CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the

Richard Mieritz Mining Collection

ACCESS STATEMENT

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

CONSTRAINTS STATEMENT

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

QUALITY STATEMENT

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

LOS ANGELES MEETING

MINING & MILLING DIVISION

OCTOBER 24, 1947

CORONADO COPPER AND ZINC COMPANY
ORE CONCENTRATION AT JOHNSON CAMP
REAGENTS AND REAGENT COMBINATIONS

BY

GEORGE A. FREEMAN, MILL SUPT.

Republic Mine, Johnson Camp,

Dragoon, Arizona

****

CORONADO COPPER AND ZINC COMPANY
ORE CONCENTRATION AT JOHNSON CAMP
Reagents and Reagent Combinations

The Johnson Camp Concentrator is located about 6½ miles northwest of Dragoon, Arizona. 190 tons of ore are milled daily. Most of the tonnage supplied is from the Republic Mine, with a small portion being supplied by the Mammoth Mine. Ore from the latter is trucked 1½ miles to the concentrator. Both mines are owned and operated by Coronado Copper and Zinc Company.

NATURE OF ORE

The copper occurs mainly as chalcopyrite, with some bornite and a very small amount of covellite, chalcocite and metallic copper. The Mammoth Ore contains slight amounts of oxidized copper minerals. The zinc occurs mainly as a grey sphalerite with some dark marmatitic zinc. About 0.04% Cu and 0.11% Zn are present in oxidized form. The mill feed contains approximately 0.45 oz. of silver and 0.003 oz. of gold. About 40% of the silver is recovered in the copper concentrate and 40% in the zinc concentrate. Nothing is realized from the small amount of gold in the concentrates. The heads assay up to 0.11% tungsten and a trace of molybdenum but no attempt has been made to recover these in the concentrates. The gangue consists mainly of silicified limestone, hornstone and garnet with some pyrite. The Republic ore contains only about 0.5% pyrite and the Mammoth ore about 1% pyrite or slightly less.

"Sink and Float" tests were made on both ores but satisfactory results were not obtained due to the minerals being so finely disseminated and the specific gravities of the minerals and gangue being so near the same. The specific gravity of the garnet, combined with the other gangue minerals, varies from 3.8-4.0. The sphalerite is 4.0 and chalcopyrite about 4.1.

CRUSHING AND FINE GRINDING

The ore is discharged from either of two run-of-mine ore bins onto a 42" x 36' Pan Conveyor traveling 3.84 feet per minute. This feeds a 13" x 24" Telsmith crusher. The ore is crushed to 2" and is then conveyed by a 16" x 75' belt conveyor, traveling 144 feet per minute to a 3' Symons cone crusher. It passes enroute under a Dings magnet to remove tramp iron. The Symons reduces the ore to 5/8" and it is then conveyed with a 14" x 56' belt conveyor, traveling 270 feet per minute over a Merrick weightometer. It is then conveyed to the mill fine ore

bin with another belt conveyor, 14" x 192', traveling 192' per minute. This bin is of cylindrical steel construction and has a live capacity of 210 tons.

The crushing is done on one 8-hour shift.

The ore is conveyed from the fine ore bin to the ball mill by a 16" x 27' belt conveyor. This conveyor is driven with a vari-speed motor. The ball mill is a 6' x 8' Eimco overflow type ball mill, running at a speed of 27 revolutions per minute. The ball mill discharges into a 48" Akins type spiral classifier. Chilled 3" cast iron balls are used as the grinding media. These balls have a brinnell hardness of 450-470. The ball consumption averages about 2.3 pounds per ton of ore milled. Manganese liners are used in the mill; the liner consumption averaging 0.227 pounds per ton of ore milled.

Although the texture of the ore and the dissemination of minerals is not uniform, an effective liberation of the minerals is accomplished by grinding the mill feed to approximately 68% minus 200 mesh. A finer grind would not be warranted economically. Laboratory tests indicated that with a much finer grind, more zinc would be introduced into the copper concentrate due to sliming.

COPPER FLOTATION

The rougher copper section consists of 8 - #18 Denver Sub A cells. The cleaning section consists of 2 - #15 Denver Sub A cells. The feed, after a conditioning period of 10 minutes, is taken into #1 rougher cell. The product from the first 3 roughers goes to the cleaners for one cleaning and the product from the last 5 rougher cells returns to #1 rougher cell. The cleaner tails are returned, without regrinding, to #1 rougher cell.

Neither the Republic nor Mammoth ore is readily amenable to copper flotation. The copper is difficult to promote and floats slowly. This is due somewhat to the water available for milling. About 8% of the water has a pH of 7.8 and is supplied from the Republic Mine. The remainder has a pH of 8.6 and is pumped from a well near Willcox Dry Lake in Sulphur Springs Valley, 8½ miles from the mines and mill. This water combination, together with reagents introduced into the copper circuit, produces a pH of 8.6 to 8.8. The pH in the copper circuit was lowered to 7.3 with the addition of Sulphuric Acid. This resulted in a lower copper tailing but a higher percentage of zinc in the copper concentrate. Determinations of pH suggest the possibility that some of the interference may be due to various salts in the water. Analyses of the waters used show high contents of chlorides and bicarbonates, with a small amount of fluorine, but to date we have not been able to isolate any one of these as the known interference.

Many reagents and reagent combinations have been tried. Thiocarbanilide 130 is used as the main collector for the copper with a small amount of Potassium Ethyl Xanthate - Z3. Z3 only was used for a short time, but the Thio.-130 proved to be much more selective, pulling less zinc into the copper concentrate. When using the Thio.-130, a lower copper content is realized in the copper tailing if a small amount of Z-3 is added to the copper conditioner and also if a small amount, mixed 50/50 with 301, is fed to #4 copper rougher cell.

Sodium Cyanide, Calcium Cyanide (Aero Brand), Zinc Sulphate, Sodium Sulphite and Reagent #505 have all been tried as zinc depressants and inhibitors. Sodium Cyanide was used for some time as the main depressant but Calcium Cyanide was found later to give much better results when fed in the dry form. Some of the better metallurgical results were realized by using Calcium Cyanide, which are probably due to the lime content of the Calcium Cyanide having a beneficial effect on the water; the lime combines with the bicarbonates, forming calcium carbonate and calcium hydroxide. Sodium Sulphite is used in conjunction with the Calcium Cyanide as a zinc inhibitor and has proven very satisfactory. In addition to its inhibiting effect, it produces a more brittle copper froth, floating the copper much faster. Zinc Sulphate is also fed, as a zinc inhibitor, to the copper cleaner cells. Reagent #505 has a good depressing effect on our zinc but trouble was had in reactivating the zinc in the zinc circuit. It could be reactivated in an acid circuit. When this was tried out the zinc recovery was much lower and the zinc concentrate contained more insol. than in the present alkaline circuit.

DuPont Frother B-23 and Cresylic Acid were both tried as frothers in the copper circuit. The alcohol frother produced a much lighter froth than Cresylic Acid, pulling less zinc into the copper concentrate. Pine Oil is used in conjunction with the B-23 so as to make a little stronger froth. Better results are obtained when the Pine Oil is fed to the ball mill.

Reagent #425 is used as a sulphidizer when enough oxides are present in the ore to warrant the use of it. Most of the ores, however, do not contain enough oxides or oxide coating to require the use of a sulphidizer.

Reagent #242 showed possibilities as a frother and collector in the copper circuit when tried in the laboratory. When used in the mill circuit, however, a high grade copper concentrate could not be obtained.

Minerac "B" was tried in the copper circuit, but when fed in the most minute quantities possible it pulled zinc immediately. It, therefore, was not used in the copper circuit but is giving very satisfactory results in the zinc circuit. It lowers the copper in the Final Tailing considerably and also lowers somewhat the zinc in the Final Tailing.

Soda ash was tried for some time in the mill and produced a little higher copper concentrate, but too much copper was sacrificed into the Copper Tailing.

Calcium Cyanide, Thiocarbanilide - 130, Sodium Sulphite and Pine Oil are fed to the ball mill. Z-3 and B-23 are fed to the copper conditioner.

One of the major problems in the copper circuit is the variable amounts of cyanide needed to satisfactorily depress the zinc. Ore from some sections of the mine consume much more cyanide than ore from other sections. The reason is that some sections of the mine have more metallic copper and soluble copper salts than others. The cyanide consumption of Republic Ore varies from as low as 0.10 pounds per ton of ore to a high of 0.60 pounds per ton. Flotation operators have to learn to observe these changes in the ore and adjust the cyanide accordingly. If the cyanide is allowed to remain too high, much of the copper is depressed along with the zinc, and if the cyanide is not fed in sufficient quantities to dissolve the soluble copper salts present, the zinc will immediately be activated. Various methods have been tried in attempting to titrate for free cyanide in the copper circuit, but to date none has been satisfactory. The interfering elements in the titrations are the soluble sulphides present in the circuit which prohibit the use of the standard Silver Nitrate Method.

The cyanide irregularity could be overcome somewhat if the ores from the different sections of the mine could be more thoroughly mixed. Due to the inability to thoroughly mix the ores, the Mammoth ore has to be milled separately from the Republic ore. The reagent consumption when milling Mammoth ore is the same as when milling Republic, with the exception of the quantity of cyanide required. The Mammoth ore contains more oxidized copper minerals and metallic copper than does the Republic ore. The cyanide consumption is therefore higher, ranging from 1.5 - 3.0 pounds per ton of ore. Calcium Cyanide is replaced with Sodium Cyanide when milling Mammoth ore. Calcium Cyanide when fed in this large amount builds up such a high lime content in the mill waters that a satisfactory copper tailing or concentrate can not be made.

Return water can be used only to the amount of approximately 700 pounds per ton of ore or 20% of total water used. This varies somewhat as again the lime content is the controlling factor. When milling the Republic ore, where the Calcium Cyanide consumption is below 0.5 pounds per ton, 700 pounds of return water per ton of ore produces the best metallurgical results. Return water, used accordingly with Calcium Cyanide, is very beneficial to the copper flotation. The same amount of lime fed to the copper circuit has the same effect but, of course, would be at an additional cost. There is no overflow water from the concentrate thickeners used for return water. This water introduces a reagent build up that is uncontrollable in the copper circuit. Only overflow water from the tailings thickener is used and no trouble is had with reagent returns other than lime, as above mentioned.

The present reagent combination and consumption for the copper circuit is as follows:

REPUBLIC ORE:

To Ball Mill:		
Calcium Cyanide	- 0.20 - 0.50	pounds per ton ore
Thiocarbanilide-130	- 0.11	" " " "
Sodium Sulphite	- 0.33	" " " "
Pine Oil	- 0.009	" " " "
To Copper Conditioner:		
B-23	- 0.12	" " " "
Potassium Ethyl Xanthate-Z-3	- 0.02	" " " "
To #4 Cu Rougher Cell:		
Butyl Xanthate(secondary)-301	- 0.01	" " " "
Potassium Ethyl Xanthate-Z-3	- 0.01	" " " "
To Cu Cleaner Cell:		
Zinc Sulphate	- 0.11	" " " "

MAMMOTH ORE:

Reagents are the same as for Republic ore except that Sodium Cyanide is substituted for Calcium Cyanide. The consumption of the NaCN varies from 1.5 - 3.0 pounds per ton of ore.

The copper recoveries for two typical month's run of Republic ore, using the above reagent setup, are as follows:

	Assay % Cu	Distribution % Cu		Assay % Cu	Distribution % Cu
Head	1.94	100.00	: Head	1.38	100.00
Cu Conc.	29.99	84.27	: Cu Conc	30.51	75.37
Zn Conc.	2.38	11.94	: Zn Conc.	2.52	18.49
Tailing	0.087	3.79	: Tailing	0.098	6.14

The average copper recoveries while milling Mammoth ore are as follows:

	Assay %Cu	Distribution %Cu
Head	3.13	100.00
Cu Conc	30.20	83.75
Zn Conc	4.52	10.62
Tailing	0.21	5.63

ZINC CIRCUIT

The copper tailing is pumped to a 6' x 6' conditioner, where it is conditioned for 10 minutes and then gravity fed to the zinc circuit. The zinc circuit consists of 8 - #18 Denver Sub A cells and 2 - #15 Denver Sub A cells for the rougher section. For the cleaning section, there are 2 - #15 Denver Sub A cells. The feed is split between the first 3 rougher cells. The froth from the first 5 roughers is taken to the cleaners for one cleaning. When running on a low zinc head, as with Mammoth ore, two cleanings are made. The last 5 roughers return to #3 rougher, and as in the copper circuit, the cleaner tails pass on to #1 rougher.

Both of the ores are more amenable to zinc flotation than to copper flotation. No particular difficulty was had in arriving at an acceptable reagent combination. It is impossible to make an extremely high grade zinc concentrate, due, in part, to the necessity of recovering in the zinc concentrate, the copper remaining in the Copper Tailing.

Xanthates, Amyl - Z5, Pentasol - Z6 and Butyl (secondary) - 301, were all tried as collectors in the zinc circuit. It was finally determined that the 301 produced the lowest tailing and a concentrate of good grade was made.

Cresylic Acid is used as a frother.

Copper Sulphate, zinc activator, is fed to the conditioner and also to the fourth rougher cell to insure complete activation.

Processed lime is fed to the conditioner mainly as a pH regulator. The pyrite content of the ore is very low. Much experimenting has been done to determine the proper pH. Best results are obtained with a pH of 10.7 - 10.9 for the zinc circuit.

Hydrated lime was tried in place of processed lime, with no appreciable effect on metallurgy, but it does not have the good settling effect on the zinc concentrate. This, therefore, produces a much wetter cake on the filter discs. The processed lime is fed dry, with a belt feeder, and offers much less feeding inconvenience than does the hydrated lime. "Processed" lime is actually what they sometimes call pulverized quick lime. It has 96-97% CaO content with 88-89% available CaO.

Minerac "B", as mentioned previously, is fed to the zinc conditioner. It enabled us to make a much better recovery in the zinc concentrate of the copper remaining in the copper tailing. The zinc recovery is also improved somewhat. Due to its potency, this reagent has to be very carefully controlled.

The present reagent combination and consumption for the zinc circuit is as follows:

To Zinc Conditioner:

Copper Sulphate	0.68 lbs. per ton
Lime	5.41 " " "
Butyl Xanthate-Secondary-301	0.15 " " "
Cresylic Acid	0.087 " " "
Minerac "B"	0.0068" " "

To No. 4 Zinc Rougher Cell:

Copper sulphate	0.12 lbs. per ton
301	0.04 " " "

The following grades and recoveries are for two typical months using the above mentioned sets of reagents:

	ASSAY		DISTRIBUTION	
	%Cu	%Zn	%Cu	%Zn
Head	1.38	6.00	100.00	100.00
Cu Conc	30.51	5.99	75.37	3.40
Zn Conc.	2.52	54.85	18.49	92.58
Final Tailing	0.098	0.279	6.14	4.02

	ASSAY		DISTRIBUTION	
	%Cu	%Zn	%Cu	%Zn
Head	1.94	5.92	100.00	100.00
Cu Conc.	29.99	6.31	84.27	5.81
Zn Conc.	2.38	55.02	11.94	90.42
Final Tailing	0.087	0.263	3.79	3.77

The following grades and recoveries are typical for a run of straight Mammoth ore:

	ASSAY		DISTRIBUTION	
	%Cu	%Zn	%Cu	%Zn
Head	3.13	4.4	100.00	100.00
Cu Conc.	30.20	6.4	83.75	12.63
Zn Conc.	4.52	49.3	10.62	82.41
Final Tailing	0.21	0.26	5.63	4.96

There are only two changes necessary in the zinc circuit when milling Mammoth ore. The Xanthate - 301 has to be nearly cut in half or too much insol. is pulled into the zinc concentrate. Secondly, due to the lower zinc head, two cleanings are necessary on the zinc concentrate. Although it has no connection with the metallurgy, Ferrous Sulphate is fed to the final tailing when milling Mammoth ore. This is for the purpose of neutralizing any possible free cyanide that may remain.

Both concentrates are pumped to their respective thickeners with 1" Denver concentrate pumps. The zinc concentrate thickener has a diameter of 20' and is 8' deep with a capacity of 18,000 gallons. The copper concentrate thickener is 18' x 8' with a capacity of 15,000 gallons. The thickened concentrates are pumped with 4" Dagley Diaphragm pumps, one for each concentrate, to an American Filter with 6'3" discs. Two discs are used for the zinc and one for the copper concentrate. By maintaining a thick feed to the filter, about 70% solids, both the zinc and the copper can be filtered by one man, in one 8-hour shift. The concentrates drop from the filter to the concentrate floors, from which they are scraped over grizzlys with a 7½ H.P. Sullivan slusher into trucks. The moisture content of the zinc concentrate is about 9% and the copper concentrate about 7%.

The final tailing discharges into a thickener 30' in diameter by 10' deep with a capacity of 53,000 gallons. The tailing goes into the thickener at about 22% solids and is pumped out at around 40% solids with a Wemco diaphragm pump. The diaphragm pump discharges into a 4' x 10' tank and from here the tailing is pumped with a 2" Wemco sand pump through a 2½" pipeline 900' to the tailing pond. The 2½" line continues around the outer edge of the pond with tees and plugs at 21' intervals. With this arrangement, the coarse material is deposited at the outer edges of the pond with the slimes flowing to the center. The tailing pond is built on a side hill slope and is approximately 400' by 800'.

MANPOWER:

There is a total of 13 men employed for the 24 hour mill operations. Each 8 hour shift has one shift boss, who acts as flotation operator, and one ball mill operator. Day shift includes one filter operator and two crusher operators. The tailing pond is maintained on two shifts with one man to the shift. There is one relief man for the 6 mill operators and one relief man for the filter, crusher and tailing pond. The following shift staggering allows every man to work 12 days and then have 2 days off:

	Flotation			Ball Mill				Operators
Days Week	Swing	Day	Grave	Swing	Day	Grave		Key to Days Off*
Fri.	A	C	R	E	G	D		A-Wed. & Thur.
Sat.	A	C	R	E	G	D		B-Fri. & Sat.
Sun.	A	B	R	E	G	D		C-Sun. & Mon.
Mon.	A	B	R	E	G	D		D-Tues.& Wed.
Tues.	A	B	C	E	G	R		E-Thur.& Fri.
Wed.	A	B	C	E	G	R		G-Sat. & Sun.
Thus.	A	B	C	D	G	R		R-Mon. & Tues.
Fri.	A	B	C	D	G	R		
Sat.	A	B	C	D	E	R	*	
Sun.	A	B	C	D	E	R	A	Flotation Operators
Mon.	A	B	C	D	E	G	B	
Tues.	A	B	C	D	E	G	C	
Wed.	R	B	C	D	E	G		
Thur.	R	B	C	D	E	G	D	Ball Mill Operators
							E	
							G	

R -- Relief Men

OPERATING COSTS:

Following are the costs per ton of ore at a milling rate of 190 tons per 24 hours:

Labor -	$0.95
Power -	0.28
Reagents -	0.35
Supplies -	0.25
Balls -	0.07
Liners -	0.06
Misc. Costs -	0.01
	$1.96 per ton of ore milled

The above cost shown for labor includes the 13 regular mill men plus mill supt. and also all repair and maintenance labor. The above costs do not include workmen's compensation insurance or taxes. General supervision, office or assaying was not allocated to the above costs.

The reagent cost breakdown is as follows:

Calcium Cyanide	$0.026	Alcohol-B-23	$0.017
Copper Sulphate	0.053	Zinc Sulphate	0.006
Processed Lime	0.078	Minerac "B"	0.006
Xanthate 301	0.037	Pine Oil	0.001
Xanthate Z-3	0.005	Sodium Cyanide	0.031
Cresylic Acid	0.009	Reagent #425	0.001
Sodium Sulphite	0.025	Ferrous Sulphate	0.014
Thiocarbanilide-130	0.043		
		Total	$0.352

The above cost per ton figure is for the total tonnage milled of both Republic and Mammoth ore. Sodium Cyanide and Ferrous Sulphate is used only on Mammoth ore. The average cost per ton of Mammoth ore milled is 29¢ for Sodium Cyanide and 14¢ for Ferrous Sulphate.

COBRIZA DUMP

The Cobriza Dump is an old reject dump for sorting operations on Republic ore mined during 1912-22. This dump consists of coarse ore, plus 2". It is milled occasionally when sufficient tonnage cannot be supplied from the Republic and Mammoth mines. The metallic content averages about 1.0% Cu and 2.0% Zn. One would expect considerable oxidation during the 26 year minimum period it has been exposed to moisture and air. However, the oxide content is nearly the same as in newly mined Republic ore, about 0.04% Cu and 0.11% Zn. A little more oxide coating can be seen than with Republic ore.

The reagent combination for flotation of the dump ore is nearly the same as for Republic ore. The main change is in reagent consumption. Thiocarbanilide and the Xanthates are cut

down in the copper circuit. More Reagent #425 is fed to this circuit as a sulphidizer for the oxide content. The Xanthate - 301 is also cut down in the zinc circuit to about half and the zinc concentrate is double cleaned, resulting in a product assaying about 46% zinc. If more cells were available for cleaning, a higher grade zinc concentrate could be made by increasing the circulating load. The lower grade zinc concentrate is mixed with the normal 54 - 55% zinc concentrate so as to make an acceptable shipping product.

Average grades of concentrates and recoveries of copper and zinc from Cobriza Dump ore are as follows:

	ASSAY		DISTRIBUTION	
	%Cu	%Zn	%Cu	%Zn
Head	1.00	1.8	100.00	100.00
Cu Conc.	29.75	6.2	73.42	8.50
Zn Conc.	5.26	46.0	17.15	83.13
Final Tailing	0.10	0.16	9.43	8.37

****
****

Metals Engineering Company

Box 597
Casa Grande, Arizona

DATE Mar. 5, '63

ORE NO. Magectic #31 TEST NO. SF1 PRODUCT High Oxide Ore

GRIND – PRIMARY -10 FINAL – MILL Rod MESH -100 TIME 25 min

WATER – GRIND 500 cc Tap FLOTATION Tap + Grind.

CHARGE – GRAMS 500 CELL USED Denver Sub A PERCENT SOLIDS 20

OBJECT OF TEST – Duplication of Test on Mixed oxide–sulfide sample (Test # SF-2)

REFERENCE – 1.25% Coke 1.5% NaCl 3% H_2O 750°C 1 hr.

PRODUCT	WEIGHT		ASSAY, PERCENT				DISTRIBUTION, PERCENT			
	GRAMS	PERCENT	Cu		Cu du		Cu			
Conc	47.4	9.92	46.96		465.8		97.37			
Tail	430.4	90.08	0.14		12.6		2.63			
Comp	477.8				478.4		100.00			
Head Assay			3.85							

REAGENT CHARGE	POUNDS PER TON									
	Grind	Cond	R_1	R_2	R_3					
CaO	10.0	0.4		0.4	0.4					
#425					0.1					
M113C		①		½	½					
TIME, MIN.										
PH										

REMARKS –

Metals Engineering Company

Box 597
Casa Grande, Arizona

DATE Feb. 26, 1963

ORE NO Majestic #28 TEST NO. SF-2 PRODUCT Mixed oxide-sulfide drill cuttings

GRIND – PRIMARY -10 FINAL – MILL Rod MESH -100 TIME 25 min

WATER – GRIND 500 cc Tap FLOTATION Tap + grind

CHARGE – GRAMS 500 CELL USED Denver Sub A PERCENT SOLIDS 20

OBJECT OF TEST – Re-run of SF-1 with added coke + 425 in float.

REFERENCE – 1.25% Coke 1.5% NaCl 3% H_2O 750°C 1 hr.

PRODUCT	WEIGHT		ASSAY, PERCENT				DISTRIBUTION, PERCENT			
	GRAMS	PERCENT	Cu	Ag	Cu dw	Ag dw	Cu	Ag		
Conc	62.9	12.87	41.6	19.4	535.4	249.7	96.08	93.48		
Tail	425.8	87.13	0.25	0.7	21.8	17.4	3.92	6.52		
Comp	488.7				557.2	267.1				

REAGENT CHARGE	POUNDS PER TON									
	Grind	Cond	R_1	R_2	R_3					
CaO	10.0	0.4		0.4	0.4					
#425					0.1					
MIBC		0		(½)	(½)					
TIME, MIN.										
PH		11.6								

REMARKS –

500 g	ore	
6.25 g	coke	1.25 %
7.5 g	$NaCl$	1.50 %
15 cc	H_2O	3.0 %

4:07	750°	Charge in – No dust Considerable fumes
5:07	750°	Gas off – cool
5:16	200°	Start 25 min. grind.

Phone ELgin 9-9962

Ken McGriffin
438 South Main
Salt Lake City, Utah

ASSAY REPORT

MINERAL SERVICES, INC.
ASSAYERS & CHEMISTS
Merwin G. White, President
Don Johns, Vice-President
158 South West Temple Street
Salt Lake City 1, Utah

Lab #1645-8 March 1, 1963

ASSAY PER TON OF 2000 POUNDS

DESCRIPTION	NO.	GOLD OUNCES	SILVER OUNCES	WET LEAD %	COPPER %	ZINC %	INSOL %	%	%	%	VALUE OF GOLD PER TON
~~Majestic #28~~ Test SF-1:											
Tails			0.6		1.25			Ox Cu 0.40			
Conc.			17.0		53.90			5.45			
Test SF-2:											
Tails			0.2		0.25			0.15			
Conc.			19.4		41.60			5.45			

CHARGES $ See Invoice

BY Don Johns

30 So. Main St.
P. O. Box 1889

Jacobs Assay Office

Registered Assayers

PHONE Main 2-0813

Certificate No. 33041 Tucson, Arizona, Feb 26 1932

Sample Submitted by Mr. Metals Engineering

SAMPLE MARKED	GOLD Ozs. per ton ore	GOLD Value per ton ore *	SILVER Ozs. per ton ore	COPPER Per cent Wet Assay	LEAD Per cent Wet Assay	Ox Cu Per cent Wet Assay	Per cent Wet Assay
#28 Heads		$		4.27	—	1.54	
Tail				1.04			
Conc.				50.28			
#31 Heads				3.85	—	2.69	

* Gold Figured $35.00 per oz. Troy

Charges $ 10.00 / 3.00 Samples / 13.00

Very respectfully,
Ben C. Jacobs

30 So. Main St.
P. O. Box 1889

Jacobs Assay Office

Registered Assayers

PHONE Main 2-0813

DUPLICATE

Certificate No. 36041

Tucson, Arizona, Feb 26, 1923

Sample Submitted by Mr. Metals Engineering

SAMPLE MARKED	GOLD Ozs. per ton ore	GOLD Value per ton ore *	SILVER Ozs. per ton ore	COPPER Per cent Wet Assay	LEAD Per cent Wet Assay	Ox Cu Per cent Wet Assay	Per cent Wet Assay
#28. Heads		$		4.27	—	1.54	
Tail				1.04			
Conc.				30.28			
#31. Heads				3.81	—	2.69	

* Gold Figured $35.00 per oz. Troy

Charges $ 10.00 / 3.00 Samples / 13.00

Very respectfully,

Ben D. Jacobs

30 So. Main St.
P. O. Box 1889

Jacobs Assay Office

Registered Assayers

PHONE Main 2-0813

Certifieate No. 32009, Tucson, Arizona, Feb 5-62

Sample Submitted by Mr. Metals Engineering

SAMPLE MARKED	GOLD Ozs. per ton ore	GOLD Value per ton ore *	SILVER Ozs. per ton ore	COPPER Per cent Wet Assay	LEAD Per cent Wet Assay	Per cent Wet Assay	Per cent Wet Assay
		$					
4969	Trace		0 3/10				
70	0 001	0 17	0 3/10				
71	0 001	0 35	0 2/10				
72	Trace		0 1/10				
73	0 001	0 17	0 2/10				

* Gold Figured $35.00 per oz. Troy

Charges $ 12.50

Very respectfully

Ben D. Jacobs