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MINES BRANCH INVESTIGATION REPORT IR 66-63

## PILOT PLANT INVESTIGATION OF A Cu-Pb-Zn ORE FROM CUPRA MINES LIMITED, STRATFORD CENTRE, QUEBEC

T. F. BERRY

by

## MINERAL PROCESSING DIVISION

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### Mines Branch Investigation Report IR 66-63

Pilot Plant Investigation of a Cu-Pb-Zn Ore From Cupra Mines Limited, Stratford Centre, Quebec.

by

#### T.F. Berry\*

#### SUMMARY OF RESULTS

The ore from Cupra Mines Limited analysed 2.44% Cu, 0.55% Pb and 2.04% Zn and contained 0.028 oz Au/ton and 2.24 oz Ag/ton.

Three main problems were associated with the treatment of this ore:

1. Depression of the sphalerite during Cu-Pb rougher flotation.

2. Cu-Pb separation.

3. Elimination of Cu from the zinc concentrate.

Generally, Cu-Pb rougher concentrates contained about 90% of the copper and 85% to 90% of the lead. The presence of bornite in the ore reduced the effectiveness of the cyanide used to depress the sphalerite during Cu-Pb flotation with the result that from 20% to as much as 75% of the zinc reported in the Cu-Pb rougher concentrates.

Cyanide was equally ineffective in the Cu-Pb separation circuit and tabling of the Cu-Pb rougher concentrate was tested with limited success.

Little success was achieved in stripping the copper from a final zinc concentrate.

\*Technical Officer, Non-Ferrous Minerals Section, Mineral Processing Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

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Product	Wt		Assays %		Dis	stributio	on %
	%	Cu	Pb	Zn	Cu	Pb	Zn
Cu conc	13.40	15.80	1.95	3.10	92.0	52.6	21.9
Pb conc	0.40	3.10	45.20	0.55	0.5	36.4	0.1
Zn conc	2.36	2.80	0.55	55.60	2.9	2.6	69.Z
Flot tail	83.84	0.12	0.05	0.20	4.6	8.4	8.8
Head (calcd)	100.00	2.30	0.50	1.90	100.0	100.0	100.0

The results contained in the following table from Run No. 9 are representative of those obtained during the pilot plant test.

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#### INTRODUCTION

On August 19, 1965, Mr. R.B. Gosselin, P. Eng., Manager of Solbec Copper Mines Limited, Stratford Centre, Quebec, requested a pilot plant investigation designed to develop a flowsheet for the milling of a copper-zinc-lead ore from a wholly owned subsidiary, Cupra Mines Limited.

Mr. E. W. Thorton, Mill Superintendent of Solbec Copper Mines Limited was in charge of this pilot plant investigation and the author was assigned to collaborate with him.

#### Location of Property

Cupra Mines Limited is a copper-zinc-lead property located about two miles from Stratford Centre, Quebec.

#### Shipment

Approximately 40 tons of freshly mined ore was received from Cupra Mines Limited on September 8, 1965.

#### Sampling and Analysis

As the ore was crushed, a head sample was riffled out for a semiquantitative spectrographic and a chemical analysis. Representative pieces of the ore were retained for a mineralogical examination.

Chemical analysis of a riffled sample of the crushed ore (Table 1) showed the presence of copper, lead, zinc, gold and silver. During the pilot plant investigation, daily samples of flotation feed were assayed for copper, lead and zinc with good reproducibility.

#### TABLE 1

#### Element Amount Copper (Cu) 2.44 per cent 0.55 " Lead (Pb) 2.04 ." Zinc (Zn) 16.96 " Iron (sol Fe) 20.89 " Sulphur (tot S) Insoluble 50.52 " Gold 0.028 oz/ton(Au) 2.24 11 Silver (Ag)

\*Internal Report MS-AC-65-1038

### MINERALOGICAL INVESTIGATION\*

#### Summary of Results

A mineralogical study of a copper-zinc-lead ore from the Cupra Mine in the Eastern Townships of Quebec shows that the ore minerals are chalcopyrite, bornite, tennantite, sphalerite and galena. They occur largely as interstitial material between rounded pyrite grains, minute inclusions in pyrite, and as small masses. The chalcopyrite also occurs as veins in quartz. A study of mill products to about 82.5% -200 mesh shows that at this size the ore minerals are largely liberated.

#### Procedure

Ten polished sections and one thin section were prepared from the hand specimens, and one polished section was prepared from each mill product. The minerals were identified by microscopical and X-ray diffraction studies, and the textural relationships of the minerals were determined microscopically.

\*From Mines Branch Investigation Report IR65-90, by W. Petruck, Mineral Sciences Division, October 20, 1965.

## Chemical Analysis\* of Head Sample

#### Character of the Ore

The hand specimens vary considerably in composition, some consisting of massive sulphides, others of gangue, and still others of quartz with chalcopyrite and chlorite veins. The massive sulphides consist chiefly of rounded pyrite grains. The ore minerals occur as interstitial material between the pyrite grains, and as small masses. The gangue is a schistose rock that consists of quartz-talc layers and chlorite layers and contains disseminated pyrite. The chalcopyrite and chlorite veins in quartz are up to one-quarter inch wide; the chlorite veins contain disseminated pyrite.

#### Detailed Mineralogy

Pyrite is the most abundant mineral in the ore. It occurs as rounded grains in the massive sulphides and as euhedral crystals in chlorite veins and chloritic layers of the gangue. The grains and crystals vary from about 20 to 1000 microns in size and contain inclusions of the ore minerals.

The ore minerals are chalcopyrite, bornite, tennantite, sphalerite and galena. They occur chiefly in the massive sulphides and disseminated pyrite, although some chalcopyrite also occurs as veins. Those in the massive sulphides are present as interstitial material between rounded pyrite grains (Figure 1), as inclusions in pyrite, and as small masses. The interstitial material consists of complex mixtures of the ore minerals, and fills interstices that vary from about 2 to 300 microns in size. The inclusions in pyrite, both in the massive ore and disseminated pyrite, are present as rounded to irregular grains that vary from about 1 to 100 microns in size (Figure 2). Chalcopyrite is the most common type of inclusion and most of it is within the size range from 10 to 50 microns. The inclusions of the other minerals are generally smaller in size.

The unit cell parameter of the sphalerite, as determined by X-ray diffraction, is 5.411A. When applied to Kullerud's curve, this indicates 3.8 mol per cent FeS in the sphalerite, which corresponds to a composition of Zn 64.6%, Fe 2.4% and S 33.0%. The unit cell parameter of tennantite was found to be 10.22A, which is slightly higher than that of pure tennantite (10.19A). This may indicate either that the tennantite contains small amounts of silver or that some of the arsenic is replaced by antimony.

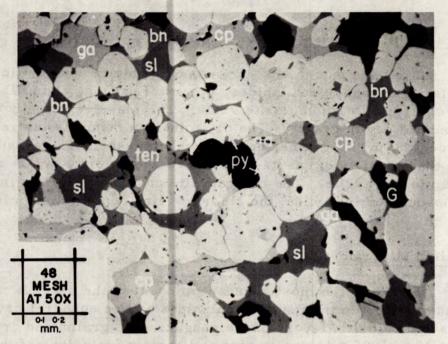


Figure 1 - Photomicrograph of a polished section of the massive sulphides showing the rounded pyrite grains (py) with interstitial chalcopyrite (cp), tennantite (ten), bornite (bn), sphalerite (sl) and galena (ga). The black areas marked G represent gangue.

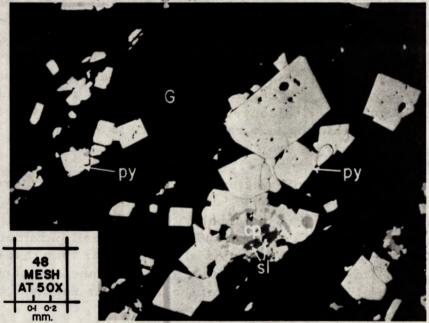


Figure 2 - Photomicrograph of a polished section of a chloritic layer of the rock showing euhedral pyrite crystals (py) with inclusions of chalcopyrite (cp) and sphalerite (sl). The dark area marked G represents the chloritic gangue.

#### Conclusions

The ore minerals present in the ore from Cupra Mine are chalcopyrite, bornite, tennantite, sphalerite and galena. They occur as interstitial material between pyrite, as minute inclusions in pyrite, as small masses, and as chalcopyrite veins. All the ore mineral grains, with the exception of the minute inclusions in pyrite, are largely liberated at a grind of 82.5% -200 mesh.

#### DETAILS OF INVESTIGATION

The basic flowsheet used in the treatment of this ore is shown in the Appendix. The variations in this flowsheet which are shown in dotted lines, were necessary to attempt to depress the sphalerite and pyrite in the copper circuit, to make a copper-lead separation and to reduce the copper content of the final zinc concentrate.

Grinding was tested in open circuit and in closed circuit with a Dorr classifier, with and without aeration of the ground pulp.

Cyanide and zinc sulphate were used to depress the sphalerite and pyrite in the copper circuit. The copper-lead separation circuit involved the conventional flotation method using cyanide as the copper depressant and one or more tabling steps to recover a lead concentrate.

In conventional zinc rougher flotation, lime, copper sulphate and Z-200 were used. The rougher zinc concentrate was cleaned three times in all tests. In two tests (Nos 7 and 9) the zinc recleaner concentrate was refloated using zinc sulphate in an attempt to reduce the copper content of the final zinc concentrate.

#### CONCLUSIONS AND DISCUSSION

There were two main problems associated with the pilot plant investigation of the Cupra ore. These were the depression of the sphalerite and the pyrite in the copper-lead rougher circuit and a copperlead separation.

The ore contained substantial amounts of tennantite and bornite and these two minerals, particularly the latter, probably exerted a destructive influence on the cyanide, which was used in the grinding circuit to depress the sphalerite and pyrite. The same destruction of cyanide would account for the poor copper-lead, separation by flotation.

There was also the problem of lowering the copper content of the zinc concentrate to comply with smelter requirements. This problem was accentuated by the high copper to zinc ratio in this ore and is probably related to the difficulties experienced in the copper-lead rougher circuit in which efforts to improve the grade and selectivity in the copper circuit tended to squeeze out some of the copper minerals which subsequently reported in the zinc concentrate.

Lime seemed to have little effect as a pyrite depressant and in some cases appeared to activate zinc in the copper-lead circuit. Of the reagent combinations tried the only one which exerted some control over the zinc and iron minerals was cyanide and zinc sulphate. The amounts of potassium amyl xanthate and Z-200 used had some effect but their influence was less important. A good part of the time during the pilot plant investigation was spent trying to obtain a reasonable reagent balance.

The lead in the copper-lead rougher concentrate posed a difficult problem and defied all attempts at a separation by conventional flotation using cyanide as the copper depressant. The rather unconventional method (for a base metal operation), of tabling the copper-lead rougher concentrate offered some hope. Retabling of the primary table tailing to recover additional slimed lead showed some merit but results were not as good as appeared from a visual examination. Further work on this method of lead recovery, perhaps on a classified feed should prove valuable.

Several mill products from Run No. 10 were prepared for a mineralogical examination. This report is included in the Appendix showing the metallurgical balance for Run No. 10. Generally while most of the minerals in the products examined were present as free grains, some mineral grains occurred as minute rounded inclusions in pyrite and as irregular grains at the edges of the pyrite. Chalcopyrite, sphalerite, pyrite, galena, bornite and tennantite were present in all of the mill products.

#### ACKNOWLEDGMENT

The author wishes to thank W. Petruck of the Mineralogical Section, Mineral Sciences Division, and the staff of the Analytical Chemistry Subdivision of the Mineral Sciences Division of the Mines Branch who contributed to the results of this pilot plant investigation.

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# APPENDIX

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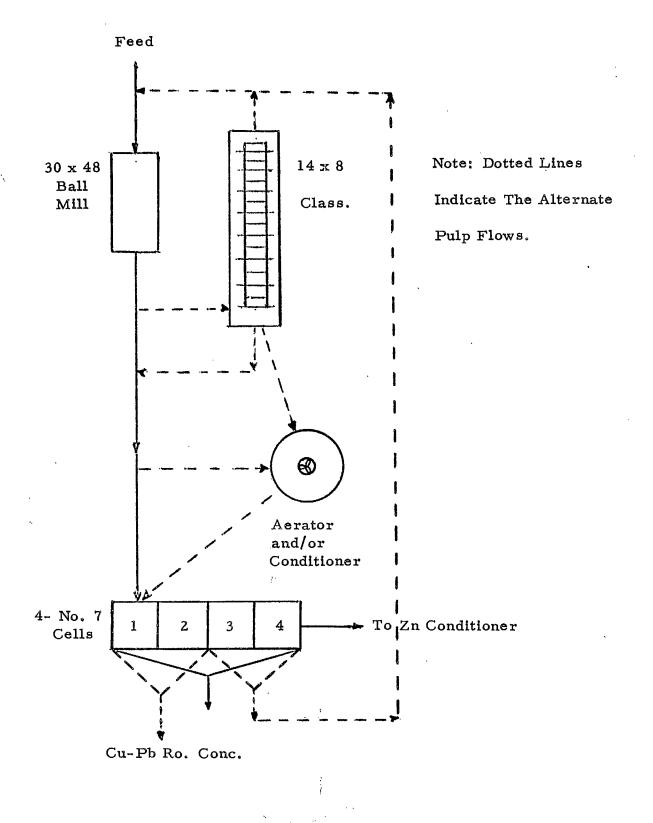
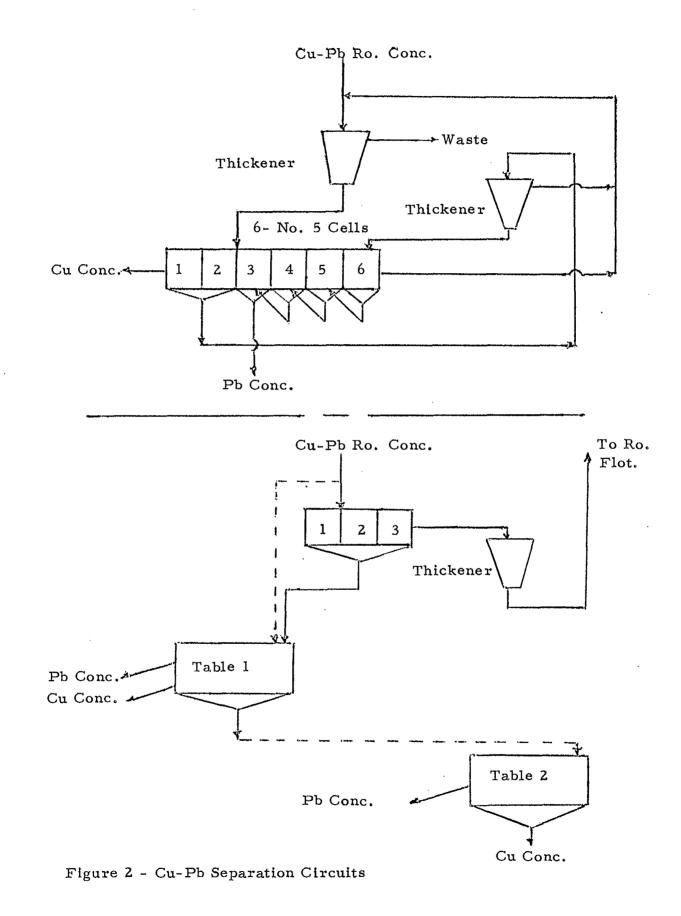
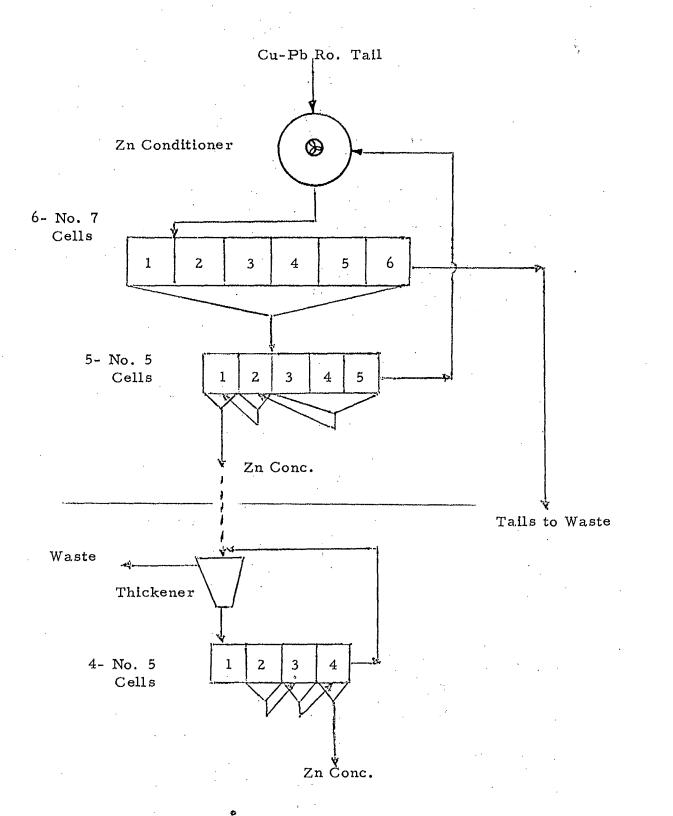
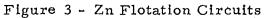


Figure 1 - Grinding - Classification & Cu-Pb Rougher Flotation







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Ball mill disch - Wt. $%$ 4.8       4.8       9.8       7.8       14.1       58.7       72.8         METALLURGICAL BALANCE         DISTRIBUTION - $%$ OUT       ASSAYS       DISTRIBUTION - $%$ Cu Pb Zn Cu Pb Zn         Cu Pb Zn       Cu Pb Zn         Cu-Pb conc       10.28       18.89       4.04       9.79       87.5       70.2       49.3         Zn "       1.05       6.20       1.62       46.92       2.9       2.9       24.2         Flot tail       88.67       0.24       0.18       0.61       9.6       26.9       26.5         Head (calcd)       100.00       2.22       0.57       2.04       100.0       100.0       100.0	Total	0.27	4.5	0.45	0.03		<b> </b>		· · · · · · · · · · · · · · · · · · ·		·	·
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		<b> </b>			<u> </u>		· · ·			<u></u>	ļ	-
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	·	<u> </u>	L	<u> </u>	Ll	<u> </u>		-L			<u>L</u>	-
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	-											-
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Ball Mil	r arso				_		9.8	1.8 114.	L   58.7	72.8	=
$\begin{array}{c c c c c c c c c c c c c c c c c c c $									DISTR	IBUTION	- %	Ļ
Cu-Pb conc       10.28       18.89       4.04       9.79       87.5       70.2       49.3         Zn       "       1.05       6.20       1.62       46.92       2.9       2.9       24.2         Flot tail       88.67       0.24       0.18       0.61       9.6       26.9       26.5         Head (calcd)       100.00       2.22       0.57       2.04       100.0       100.0       100.0	PRODUCT			wr.%	•	1		Zn		,	· · · · · · · · · · · · · · · · · · ·	1
Zn       "       1.05       6.20       1.62       46.92       2.9       2.9       24.2         Flot tail       88.67       0.24       0.18       0.61       9.6       26.9       26.5         Head (calcd)       100.00       2.22       0.57       2.04       100.0       100.0       100.0	Cu-Pb conc			10,28								=
Flot tail       88.67       0.24       0.18       0.61       9.6       26.9       26.5         Head (calcd)       100.00       2.22       0.57       2.04       100.0       100.0       100.0	*											1
	Flot tail											
	Head (calcd	)		100.00	2.22	2 0.	57	2.04	100.0			_  ·
	*******					;  -						_
												4
	• •			-					-			-ľ
	· · · · · · · · · · · · · · · · · · ·					<u>;                                     </u>						-
		······································						· · ·				-
┝╌┄╴╌╴╴╴╴╴╴╴╴╴╴┥╴╴╴╷┿╬┈┈╴╴╴┠╌┈┈┈╴┠╼┈┈┈╴╴┠╴╴╴╴╸┫╴┉┉┉╴╴	· · ·	····	ł	<u>-</u>		- <del> </del>	+		- <b>F</b>	ļ		-

RUN NO1 5					FEEI	) R	ATE	11		4	80	)			
DATE: Se	pt. 1	5 - 65			TIMI	<u> </u>	PER	ATE	Dı	3	13	hr			
ORE: CU	ipra				SAME	PLI.	NG	PER	10	Dı	2:	<u>30 I</u>	2M	<u>4_PM</u>	
PURPOSE OF		Open	circu						-						
circuit op															
							,			~~~~~					
	······											2002			
		AVE	AGE CO	NDI	TIOI	NS	DUI	lNG	S	AMPL	IN	G PE	RIOD		
Point	Reag	ents -	lbs./t	on (	ore	tr	eat	ed			<u> </u>			<u></u>	
of Addition	NaCN	1	CuSO <sub>4</sub>	1			200			F	'r(	oduct		% Solids	, pH
Ball mill	0.1			0.0		0.	.03			Bal	1	mill	. disc	ch 54	
Flot feed	0.1									Flo	t	feed	l	29	8.5
Cu-Pb ro#3	Cu-Pb ro <sup>#</sup> 3 0.25 Zn cond 11.8														
.[	1														
11 11 11 7/ 2															
" " " " # <u>4</u>	0.05	ļ					]								
Zn cond	ļ	6.0	0.5	ļ				ļ		ļ					
Total	0.80	6.0	0.5	lo.	<u>01</u>	0	.03	l		l		<b></b>	****		
		alysis	•	<del></del>	+6	5M	+1	0 <sup>0</sup> M	+1	.50M	+:	200М	<b>+325</b> №	M -325M	-200M
Ball m	ill di				1	9		!	6	.3		5.9	12.6	69.4	82.0
		MET	ALLURG	I CAL					<del>~ 11 11</del>		-	-	x22200437.0022		
PRODUCT			พาก ศ	<u> </u>	A:	SSA	AYS		<b>.</b>			D	ISTRI	BUTION	- %
× 100001			Wr.%	C	u	+	Pł	<u>b</u>	ļ	Zn		Cı	<u>u</u>	Pb	Zn
Cu conc			3.07	1				00_		9,90		18		18.4	15.5
PD			5.41					50	T	7.70		73		70.4	19.3
<u>211</u>	10-10-11-0-1		2.20		.60			92	}	2.00			.6	4.0	58.3
Flot tail			<u>89,32</u>		14	1		04	1	0.1			.6	7.2	6.9
Head (calcd)	)		100.00	2	.22		0.	50		1.96	6	100	-0	100.0	100.0
	<u></u>					+			$\vdash$						
						+			<u> </u>		$\neg$				

RUN NO: 7		•		- []	FEE	D R	ATE	1		48	30			······	
DATE: Sent	. 16	- 65			(MI)	E C	OPERA	ATE	Dı	37	h h	ır			
ORE: Cupr	-				SAMI	PL I	ING I	PER	101	): 1	h h	ır			
PURPOSE OF F	UN:	720504	<u>in gr</u>		, ,								tahi	inc	
Zn-Cu Separ			Ų						Ťvrr						
	······································			******					,			· .			
			······				~^~~~							-	
· ·															
	· · ·													,	
		AVE	AGE CO	NDI	rio	NS	DUR	ING	S/	AMPL	INC	} PE	RIOD		
Point	Reare	ents -	lbs./to	on o	ore	tr	reate	ed						1,	T
of Addition		ZnSO4					· ·	<u> </u>		P	rọc	iuct		% Solids	pH
Ball mill		0.27	122,110	·			200- 025			B911	<b>.</b>		disc	1	
Flot feed	0,10								1					34	8.3
Flot feed0.10Flot feed34Cu-Pb ro $34$ $2n$ cond $2n$ cond													11 7		
Zn cond			6,1 0,54 Zn cond Zn cleaner												11.7
Zn-Cu sep#1		0.54	1							Zn-C					7.0
" " " # <sub>3</sub>		0.54													
					•		Ī			. •					
Total	0.30	1.35	6.1	· 0.	54	0	025								
Scre	en An	alysis			+0	5M	+10	ю	+1	50M	+2	оом	+325	M -325M	-200M
Ball_mil	1 dis	<u>ch - W</u>	t. %		1,	9	2.9	9	6	.3	5	.9	12.6	69.4	82.0
		MET	ALLURGI	CAL	BA	LA	NCE						aladekonar a saar a		
PRODUCT			11170	••••••	A	SS/	AYS		·			D	ISTRI	BUTION	- %
FRODUCT			WT.%	C	<u>u</u>		Pb	)		Zn	_	C	<u>u  </u>	Pb	Zn
Cu conc			13.40			_	2.0			0.00		90	.4	53.7	65.7
dA			0.44		.26	<u>-</u>	39.4	40	·	1.33		0	.8	34.8	0.3
Zn recl con	c		0,63		<u>, 56</u>		0.9	95	5	4,26	_	1	<u> </u>	1.2	16.8
Flot tail			85,53		. 20	<u>_</u>	0.0	06		0.41		7	.8	10.3	17.2
Head (calcd	)		100.00	_2	. 22		0:1	50_	<u>·</u>	2.04	+	100	-0	100.0_	_100.0
Zn-Cu circu	it														
Head						4	0,9	95	54	4.26				•	
Conc				3	.44		1.4	42	3′	7.32				•	· ·
Tail			8	3	. 44		1.:	27_	5	2,22					

· · {

RUN NO1 9		·			FEED	R/	ATE	1		48	0				
DATE: Sep	ot. 17	- 65		1	<b>FIME</b>	OI	PER	ATE	Dı	5	1	1r			
ORE: Cup	ra			1	SAMP	LII	NG	PER	101	<u>), 1;</u>	30	)	3:30	PM	-
PURPOSE OF F		Repea	t of R	un	No.	7		Cha	ng	e ir	1	reag	ent s	mounts	£
															<sup></sup>
							1								
															·····
	······					 									
		AVER	AGE CO		TION	5			5/				RIOD		
Point of	Reage	ents -	lbs./to	on d	ore	tre	eat	ed		р	ro	duct	:	de Re	рН
Addition	NaCN	ZnS04	Lime	Cu	504 Z	2-2	200	frö -250	ţh					Solids	3
Ball mill		1.08					03			Ball	<u>L 1</u>	mi11	disc	<u>n 58</u>	
Flot feed	0,16		<u> </u>							Flot		feed		34	8.3
Cu-Pb ro-#3														11.5	
Zn_cond			6.8	1.02 Zn cleaner 1										11.2	
Zn cleaner								0.0	21						
$Zn-Cu_{sep}''_1$		1.08	<u> </u>											_	
Zn-Cu_sep <sup>#3</sup>		0.54	ļ											<u> </u>	
Total	0.48	2.70	6.8	1	. 02	<u>0</u> .	03	0.0	01						
Scre	en An	alysis	••••••••••••••••••••••••••••••••••••••		+6	<u>5M</u>	+1	οίοΜ	+1	50M	+2	200M	+3251	4 -325M	-200M
					<u> </u>						-	<u></u>			
		MET	ALLURGI	CAL	BAI	LAN	1CE	<del>_</del>							
DRODUCIM					AS	SA	YS		u			D	ISTRI	BUTION	- %
PRODUCT			WT.%	C	u	<u> </u>	P	<u>b</u>		Zn		C	<u>u</u>	Pb	Zn
Cu conc			13.40	15	.80		1.	95	:	3.10		92	.0	52,6	21.9
_Pb''			0.40		<u>.10</u> .80	4	<u>15.</u>	<u>20</u> 55		0.55	- 1		.5	36.4	0.1
[	Zn recl conc 2.3									5,60	-		.9	2.6	69.2
Flot tail	<del></del>		83.84		. 12	-	0.	05		0.20	_	4	.6	8.4	8.8
Head (calcd)			100.00	_2	.30	-	0.	50	<u> </u>	1 <u>.90</u>	_	100	.0	100.0	100.0
Zn-Cu Circu	it														
Head	Head				, 80		0,	55	5	5,60					
Conc					,65		0.	30	2	3,00					ļ
Tail				4	.00	1	1.	30	5	5,40					L

FEED BATE: 480         DATE: Sept. 20 - 65       TIME OPERATED: 6 hr         ORE: CUDRA       SAMPLING PERIOD: 2 hr         PURPOSE OF RUN: Tabling of Cu-Pb rougher cone to recover Pb cone and 2nd Cu cone. No assays of zine circuit.         AVERAGE CONDITIONS DURING SAMPLING PERIOD         Point of Reagents - 1bs./ton ore treated of a curcuit.         Product \$ pI         Point $of$ Reagents - 1bs./ton ore treated       Product $$ pII$ AVERAGE CONDITIONS DURING SAMPLING PERIOD         Point of a curcuit.         OLD TO YERAGE CONDITIONS DURING SAMPLING PERIOD         Point of Reagents - 1bs./ton ore treated of a curcuit. $$ pII$ AVERAGE CONDITIONS DURING SAMPLING PERIOD         Point of a curcuit. $$ pII$ Addition NaCN Lime CuSOA Z=6 Z-200         Product \$ solids         Curcleaner	·····														·····	
ORE:         CUDPA         SAMPLING PERIOD:         2 hr           PURPOSE OF RUN1         Tabling of Cu-Pb rougher cone to recover Pb cone and 2nd Cu cone. No assays of zine circuit.	RUN NO: 10				F	TEED	RA	ľE i			480	)				
PURPOSE OF RUNI         Tabling of Cu=Pb rougher cone to recover Pb cone           and 2nd Cu cone. No assays of zine circuit.           AVERAGE CONDITIONS DURING SAMPLING PERIOD           AVERAGE CONDITIONS DURING SAMPLING PERIOD           Point of Addition           NaCN         Lime         CuSO4         Z-200         Product         \$\$         pH           Addition         NaCN         Lime         CuSO4         Z-200         Product         \$\$         pH           Addition         NaCN         Lime         CuSO4         Z-200         Product         \$\$         pH           Ball mill         0.22         0.01         0.03         Ball mill disch 56         11.6           Flot         feed         0.22         0.01         0.03         Cn         cond         11.1           Zn         cond         5.4         1.02         0.01         0.03         Entropy         -325M         -200M           Screen Analysis         +65M         +100M         +150M         +200M         +325M         -325M         -200M           Ball mill disch - Wt. %         2.5         2.8         6.2         6.0         12.2         70.3         82.5<	DATE: Sei	ot. 20	- 65	····-	1	'IME	OPI	ERATE	Di		<u>6 1</u>	1 <b>r</b> .		•		
and 2nd Cu cone. No assays of zinc circuit.           AVERAGE CONDITIONS DURING SAMPLING PERIOD           Point of Addition         Reagents - 1bs./ton ore treated of Addition         Product \$\$ Solids         pH           Ball mill         0.22         0.01         0.03         Ball mill disch .56         pH           Flot feed         0.22         0.01         0.03         Ball mill disch .56         11.6           Cu-Pb ro#3         0.22         0.01         0.03         Ball mill disch .56         11.6           Zn cond         5.4         1.02         7n recleaner         11.1           Zn recleaner         11.1         11.1         11.1           Soreen Analysis         +65M +100M +150M +200M +325M -325M -200M         82.5           METALURGICAL BALANCE         0.01         0.03         12.2         70.3         82.5           METALURGICAL BALANCE         ASSAYS         DISTRIBUTION - \$         7n         70.3         82.5           Cu conc *1         8.38         15.48         1.55         6.94         58.9         25.8         30.19           Cu conc *2         3.87         18.52         3.25         1.42         32.6         25.0         22.95 <t< td=""><td>ORE: Cur</td><td>ora</td><td></td><td></td><td><u> </u></td><td>SAMP.</td><td>LIN</td><td>) PER</td><td>101</td><td>):</td><td><u>2</u>1</td><td><u>ir</u></td><td></td><td></td><td></td></t<>	ORE: Cur	ora			<u> </u>	SAMP.	LIN	) PER	101	):	<u>2</u> 1	<u>ir</u>				
AVERAGE CONDITIONS DURING SAMPLING PERIOD         Point of macm Lime CuSO4 Z-6 Z-200       Product $%$ pH ddition NaCN Lime CuSO4 Z-6 Z-200         Ball mill       0.22       0.01 0.03       Ball mill disch 56         Flot feed 0.22       Solids         Cu-Pb ro <sup>#3</sup> 0.22       Zn cond       Solids         Cu-Pb ro <sup>#3</sup> 0.22       Zn cond       Silis         Solids       Flot feed 31 8.6         Cu-Pb ro <sup>#3</sup> 0.22       Zn cond       II.6         Zn cond       II.6         Solids       Solids         Solids       Solids       Solids         Solids       Soli	PURPOSE OF I	RUNE	Tabl	ing of	Cu-	Pb_	rou	gher_		mc	to.	rec	over	Ph_cond		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	and 2nd Cu	conc.	No a	ssays	of <sup>.</sup>	zind	<u>c c</u> :	rcui	t.						·	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			· · · · · · · · · · · · · · · · · · ·													
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	•••••••••••••••••••••••••••••••••••••••			`	~	•		بمجمعينين وسراكتها								
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	······································					·										
$\begin{array}{c c c c c c c c c c c c c c c c c c c $						1.77941-112										
of Addition         Reagents         10s. / ton ore         treated         Product $g$ pH           Ball mill         0.22         0.01         0.03         Ball mill disch         56            Flot         feed         0.22         0.01         0.03         Ball mill disch         56            Flot         feed         0.22          Flot         feed         31         8.6           Cu-Pb ro <sup>#/3</sup> 0.22           Zn cond         111.6           Zn cond         5.4         1.02          Zn recleaner             Total         0.66         5.4         1.02         0.01         0.03              Screen Analysis         +65M         +100M         +150M         +325M         -325M         -200M           Ball mill disch - Wt. $\%$ 2.5         2.8         6.2         6.0         12.2         70.3         82.5           METALLURGICAL         BALANCE                 Cu conc $\%$ 1         8.38         15.48         1.55			AVEF	AGE CO	NDI	rion	S D	URING	S	AMPL	INC	} PE	riod			
Addition         NaCN         Lime         CuSO4         Z-6         Z-200         Product         Solids         ph           Ball mill         0.22         0.01         0.03         Ball mill disch         56            Flot         feed         0.22          Flot         feed         31         8.6           Cu-Pb ro <sup>#/3</sup> 0.22           Zn cond         11.6           Zn cond         5.4         1.02          Zn recleaner          11.1.6           Zn recleaner           Zn recleaner		Reage	ents -	lbs./to	on c	ore	tre	ated		. n		41104		d	nH	
Flot feed       0.22       Image: cond state s		NaCN	Lime	CuSO4	Z-	6 Z	2-20	0		·						
Cu-Pb ro <sup>#</sup> 3       0.22       Image: condent	Ball mill	0.22			0.	01	0.0	3		Bal	<u>1 n</u>	<u>nill</u>	disc	h . 56		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Flot feed	0.22					•			<u>F10</u>	<u>t</u>	fee	<u>d</u>	31	8.6	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Cu-Pb ro <sup>#</sup> 3 0.22 Zn cond 11.6															
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Zn_cond		5_4	1.02												
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Zn recleaner			<u> </u>	<u> </u>					ļ			• .		ļ	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $					ļ					<u> </u>						
Ball mill disch - Wt. %       2.5       2.8       6.2       6.0       12.2       70.3       82.5         METALLURGICAL BALANCE         PRODUCT       ASSAYS       DISTRIBUTION - %         Cu conc $^{4}$ 1       8.38       15.48       1.55       6.94       58.9       25.8       30.19         Cu conc $^{4}$ 1       8.38       15.48       1.55       6.94       58.9       25.8       30.19         Cu conc $^{4}$ 2       3.87       18.52       3.25       11.42       32.6       25.0       22.95         Combined (calcd)       12.25       16.44       2.09       8.36       91.5       50.8       53.14         Pb cone       0.40       2.32       50.20       0.17       0.4       39.9       0.04         Zn conc       1.34       2.40       0.92       54.47       1.5       2.4       37.89       51.43         Flot tail       86.01       0.17       0.04       0.20       6.6       6.9       8.93       4.93         Head (calcd)       100.00       2.20       0.50       1.93       100.0       100.0       100.0       100.0 <td>Total</td> <td>0.66</td> <td>5.4</td> <td>1.02</td> <td>0.</td> <td>01</td> <td>0_0</td> <td>з </td> <td></td> <td>, </td> <td></td> <td></td> <td>;</td> <td>· .</td> <td></td>	Total	0.66	5.4	1.02	0.	01	0_0	з		, 			;	· .		
Ball mill disch - Wt. %       2.5       2.8       6.2       6.0       12.2       70.3       82.5         METALLURGICAL BALANCE         PRODUCT       ASSAYS       DISTRIBUTION - %         Cu conc $^{4}$ 1       8.38       15.48       1.55       6.94       58.9       25.8       30.19         Cu conc $^{4}$ 1       8.38       15.48       1.55       6.94       58.9       25.8       30.19         Cu conc $^{4}$ 2       3.87       18.52       3.25       11.42       32.6       25.0       22.95         Combined (calcd)       12.25       16.44       2.09       8.36       91.5       50.8       53.14         Pb cone       0.40       2.32       50.20       0.17       0.4       39.9       0.04         Zn conc       1.34       2.40       0.92       54.47       1.5       2.4       37.89       51.43         Flot tail       86.01       0.17       0.04       0.20       6.6       6.9       8.93       4.93         Head (calcd)       100.00       2.20       0.50       1.93       100.0       100.0       100.0       100.0 <td>······</td> <td><u> </u></td> <td><u> </u></td> <td></td> <td>L</td> <td>l</td> <td></td> <td><u></u></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	······	<u> </u>	<u> </u>		L	l		<u></u>								
METALLURGICAL BALANCE           DISTRIBUTION - $\%$ ASSAYS         DISTRIBUTION - $\%$ Cu conc $\%$ 1         8.38         15.48         1.55         6.94         58.9         25.8         30.19           Cu conc $\%$ 1         8.38         15.48         1.55         6.94         58.9         25.8         30.19           Cu conc $\%$ 2         3.87         18.52         3.25         11.42         32.6         25.0         22.95           Combined (calcd)         12.25         16.44         2.09         8.36         91.5         50.8         53.14           Pb conc         0.40         2.32         50.20         0.17         0.4         39.9         0.04           Pb conc         0.40         2.4         37.89         Flot tail         86.01         0.04         0.00				The second descent of the second s												
ASSAYS         DISTRIBUTION - $%$ PRODUCT         WT. $%$ $Cu$ Pb         Zn         Cu         Pb         Zn           Cu conc $^{/k}1$ 8.38         15.48         1.55         6.94         58.9         25.8         30.19           Cu conc $^{/k}2$ 3.87         18.52         3.25         11.42         32.6         25.0         22.95           Combined (calcd)         12.25         16.44         2.09         8.36         91.5         50.8         53.14           Pb conc         0.40         2.32         50.20         0.17         0.4         39.9         0.04           Zn conc         1.34         2.40         0.92         54.47         1.5         2.4         37.89           Flot tail         86.01         0.17         0.04         0.20         6.6         6.9         8.93           Head (calcd)         100.00         2.20         0.50         1.93         100.0         100.0	Ball m	111 di							6	5.2	6.	0	12.2	70.3	82.5	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			MET	ALLURG						LITERARD.						
$m_{\mu}$ CuPbZnCuPbZnCu conc $//2$ 8.3815.481.556.9458.925.830.19Cu conc $//2$ 3.8718.523.2511.4232.625.022.95Combined (calcd)12.2516.442.098.3691.550.853.14Pb conc0.402.3250.200.170.439.90.04Zn conc1.342.400.9254.471.52.437.89Flot tail86.010.170.040.206.66.98.93Head (calcd)100.002.200.501.93100.0100.0100.0	PRODUCT			WT.%	:: 		- <u>T</u>		1				r	· · · · · · · · · · · · · · · · · · ·		
Cu conc $\#2$ 3.8718.523.2511.4232.625.022.95Combined (calcd)12.2516.442.098.3691.550.853.14Pb conc0.402.3250.200.170.439.90.04Zn conc1.342.400.9254.471.52.437.89Flot tail86.010.170.040.206.66.98.93Head (calcd)100.002.200.501.93100.0100.0100.0									-							
Combined (calcd)       12.25       16.44       2.09       8.36       91.5       50.8       53.14         Pb conc       0.40       2.32       50.20       0.17       0.4       39.9       0.04         Zn conc       1.34       2.40       0.92       54.47       1.5       2.4       37.89         Flot tail       86.01       0.17       0.04       0.20       6.6       6.9       8.93         Head (calcd)       100.00       2.20       0.50       1.93       100.0       100.0	***************************************						<b>—</b>		1							
Pb conc       0.40       2.32       50.20       0.17       0.4       39.9       0.04         Zn conc       1.34       2.40       0.92       54.47       1.5       2.4       37.89         Flot tail       86.01       0.17       0.04       0.20       6.6       6.9       8.93         Head (calcd)       100.00       2.20       0.50       1.93       100.0       100.0					[		-						· · •			
Zn conc       1.34       2.40       0.92       54.47       1.5       2.4       37.89         Flot tail       86.01       0.17       0.04       0.20       6.6       6.9       8.93         Head (calcd)       100.00       2.20       0.50       1.93       100.0       100.0       100.0	companed (c	alcd)	,	12,20	110	. 44	<u> </u>	.09	1-2	5,36		91	- <u>-</u>	50.8	JJ . 14	
Zn conc       1.34       2.40       0.92       54.47       1.5       2.4       37.89         Flot tail       86.01       0.17       0.04       0.20       6.6       6.9       8.93         Head (calcd)       100.00       2.20       0.50       1.93       100.0       100.0       100.0	Ph. conc			0.40			1 50		+	 	<del>;  </del>			20.0	0.04	
Flot tail         86.01         0.17         0.04         0.20         6.6         6.9         8.93           Head (calcd)         100.00         2.20         0.50         1.93         100.0         100.0         100.0									1		- 1			•		
Head (calcd) 100.00 2.20 0.50 1.93 100.0 100.0 100.0	·	<u></u>		[					Т							
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		- -		·	ļ		·									

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## Mineralogy of the Mill Products Run No. $10^{*}$

The mill products from mill run No. 10 are composed of grains that vary from about 5 to 120 microns in size. The flotation feed consists of pyrite, ore minerals and gangue. A grain count on the ore minerals shows that about 95% of the chalcopyrite, 88% of the sphalerite and most of the bornite, tennantite and galena are free. The remainder are present as minute inclusions in pyrite, irregular grains on the edges of pyrite, and intergrowths with other minerals.

The feed to No. 4 cell consists of gangue, pyrite, and small amounts of sphalerite, chalcopyrite, galena, and bornite. Most of the minerals are present as free grains, but a few of the ore mineral grains occur as minute rounded inclusions in pyrite and as irregular grains on the edges of pyrite.

The No. 4 copper-lead rougher concentrate consists of pyrite, sphalerite, chalcopyrite, and small amounts of galena and bornite. Most of the minerals are free of attached particles.

The copper-lead rougher concentrate consists chiefly of pyrite, chalcopyrite, sphalerite, and small amounts of tennantite, galena and bornite. Most of the minerals occur as free grains, but small amounts of the ore minerals are also present as inclusions in pyrite and irregular grains at the edges of pyrite.

The table tail (copper concentrate) is composed of very fine grained material and consists of chalcopyrite, sphalerite, pyrite, and small amounts of galena, bornite, and tennantite. Most of the grains are free but some of the bornite is intergrown with chalcopyrite, and traces of the bornite and sphalerite are present as minute inclusions in pyrite.

The zinc recleaner concentrate consists of sphalerite and traces of chalcopyrite, pyrite, bornite, galena and tennantite. Most of the sphalerite and some of the pyrite and chalcopyrite grains are free. The remaining sphalerite contains inclusions of the other minerals.

The flotation tail consists of gangue, pyrite, and traces of sphalerite and chalcopyrite. Most of the grains are free but some of the chalcopyrite is present as minute inclusions in pyrite.

<sup>\*</sup> Mines Branch Investigation Report IR 65-90 by W. Petruk, Mineral Sciences Division, October 20, 1965.

RUN NOt 1	1		<u></u>	FEED	RATE:		480			
DATE: S	ept. 2	1 - 65	<u></u>	TIME	OPERAT		7 hr			
	upra					RIOD: 1				
PURPOSE OF	RUNI	Table	Cu-Pb	roughe	er conc	to reco	over a Ci	ı and a P	b	
								ing to re		
slimed Pb co								-	· · ·	
No sampling						,				
		AVER	AGE CO	NDITION	S DURIN	G SAMPL	ING PERIO	מ	•	
Point	Reage	nts -	lbs./t	on ore	treated			~		
of Addition			1	CuSO <sub>4</sub>		P	roduct	% Solids	pH	
Ball mill	0.16	1,62			2.03	Bal	<u>1 mill d</u>	isch 58		
Flot feed	0.16					F10	t_feed	31	7.9	
Cu-Pb ro <sup>#2</sup>	0.16					Zn	cond		11.7	
Zn_cond			6.8	1.02		Zn	recleane:	r		
Zn recleaner			<u> </u>							
				<b> </b>					· ·	
Total .	0.48	1.62	6.8	1.02	0.03					
· · · · ·		L	<u> </u>	L.		l				
Scr	een An:	alysis	······	+6	5M +100	4 4150M	+200M +32	25M -325M	-200M	
		MET	ALLURG	CAL BAI	LANCE	<u></u>		<u>.</u>		
1			orarelations,	<u>.</u>	SAYS		DIST	RIBUTION	- %	
PRODUCT			W <b>T.%</b>	Cu	Pb	Zn	Cu	Pb	Zn	
Cu conc $^{\prime\prime}$ 1			1.28	18.72		3.77		8.0	2.3	
Cu_conc <sup>#</sup> 2				22.26				50.1	20.4	
	calcd)		7.89	21,68	3.94	6.08	74.9	58.1	22.7	
Pb_conc <sup>#1</sup>			0.144	2.54	58.20	0.71	0.2	15.7	0_05	•
Pb conc #2					38,20		,	2.4	0.02	
	calcd)		0,177		1			18.1	0.07	
Cu-Pb scav c Cu-Pb ro tai				6.48	0.90	8.57		7.4	17.9	,
Head (calcd)				0.32		1,43 2,11		<u>16.4</u> 100.0	59.3 100.0	:
and watch				r2-28-					10010	
f					• <b>#</b> ••• <b>•</b> •••					

RUN NO:	13	A	•		FEED	RAT	61			480			
DATE: S	Sept.	22 - 6	5	, ,	CIME	OPE	RATE	D۱		6 <sup>1</sup> / <sub>2</sub> hr			
ORE: C	Cupra			6	SAMP	LING	PER	10	Dı	2½ hr			
PURPOSE OF	RUNI	Tabli	ng of	Cu-	Pb	clear	ner	co	nc to	recover	Pb con	centrates	
and copper of	concen	trates	. Rep	eat	of	Run	11	. a	ssay	zinc cir	cuit.		
	****				********					*****			
										******	,, <del>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</del>		
		Avei	RAGE CO	NDI	rion	IS DU	RING	· S	AMPLIN	IG PERIOD	)		
Point	Reage	ents -	lbs./t	011 0	re	trea	ted					1	
of Addition		ZnSO4	Lime		1		1		Pro	oduct	% S Solid	, pH	
Ball mill	1	1.62	L HT III C	فلللك	~ )	0.01	1	Ĩ	Ball	mill di		ð <b></b>	
Flot feed	0.16								Clas	s o'flow	32	7.9	
Cu-Pb ro <sup>7/</sup> 3	0.16								Cu-P	bro 3		8.0	
Zn cond			10.5	1.	1.03 Zn cond								
Zn recl <sup>#</sup> 3										·····		11.9	
Total .	0.48	1.62	10.5	1.	03	0.01	0.	03					
Scro	en Ana	alysis	•		+6	5M +1	NO'O.	<b>≁</b> 1	50M -+-	200M +325	5M -325M	-200M	
<u> </u>	)'flow	<u>- Wt.</u>	%		1.	1   1	.2	3	.0	3.5 10.4	80.8	91.2	
		MET	ALLURGI	CAL	BAI	ANCE		*****		1			
PRODUCT					AS	SAYS				DISTR	IBUTION	- ¢	
FRODUCT			WT.%	Cu	1	P	b	<u> </u>	Zn	Cu	Pb	Zn	
Table #1 Cu			1.06		7.94		.35		. 79	11.87	4.08	2.26	
Table 2 Cu	conc		7.07	27	7.02	3	.35	7	7.55	75.56	67.51	23.81	
	calcd)		8.13	27	7.14	3	.09	7	7.19	88.43	71.59	26.07	
Table <sup>#</sup> 1 Pb			0.02	15	5.48	17	.20		.,12	0.14	1.08	0.01	
Table <sup>77</sup> 2 Pb			0.09			1	.10		.16	0,79	3.36	0,13	
	calcd)		-0.11	<u> </u>	).70		.84		8.79	0.93	4.44	<u> </u>	
<u>Zn recl conc</u> Flot tail			1.94 89.82		<u>3.96</u> ).21	1	. <u>63</u> .08		7 <u>.94</u> ).59	<u>3.08</u> 7.56	$\frac{3.48}{20.49}$	50.15 23.64	
Head (calcd)			100.00		2.49	1	.35		2.24		100.00	}	
					. <u>.</u>	1	.55		4 . <i>24</i> *\$	100.00	100.00	100.00	
						ł						Į	

				معشين معه									n por e seu impelificado		7	
RUN NO: 1	.4				EEC	) R.	ATE	1			6	90				
DATE: S	Sept.	23 - 6	5	1	LINE	0	PER	ATE	D:		5	1/2 hr				
ORE: C	Cupra			5	BAMI	LI	NG	PER	101	01	1	: 30	- 3:3	O PM		
PURPOSE OF I	RUN:	Ident	ical t	of	10%	/sh	eet	: sh	OW	n ir	1	Run	13 e	xcept	that	
Cu-Pb cleane	er tai	ls wer	e retu	rne	d t	o i	Cu-	-Pb	ro	ughe	er	f10	at fe	ed ins	tead	
of the ball	mil1.												~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		•	
					•											
		AVER	AGE CO	NDI	ri of	İS	DUF	RING	S	AMPL	IN	g Pe	RIOD			
Point	Rogar	ents -	1he /+.			+ **		ed.		[				T.	1 ·	
of Addition		ZnSO4	Lime		r			Z-20	on		rc	duct	;	% Solids	pH	
Ball mill	0.15												dis			
	0.15	0.00			-	<u>.</u> V.	01	<u> </u>						2h_58_ 31	8.0	
Flot feed Cu-Pb ro <sup>7/3</sup>	0.15											1			8.2	
$\frac{\operatorname{Ou} + \operatorname{D} + \operatorname{O}}{\operatorname{Cu} - \operatorname{Pb} + \operatorname{c1}^{\mathcal{H}} 2}$	0.10		Cu-Pb c1 2         8.           Zn cond         11.													
Zn cond	4,8         1,06         Zn recl         11.															
Zn recleaner														-		
Total	0.45	0.99	4.8	1.0	06	0.	. 01	0.0	03							
Scre	een An	alysis		<u> </u>	+6	5M	+1	о́ом	41	.50M	÷.	гоом	+3251	4 -325M	-200M	
Class O			%		0.	-	1.			.4		7.5		67.6	·····	
		MET	LLURGI	CAL	BA	LAI	NCE									
					A	SSA	YS		a <u>- 2 - 2 - 2</u>			D	ISTRI	BUTION	- %	
PRODUCT			wr.%	C	u		P	b .		Zn		С	u	Pb	Zn	
Table 1 Cu			1.00	29	.14		1.	80		5.61		13	.2	5.1	2.8	
Table 2 Cu			5.25	26	.42		3.	50		9.79	)	63	.2	52.1	25.8	
	alcd)		6,25	26	.85	<u> </u>	3.	23		9.12	?	76	.4	57.2	28.6	
Table #1 Pb		0.03	19	.32		20.	50		2.09	2	0	.3	1.8	0.1		
Table <sup>#</sup> 2 Pb			0.08	21	.,26	<u>\$</u>	16	.20		4,6	9	0	.8	3.8	0.1	
Combined (c			0.11		). 73			37		3.98			.1	5.6	0.3	
Zn recl cond	2		1.54		.94 .47			73		8,55			.8	3.2	45.3	
Flot tail								13		0.50			.7	34.0	25.8	
Head (calcd)			100.00	2	.20	4	0.	35	ļ	1,99	2	_100	-0	100.0	100.0	
ļ					<u> </u>				L						ł	

RUN NO:	16			FEI	FEED RATE:											
DATE:	Sept.	24 -	65		TIME OPERATED: 6 hr											
ORE:	Cupra			SAI	SAMPLING PERIOD: 22 hr											
PURPOSE OF 1 the flot												ept tha	.t			
		Aver	AGE CO	NDITI	оля	DUI	RING	SAMP	LIN	1G PE	RIOD					
Point	Point Reagents -					treated						1	T ·			
of Addition		ZnSO4	1	CuSO4			Z-2	11	Pro	oduct		% Solid:	, pH			
Ball mill	0.16	1.08			0	.01	0.0	03 Bal		mi11	disc	h 58				
Class o'flow										feed		31	7.7			
Cu-Pb ro#2									Cu-Pb ro 2				8.3			
Jr.	0.16								Zn_cond				11.7			
In cond			8.1	1.02				Zn	re	c1	2		11.1			
Zn recl <sup>#</sup> 2																
												<u> </u>				
Total	0.48	1.08	8.1	1.0		0_01	0.0	03								
Scre	en An	alysis		4	651	1 +1	0 <sup>0</sup> 0M	<b>≁150</b> №	1 +	200м	+325M	-325M	-200M			
		METY	<b>LLURGI</b>	CAL B	AL/	ANCE										
				AS		SAYS				DISTRIE		BUTION	- %			
PRODUCT			WT.%	Cu		P	<u>b</u>	Zn	Zn		u	Pb	Zn			
Table <sup>#1</sup> 1 Cu				24.0		1.	90	7.8	7.80		.2	9.7	9.3			
Table <sup>#</sup> 2 Cu				25.1		3.	60	10.20		56.9		38.1	25.4			
	alcd)		6.89	24.7	4	3.	05	9.4	9.42		1	47.8	34,8			
Table <sup>##</sup> 1 Pb			0.07	3.3	0	67.20		0.30		0.1		10.7	0.0			
Table <sup>#</sup> 2 Pb	conc		0.01	29.8	0	9.	00	3.0	0	0.1		0.2	0.0			
Combined (c	alcd)		0.08	6.6	1	59.	92	_0.6	4_	0.2		10.9	0.0			
Zn recl conc			1.47	4.0		_1.	15_	57.6	37.60		9	3.8	45.4			
Flot tail			91,56		- 1		18	0.4		_13		37.5	19.6			
Head (calcd)		-	100.00	2.0	5	0	44	1,8	6	100	0 11	.00.0	100.0			

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- 21 -

RUN NO:	FEI	FEED RATE: 480																
DATE							TIME OPERATED: 5 hr											
ORE	SAN	SAMPLING PERIOD: 2 hr																
PURPOSE OF	RUN:	Grind	in op	<u>en ci</u>	rcu	<u>it.</u>	A	er	ate :	flot	feed.	Retur	'n					
scavenger o	oncen	trate	from C	u-Pb	ro	<u>cel</u>	<u>1s</u> 7	<u>'3</u>	and	<u>4 to</u>	_ba11		able					
Cu-Pb ro co	onc,				·							+++						
						<del></del>					·····							
		AVER	AGE CO	NDITIO	DNS	DUR	ING	S	AMPLI	NG PE	RIOD							
Point	Reage	ents -	lbs./t	on ore	e tr	eat	ed		n	oduct		d	nH/					
of Addition	ZnS04	Z-200	Lime	CuSO4	4 NaCN Aero		PI	oauct		% Solids	рH							
Ball mill	0.54	0.03						Ball	. mil	l dis	h 56							
Cu-Pb ro <sup>#1</sup>		0,03			0	.28		Flot feed			40	8.7						
Cu-Pb ro <sup>#2</sup>						.28	28		Aerator				7.8					
Zn cond			ļ	1.03		·			Zn r	o fe	əd		12.0					
Zn_ro <sup>#1</sup>			6.04				0.0	28	Zn C	l ce	11_3	<u> </u>	11.7					
	ļ			i	_ <b> </b>		••••••				, 	ļ						
Total .	0.54	0.06	6.04	1.03	0	<u>. 56</u>	0,0	28				<u> .</u>						
	<u> </u>			l	J		. 1	]	<u> </u>	<b>1</b> 2		   						
Class		alysis			65M							1 -325M						
			· 10 ALLURGI			<u></u>	.6		5	6.6	13,6	65.0	78,6					
dan nénin dipikati ng pangangan pangangan					ASSA	÷		<del></del>		T n	TSTDTI	BUTION	d					
PRODUCT			wr.%	Cu			Pb 2.15 1		Zn									
Cu conc			11.02	16.	50						u 2.6	рь 42.7	Zn					
Pb conc			0.53	6,8					. 73		L.6	$\frac{42.7}{35.4}$	<u>64.5</u> 0.4					
Zn conc			3,65	8.0			.63 1		• •		3.4	17.3	28.8					
Flot tail			84.80	0.0					).15	1	2.4	4.6	6.3					
Head (calcd)			100.00	2.2	20	0.	.55	2	2.04	100.0		100.0	100.0					
<u></u>																		
									:									
											·							

RUN NO:	19					D R	ATE	] 1 				480						
DATEL	Sept.		<b>FIM</b>	E C	PER	ATE	Dı			$5\frac{1}{2}$ hr								
ORE :	Cupra			SAMPLING PERIOD:								3 hr						
PURPOSE OF	RUN:	Repea	t of R	un	#18	3 w	ith	n no	Z	nSO4		in g	rind	•				
		<u></u>																
							-y	, 										
				·														
										I <sup>i</sup>					, 			
		AVER	AGE CO	NDI	T10	NS	DÚI	RING	S/	AMPL	IN	G , PE	RIOD;	»				
Point of	Reage	nts -	lbs./to	on c	ore	tr	eat	ed		P	ro	duct	:	de No.	pH			
Addition	NaCN	Z-6	Z-200	Li	me	Cu	SO1							Solid				
Ball mill	0.16	0.02	0.04															
Cu-Pb ro #2	0.16									Flo	ıt.	fee	d					
Cu-Pb ro <sup>#</sup> 3	0.16									Zn	.e.	ond.		-				
Zn cond		. <u></u> ,	ļ	6.	0	0	.8			Zn	r	<u> </u>	cel]	1				
Aerator	0.16									Zn	<u>C</u> :	L <u>3</u>	·cel]	1				
Total .	0.64	0.02	0.04	6.	0	0	.8											
Scre	een Ana	lysis	•		+6	55M	+1	0 <sup>0</sup> 0M	+1	50M	+2	200M	+325	M -325M	-200M			
Flot	%		3.	5	3.	4	6	.8	(	5.2	12.:	3 67.8	8.0					
			ALLURGI	CAL	BA	LAI	NCE		~~~~~									
N							SAYS		Zn			DISTRII Cu		BUTION	- %			
PRODUCT			WT.%	Cu		Pb		b						Pb	Zn			
Cu conc			9.79		5.68	8	2.	, 35	1	1.53	3	8	4.3	45.9	58.			
Pb conc			0.44	4	.14	<u>1</u>	<u>36</u> ,	90		1.43	3		1.0	32.4	0.			
Zn_conc			1.96	9	.50	3 <u> </u>	3	30_	3	6.52	2	1	0.4	12.9	36.			
Flot tail			87.81	0	0.0	≱_	0.	05		0.10	<u> </u>		4.3	8.8	4.			
Head (calcd)	)		<u>100, 00</u>	1	. 82	2	0.	50		1.94	4	10	0.0	100.0	100.			
						╉									1			
														·····				
							·····				_			•				
						<u> </u>			L		_							

RUN NO1 FEED RATE: 510 20 5 hr Sept. 30 - 65 TIME OPERATED: DATE:  $1\frac{1}{2}$  hr Cupra SAMPLING PERIOD: ORE: PURPOSE OF RUN: Conditioner placed in circuit in place of aerator AVERAGE CONDITIONS DURING SAMPLING PERIOD Point Reagents - 1bs./ton ore treated pН ø. Product of Z-6 Z-200 Lime CuSO4 NaCN lids Addition Ball mill disch :58 Ball mill 0.16 34 8.6 Cu-Pb cond 0.04 0.16 0.02 Cu-Pb cond ÷ · · . Cu-Pb ro<sup>#2</sup> 0.16 11.8 Zn cond 6.0 0.8 . ... Zn (1 # 2 11.2 0.48 0.02 0.04 6.0 0.8 Total +65M +100M +150M +200M +325M -325M -200M Screen Analysis 6.9 6.4 13.6 Flot Feed - Wt. % 2.6 3.2 67.3 80.9 METALLURGICAL BALANCE ASSAYS DISTRIBUTION - % PRODUCT WT.% Cu Pb Zn Cu Pb Zn Cu conc 10.48 17.20 2.53 90.2 45.7 10.20 44.9 0.1 Pb conc 0.4 13.0 0.18 4 10 41.80 1.00 Zn conc 3.04 3.10 0.78 38,80 4.1 49.6 4.7 Flot tail 86.30 0.11 0.25 0.15 4.7 37.2 5.4 Head (calcd) 100,0 100.Od 2.00 0.58 2.40 100.0 100\_0 . .

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RUN NO1 2	1	•		- F	FEED RATE: 510 / hr								<u></u>			
				- - <sup>1</sup>	-1 -											
DATE: O	et. 1	- 65			TIME OPERATED: 31/2 hr											
ORE: C	upra			S	SAMPLING PERIOD: 1 <sup>1</sup> / <sub>2</sub> hr											
PURPOSE OF 1	RUN :	<u>To in</u>	crease	_gr	ade	of_	Cu-P	b	roug	her c	onc b	<u>y using</u>	only			
the first 2	No.	7 cell	s whil	e ma	ain	tain	ing	Cu	rec	overy	<u>. Lo</u>	nger fl	oat			
time seems	to fl	<u>oat mo</u>	re pyr	<u>ite</u>	an	<u>d zi</u>	nc.									
Open circui	t con	dition	ing of	Cu	-Pb	ro	feed	_n	o_ae	ratio	n					
							·									
								<b>4.77</b> 0								
		AVER	AGE CO	NDIJ	LION	IS DU	RING	S.	AMPL	ING PE	RIOD					
Point	Reagents - lbs./tor						ted			oduct		4				
of Addition				Lin	ne (	LuSO4				oduci	·	% Solids	рн			
Ball mill	0.16	0.02	0.04						Bal]	L mill	l dis	ch 55				
Cu-Pb cond									Flo	t fee	1	32	8.6			
Cu-Pb ro 1	0.16								Zn_o	ond			11.7			
Cu-Pb ro 2	0.16		<u> </u>				ļ		Zn (	C1 3		_	11.4			
Zn_cond			<u> </u>	6.2	2	0.8	ļ						ļ			
	ļ	ļ	<u> </u>		-		ļ						ļ			
Total ·	0,48	0,02	0.04	6.2	2	0,8	ļ						<u> </u>			
	1		<u> </u>	L			<u> </u>		l			- <u> </u>				
		alysis	· · ·					**				4 -325M				
Flot	Feed	- Wt.			3.3		3.2	6	.5	5.9	12.5	68.6	81.1			
		MET	ALLURGI	CAL			••••••	1					•••••••••••••••••••••••			
PRODUCT			Wr.%				SAYS				ISTRI	BUTION	- %			
Cu conc					Cu		Pb		Zn			Pb	Zn			
Pb conc			9.48				1.92		9.18		3.4	32.8	43.8			
Zn conc	<u>,</u>		<u>0,53</u> 2,40		<u>. 93</u>		.08_		0.82			37.3	0.2			
······································							.82_		0_20		6.5	7.9	48,5			
Head (calcd)	Flot tail		87.59 100.00		.23		- <u>14</u>		0,17 1 00	1	9.4	22.0	$\frac{7.5}{100.0}$			
ouu (Gardu)			<u>+00.00</u>		<u>. 19.</u>	$+^{\circ}$	.56	-	1.99		0.0	100.0				
<u></u>						1		F		1						
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