1914

Design of a 250 ton mill, for cyanidation of a cobalt silver ore

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Department:

DESIGN OF A 250 TON MILL,

for

CYANIDATION OF A COBALT SILVER ORE.

by

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A

THESIS

submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI

in partial fulfillment of the work required for the

DEGREE OF

ENGINEER OF MINES.

Rolla, Mo.

1914.

Approved by Horace T. Mann

Instructor in Metallurgy.

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INTRODUCTION.

My aim in the designing of this 250-Ton Mill for cyanidation of a Cobalt Silver Ore, has been to select the simplest process of extraction in connection with the Labratory Experiments which showed the highest per cent of extraction.

Care has been taken in the selection of the machinery, and the location of it in the Mill is such, that if a greater capacity is required, that could be done without interfering with the machines in the Mill in question.

CHARACTER OF THE ORE.

Very fine particles of metallic silver constitute the values in this ore, also silver is present in combination with sulphide of Cobalt and Nickel...etc.

The greater part of the gange is crystals of calcite with a small percent of limonite...etc.

The ore is soft and easy to slime on account of the calcite.

Several pounds of ore were ground to pass a 20 mesh screen and 80% of that could pass through 150 mesh.

Plate No 1

Showing Results obtained by Percolation

No	Wt. of Ore	Size	Quantity Solution	Strength of Solution	Time of Contact	KCN Consumption	Assay of Sample	Assay of Residue
	A.T.	Mesh	A.T.	KCN%	Hours	Pounds per ton	Ounces of Silver per ton	
1	1	30	1	.1	72	1.2	16.60	12.64
2	"	"	1	.3	"	1.4		14.56
3	"	"	1	.5	"	2.0		5.54
4	"	"	3	.1	"	3.6		11.04
5	"	"	3	.3	"	4.6		12.66
6	"	"	3	.5	"	6.5		7.56
7	"	"	1	.1	168	1.6		11.42
8	"	"	1	.3	"	1.8		12.26
9	"	"	1	.5	"	4.0		4.20
10	"	"	3	.1	"	42		10.12
11	"	"	3	.3	"	68		11.40
12	"	"	3	.5	"	10.8		5.48
13	"	50	1	.1	72	1.0	10.04	6.20
14	"	"	1	.3	"	2.0		4.76
15	"	"	1	.5	"	4.8		5.22
16	"	"	3	.1	"	5.0		6.46
17	"	"	3	.3	"	5.2		5.20
18	"	"	3	.5	"	6.0		6.32
19	"	"	1	.1	168	1.5		5.60
20	"	"	1	.3	"	3.4		6.04
21	"	"	1	.5	"	5.4		4.64
22	"	"	3	.1	"	43		7.00
23	"	"	3	.3	"	5.6		5.00
24	"	"	3	.5	"	8.8		6.64
25	"	80	1	.1	72	0.8	7.24	6.78
26	"	"	1	.3	"	1.0		4.32
27	"	"	1	.5	"	3.2		6.04
28	"	"	3	.1	"	4.2		5.12
29	"	"	3	.3	"	6.0		3.66
30	"	"	3	.5	"	10.0		3.46
31	"	"	1	.1	168	1.6		4.00
32	"	"	1	.3	"	3.6		3.80
33	"	"	1	.5	"	6.0		2.80
34	"	"	3	.1	"	5.4		3.80
35	"	"	3	.3	"	6.0		3.00
36	"	"	3	.5	"	10.0		2.86
37	"	120	1	.1	72	1.8	4.82	4.34
38	"	"	1	.3	"	4.0		4.24
39	"	"	1	.5	"	8.0		4.30
40	"	"	3	.1	"	5.2		3.00
41	"	"	3	.3	"	9.0		2.96
42	"	"	3	.5	"	11.0		2.98
43	"	"	1	.1	168	1.8		2.46
44	"	"	1	.3	"	5.0		2.96
45	"	"	1	.5	"	6.8		1.56
46	"	"	3	.1	"	5.4		2.56
47	"	"	3	.3	"	10.0		2.82
48	"	"	3	.5	"	12.0		1.62
49	"	150	1	.1	72	1.7	5.20	4.82
50	"	"	1	.3	"	4.2		4.58
51	"	"	1	.5	"	7.6		4.90
52	"	"	3	.1	"	5.6		4.20
53	"	"	3	.3	"	7.2		3.00
54	"	"	3	.5	"	9.0		1.80
55	"	"	1	.1	168	1.9		1.60
56	"	"	1	.3	"	4.8		1.40
57	"	"	1	.5	"	9.0		1.60
58	"	"	3	.1	"	5.0		1.80
59	"	"	3	.3	"	10.0		1.86
60	"	"	3	.5	"	12.1		2.00

Plate N° 2

Showing Results obtained by Agitation

N°	Wt. of Ore	Size	Quantity of solution	Strength of Solution	Time of Contact	KCN Consumption	Assay of Sample	Assay of Residue
	A.T.	Mesh	A.T.	KCN%	Hours	Pounds per ton	Ounces of Silver per ton	
1	1	150	2	.1	24	2.0	9.64	2.60
2	"	"	"	"	"	2.1	"	2.56
3	"	"	"	"	"	2.0	"	2.58
4	"	"	"	"	"	2.0	"	2.52
5	"	"	"	"	"	1.9	"	2.60
6	"	"	"	"	20	1.8	"	2.80
7	"	"	"	"	6	1.4	"	7.66
8	"	"	"	.3	30	3.6	"	3.16
9	"	"	"	"	30	4.0	"	4.08
10	"	"	"	.1	36	2.2	"	2.46
11	"	"	4	"	24	2.8	"	2.48
12	"	"	3	.05	24	1.4	"	4.80
13	"	"	3	.1	36	2.5	"	2.40
14	"	"	4	"	"	3.0	"	2.40
15	"	"	6	.05	"	1.8	"	4.40

LABRATORY EXPERIMENTS.

Several experiments were performed in order to find out if a good extraction could be made:

1st-By percolation.

2nd-By agitation.

Table No.1 shows the results obtained using the system of percolation.

Table No.2 shows the results obtained by agitation.

At the same time the following were also determined:-

1st. Experiment-

Value of the ore per ton- this was determined by assaying 8 samples of the ore passed through 30 mesh screen. The results were:-

Ounces of silver per ton of ore.

11.84
9.74
9.16
9.20
9.20
8.44
8.68
10.96

Average = 9.64 ounces of silver per ton or,

$4.82 when the price of silver is $.50 per Troy ounce.

Note:-The difference in the results is caused by the metallic silver present in the ore.

2nd.Experiment-Assay of the classified product used in the experiments shown in Table No. 1.

3rd.Experiment-Size to which it is necessary to crush the ore so that the silver can be extracted by cyanide.

4th.Experiment-The strength of solution for the best extraction.

5th.Experiment-The best time of contact of solution with the ore.

6th.Experiment-The ratio of ore to solution.

7th.Experiment-The KCN consumption.

8th.Experiment-Determination of the most suitable quantity of CaO to be added to the ore. 6 samples containing 1/2 A.T. of ore each were mixed with 0.1%, 0.2%, .3%, .4%, .5%, .6% CaO and 50 CC of a .5% KCN solution was added and those samples were agitated for one hour and the solution titrated with $AgNO_3$ solution. The results were as follows:-

Silver Nitrate used.

No. 1----------9.1 C.C.

" 2----------9.3 " "

" 3----------9.6 " "

" 4----------9.7 " "

" 5----------9.8 " "

" 6----------9.8 " "

After No. 5 we do not save more KCN by adding more lime.

CONCLUSIONS as to CHARACTER of the MILL REQUIRED.

A comparison of the results obtained in the tests run on this Cobalt Silver Ore, shows readily that the ore ought to be treated by agitation. We can see that the percolation tests as shown in Plate No. 1 gave not only a low per cent of extraction but at the same time a great loss of cyanide.

Classification by sizing is not profitable on account of the low grade of the ore. The classified ore passing through 150 mesh runs 5.2 ounces of silver per ton, while the 30 mesh only runs 16.64 ounces as shown in Plate No.1. The concentration of the metallic parts is not great enough to pay for a mechanical concentration process followed perhaps by amalgamation. The ore is low grade and would not pay if treated under an expensive process of concentration and then of extraction.

Plate NO.2 shows that the greater per cent of extraction with the least cost of KCN and at the same time with the least time of contact is obtained with the agitation process. This kind of treatment gives a total extraction of $3.59 out of $4.82 that the ore contains.

Therefore, all my aim was to design a Mill where the ore could be treated under a process of agitation.

The ore will be in contact with the solution as soon as it passes out of the bins and agitated until the end of the process.

DESCRIPTION OF THE MILL.

The ore bin was designed so as to have two compartments. The elevation of the bottom of the compartments above which the grizzly is located, is 2 feet, 3 inches lower than the bottom of the compartment into which the oversize drops.

The ore is dumped over 1 inch grizzly, 4 feet wide by 10 feet long, the oversize drops by gravity into one of the compartments of the bin, and the undersize drops into the compartment under the grizzly. Each compartment has a 36 in. X 36in. ore gate.

The undersize is fed by gravity into a 48in.X 10 ft. trommel with 0.2 inch holes. The oversize is fed also by gravity to a 9 X 15 BLAKE CRUSHER, giving a product 1 inch size. This product drops into the LAUNDER which feeds the undersize to the trommel.

The undersize of the trommel goes by gravity to two Dorr Classifiers set in parallel, and the oversize drops to a pair of Rolls 15 by 26inches, located under the trommel. The product of those rolls is elevated by a 9 X 9 in. single head bucket elevator and dropped into the upper part of the trommel.

The slimes from the classifiers are pumped by two 8 by 54 inch Frenier pumps, to two Dorr Thickners, diameter 30 by 10 feet deep for agitation in the proportion 1:2. The sands from the classifiers drop into two Harding Pebble Mills 8 ft. by 72in. The product from these mills will be returned by gravity to the classifiers.

This makes a closed circuit which has for it's object the removal of all the fine material from the ore before feeding to the mills, and second, to avoid any particle larger than 0.2in. to be fed to the mills, at the same time a greater amount of fines are obtained and less work for the mills and crushers are secured.

The pulp coming from the Dorr Thickners will be elevated by one 8 by 54 inch Frenier Pump, to a pair of 30 by 16 foot Dorr Agitators connected in series; the overflow goes into one 15 by 15 foot tank from which the solution is pumped by a Taylor's Centrifugal Pump NO.2, to a 4 by 4 by 20 foot frame clarifying press.

The cake formed in that press will be returned to the agitators and the solution will go by gravity into the zinc dust precipitation tank. After the precipitation process, the precipitate and the solution

will flow still by gravity into two Merrill Precipitation Presses. The precipitate from the presses will go to the refinery and the solution will be pumped by a Taylor Centrifugal Pump No.2 to Thickner No. 3.

A system of continuous decantation is used by means of four more 30ft.X 10ft. Dorr Thickners, classified as NO.1,NO.2, No.3 and No.4 Thickners. No.4 Thickner will be set 3 feet higher than No.1 so the over flow of N0.4 will go by gravity to NO.3 the overflow of this will go by gravity to NO.2 and the overflow of NO.2 will go by gravity to NO.1 Thickner.

The process will be as follows: The pulp in the proportion of 2 of solution for 1 of slimes coming from the agitators, will drop by gravity into Dorr Thickner NO.1 The underflow of this will be pumped to Dorr Thickner NO.2 by one 8in. X 48in. Frenier Pump, the underflow of this will be pumped to Dorr Thickner NO.3, by one 8in.X 48in. Frenier Pump. The underflow of this will be pumped to Dorr Thickner NO.4, by one 8in.X48in. Frenier Pump, the underflow of this will go to waste.

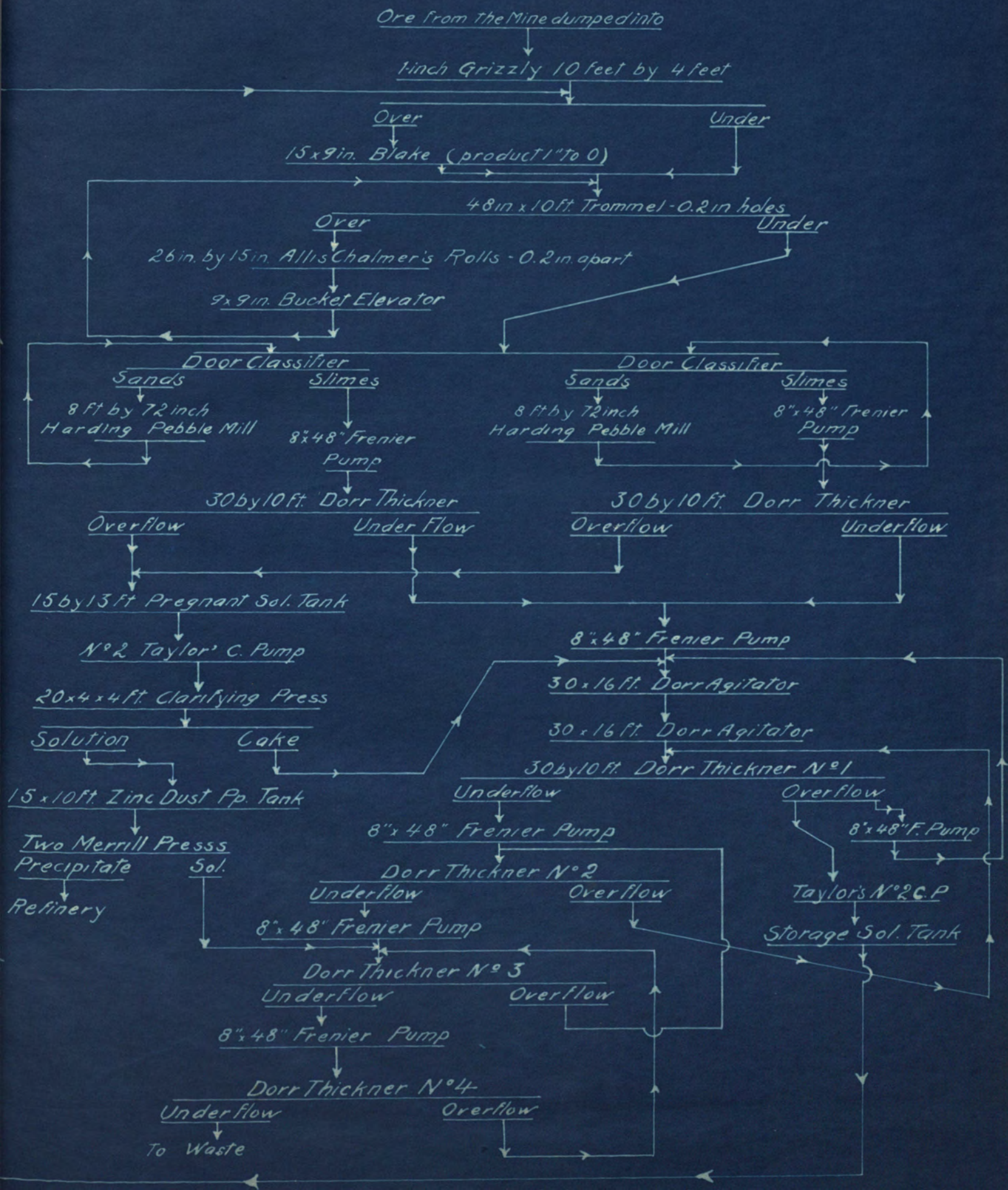
The overflow of Thickner NO.1 is:

1st---500 Tons of solution that are pumped 39½ feet high, by a Taylor's Centrifugal Pump NO.2, giving 953 R.P.M. to the storage solution tank, located 18ft. 4in. above

the overflow discharge pipe of the Thickner NO.1 .

2nd--112½ Tons will be pumped to the Dorr Agitators by one 8in.X48in. Frenier Pump. From NO.2 Thickner will overflow to NO.1 Thickner, 500 Tons of solution. From NO.3 to NO.2 will overflow 500 Tons of solution, 425 tons coming from the two Merrill Presses and 75 tons overflowing from NO.4 Thickner. NO.4 Thickner is fed with 75 tons of water, from the water storage tank located 20 feet above the top at the storage solution tank. The solution is fed at the Blake Crusher and at the Lauder connecting the undersize of the grizzly with the trommel. The flow of solution is illustrated in Plate NO.4 During the total process the ore is in contact with the solution and in continuous agitation.

Plate N° 3
Flow Sheet of Mill



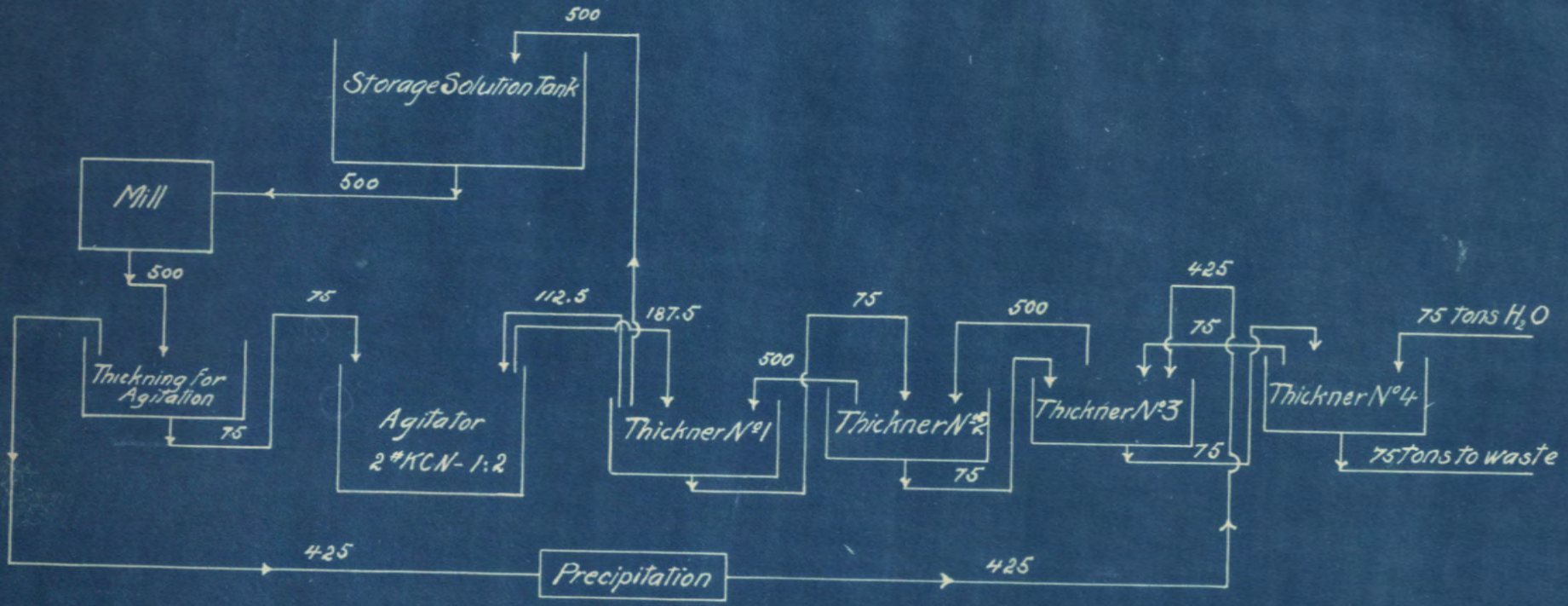


Plate N°4

Flow Sheet of Solution

Figures apply to solution only

SPECIFICATIONS.

GRIZZLY.

There shall be two grizzly's, one 4 feet wide by 10 feet long. It shall have a slope of 45°. The openings between the bars at top will be 1 inch. The other grizzly will be 2½ feet wide by 5 feet long and shall have a slope of 45°. This second grizzly will be located at right angles to the 4ft. by 10ft. grizzly and sloping towards the com-partment of the bin, as per plans.

Those two grizzly's shall be built of steel bars of taper section, 2/8 inch by 3/4 inch by 3 inches, and the bars will be held together by throughgoing bolts, with taper washers placed between the bars. The weight of those two bins is about 2500 pounds. Upright sides of 3 inch lumber will be constructed for both grizzly's, lined with 3/8 inch steel plate.

The lower part of the 2½ ft. X 5 ft. grizzly will be held in place by a bar of iron 1 inch by 2½ ft. shaped and bolted to the timber above, as per plans.

ORE-BINS.

The bin is divided into two compartments 9½ feet wide by 19 feet, 5 inches long, by 22 feet deep, each. Those two compartments shall have sloped bottoms, which will have a difference of elevation of 2 feet, 3 inches.

The compartment to hold the undersize from the grizzly will be lower. The slope shall be 45° The bottom of those compartments will begin 5 ft. and 3 ft. respectively, below the bottom of the cap timbers. The floor of the bins will be of 1 inch boards over 2 inch planks, supported on 6 in.X 8in.timber, 1 foot apart and at right angles of the 6in.X 8in.timber, will be 12in.X 12in. lumber, 2 feet apart. All parts and caps are to be made of 12in. X 12in. timber, framed as shown in plans.

Each compartment shall have one Ore-Gate 36in. by 36inches.

This bin has a combined capacity of 400 tons.

The sides will be lined with steel plates 1/8 inch thick, and the bottom with 1/4 inch plates.

BLAKE.

It shall be a 9 X 15 Allis-Chalmers,Blake Crusher. The driving pulley of this crusher is 24 inches in diameter by 12½ inches face, and runs at 250 R.P.M. requiring 15 H.P. to run.

TROMMEL.

It shall be a Trommel 48 inches in diameter, by 10 feet long, and with 0.2 inch holes. This trommel will make 16 R.P.M. and will be placed as per accompanying plans. 5 H.P. required to run it.

Rolls.

It shall be a pair of Rolls style A, 15 X 26 Allis-Chalmers. Size of driving pulleys are; one 72 in. X 12 in. and one 48 in. X 8 in., runs at 100 R.P.M. 15 H.P. is required to run this machine. It weighs about 16,500 pounds.

ELEVATOR.

It shall be one 9 X 9 single head bucket elevator. Belt 10 inches in width and 23 feet,4 inches,center to center. It will require 8 H.P. running at full capacity.

CLASSIFIERS.

There shall be two Dorr Classifiers which mechanisms shall be mounted in a wood trough to be constructed by the purchaser in accordance with drawings furnished by the Dorr Cyanide Machinery Company. 2 H.P. is required to run these classifiers.

MILLS.

There shall be two Harding Pebble Mills, 8 feet diameter by 72 inches. A Pebbel Mill charge of 10,000 pounds of pebbles shall be used in each mill. They shall be direct connected to 40 H.P. motor and located as per plans.

A Silex (flint Blocks) to be cemented in place, will be used as lining in those two mills.

A feeder, Harding's Patent Reversible Scoop Type, will be attached by extension piece to each mill and

Motor's and Mills will be mounted on concrete foundations as per plans.

THICKNERS.

There shall be six Dorr Thickners with wooden tanks 30 feet diameter by 10 feet each,as furnished by the Dorr Cyanide Machinery Company.

Two of these Thickner's will be used to thicken the pulp for agitation in the proportions 2 of solution to 1 of slimes. The other four will be used in connection with the continuous decantation process used in this mill. 0.5 H.P. requires each Thickner.

These Thickner's must be mounted as per plans:

NO.1--Thickner will be 4½ feet high.

" 2--Thickner will be 5½ feet high.

" 3--Thickner will be 6½ feet high.

" 4--Thickner will be 7½ feet high.

AGITATORS.

There shall be two Dorr Agitators with wooden tanks 30ft. diameter by 16 feet, as furnished by the Dorr Cyanide Machinery Company. About 2 H.P. is required for each machine to run. They will be mounted as per plans.

TANKS.

One 15 feet diameter by 13 feet tank , made of 2½ inch redwood, banded with log hoops, shall be re-

quired to receive the pregnant solutions overflowing from the first two Thickner's and located and mounted on a concrete floor 2 feet high and 16 feet in diameter, at an elevation as per plans. This tank will hold 74 tons of solution.

Another tank for the precipitation of the silver from the KCN solution by means of Zinc Dust. It shall be of 15 feet diameter and 10 feet deep. This tank will be mounted in foundations 5 feet high. One storage solution tank 35 feet in diameter by 20 feet deep, mounted in concrete foundations 2 feet high and 36 feet in diameter, at a level of 35 feet and 4 inches higher than the Thickner's floor level. The capacity of this tank is 620 tons of Solution.

There shall be one tank for water of the same capacity and mounted 20 feet higher than the storage solution tank.

Those two tanks shall be made of 3½ inch redwood banded with log hoops.

PRESSES.

There shall be one 20 ft. X 4ft. X 4ft. frame press for clarification of the pregnant solution and mounted as per plans, 18 feet high.

There shall be two Merrill Precipitation Presses 4 feet by 12 feet.

PUMPS.

Three Taylor's Centrufugal Pumps will be used, one Taylor's C.P. , NO.2, giving 953 R.P.M. will lift

38 feet 4 inch, the overflow from Thickner NO.1 to storage solution tank. Will require a 4 H.P. Motor direst connected.

One Taylor's Centrifugal Pump giving 603 R.P.M. will be used to lift 22½ feet, the pregnant solution to the clarifying press. A 6 H.P. direst connected motor is required.

One Taylor's Centrifugal Pump giving 953 R.P.M. to lift 18 feet high the solutions coming from the Merrill Press the Dorr Thickner NO.3, an 8 H.P. direct connected is required to run this pump.

Two 8in. X 48 in. Frenier pumps will be used in connection with the Classifiers, the solution and slimes will be lifted 15 feet.

One 8 in. X 48 in. to be used in connection with the Thickners for agitation, lifting the underflow of both Thickners to the agitator NO.1 4 more Frenier Pumps 6 in. X 54 in. are used in connection with the other four Thickners. These pumps require an average of 2 H.P. They shall be located and mounted as per plans.

Other Machines...as motor...etc. will be specified under the head "Power Transmission".

POWER TRANSMISSION.

All the above described machinery will be driven by motors, pulleys, shafting, bearing, belting..etc. as per specifications.

1.50 H.P. General Electric Company D.C.Motor 4 poles, Form H. Pulley, 14¾ inches diameter, 13¾ inches face, to be run at 220 volts, 840 R.P.M. 1 starting rhoestat for same.

This motor will be connected as per plans, and will drive the following machinery: Blake, Trommel, Elevator, Rolls.

120 H.P. General Electric Company, slow speed D.C.Motor, Type M, Form H. Pulley, 10 inches in diameter, 10½ inch face, to be run at 220 volts and 745 R.P.M. 1 starting rhoestat and one speed regulator for same.

This motor is intended to drive the Thickners, agitators and pumps, as per plans.

2-40 H.P. General Electric Company D.C. 220 volts to be direct connected to the mills, as per plans, 1 starting rhoestat for same.

1-8 H.P. General Electric Company, 220 volts D.C. motor, to be direct connected to a Taylor's Centrifugal Pump NO.2, to lift the overflow of Dorr Thickner NO.1 to storage tank. Speed regulator and rhoestat for same.

1-6 H.P.General Electric Company, 220 volts D.C. Motor, to be direct connected to a Taylor's Centrifugal Pump NO.2, to lift the pregnant solutions to the clarifying press. Speed regulator and rhoestat for same.

1-8 H.P. General Electric Company, 220 volts D.C.Motor, to be direct connected to a Taylor's Centrifugal Pump NO.2, to lift the solution from the Merrill Presses to Dorr Thickner NO.3. Speed regulator and rhoestat for same.

SHAFTING.

All shafting to be cold rolled steel key-seated to suit pulleys , as per plans:

NO.pieces	Length	Diameter in inches.
1	25 feet	$2^{11}/16$ inches
1	55 "	$1^{7}/16$ "
2	90 "	$1^{7}/16$ "

To transmite, respectively:

50 H.P. at 202 R.P.M.

7 H.P. " 118 R.P.M.

13 H.P. " 135 R.P.M.

BEARINGS.

2 rigid pillow blocks, wick oiling for $2^{11}/16$ in. shafting, with bolts, nuts and washers for 12 inch timber.

2 rigid pillow blocks, wick oiling for $1^{7}/16$ in. shafting, with bolts, nuts and washers for 10 inch timber.

10 shaft hangers, ring-oiling, ball and socket head for a $1^{7}/16$ inch shafting, with bolts, nuts and washers for a 4 inch timber.

PULLEYS.

All pulleys shall be of cast iron, bored to suit shaft size, they shall be key-seated and provided with key and set screws.

All key-seats shall be of standard cross-section and all set screws shall be on the keys.

NO.	Diameter	Face	Bore
1	5 feet	14 in.	$2^{11}/16$ in.
1	2ft,16in.	13 "	$2^{11}/16$ "
1	3 feet	12½ "	$2^{11}/16$ "
1	2 feet	8½ "	$2^{11}/16$ "
1	2ft, 7in.	10½ "	$2^{11}/16$ "
1	1 " 8 "	6 "	$2^{11}/16$ "
2	8 "	4 "	$2^{11}/16$ "
1	5 " 0 "	10 "	$1^{7}/16$ "
1	4 " 0 "	8 "	$1^{7}/16$ "
1	3½" 0 "	8 "	$1^{7}/16$ "
2	2 " 0 "	6 "	$1^{7}/16$ "
2	1 " 2 "	5 "	$1^{7}/16$ "
7	4 " 0 "	5 "	$1^{7}/16$ "
6(grooved	4 " 0 "	¾ (groove)	$1^{7}/16$ "

BELTING.

Rubber belting of the best grade shall be used as specified:

NO.pieces,	Length, center to center,	Width,	Ply,
1	16 feet, 6 inches	14 in.	4
1	14 " 8 "	12 "	3
1	23 " 4 "	12 "	2
1	23 " 3 "	8 "	2
1	23 " 3 "	8 "	2
1	13 " 5 "	6 "	2
1	27 " 6 "	3½ "	2
2	26 " 10 "	4½ "	2
1	29 " 2 "	4½ "	2
4	29 " 0 "	4½ "	2
2	18 " 6 "	5 "	2
1	31 " 0 "	9 "	3
1	35 " 2 "	7 "	2
1	35 " 6 "	6 "	2
1	19 " 0 "	5 "	2

TRANSMISSION ROPE.

264 feet,5/8 inch Manilla rope for Power Transmission for Thickners.

PIPE AND PIPE SETTINGS.

160 feet 3 inch pipe.
500 " 5 " "
200 " 5 " "
200 " 2½ " "

All this pipe, elbows..etc. shall be placed as per plans. They should be of wrought iron.

VALVES.

Globe Pattern Valves shall be used and placed as per plans. Brass valves shall be used on the water line and valves made entirely of iron shall be used on the cyanide solution pipe line.

LUMBER.

All lumber shall be free from knots,and well seasoned:

Bin Lumber:

NO.pieces	size.	Length.
50	12 X 12 in.	24 feet.
40	2 X 4 "	12 "
20	2 X 10 "	15 "
50	1 X 12 "	10 "
100	2 X 6 "	10 "
40	6 X 8 "	10 "
2500. sq.ft.	1 X 12 "	26 "
2500. " "	2 X 12 "	26 "

Building Material.

NO.pieces	Size	Length.
4	12 X 12 in.	32 feet.
4	12 X 12 "	20 "
4	12 X 12 "	16 "
4	2 X 12 "	22 "
2	10 X 10 "	26 "
2	10 X 10 "	20 "
9	10 X 10 "	26 "
10	10 X 10 "	16 "

Building Material-continued.

NO.pieces	Size	Length.
8	10 X 10 in.	32 feet.
4	10 X 10 "	20 "
14	2 X 10 "	26 "
6	4 X 8 "	12 "
10	2 X 10 "	26 "
16	2 X 10 "	26 "
8	2 X 10 "	30 "
10	2 X 10 "	16 "
20	4 X 6 "	10 "
40	2 X 4 "	12 "
32	2 X 4 "	30 "
450	2 X 4 "	20 "
2760 sq.ft.	1 X 8 "	22 "
4920 " "	1 X 8 "	26 "
2160 " "	1 X 8 "	30 "
1800 " "	1 X 8 "	12 "
5600 " "	1 X 8 "	24 "

FLOORING.

The following lumber to be used for flooring. It must be of yellow pine, tongue and groove.

13,000 sq. feet 7/8 X $3\frac{1}{4}$ Commercial length.

LAUNDERS.

The best grade of California redwood shall be used, it must be free from imperfections and smooth on both sides. They shall be placed and made as

per plans. All doors and windows for the mill to be placed in accordance with the plans.

The following doors and window frames shall be built:

1-swinging door, 10 feet X 15 feet.
1-swinging door, 8 " X 12 "
3-swinging doors, 5 " X 10 "
2-swinging doors, 5½ " X 10 "
12-window frames, 6 feet wide X 8 feet high.
35 " " 4 " " X 6 " "

Panes of glass used in those windows will be of convenient commercial size.

ROOFING.

17,800 square feet of 20 gage corrugated iron shall be used. All the corrugated iron shall be painted with a mineral paint in oil.

I N D E X .

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