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# Sulpho - telluride ore

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# SULPHO - TELLURIDE ORE.



by

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A

THESIS

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- THE CYANIDATION OF A SULPHO-TELLURIDE ORE.-

The problem considered in this work, is the determination of a suitable scheme for cyaniding a low grade Cripple Creek ore. For several years many attempts have been made to solve the metalurgical problem presented by such ores.

Shipping to Colorado City costs $1.00 per ton and roasting costs $0.76 per ton. The treatment followed on the high grade ores which is chlorination or chlorination followed by or by cyanidation alone, each of which processes is precluded by commercial consideration.

The process followed at the Independence Mill at Victor, Colo., is that of fine grinding followed by cyanidation.

At the Golden Cycle Mill at Colorado City, a roast is given the ore previous to cyanidation. A flow sheet is shown herewith.

Flow sheet Golden Cycle Mill.

Ore-unloaded from R. R. cars.

↓

Crushed and Sampled

↓

Storage bins

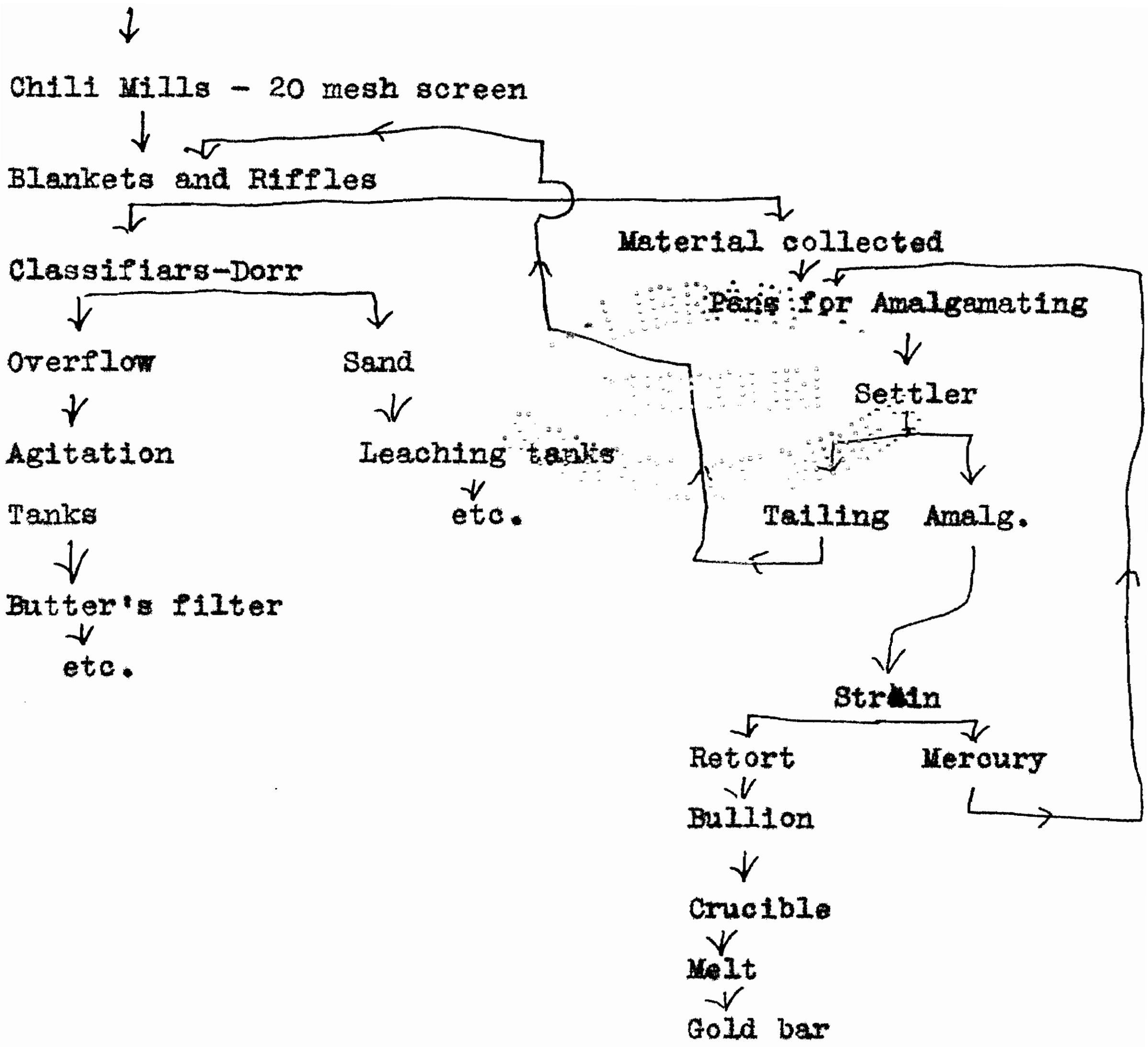
↓

Ball Mills

↓

Roasting Furnaces - Edwards Duplex.

↓




The Portland Mill of Colorado City gives a roast to the ore followed by chlorination in barrels and cyanidation of tailing from chlorination.

A flow sheet follows:

Flow sheet Portland Mill.

Ore R. R. cars

↓

Bins

↓

Crushed and smapled

↓

Roast

↓

Chlorination barrels ← $CaOCl$-100# ; $H_2SO_4$ - 300#

Solution

$H_2S$ → Tanks

↓

Filter Press

$Au_2S_3$ ; Solution

↓

Melted

↓

Refined

Tailing

↓

Classifiers

Slimes ; Sands

Slimes ↓ agitated with KCN

↓

Vacumn Filters

KCN sol ; Tailing

Sands ↓ leached with KCN

↓

sol.

KCN sol → ↓ ← sol.

Au. Precipated

with Zn fume

Au. ppt ; Sol.

↓

Refined

Many solutions of the problem presented by these low grade ores of Cripple Creek have been suggested and the failures are equal in number to the suggestions. The reason for failure seems due to the difference between the action of KCy., on gold and on the telluride of gold.

In our experiments we attempted to determine the extraction attainable by the following methods of cyanide treatment.

(1) straight leaching on raw ore of different degrees of finess; (2) Fine grinding in tube mill followed by agitation; (3) concentration with cyanidation of tailing and of concentrates; (4) Roasting the ore followed by (a) straight leaching; (b) Fine grinding and agitation; (c) Classification of material with leaching of sands and agitation of slimes.

## THE ORE.

The ore upon which these experiments have been made is a typical low grade ore of the Cripple Creek district. It is a lot of 50 pounds received from the Rexall Mine of Victor, Colo.

The values are contained in the telluride of gold associated with pyrite and fluorite in a phonolite gangue.

The analysis of the Ore is:

| | |
|---|---|
| $SiO_2$ | - 57.00 |
| $Al_2O_3$ | -17.80 |
| CaO | 2.82 |
| MgO | .40 |
| FeO | 3.54 |
| $Na_2O$, $K_2O$ | 12.00 |
| S | 3.59 |
| Au. | $7.00 |
| Ag. | 0.22 oz. |

Acidity- (1) Solution acidity - 20 gms ore made to pass a 100 mesh screen were aqitated with 50 cc water 15 minutes and filtered. The Filtrate was titrated with (N) NaOH solution giving a trace of soluble acidity (2) Latent acidity- 10cc (N) NaOH were added to the residue from (1) and agitated for 15 minutes and filtred. The Filtrate was treated with Normal $H_2SO_4$ solution giving latent acidity 10.8 lbs CaO per ton. (3) Total acidity- 20 gms of ore made to pass a 100 mesh screen were agitated with 10 cc (N) NaOH solution and 25 cc water for 15 minutes and filtered. The Filtrate was titrated with (N) $H_2SO_4$ solution giving total acidity 22 lbs of CaO per ton. This increase of total acidity may have been due to some action of NaOH on soluble salts associated with the gangue.

Leaching and Percolation:-

The object of this series of experiments is to find the extraction attainable by simple leaching or percolation. Three samples of 3 A. T. each thru 20, 40 and 60 mesh respectively were put into 3 beakers and 100 cc of KCN solution containing to lb. KCN per ton were added, after standing 48 hours the substances were filtered and washed. The KCN was determined in the filtrate and the residue assayed for Au. The results of this series of experiments are given in the following table.

Table No. I.

| | | | |
|---|---|---|---|
| Screen mesh | 20 | 40 | 60 |
| KCN consumption lbs per ton | 9.1 | 9.6 | 9.5 |
| Assay before | 9.6 | 5.60 | 6.80 |
| Assay after | 9.6 | 5.60 | 6.80 |

# No lime added.

The KCN solution under the conditions used, has according to these tests, no action whatever on the gold of this ore.

The next experiment was to determine whether fine grinding would make the gold amenable to KCN solution. A sample of 2 lbs was put thru 100 mesh screen previous to dry grinding in a tube mill. Three campaigns of 1 hour, 10 hours, and 24 hours duration in the tube mill were made, a sample being taken after each campaign.

A screen analysis and an extraction test were made on these samples with the results shown in Table No.2

Table No. 2.

SCREEN ANALYSIS.

| Screen | Feed to Mill wt. gms. | Feed to Mill % | sample 1 hr. wt. | sample 1 hr. % | sample 10 hr wt | sample 10 hr % | sample 24 hr. wt | sample 24 hr. % |
|---|---|---|---|---|---|---|---|---|
| On 150 | 83 | 25 | 35 | 22 | | | | |
| On 200 | 33 | 10 | 16 | 10 | | | | |
| Thru 200 | 213 | 64 | 109 | 67 | 162 | 98 | 783 | 99 |
| Total | 329 | 99 | 160 | 99 | 162 | 98 | 783 | 99 |
| Loss | 3 | 1 | 2 | 1 | 3 | 2 | 8 | 1 |

On the extraction tests the results of which are shown in Table No3 3 A T of pulp were agitated with 12 A T of 0.5% KCN solution for 24 hours. The high gold content in this ~~smaple~~ sample is due to the spotty nature of ore.

Table No. 3.

| Pulp | Wt of sample | Pulp oz ton | pulp after treatment | extraction oz ton | KCN cons | % extract. |
|---|---|---|---|---|---|---|
| 1hr | 162 gms. | 0.46 | 0.24 | 0.22 | 7.5 | 48 |
| 10 hr. | 165 " | 0.50 | 0.25 | 0.25 | 1.5 | 50 |
| 24 hr. | 791 " | 0.48 | 0.26 | 0.2 | 3.2 | 54 |

This shows that fine grinding furthers the extraction obtained. The results, however, do not show a commercial practicability for such a scheme since the tailing still contains 50% of the original value.

Concentration with cyanidation of Concentrates and of tailing.- In this test a sample of 880 grams of ore was crushed to pass a 40 mesh screen. This product was concentrated by panning with an ordinary gold pan. The concentrates and tailing from this concentration were cyanided separately using a 10 lb KCN solution for tailing and a 40 lb KCN sol for concentrates with the results given in the tables 4 and 5.

Table No. 4.

| Material | wt. gms. | assay oz ton | wt of Au. gm | Percent of total Au. |
|---|---|---|---|---|
| Original ore | 880 | 0.64 | 0.01931 | 100% |
| Concentrates | 55.5 | 2.20 | .00418 | 21.6% |
| Tailing | 809 | 0.40 | .011934 | 61.8% |

The loss of gold equal to 16.6% was due to the loss of slimed sulphides in concentration. The ratio of concentration is 16 into one.

Table No. 5.

| | Screen mesh | wt of sample | Au oz ton | extract. oz/ton | % extract | KCN Cons |
|---|---|---|---|---|---|---|
| Tailing | Thru 200 | 5 AT | 0.48 | 0.072 | 15 | 4.5 |
| | Thru 100 | 5 " | 0.28 | 0.046 | 16.43 | 4.0 |
| | On 100 | 2 " | 0.26 | 0.02 | 16.6 | 4.6 |
| Conc | Thru 200 | 1 " | 2.2 | 0.40 | 18.18 | 20 |

This process is not suitable on the ore giving only a low extraction of the gold therein.

The next experiment was to determine the effect of roasting the ore previous to cyanidation on the extraction obtainable. Roasting makes the ore more permeable to solution, and also frees the gold from combination with sulphur and tellurium. A sample of 908 grams of ore, all of which was thru a 16 mesh screen, was roasted in an assay muffle. The content was lowered from 3.59% to 0.24% S. The temperature at the start was less than 600° C. and then rasied to 1050°C at the finish. The fritting temperature as determined by # Mack & Scibird on a similar ore was 1090°C. The sample of the roasted ore was tested thus with a 0.5% KCN solution, according to the following schemes: (a) 3 A.T. leached by 100cc solution in a beaker for 48 hours. (b)2 A.T. ground thru 200 mesh and agitated with 6 A.T. of solution. (c) 4 A.T. classified sands leached- slimes agitated with 3 times as much solution.

The results of the roast are given in the Table No.6.

Table No. 6.

| Thickness of bed | Time hours | Oz Au per ton before | Oz Au per ton after | Final Temp. |
|---|---|---|---|---|
| ½ inch | 11 | 0.44 | 0.54 | 1050° |

Roasting of a Telluride ore.

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The results in the extraction are given in Table No.7.

Table No. 7.

| | Treatment given | Ore A.T. | | KCN Cons. lb per ton | Assay ore oz ton | Assay tails oz ton | ext. oz ton | % ext. |
|---|---|---|---|---|---|---|---|---|
| a | leaching | 3 | | 1.4 | 0.54 | 0.27 | 0.27 | 50.0 |
| b | agitation | 2 | | 2.0 | 0.54 | 0.26 | 0.28 | 51.8 |
| c | combination | 4 | slime<br>sand | 3.7<br>1.5 | 0.54 | slimes were very small in amt.-tails combined<br>0.50 | .04 | 0.74 |

The extraction obtained is only 50% leaving 50% of the value in the tailing. The small additional recovery in case (b) does not warrant the added cost of sliming and agitation. In case (c) the recovery is comparatively small. The reason for which is not known as the treatment given sands was exactly the same as in case (a).

GENERAL CONCLUSIONS:-

In general a roast gives approximately the same extraction of gold as fine grinding. The low value of the ore would hardly warrant either of such processes as the changes for milling would exceed the values recovered. With a recovery of 50% or $3.50 in the roast cyanide schemes the changes of $4.76 apportioned between # freight to Colorado Springs $1.00 roasting $0.76, mining $2.00, general expense $1.00, would cause a deficit of $1.26. Fine grinding is as expensive as roasting but would decrease the deficit as ore could be credited with $3.85 for a 55% extraction. It follows that (1) a cheaper scheme of treatment is necessary in which (a) the roast is eliminated (b) a greater extraction is obtained (2) The mill must be near the mine to save transportation charges. (3) the output of mine and mill must be large to lower the item of general expenses.



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