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A study to determine a process for the treatment of an amalgamation tailing

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A STUDY TO DETERMINE A PROCESS FOR THE TREATMENT OF AN AMALGAMATION TAILING

by

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T H E S I S

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PREFACE

The ore for this series of experiments is the tailing from the old ore-dressing mill at Missouri School of mines. In undertaking the task of devising a cyanide scheme for this tailing we knew that we had no little amount of work before us, neither were we sure of success, for all attempts thus far to cyanide this tailing had failed.

We wish to thank Professor Copeland for his valuable advise, many suggestions, and assistance while we were working on this thesis.

NATURE OF THE ORE

Method of determation of soluble alkali

A fifty gram sample of the ore was agitated in 200 cc. of distilled water for 12 hours. The filtered solution being alkaline was then titrated against a standard HCL solution. The alkalinity is equal to 42.8 lbs of CaO per ton of raw ore.

The amount and nature of the soluble salt. A fifty gram sample of the ore was agitated for three days in 200 cc. of distilled water. The water was filtered off and the filtrate evaporated to dryness. On the weighing of the residue it was found that the ore contains 0.67 % soluble material. The residue from the solution showed nothing but calcium carbonate, the soluble CaO being equal to 0.21 % of the raw ore.

Qualitative analysis of the ore showed it to contain Cu, Fe, Al, Zn, Ca, Sr, and S .

Quanitatively the contents of the ore are as follows;

Gold --- 0.37 oz per ton

Silver-- 7.83 oz per ton

Copper -----------	0.51 %
Iron -------------	8.00 %
Alumna -----------	17.39 %
Zinc -------------	2.69 %
Lime -------------	11.18 %
Sulphur ----------	11.56 %
Silica -----------	24.79 %
Total	76.12 %

Water, wood fiber, undetermined oxygen, CO_2 , and SO_2 probably make up the remaining 24 percent.

The minerals contained in the ore as near as could be determined with the aid of a small lense were, quartz, sphalerite, pyrite, chalcopyrite,and galena (?). Besides this the ore contained a large amount of wood and other debris with perhaps some clay and other minerals that were in too fine a condition to be determined with a small lense.

There was some trouble in checking the fire assays of the ore. This was probabld due to the fact that the ore is spotty.

AMALGAMATION OF THE ORE.

Method.

A 200 gram sample, which had been passed through an 80 mesh screen, was ground with 50 grams of mercury, in a Wedgewood mortar for one hour and then the amalgam removed by panning. The mercury sickened and floured badly and sodium amalgam was added several times before the amalgam and the mercury could be removed from the pulp. The pulp was the dried, weighed, and assayed. The results are shown in Table I

Table I

Weight of ore.	Weight of Mercury.	Weight of Tailing.	Assay of ore. oz. per ton.		Assay of Tailing. oz. per ton.		Amt. Amalgamate: Gold.		Silver.	
			Au	Ag	Au	Ag	%	oz/ton	%	oz/ton
200. gms	50. gms	192. gms	0.28	7.9	0.28	7.5	0.0	0.0	1.0	0.4

Conclusion.

The above results show that direct amalgamation of the ore will not pay.

LEACHING OR PERCOLATION

The object of this series of experiments was to determine the extraction attainable on different sizes of ore and the cyanide consumed by simple leaching or percolation process.

Method.

A sample of four assay tons each of ore of 20, 60, and 100 meshes respectively, were placed in 300 cc. beakers and six assay tons of KCN solution (9.5 lbs KCN per ton of solution) were added. After two days these were filtered and the tailing assayed. The consumption of KCN was also determined. The results of this experiment are shown in Table II

Table II

Str'gt of Sol. lbs. Per ton.	Amt. of ore.	Amt. of Sol.	Mesh	Time days.	Tailing Assay oz. Per ton		Extraction		KCN Consumption.		
					Au.	Ag.	Au.	Ag.	%	lbs Per ton. Sol.	lbs. Per. ton ore.
9.5	4.A.T.	6.A.T.	20	2	0.25	7.33	0.12	0.52	77.3	8.05	12.10
9.5	4.A.T.	6.A.T.	60	2	0.29	7.72	0.08	0.11	81.9	8.35	12.23
9.6	4.A.T.	6.A.T.	100	2	0.25	7.41	0.12	0.42	81.7	8.40	12.60

Conclusion.

The extraction of gold and silver is small compared to the KCN consumed. According to the experiments there is no hope for success in simple leaching or percolation.

AGITATION

The object of this series of experiments is to determine the possibilities of extracting values by straight cyanide-agitation on different meshes of ore.

Method.

Samples of two assay tons each, through 30, 100, and 200 mesh respectively were agitated with 200 cc. of cyanide solution (9.5 lbs KCN per ton sol.) . The 30 and 100 mesh for 10 hours and the 200 mesh for 24 hours. After filtration the cyanide consumption ~~and the extraction~~ and the extraction of values were determined. The results of this experiment are shown in Table III

Table III

Amt. of ore.	Mesh.	Time of Agitation Hours.	Assay of Ore. oz-Per ton.		Assay of Tailing. oz-Per ton.		KCN Solution		KCN Consumption.	
			AU.	Ag.	AU.	Ag.	Amt. C.C.	lbs. Per ton Sol.	%	lbs. Per ton Ore.
2.A.T.	30.	10.	0.37	7.83	0.20	4.6	200.	9.5	92.0	29.67
2.A.T.	100.	10.	0.37	7.83	0.16	4.0	200.	9.5	91.0	29.58
2.A.T.	200.	24.	0.37	7.83	0.10	4.2	200.	9.5	93.0	30.26

Conclusion.

From the above table we see that the 100 mesh material consumes the least cyanide and gives the best silver extraction, while the 200 mesh ore consumes more cyanide but has a better extraction. But in no case was the extraction of values at all satisfactory and in every case the cyanide consumption was excessive.

CONCENTRATION.

The object of this series of experiments is to determine whether the values are in the concentrate or, in the tailing, in other words to determine if the values are in the heavy or in the light minerals of the ore.

Method.

A 500 gram sample of the ore which had been put through a 30 mesh screen was panned. The water was filtered from the tailings and concentrates and each was dried, weighed, and assayed. The results of this experiment are shown in Table IV

Table IV

Material	Weight grams.	Assay in oz-per ton.		Total grams.		Loss.					
						Weight		Gold		Silver	
		Au.	Ag.	Au.	Ag.	gms.	%	oz-ton	%	oz-ton	%
Raw Ore	500.	0.31	7.94	0.005	0.14	10	2.0	0.01	1.8	0.1	1.3
Conc.	180.	0.29	6.32	0.002	0.04						
Tailing.	310.	0.31	8.95	0.003	0.10						

Conclusions.

There was a slight loss of both gold and silver which was no doubt due to mechanical loss. There was little difference in the value per ton of concentrates and of tailings and the ore therefore is not benefited by concentration.

CYANIDING OF THE CONCENTRATE AND THE TAILING FROM THE PANNING EXPERIMENT

The object of this experiment is to determine if there is any difference in the effect of action of the cyanide on the concentrate from that in the tailing.

Method.

A two,assay ton sample from the concentrate and tailing respectively, was agitated with cyanide solution for 24 hours. The solution was filtered off and the pulp was weighed, dried, and assayed. The results of this experiment are given in Table V .

Table V

Material.	Wt. of ore.	Sol. in C.C.	Solution lbs. KCN Per ton.		Assay oz. Per ton.		Assay. oz Per ton After		Extraction				KCN Cons'mpt.	
									gold		Silver			
			befor	After	AU	Ag	AU	Ag	%	oz/ton	%	oz/ton	%	lbs. KCN Per ton ore.
Conc.	2. A.T.	2.A.T.	9.5	1.0	0.29	6.32	0.10	2.30	65	0.19	63.	4.02	84.	28.9
Tail.	2 A.T.	2.A.T.	9.5	0.9	0.31	8.95	0.08	3.27	74	0.23	63.	5.68	84.	29.2

Conclusions.

There is certainly not enough increase in the extraction to pay the expense of concentration.

SCREEN ANALYSIS

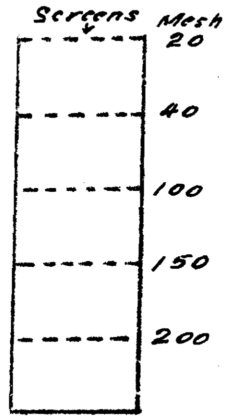
The object of this series of experiments was to find whether the values are in the part of the ore which breaks fine in crushing or in the part which remains relatively coarse.

Method.

A 400 gram sample of the origional ore was crushed through a 20 mesh screen and then through the rest of the screens as shown in the sketch. The ore remaining on each screen was weighed and assayed. The results of this series of experiments is shown in Table VI.

Table VI

Material	Weight grams	Hole Sizes in M.M.	% of Total Weight	Assay-oz-Per ton		% Total	
				gold	silver	gold	silver
orig. ore	400.		100.00	0.37	7.83	100.00	100.00
Through 20 On 40	73.9	1.27	18.47	0.15	5.54	7.48	13.01
40-100	101.3	0.63	25.32	0.41	12.62	28.05	40.76
100-150	108.3	0.25	27.07	0.30	6.24	21.94	21.57
150-200	34.2	0.16	8.54	0.24	7.94	5.54	8.66
Thru. 200.	81.3	0.12	23.63	0.25	5.30	15.96	16.00
Loss.	1.0	——	0.25	——	——	——	0.05



Conclusions.

Most of the values of gold and silver lie in the sizes between 40 mesh and 100 mesh. The greater part of the ore, also, with the crushing scheme used, passed the 40 mesh but remained on the 100 mesh.

RELATIVE GRINDING.

The object of this series of experiments was to determine the effects of fine grinding on the extraction attainable.

Method.

A sample of the ore through a 100 mesh screen was ground in a tube mill. After grinding for one hour a sample was taken from the mill. The reject was again placed in the mill and grinding continued. At the end of 6, 15, and 24 hours respectively other similar samples were taken from the mill. Two assay tons of each of these mill samples was agitated with 200cc. of cyanide solution (9.5 lbs KCN per ton sol.) . After a thorough agitation the solution was filtered, the consumption of KCN, and the values extracted being determined in each case. The results of this series of experiments are shown in Table VII .

Table VII

Material	Amt. of ore A.T	Time hrs. cyanide Agitation	Assay-oz-Per ton. Original. Au.	Ag.	Tailing. Au.	Ag.	KCN.-Sol. Amt. c.c.	lbs. per ton Sol.	KCN. Consump. lbs. per ton Ore.
100 Mesh	2	24	0.32	7.68	0.13	5.90	200	9.5	29.60
Tube. 1-hr	2	24	0.32	7.68	0.10	5.84	200	9.5	29.58
" 6 "	2	24	0.32	7.68	0.10	5.66	200	9.5	30.60
" 15 "	2	24	0.32	7.68	0.10	5.55	200	9.5	30.94
" 24 "	2	24	0.32	7.68	0.10	5.44	200	9.5	30.26

Conclusions.

The extraction varries little with the fineness of grinding. The extraction of gold was constant. The extraction of silver was increased only 0.04 oz more per ton by additional grinding. The small increase would not pay for the extra grinding. The consumption of cyanide increased slightly. Seemingly the 100 mesh gives about as good as an extraction as can be obtained with a finer grinding. A finer grinding therefore is of no benefit to this ore.

THE EFFECT OF LEAD SALTS ON THE CYANIDING OF THE ORE

It was thought that the ore contained some soluble sulphides and that the lead salts might help the extraction. The object therefore of this series of experiments was to determine the effects of various lead salts.

Method.

Two samples of the ore through a 200 mesh screen were mixed respectively with 1/2 gram of lead oxide and with 1/2 gram of lead acetate. Them 200cc. of 9.5 lbs per ton KCN solution was added to each and agitation was given for 24 hours. The solution was filtered, the amount of KCN consumed, and the extraction determined. The result of this series of experiments are shown in Table VIII .

Table VIII

Material Mesh.	Amt Ore A.T.	Time Treat hours	orig Assay oz Per ton.		Tailing Assay oz Per ton.		oz-Per ton Extraction		lbs. KCN. Per ton Solution	KCN Consumpt. lbs Per ton. ore
			AU.	Ag.	AU.	Ag.	AU.	Ag.		
200 Mesh ½ gr Pb ac.	2	24	0.37	7.83	0.14	5.26	0.23	2.57	9.5	30.26
200 Mesh ½ gr PbO	2	24	0.37	7.83	0.18	3.68	0.19	4.25	9.5	30.26

Conclusions.

From the experiments it seems that it would not pay to treat the ore with either lead oxide or lead acetate.

ROAST-AGITATION

The object of this series of experiments is to determine if either the chloridizing or oxadizing roasts will aid the extraction of the values by cyanidation.

Method.

Two samples of 10 assay tons each of the ore through a 30 mesh screen were roasted. One under oxadizing roasting and the other under chloridizing roasting conditions. Each sample was roasted about four hours. Each was weighed and assayed and the loss of gold and silver determined. A sample of each roast was then cyanided and the loss of cyanide and the amount of extraction determined. The results of this series of experiments are shown in Tables IX and X

Table IX

Type of Roast	Mesh in Roast	Wt. of ore A.T.		Assay oz per ton				Loss in Roast				Sulphur	
				gold		silver		gold		silver		Before %	% After
		before	after	before	after	before	after	%	oz per ton	%	oz per ton	%	%
oxidize	30	10	8.46	0.37	0.34	7.83	7.18	22.43	0.08	22.43	1.75	11.53	1.13
chlor-idize	30	10	8.46	0.37	0.25	7.83	7.52	38.60	0.16	15.00	1.17	11.56	0.85

Table X

Amt. of Sol.	Sol. Strgt.	Mesh Cyanided.	Wt. of ore cyanid.	Time Agitated.	Extraction				Tailing Assay oz-per ton		KCN Consump't.	
					gold		Silver					
					%	oz	%	oz	AU	AG	%	lbs. per ton.
9 A.T.	0.5	60	3 A.T.	1 day	52.9	0.18	12.9	0.93	0.16	6.23	78.	8.4
9 A.T.	0.5	60	3 A.T.	1 "	76.0	0.19	86.4	6.52	0.06	1.02	53.	7.2

Conclusions.

The least loss of gold and silver during the roast was under the oxidizing conditions. The best extraction of gold and silver by cyanide was on the material f from the oxidizing roast. However the extraction in neither was sufficient to pay.

FINAL CONCLUSIONS.

From what we have determined there seemes to be no profitable scheme of cyaniding for this ore.

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