. This process has proved to be unsuccessful on account of the slime that the pulp contained, the solution remaining on top of the ore instead of percolating through it. After many attempts to treat the ore successfully, the old Sacramento Plant was forced to shut down after a highly profitable run of eleven years, most of which time less slime was encountered, than at the time of shutting down.

In order to determine the value of the dump, iron pipes were sunk at intervals of 25 feet, all over the surface and the sides. First an eight foot pipe was sunk into the ground, and then withdrawn and the core knocked out. A second pipe was sunk to 12 feet, and a third to 16 feet.

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The average of these samples was taken as the average for the first eight, twelve and sixteen feet respectively. Pipes could have been sunk deeper into the dump, but the average of the above samples was so satisfactory that it was not considered necessary.

TESTS.

To determine the method and cost of treatment, a number of tests were made by the writer in the Plant of the Holderman Filter Tank Company of Salt Lake City, Utah, which company kindly gave me the use of their laboratory.

TEST NO. 1.

An average sample was taken, dried, weighed, sample taken for assay, and screen tests made under water, the results being as follows:

Assay General Sample $2.10

	On 1/4" Screen	On 20 Mesh	On 80 Mesh	Through 80 Mesh
	37.6%	24.6%	6.4%	31.4%
Assay	$1.20	$1.40	$.90	$.80

This test was a great surprise, and could not be understood until another sample was taken and dried and the screen tests made dry.

TEST NO. 2.

	On 1/4" Screen	On 20 Mesh	On 80 Mesh	Through 80 Mesh
	38.2%	25.3%	6.7%	29.8%
Assay	$1.20	$1.40	$2.60	$3.80

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This went to show that the values are already more or less dissolved and probably in the form of a double cyanide of gold and potassium, as most of the values as seen by test No. 1 were washed but by clear water, while in test No. 2, which was made dry, the values remain. To further demonstrate this, the samples of test No. 2 were washed thoroughly with water and the following results obtained:

TEST No. 3.

	On 1/4" Screen	On 20 Mesh	On 80 Mesh	Through 80 Mesh
Assay	$1.00	$1.20	$1.10	$.90

From the above results two important points were determined:

1st - Values mostly in solution.

2nd - Values mostly in the slime.

Another series of tests were made to determine, time of treatment, consumption of cyanide, and lime.

TEST No. 4.

	On 1/4" Screen	On 20 Mesh	On 80 Mesh	Through 80 Mesh
Heads	$1.20	$1.30	$2.40	$4.20
Tails	.90	1.10	1.00	.80

In the above test the samples were washed for 30 minutes in a 1 Pound Cyanide solution.

TEST No. 5.

	On 1/4" Screen	On 20 Mesh	On 80 Mesh	Through 80 Mesh (Slime)
Heads	$1.10	$1.40	$2.20	$4.00
Tails	.50	.50	.40	.50

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In the above test the sand was leached for 24 hours and the slime agitated for 4 hours.

TEST No. 6.

	On 1/4" Screen	On 20 Mesh	On 80 Mesh	Through 80 Mesh (Slime)
Heads	$1.20	$1.30	$2.40	$3.80
Tails	.50	.40	.40	.50

In the above test the sand was leached for 48 hours and the slime agitated 12 hours. The extraction was about the same as for Test No. 5, the longer time did not dissolve much more of the values, showing that a certain amount of the gold is insoluble or is not acted upon by the Cyanide. Possibly some of the gold is in combination with Arsenic or Antimony, and would only be acted on by the Cyanide after roasting, and so small amount is insoluble that this would be out of the question, so far as profit is concerned.

TEST No. 7.

	STRENGTH SOL.	HEADS	TAILS	STRENGTH SOL.	TAILS
On 1/4" Screen	1# KCN 1#CaO	1.20	.50	2# KCN 2#CaO	.50
On 20 Mesh	1# KCN 1#CaO	1.40	.40	2# KCN 2#CaO	.40
On 80 Mesh	1# KCN 1#CaO	2.40	.40	2# KCN 2#CaO	.40
Thru 80 Mesh	1# KCN 1#CaO	4.10	.50	2# KCN 2#CaO	.50

In the above test the 1# or .05% solution gave as good an extraction as the .10% solution and with a consumption of Cyanide of 0.4# per ton of ore, while with a 2# solution the consumption was 0.6# per ton of ore. The consumption of lime was 1.9 pounds in the first case and 2.4 pounds in the second case, per ton of ore.

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From the above experiments we find that 24 hours leaching and 4 hours agitating is all that is necessary to obtain a maximum extraction, and that with a very dilute solution of 1# KCN and 1# CaO per ton.

PLANT.

The old tailings are scraped into a small bin by horses and tongue scrapers, from which it is drawn into cars and trammed into the 150 ton bin at the mill, some 150 feet away. The tailings,or ore, is now fed by a plunger feeder with a 12 inch stroke, into an 18 foot mixer-classifier. This is an improvement on the old log washers used for washing coal. It consists of a rectangular box 18 feet long, 2 feet 8 inches deep and 2 feet 7 inches wide, set at an angle of 11° with the horizontal. In the center of the box is a shaft 4 inches in diameter, made of double extra strong wrought iron pipe, on which is bolted a series of blades, spaced 6 inches apart. When the shaft revolves, these blades mix up the ore and solution, the coarse material is gradually worked up to the top, on the principal of a screw conveyor, while the fine sand and slime flows off at the lower end over a baffle board into a 4 inch pipe. The coarse material discharges into a second mixer-classifier, where it is washed a second time.

The fine sand and slime from both mixer-classifiers discharges into a 6 foot hydraulic classifier, where it undergoes a second classification, the overflow is fed to

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three large slime tanks 14' diameter x 24' deep, while the underflow is fed to the sand tanks to be leached.

The coarse product from the second mixer discharges onto a conveyor belt and is thence taken to the leaching tanks, six in number, 9' deep x 16' diameter. Here it is leached for 24 hours, with a 1# KCN solution, washed, drained and then shoveled onto a conveyor belt, which discharges the tailings on the dump.

The slime from the hydraulic classifier enters the cone bottomed slime tanks at the center and is diverted to the bottom through a 12 inch diameter cylinder, where the slime is unable to rise as fast as the solution, on account of the ascending current being reduced by the increased area of the tank. The clear solution overflows at the top into a launder around the rim of the tank, and is carried by a 3 inch pipe to the Gold Tank. When a slime tank is full of slime the slime is sent to one of the other slime tanks, and the slime is settled and the rich solution decanted off and sent to the gold tank. A tank of slime is collected on each shift. This gives a shift for filling, a shift for settling and decanting and a shift for sending to the filter plant.

FILTER PLANT.

The filter plant consists of 2 steel tanks 9'2" x 12'6" x 10' to bottom of cone. Each tank contains 30 filter leaves, which consist of a frame of pipe over which two pieces of

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16 Oz. duck is stretched. The duck is sewed together on the sides and a number of seams are made 2 inches apart, in between which a 1 inch grooved slat is placed. The frame has a plug placed inside the pipe on opposite corners, so that when the vacuum acts the solution is drawn from the bottom of each leaf, while the pressure of air and water acts at the top of the leaf. The tank is first filled with slime, then the vacuum is put on for 30 minutes, the excess slime is drawn off to the excess slime tank by gravity to be afterwards pumped to the excess slime tank above the filter level, to be used again. Wash water is then run into the filter tank, the vacuum put on and the cake thoroughly washed, air and water is then forced on the inside of the filters and the cake discharged. The excess wash water is drawn off by gravity to the excess wash water tank to be afterwards pumped to its respective tank, above the filter level, to be used over again.

GOLD TANK.

The solution collected in the gold tank is sent through 4 zinc boxes 2' x 2-1/2" x 16' each, with 7 compartments, and thence to the 8' x 18' sump, from which it is pumped by a 3" centrifugal pump to the 12' x 14' solution tank, at the head of the mill, to be used over again.

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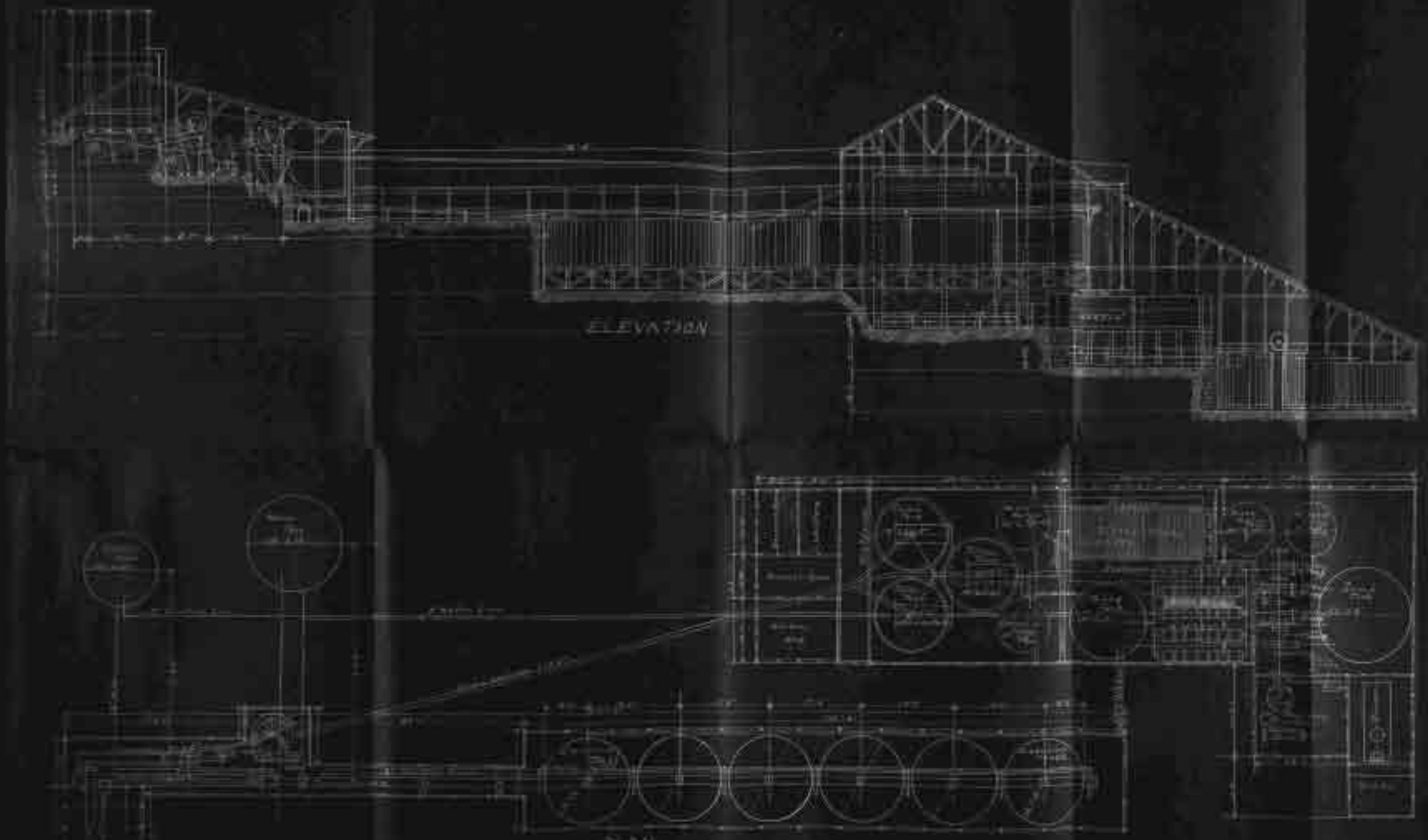

CYANIDE PLANT
UTAH-NEVADA M[illegible] CO.
MERCUR, UTAH