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The Russell process -- Laboratory tests and design of plant

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THESIS

FOR THE

Degree of Bachelor of Science

IN

MINE ENGINEERING.

♪ ♪

SUBJECT:

“The Russell Process—Laboratory Tests and Design of Plant.”

♪ ♪

ALFRED A. THOMAS, JR.

THOMAS COWPERTHWAITÉ.

JUNE 9, 1905.

A DETERMINATION OF THE BEST METHOD FOR TREATING A
MONTANA SILVER ORE AND THE DESIGN
OF A 100 TON PLANT.

The ore runs about forty ounces silver per ton. Most of the silver is present as cerargyrite (AgCl) but some is in combination with antimony. The gangue is chiefly quartz.

Some of the important constituents are in the following percents:

	Percent
SiO ₂ . . .	73
CaO . . .	15
Fe . . .	8 chiefly limonite
MgO , . .	0

Free milling tests on the ore gave very poor extraction.

All methods of treatment tried on the unroasted ore gave practically no extraction.

Experiments were then made on the ore roasted with, or without salt.

The following results were obtained:

No.	Ore	Solution used	Time of Treatment	Percent Extraction.
1	Roast 1 hr. at low red heat	0.3 % KCN	One hr.	71
2	"	0.5 " "	" "	72
3	"	0.3 " "	2 hours	73
4	"	0.5 " "	" "	72
5	"	0.3 " "	20 "	75
6	"	0.5 " "	" "	76
7	"	hypo ($\text{Na}_2\text{S}_2\text{O}_3$)	1 hour	72
8	"	first with hypo & afterwards with Russel Solution 4 parts $\text{Na}_2\text{S}_2\text{O}_3$ & 1 part CuSO_4	2 hours	73.5
9	"	Russel	1 "	70.7
10	" with 5% salt	hypo	" "	80.5
11	"	first with hypo then with Russel	2 hours	85.
12	"	Russel alone	1 hour	85.

The last(No.12) method was chosen because it is cheaper than No.11 and gives just as good extraction.

Descriptive Flow Sheet:--

Ore is brought by tramway from the mine and dumped into the bin at the crushing plant.

The bin feeds a Blake Crusher set to one and one-half inches. Ore then goes into two trommels having one-half inch screens.

The oversize is fed to two sets of rolls by Tullock Feeders. Rolls set to one half inch.

The product from these rolls together with the undersize from trommels are elevated to a drier which discharges into a second set of trommels having twenty mesh screens.

The oversize is fed by Tullock Feeders through a second pair of rolls set so as to crush to about twenty mesh.

The undersize from the trommels goes to a bin. The product from the rolls is sent through a third set of trommels having twenty mesh screens.

Undersize goes to the bin, while the oversize runs to the elevator and goes through that part of the system again.

As the ore goes to the bin above mentioned it passes through a revolving mixer which mixes it with five percent salt. From here an elevator takes it to two Steffeldt furnaces. Automatic feeders are placed on top of the furnace.

From the furnace the hot ore is sent by steel cars to a steel bin. This discharges onto a steel plate conveyor which empties into another steel bin. From here the cooled ore goes by cars into the leaching plant.

A track is laid on top of the leaching vats and by means of turn plates the cars can be turned and dumped in any part of the vats.

After ore has filled the vat to within one foot of the top it is leached with water until the filtrate shows no precipitate with Na_2S . Next it is treated with the Russel Solution until Na_2S will give no precipitate in the filtrate.

The tailings are then sluiced out of the vat through an inclined chute which leads to the waste dump.

The charging, leaching and sluicing of one vat requires eighteen hours

The filtrate from the water treatment is run to one set of tanks and that from the Russel solution to another set.

Iron is added to the water filtrate precipitating the Silver together with any copper present.

The Russel solution filtrate is treated with just enough Na_2S to precipitate the Silver and Copper.

After complete precipitation has taken place the overlying solution is drawn off into a sump by means of an automatic siphon.

A small storage tank is placed just below the discharge of each precipitation tank. At regular intervals the precipitates are removed from these storage tanks and sent through a pressure tank to a Johnson Filter Press. The cakes of sulphide are then shipped to a refinery.

The filtrate from the press runs to a small sump situated just below it.

5.

This together with the filtrates from the main sumps can be pumped back and used over again.

General Description of Machines,
Tanks, Vats, etc.

(a) Crushing Plant.

- (1) One Bin 7' wide - 20' long - 8' deep
12" X 12" timbers. 3" siding lined
with steel plates.
- (2) One No.4 Blake Crusher
6' long, 4'2" wide
driving pulley 30" diameter, 7½" face
250 R.P.M.
- (3) Six Trommels.
72" long, 36" diameter
slope 8%
18 R.P.M.
- (4) Four Tulloch Feeders
top 2' X 3'
depth 1½'

- (5) Four sets Vesin's Rolls
 Diameter of rolls 18"
 width of face 14"
 main band wheel 60" X 10"
 small " " 30" X 12"
 for coarse crushing 75 R.P.M.
 for fine " 100 R.P.M.
- (6) Two Bucket Elevators
 width of belt 8"
 projection of buckets from belt 5"
 Travels 228' / min.
- (7) One Drier
 4' wide
 7' deep
 5' long.
- (8) Belting
 29' of 7" belting
 43' " 8" "
 48' " 4" "
 17' " 6" "
 88' " 10" "

(9) Pulleys.

One pulley 84" diam. 10" face

4 pulleys 28" " 8" "

4 " 18" " 8" "

2 " 14" " 6" "

2 " 20" " 10" "

(10) Steel Shafting.

36' of 4" shafting

23' " 3" "

(11) One bin

7' wide

20' long

8' deep

timbers 12" x 12"

siding- 3" plank lined with steel plates.

(b) Roasting Plant.

(1)

2 Stetefeldt Furnaces

48' high

8' wide

39' long.

8.

(2)

2 Steel Bins.

15' long

9' wide

8' deep

made of 1/2" steel.

(3)

One steel plate conveyor

66' long

2 1/2' wide

30" drums at ends.

(c) Leaching Plant.

All the tanks and vats are made of California white cedar, the joints being covered with white lead.

(1)

Two storage tanks for Russel Solution

12' diam.

10' deep.

(2)

One tank for dissolving CuSO_4

10' diam.

10' deep.

(3)

One tank for dissolving $\text{Na}_2\text{S}_2\text{O}_3$

10' diam.

10' deep.

- (4) One extra tank for use in case of accidents.
12' diam.
10' deep.
- (5) Four Leaching Wats
20' diam.
5' deep
vats have false bottoms made of 1" wood slats
which are covered with matting to make a filter.
- (6) Four Precipitation Tanks.
12' diam.
10' deep.
- (7) Four tanks for storing precipitates
4' long
3' wide
6' deep.
- (8) Two Sumps.
15' diam.
10' deep.
- (9) One sump
6' diameter
5' deep.

- (10) One Johnson Pressure Tank.
- (11) One Johnson Filter Press
- (12) One Knowles Plunger Pump.

(d) Power Plant.

- 1 - 100 Horse Power Corliss Engine
- 3 Heine Boilers.

(e) Miscellaneous.

- 30- 1 ton steel cars
- 415' of track
- 4 turn sheets 6' square
- 400' of 2" water pipe
- 100' of 1/2" steam pipe

Building Materials.

22042 Square feet of corrugated iron

5633 cubic " " masonry

14364 board ft in 8" X 12" timbers

1360 " " " 6" X 18" "

16200 " " " 2" X 4 " "

4280 " " " 4" X 6 " "

1360 " " " 2" X 6" "

2362 " " " 8 X 10" "

3861 " " " 6 X 8" "

49840 " " " 1" Flooring.