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A method of obtaining lead concentrates from the slimes of the St. Joseph Lead Mill

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THESIS

For The DEGREE Of ENGINEER Of MINES

At MISSOURI SCHOOL Of MINES- ROLLA, MISSOURI.

By L.A. DELANO, BONNE TERRE, MO. JUNE, 1909.

Approved
D. Copeland.

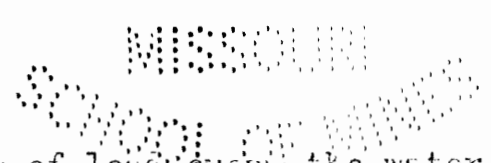
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DEPARTMENT

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A Method of Obtaining Lead Concentrate
from the Slimes of the St. Joseph Lead Mill.



Introduction,- In the concentrating of lead ores, the water used in the mills carries the tailings from the jigs and tables to chatt tanks. Here the chatts ^{and} sands settle while the greater part of the water overflows and enters a sluice or slimes branch to the settling ponds.

This overflow water carries with it a great deal of float lead.

It is impossible to catch this lead in the mill on moving machinery without using too much power and mill space to effect a profitable saving. Ninety percent of this float will pass through a 140 mesh sieve. There will always be the largest percentage of this slimes lost in ^{con}centrating no matter how many tables or frue vaners are installed on a profitable working basis. Coarse crushing in the mill lessens the bulk of slimes but increases the loss in the chatts, while on the other hand, finer crushing and classifying increases the slimes but decreases the loss in the chatts. It is my opinion after two years experience in milling, that the latter method increases the efficiency of the mill, thus lowering the total percentage of loss.

Tests of the Slimes Branch,- With the above facts in mind in July 1908, I began a few tests on samples from the slimes branch at Bonne Terre, Mo. to determine the lead loss. After working on them for a month and studying into the results, I came to the conclusion that the slimes loss generally ran equal to the percentage of lead in the ore fed to the mill. This conclusion was afterwards verified to me by Mr. Payne of the Federal Lead Co., who conducted similar experiments about the same time. This loss would amount to several hundred thousand dollars in a years time. Following is the data collected on tests from our slimes branch.-

July 2	-	Sampled from	1:30PM--3:00PM	- - - - -	4.15%	Pb.
"	-	"	"	--2:30 "	- - - - -	3.77 "
"	7	-	"	--3:00 "	- - - - -	3.38 "
		Also	"	Side of branch	- - - - -	7.33 "
"	8	-	Sampled at	"	"	lower down
			"	of	slime	- - - - -
"	9	-	"	"	from 1:00PM-3:00PM	- - -
"	10	-	"	"	"	- - - - -

July 13- Sampled from I:CCPM-3:CCPM - - - - - 3.85% Pb.
 " 14- " " " - " - - - - - 3.10 " .
 " 15- " " " - " - - - - - 3.00 " .
 " 21- Screening test of slimes (hand)

<u>Mesh</u>	<u>% St.</u>	<u>% Pb.</u>	<u># Pb.</u>	<u>% Value.</u>
on 80	17.46	.21	.037	1.1
" 140	29.46	.77	.227	6.5
thru 140 (sands)	47.88	6.03	2.957	85.2
" 140 (slimes)	5.21	4.81	<u>.251</u>	7.2
			3.473	

This test was made by catching a large sample and screening wet through sizing screens, weighing each size carefully, and assaying samples. A study of the results showed that the loss was greatest in the sands under 140 mesh. This amounted to 85% and was the lead for which we needed machinery ^{in order} to catch ^{it}. The finer slimes could not be caught in any manner.

I knew that out in the Silverton, Colo. district, stationary canvas tables had worked successfully as operated by Mr. Guest. I had seen some of these in use at the Federal Lead Co. at Flat River, but knew little of the details. Following the general plan of those, with detail changes to suit our feed and gravity fall, I designed a couple of experimental tables. These designs are shown in the blue print attached.

The Canvas Table,- This table is stationery, being built to have a surface fall of 1 - 15/16" to the foot and covered with canvas.

The slimes are fed at the top through a distributing trough and run off at the bottom through a divided launder. This launder is divided in the center by a lengthwise partition. On top of this partition is a baffle board to direct the tailings to one side and the concentrates to the other. The framework of the table is covered with flooring and on this laid a good grade of tar roofing paper to prevent the water from reaching the wood and rotting it. We used a four ply roofing paper.

Over this the canvas is stretched very tightly. We used the best grade of tenting duck -20 oz. weight - and six feet wide. It took two strips 14 ft. 3 in. long to cover one table, as the ends were tacked under the edge of it. No tacks were placed on the surface of the canvas.

Operation,- The slimes fed through 2 in. nipples to the distributing trough. We controlled the feed with a service cock which could be closed when the table was being washed. The feed was regulated to about 3 gallons/min./ft. The width of the table being 12 ft., it required about 35 gallons feed per minute. The baffle board at the foot of the table was turned to direct the overflow into the tailing launder. In about two hours time the lead would cover the table.

The feed was then turned off and a clear water feed turned on for about ten minutes. This washed the heavy sands off the surface of the table, leaving the canvas blue with a thin coat of lead concentrates.

The clear water was then turned off and the baffle board reversed to feed into the concentrates launder. A hose, fed with clear water under pressure from tank, was then used to wash the canvas clean from lead, which was collected into a concentrate sump. The process was repeated continuously.

We built our tables between the mill and slimes branch, to receive the overflow from the chatt tanks. They were started August 12, 1908.

Tests and Results,- Samples of the feed, tails and concentrates were taken on each test. The samples were taken about a half hour apart and continued for a period of two or three hours.

Following are the results,-

TABLE I.

Aug. 13 -	Sample of concentrates - - - - -	33.00 % Pb.
" 14 -	Feed - - - - -	3.96 % Pb.
	Tail - - - - -	3.66 "
" 17 -	Feed - - - - -	4.67 "
	Tail - - - - -	2.91 "
	Concentrates - - - - -	28.28 "
" 18 -	" - - - - -	35.25 "
	Feed - - - - -	4.08 "
	Tail - - - - -	3.38 "
" 19 -	Concs. - - - - -	34.24 "
	Feed - - - - -	4.12 "
	Tail - - - - -	3.38 "
" 20 -	Total weight of concs. - - - - -	1483 lbs.
	Daily average - - - - -	347 "
	Samples - Moisture - - - - -	18.60 %
	Lead - - - - -	35.32 "

Dry weight - - - - - 1208.6 lbs.

Lead contents - - - - - 427.7 "

This finished one test of a weeks duration. Immediately a second one was begun.

TEST II.

Aug. 20 - Concs. - Moisture - - - - - 18.60 %
Pb. - - - - - 41.96 "

" 21 - Feed - - - - - 4.58 % Pb.

Tail - - - - - 3.79 "

Concs. - Moisture - - - - - 17.60 "

Pb. - - - - - 40.00 "

" 24 - Screening Tests,-

FEED

TAIL

Mesh	Wt	% Pb	#Pb	% Value	Wt	% Pb	# Pb	% Val
Thru 140 (sands)	83.84	5.64	4.225	80.91	71.76	6.16	4.420	74.77
Thru 140 (slimes)	16.16	6.17	<u>.997</u>	19.09	28.24	5.36	<u>1.514</u>	25.23
			5.222				5.934	

General samples,- Feed - - - 5.23 % Pb.

Tail - - - 4.02 "

Concs. - - - - - 37.08 % Pb.

(Note- The screening test did not work very well as it was hard to separate the sizes. It shows a reduction in the tails, of the lead in the slimes. Under a good test this would show much lower. I did not repeat it because we did not have time.)

Aug. 25 - Feed - - - - - 5.63 % Pb.

Tail - - - - - 4.57 "

Concs. - Moisture - - - - - 19.40 %

Pb. - - - - - 42.20 "

" 26 - Feed - - - - - 7.13 "

Tail - - - - - 5.67 "

Concs. - Moisture - - - - - 18.40 "

Pb. - - - - - 50.28 "

Result of weeks test,-

Total weight of concs. - - - - - 1276 lbs. Pb.

Daily average - - - - - 214 "

Samples,- Moisture - - - - - 19.50 %

Pb. - - - - - 32.62 "

Dry weight - - - - - 1027.2 lbs. Pb.

Net lead contents - - - - - 334.2 " "

TEST III.

Aug. 31-	Feed	- - - - -	7.90 % Pb.
	Tail	- - - - -	4.31 "
Sept. 1 -	Feed	- - - - -	12.75 "
	Tail	- - - - -	6.34 "
	Concs.	- - - - -	48.78 % Pb.
Result of weeks run,-			
	Total weight of concs.	- - - - -	1276 lbs. Pb.
	Daily average	- - - - -	213 " "
	Samples,-	Moisture	- - - - - 19.5 %
		Pb.	- - - - - 33.62 "
	Dry weight	- - - - -	1027.2 " "
	Net lead contents	- - - - -	334.8 " "

TEST IV.

" 4 -	Feed	- - - - -	5.91 % Pb.
	Tail	- - - - -	3.04 "
" 8 -	Feed	- - - - -	3.19 "
	Tail	- - - - -	2.57 "
" 9 -	Feed	- - - - -	5.37 "
	Tail	- - - - -	4.71 "
" 10 -	Feed	- - - - -	8.27 "
	Tail	- - - - -	5.00 "
" 11 -	Feed	- - - - -	3.75 "
	Tail	- - - - -	2.41 "
Note. -	Average - Feed	- - - - -	5.30 "
	Tail	- - - - -	3.91 "

This showed a saving of 26.2 % of the lead in the slimes feed. From Aug. 25 th. to Sept. 1st. showed a saving of 38.1 % of lead in slimes feed. This saving can be increased by more careful operation. The clean up on this test was made Sept. 24th. No weight was made of the concentrates. They ran 35.6 % Pb.

Change of Table Feed,- I now desired to try a different feed on the tables. I had been using slimes from the overflow of the chatt tanks. The Harz Jigs tails in the mill ran to the chatt tanks without being retreated. I built a launder from the jigs to the canvas tables and ran the tails directly on them. It was a coarser feed, running a little lower in lead but of larger particles, being of 2mm. and under.

This lead collected faster on the canvas and had to be washed at in-

ter vals of one hour. The following was the result of a six days test,-

Sept. 29 - Feed	- - - - -	3.75	of Pb.
Tail	- - - - -	1.95	"
Oct. 3 - Feed	- - - - -	3.71	"
Tail	- - - - -	2.00	"
" 5 - Clean up,-			
Total weight of concs.	- - - - -	3279	lb. Pb.
Daily average	- - - - -	468.5	"
Samples - Moisture	- - - - -	16.00	%
Pb.	- - - - -	54.18	%
Dry weight	- - - - -	3754	"
Net lead contents	- - - - -	149.0	"

Note - This was a fine showing but this feed could be worked more profitably in the mill on Wilfley tables. This concluded my tests.

Cost of Building Tables.- The lumber, canvas and labor totaled about \$125.00 for the two tables. Of this a little over one half was for labor, a longer time being taken because the men were new to the work.

Later estimates showed the tables could be built for about \$50.00 each. We used the 20oz. grade of canvas tenting, costing us at wholesale \$1.08/yd. A four ply tar roofing paper was laid under the canvas, costing about \$1.25 wholesale per 100 sq.ft. We estimated 40 tables would cost about \$2000.00.(slightly under.)

Cost of Operation,- A man can wash a table in about ten minutes, thus allowing each man about twenty tables. The men work on eight hour shifts thus requiring three men per day. Labor hire at present rates of wages is \$1.50/day. The cost of operating forty tables is \$9.00 per day.

Remarks,- These figures were obtained by working with the lowest grade slimes in our mill. The average slimes will give about a third more value in lead. We operated these tables without keeping a man on them regularly. The mill table men washed them as regularly as they could and performed their other work. By having a man on these alone, we could have increased their efficiency. It is our intention in the spring of 1909 to build and cover with a building, forty of these tables. They will be fed with long launder between two parallel rows of tables. The concentrate ladders will empty into a pumpbox and be pumped into the table lead tanks in the mill, there being loaded into the mineral cars.

The pump will be run by a 3 horse power motor. The plant and building are estimated to cost \$2500.

(7)

Money Value of Lead Produced,- Taking an average of the first three tests, or slimes feed, we find we have 373.2 lbs. Pb. contents per weeks run.

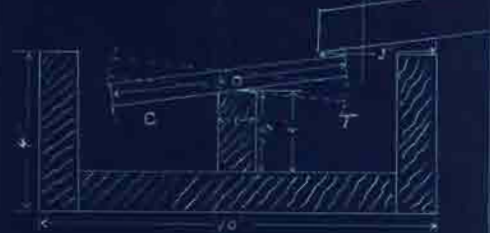
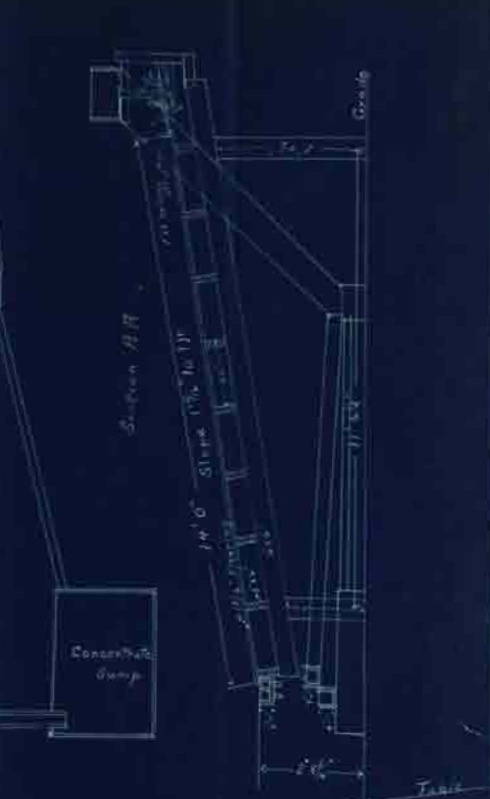
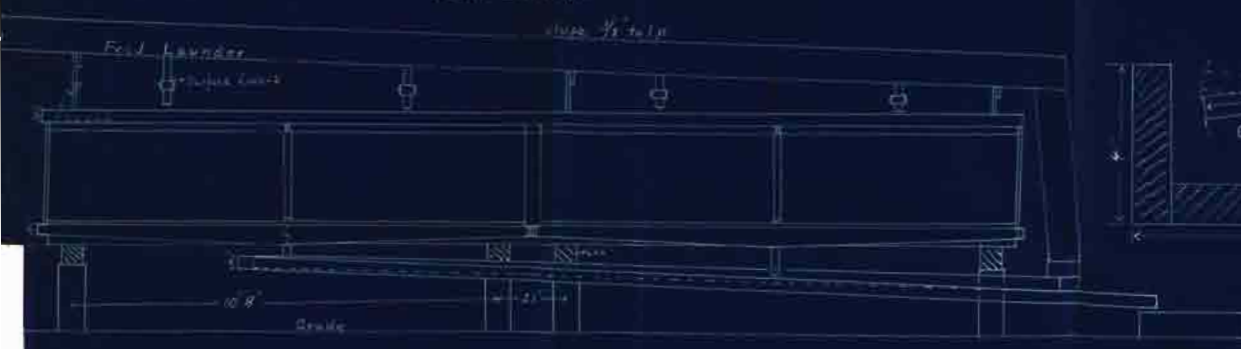
Therefore 1 yrs. run of 52 weeks_ - - - - -	19406.4 lbs. Pb.
Deduct 10% smelting loss - - - - -	194064 " "
Net lead - - - - -	17465.76 " "
For 40 tables - - - - -	349315.2 " "
Value at 41cts./lb. - - - - -	\$15719.18
Net Profit of Plant of 40 Tables,-	
Value of lead produced - - - - -	<u>\$15719.18</u>
310 working days/yr. at \$9.00/da. - - - - -	2790.00
Cost of pumping concs. - - - - -	300.00
Interest at 6% of plant - - - - -	120.00
Depreciation at 20% - - - - -	<u>400.00</u>
Total cost of ^{operating} plant - - - - -	\$3510.00
Net profit - - - - -	\$12209.18

or approximately \$1000.00/mo. These figures show a canvas plant can worked with large profits on lead slimes.

Finis.



Front Elevation



Detail of Laundry
Scale = 1/2"

Design of Convey Tables
Scale = 1" = 2'
L. A. DeLong
1st. 10 1908
Chemist