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MINES BRANCH INVESTIGATION REPORT IR 72-49

A STUDY OF SELECTIVE FLOTATION TECHNIQUES FOR CONCENTRATING A Cu-Pb-Zn-Ag ORE FROM MATTABI MINES LIMITED, STURGEON LAKE AREA, ONTARIO

by

A. STEMEROWICZ AND R. W. BRUCE

MINERAL PROCESSING DIVISION

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A Study of Selective Flotation Techniques for Concentrating Cu-Pb-Zn-Ag Ore from Mattabi Mines Limited, Sturgeon Lake Area, Ontario.

by

A. Stemerowicz* and R. W. Bruce**

- - -

SUMMARY OF RESULTS

The three ore samples investigated assayed as follows:

Sample No.	% Cu	<u>% Pb</u>	<u>%</u> Zn	oz/ton Ag
F -1	0.7	1.1	9.3	4.0
F-2	1.4	0.8	9.0	3.6
F-7	0.6	2.5	8.5	3.0

Sulphide mineralization consisted of pyrite, sphalerite,

pyrrhotite, chalcopyrite and galena. Silver was present as silver-bearing tetrahedrite.

Flotation of a bulk copper-lead concentrate and zinc concentrate at a grind of 83% minus 200 mesh followed by copper-lead separation of the bulk concentrate gave the following range of results:

•	<u>% Cu</u>	<u>% Pb</u>	<u>% Zn</u>	oz/ton Ag
Cu conc	22 - 29	1.2 - 2.4	3.2 - 5.2	27 - 83
Pb conc	0.3 - 0.9	37 - 55	3.2 - 5.3	15 - 150
Zn conc	0.1 - 0.15	0.1 - 0.2	58 - 59	0.9 - 1.3
Rougher flotation				
recovery, %	89 - 9 5	81 - 90	85 - 89	78 - 81

Similar grades of copper and lead concentrates were also produced by selective flotation directly on the ore but recoveries were lower.

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INTRODUCTION

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Location of Property

The ore deposit is located within the Abitibi Paper Company Block No. 7 near Sturgeon Lake, about 50 miles northeast of Ignace, Ontario. Recently a new company, Mattabi Mines Limited, has been formed to put the property into production. It is jointly owned by Mattagami Lake Mines Limited (60%) and Abitibi Paper Company Limited (40%). <u>Shipment</u>

Three shipments of coarsely crushed diamond drill core (about 3/8 in) were received as follows:

Sample No.	Date received	Weight, lbs
F-1	January 9, 1970	115
F-2	March 31, 1970	110
F-7	August 6, 1970	106

Nature of Investigation Requested

In his letter of December 4, 1969, Mr. M. W. Airth, Manager, Mattagami Lake Mines Limited, requested assistance in carrying out a metallurgical investigation on representative diamond-drill core. It was also stated that tests would be carried out at the Mattagami laboratories and those of associated companies. In subsequent discussions with Mr. M.J.S. Bennett and Mr. K.V. Konigsmann, metallurgical consultant and mill superintendent respectively, it was agreed that the cyanide method for copper-lead separation of a bulk copper-lead concentrate was to be investigated thoroughly in preference to other methods. This was to avoid duplication of effort by the other laboratories who would concentrate on the sulphur dioxide-starch and dichromate methods.

Sampling and Analysis

Each of the samples was first riffled into halves. One of the halves was crushed to minus 10 mesh and riffled into 16 portions, while the other half was stored for future use. One of the portions was chosen at random as a head sample; the weights of the remaining portions were adjusted to make up 2000-gram lots. In order to minimize possible oxidation of sulphides, the practice was adopted of storing both the coarsely crushed and finely crushed material in a freezer. Chemical analyses of the head samples are given in Table 1, followed by a semi-quantitative spectrographic analysis of the F-l head sample in Table 2.

		TABLE I		
	Che	emical Analyses	of Head Samples	<u>.</u> .
	•	<u>F-1</u>	<u>F-2</u>	<u>F-7</u>
Copper	(Cu)	0.72 %	1.41 %	0.59 %
Lead	(Pb) ^{~~}	1.11 "	0.79 "	2.50 "
Zinc	(Zn) ,	9.25 "	9.02 "	8.46 "
Soluble Iron	(Fe)	23.2 "	25.1 "	27.8 "
Sulphur	(S)	25.6 "	28.8 "	27.5 "
Insolubles	(Insol)	30.7 "	26.5 "	15.2 "
Silver	(Ag)	4.01 oz/ton	3.59 oz/ton	2.99 oz/ton
Gold	(Au)	0.02. " "	0.014 " "	0.012 " "
Ratio, chalcopy	rite: galena	1.6:1	4.5:1	0.6:1

TABLE 2

Semi-Quantitative Spectro	graphic Analysis* of F-1 Head Sample
Range - %	Elements
Principal constituent	Si, Fe, Zn

1.0 to 0.1	
0.1 to 0.01	•
Not detected	

Pb, Mg, Al, Cu Ni,Mo, Ca, Cr, Mn, Ti, Zr, Ag Ba, Be, B, Sb, As, W, Sn, Nb, Ta Ge, Bi, V, Sr, In, Na, Co.

*From Internal Report MS-AC-70-4.

Mineralogical Examination*

Fragments from the F-I sample and also a representative portion of the minus 10-mesh head sample were submitted to the Mineral Sciences Division for mineralogical examination.

Four polished sections for microscopic study were prepared from the diamond-drill core fragments. The -48 + 100 and the -100 +.200-mesh fractions of the minus 10-mesh head sample were separated using heavy liquids with specific gravities of 2.96, 3.3 and 3.7; the sink products at 3.7 were further separated into sub-fractions magnetically using a hand magnet and the Frantz magnetic separator. Polished sections were then prepared from several of these sub-fractions. The hand magnetic fraction was subjected to X-ray diffractometery to determine the ratio of monoclinic to hexagonal pyrrhotite. The minerals were identified by microscopy, X-ray diffraction analysis and electron-probe microanalysis.

The diamond-drill core samples consisted principally of sulphides with minor gangue; a few of the core fragments were attracted to a hand magnet and contained mainly pyrrhotite and magnetite, while a few others contained mainly gangue minerals.

Pyrite, sphalerite, pyrrhotite and magnetite all occur in major amounts. Much of the pyrite is massive, but some also occurs as grains varying in size** down to about 10 microns. The pyrite appears to be associated with all the other ore minerals***.

* From Mines Branch Investigation Report IR 70-15 "Mineralogical Examination of a Cu-Pb-Zn-Ag Ore Submitted by Mattagami Lake Mines Ltd., from the Sturgeon Lake, NW, Ontario Deposit" by R. G. Pinard.

** The word "size" as used in this report refers to the greatest dimension of the grain.

***The term "ore mineral" as used in this report does not necessarily have an economic connotation.

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The great majority of sphalerite occurs in massive form (Figure 1), but a relatively minor amount is also present as disseminated grains, which vary in size from several millimeters to less than 5 microns. It occurs as inclusions in pyrite, as isolated grains, and in veins associated with the gangue minerals (Figure 2). Electron-probe analyses showed the sphalerite to vary in Fe content from a high of about 8.1% to a low of about 6.3%. The majority of the pyrrhotite is relatively coarse, with grains up to about 1 millimetre in size; it is frequently found associated with magnetite. The pyrrhotite appears to be mainly of the magnetic monoclinic variety. The magnetite grains vary in size from 1 mm down to very fine-grained inclusions of about 5 microns in size.

The next most common ore mineral is chalcopyrite, most of which is relatively coarse, but some of which occurs as fine-grained inclusions down to about 10 microns. It appears to be associated with all other ore minerals. The galena is more fine grained, (Figure 3), with a maximum grain size of about 800 microns. It is generally associated with pyrite, chalcopyrite, and sphalerite. Marcasite was found in a few of the polished sections with grain size varying from 300 microns to less than 10 microns.

The major gangue mineral is quartz, although minor amounts of mica and chlorite were also observed. Other minerals occurring in small amounts and found in a few of the samples are tetrahedrite, siderite, ilmenite, rutile and arsenopyrite.

Tetrahedrite (freibergite) was the only silver-bearing mireral identified, and was found only in the polished section prepared from the heavy liquid concentrate of the head sample. Electron micro-probe analysis showed it to contain a relatively high silver content of 15.4%, a copper content of 27.4% and an antimony content of 24.5%.

The liberation of the ore minerals was estimated by microscopic examination of the heavy-liquid fractions of the head sample. A rough assessment is that the ore minerals occur mostly as combined grains at -48+100 mesh but mostly as free grains at -100+200 mesh.

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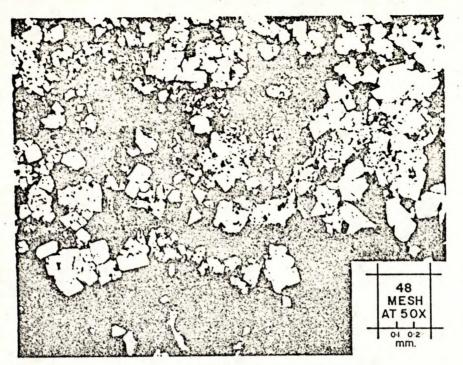
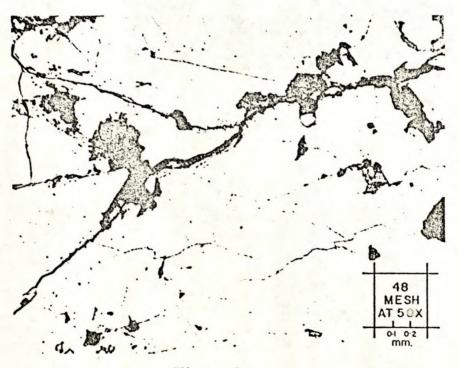


Figure 1.

Sphalerite matrix (dark grey) with inclusions of pyrite (white) and chalcopyrite (light grey). The black areas are gangue and polishing pits.





Massive pyrite (white) with veins consisting of gangue (dark grey) and sphalerite (light grey). The black areas are polishing pits.

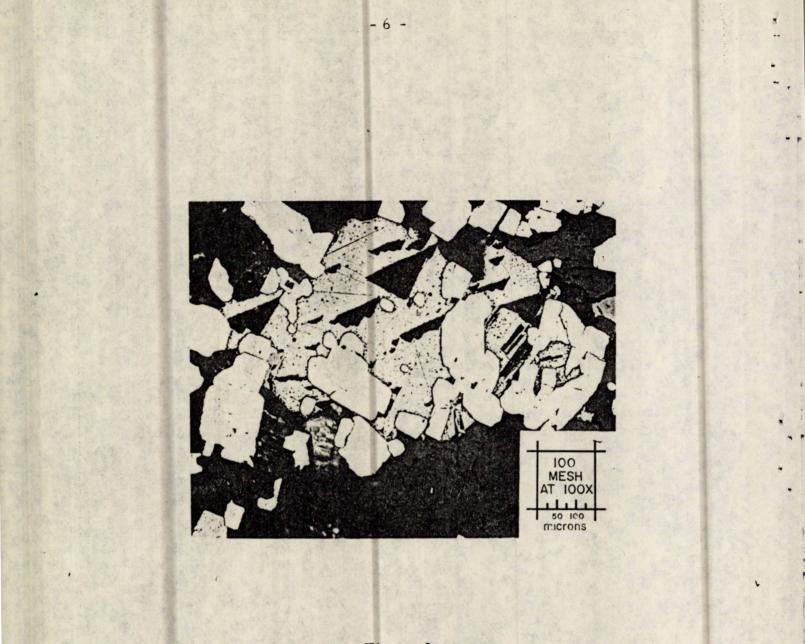


Figure 3.

Galena (light grey) with inclusions of pyrite (white) in gangue (dark grey); the black triangular areas are polishing pits.

The samples examined indicate a complex base metal ore, with sphalerite, galena and chalcopyrite as the principle sources of base metals. The other metal that would probably add to the value of the ore is the silver in the tetrahedrite.

The mineralogical examination did not reveal any factors that are likely to have a serious adverse affect on the beneficiation of the ore.

OUTLINE OF INVESTIGATION

The object of the investigation was to produce copper, lead and zinc concentrates from the ore by flotation with as much of the silver as possible to be recovered in the copper and lead concentrates.

Three schemes for the production of separate copper and lead concentrates were tried as follows:

- (1) Flotation of a bulk copper-lead concentrate followed by copper-lead separation of the bulk concentrate.
- (2) Selective flotation of copper and lead concentrates directly from the ore.
- (3) Selective flotation as in (2) augmented by copper-lead separation on one of the products.

After flotation of the copper and lead minerals, a zinc concentrate was floated from the tailing using standard procedure.

Where possible, the above three schemes were tried on each of the samples submitted. When the supply of F-l sample was exhausted it was necessary to substitute a composite made up of equal parts of the F-2 and F-7 samples the copper:lead ratio of which was approximately equal to that of the F-l sample.

Flowsheets for the valious schemes are given in Figures 4, 5, 6 and 7.

Grinding

A primary grind of approximately 83% minus 200 mesh was employed in all tests except one (Test 34) in which a coarser grind of 75% minus 200 mesh was tried.

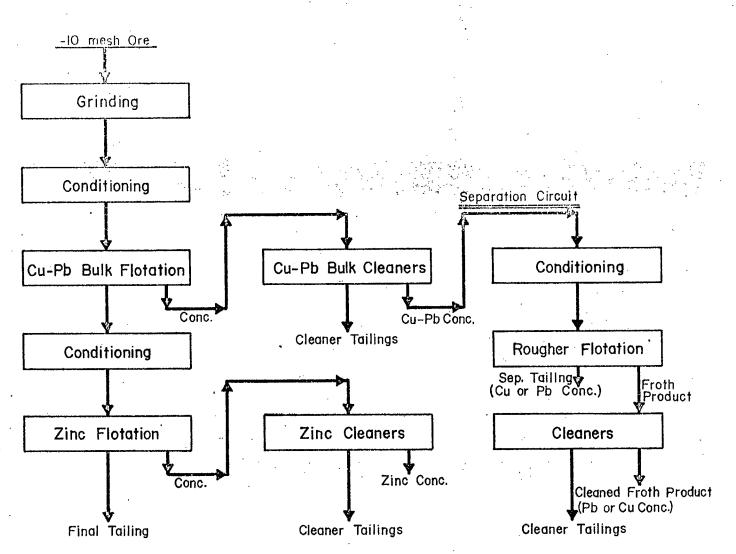


FIGURE 4 FLOWSHEET No.1 - BULK FLOTATION FOLLOWED BY COPPER LEAD SEPARATION OF BULK CONCENTRATE

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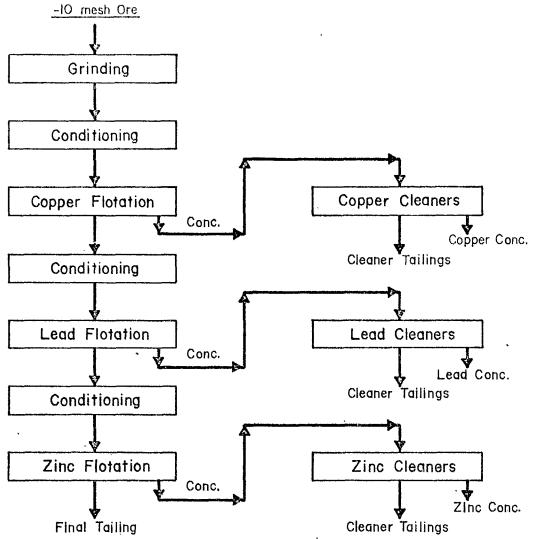


Figure 5 FLOWSHEET No. 2 - SELECTIVE FLOTATION OF COPPER AND LEAD CONCENTRATES DIRECTLY FROM THE ORE

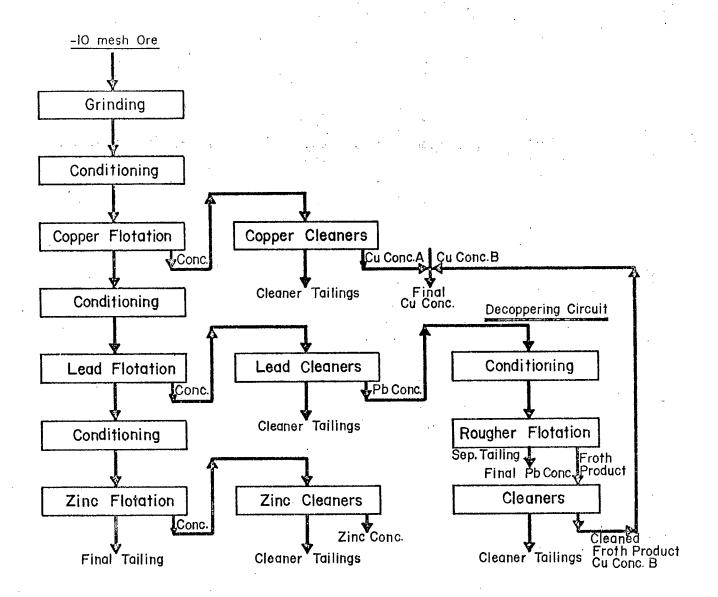


Figure 6 FLOWSHEET No.3A-SELECTIVE FLOTATION OF COPPER AND LEAD CONCENTRATES DIRECTLY FROM THE ORE AUGMENTED BY DECOPPERING OF LEAD CONCENTRATE

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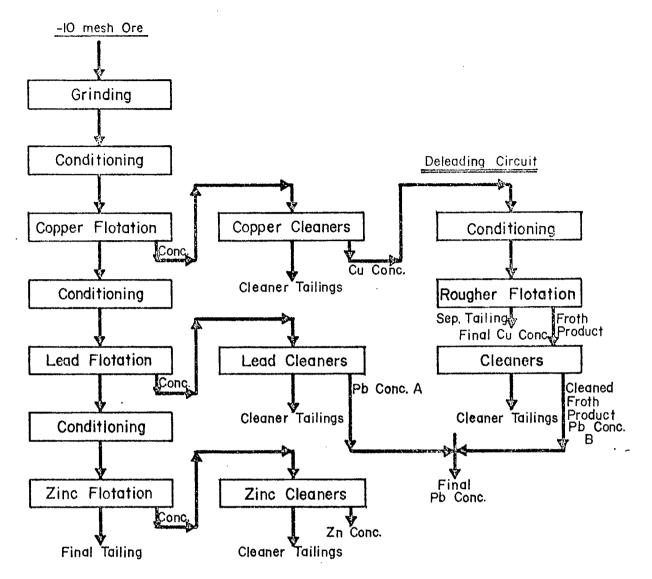


Figure 7 FLOWSHEET No. 3B-SELECTIVE FLOTATION OF COPPER AND LEAD CONCENTRATES DIRECTLY FROM THE ORE AUGMENTED BY DELEADING OF COPPER CONCENTRATE

Bulk Flotation Followed by Copper-Lead Separation of Bulk Concentrate (Flowsheet No. 1, Figure 4)

Bulk Flotation

Two combinations of alkalinity regulators and depressants were employed for bulk flotation viz; lime with zinc sulphate and cyanide, and soda ash with sodium sulphite and cyanide. Both combinations were tried with and without aeration of the pulp prior to flotation.

Combinations of Aerofloat Promoters 208 and 242 were employed as collectors for bulk flotation except in the initial tests on the F-1 sample in which amyl xanthate was used.

Generally, the bulk rougher concentrate was cleaned without additional reagents except for small amounts of frother. In two tests on the F-7 sample (39, 40) cyanide was added to the cleaners for pyrite depression.

Copper-Lead Separation

As was agreed, the cyanide method for copper-lead separation of the bulk concentrate was investigated in preference to other methods. However, the dichromate and sulphur dioxide-starch methods were tried in a few tests on the F-7 sample, the bulk concentrate from which was not amenable to separation by the cyanide method because of the high ratio of galena to chalcopyrite.

The compound $Na_2Zn(CN)_4$ was used as the chalcopyrite depressant in place of NaCN. This compound, which was prepared by adding NaCN to a dilute zinc oxide slurry, is reported to be as effective as NaCN and has the advantage of having no dissolving effect on cyanide-soluble minerals such as tetrahedrite*. It was found that high additions of the compound were required to effect a separation (10 to 20 lb/ton separation feed). This resulted in an increase in pH of the pulp to 11.5. When a lower pH was desired the required amount of NaCN was first added to the pulp followed by

*See "Flotation of Complex Copper-Lead-Zinc Ores" by F.W. McQuiston Jr., Transactions, International Mineral Dressing Congress, Stockholm 1957, page 513. the addition of $ZnSO_4$ which was employed as the pH modifier. Presumably, the cyanide and zinc sulphate would react in the pulp to form the zinc-cyanide compound.

In efforts to improve separation efficiency, test conditions were varied as follows:

- (1) Bulk concentrate slurry was boiled for a short time prior to the separation step; this was done to remove collector coatings from mineral surfaces.
- (2) The pH was reduced from 11.5 to 9.5.
- (3) Soda ash was added along with the zinc-cyanide compound
- (4) Primary grind was coarsened to 75% minus 200 mesh from the standard 83% minus 200 mesh.

Selective Flotation of Copper and Lead Concentrates Directly from the Ore (Flowsheet No. 2, Figure 5)

In this scheme, the pulp was first conditioned with sufficient sulphur dioxide to bring the pH to the acid range. Sulphur dioxide has a depressing effect on galena, sphalerite, and the iron sulphides but does not affect chalcopyrite. After floating off a copper concentrate, the galena was reactivated by adjusting the pH of the pulp to the alkaline range with lime or soda ash. Sodium cyanide was also added to ensure depression of the iron sulphides and sphalerite. A lead concentrate was then floated off with Aerofloat 242.

The scheme was tried with and without aerative conditioning prior to copper flotation. A number of copper collectors were tested viz; amyl xanthate, Minerec A, Aerofloat 194 and Z-200.

Generally, the copper rougher concentrates were cleaned without depressants but in some tests lime or sulphur dioxide was added to depress galena and pyrite. Cyanide or a combination of lime and cyanide was added to the lead cleaners for pyrite depression. Selective Flotation Augmented by Copper-Lead Separation

Two variations of this scheme were tried, as follows:

(1) Decoppering of Lead Concentrate (Flowsheet 3A, Figure 6)

A copper concentrate was selectively floated from the ore containing most, but not all of the recoverable copper. The balance of the copper was recovered in the subsequent lead flotation step. The lead concentrate was then subjected to copper-lead separation using the dichromate method and the copper concentrate from this operation was combined with the copper concentrate initially floated from the ore to give the final product.

(2) Deleading of Copper Concentrate (Flowsheet 3B, Figure 7) Copper and lead concentrates were selectively floated as in (1) with the exception that all of the copper was recovered in the copper concentrate. The copper concentrate was subjected to copper-lead separation to reduce the lead content, and the lead concentrate from this operation was combined with the lead concentrate floated from the ore to give the final product.

In both cases above, selectivity was achieved by employing a selective promoter for copper flotation such as Z-200 or Aerofloat 238. In (1) lime, zinc sulphate and cyanide were added to the grind for pyrite and sphalerite depression, while in (2) the same purpose was served by adding sodium sulphite to the grind. In (1), lead flotation was achieved simply by adding Aerofloat 242 and Aero float 238 as collectors; in (2), the copper tailing was conditioned with soda ash and cyanide before collector addition.

Zinc Flotation

No difficulty was encountered in floating a high-grade zinc concentrate from the ore with good recovery. For this reason, zinc flotation was omitted from the procedure in many of the tests. High-lime alkalinity (pH 11-5) was used in both roughers and cleaners to ensure maximum depression of pyrite. Sodium aerofloat along with smaller amounts of amyl xanthate were employed as zinc collectors.

Test Data

Details of test procedure and metallurgical balances are given in the flotation test reports which are appended.

Except as noted, analyses of test products were done by the Mattagami Lake mine assay laboratory.

In addition to the total iron as determined by chemical analysis, the iron present as iron sulphides (pyrite and pyrrhotite) has been calculated for most of the test products by subtracting the iron present in the chalcopyrite and in the sphalerite (assumed to be 7 %) from the total iron. Because the ore contains the soluble iron minerals magnetite and siderite, the calculated value for iron as iron sulphides can be considered to be an approximation only. Despite this limitation, it has been found to be useful when evaluating results.

EVALUATION AND DISCUSSION OF RESULTS

Best Results for Copper and Lead Flotation

The best copper and lead results achieved using the three schemes are summarized and compared in Tables 3, 4 and 5. In order to simplify ... comparison, all the various cleaner tailings have been lumped together with only the metal distribution shown.

Comparison of Results for Copper and Lead Flotation Using the Three Schemes on F-1 and Composite Samples

								·			
Test	Scheme	Product	Wt		Assa	ays*			Distri	bution '	70
No			%	Cu	Pb	Zn	Ag	Cu	Рb	Zn	Ag
		Cu conc	2.79	21.70	2.11	5.24	27.02	63.5	4.0	1.7	24.7
36	Cu-Pb Separation	Pb conc	1.52	0.86	55.50	5.32	49.62	. 1.4	58.0	0.9	24.7
(Comp)	of Bulk Conc,	Cl tail	7.79					30.6	28.4	8.0	31.9
	(Cyanide method)	Cu-Pb ro tail	87.90	0.05	0.16	8.84	0.65	4.5	9.6	89.4	18.7
		Feed (calcd)	100.00	0.95	1.46	8.69	3.06	100.0	100.0	100.0	100.0
•		Cu conc	2.08	23.15	1.08	4.38	89.20	62.5	1.9	1.0.	45.8
15	Selective	Pb conc	1.82	0.64	38.40	8.73	23.67	1.5	60.3	1.7	10.6
(F-1)	Flotation	Cl tail	3.86					22.8	13.9	5.0	22.2
· .		Pb ro tail	92.24	0.11	0.30	9.09	0.94	13.2	23.9	92.3	21.4
		Feed (calcd)	100.00	0.77	1.16	9.10	4.05	100.0	100.0	100.0	100.0
·	Selective	Cu conc	2.99	23.15	1.14	2.00	20.84	69.3	2.2	0.7	18.3
38	Flotation	Pb conc	2.53	0.65	32.33	6.25	32.62	1.7	53.4	1.8	24.2
(Comp)	+	Cl tail	4.97					16.4	30.9	5.7	30.0
	Cu-Pb Separation	Pb ro tail	89.51	30.14	0.23	8 . 92	1.05	12.6	13.5	91.8	27.5
	(Flowsheet 3B)	Feed (calcd)	100.00	1.00	1.53	8.70	3.41	100.0	100.0	100.0	100.0

*Assays in this and all subsequent tables are in per cent, except Ag which is in oz per ton.

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TAB	LE	4
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Comparison of Results for Copper and Lead Flotation Using the Three Schemes on F-2 Samples

	Test	Scheme	Product	Wt		Assa	ays			Distril	oution %	70
•	No			%	Cu .	Рb	Zn	Ag	Cu	Рb	Zn	Ag
		Cu-Pb Separation	Cu conc	3.51	27.41		3.22					22.9
	35	of Bulk Conc,	Pb conc	0.60	0.26	47.72	5.26	154.60		45.3		26.3
		(Creanide reathed)	Cl tail	5.16					22.6	29.4	4.6	, 3 0. 3'
		(Cyanide method)	Cu-Pb ro tail	90.73	0.07	0.13	8.96	0.79	4.9	18.7	93.7	20.5
			Feed (calcd)	100.00	1.33	0.63	8.68	3.52	100.0	100.0	100.0	100.0
]			Cu conc	3.77		1.07			72.4	6.4	1.6	34.7
	2Z ⁻	Selective	Pb conc	0.69	0.42	39.07	7.55	30.56	0.2	42.6	0.6	5.9
		Flotation	Cl tail	4.72					17.6	24.3	3.6	31.6
	, I		Pb ro tail	90.82	0.15	0.19	8.66	1.10	9.8	26.7	94.2	27.8
		· "	Feed (calcd)	100.00	1.42	0.63	8.35	3.60	100.0	100.0	100.0	100.0
		Selective	Cu conc	2.87	30.13	1.40	1.93	55.46	63.3	5.9	0.6	43.3
•••	30	Flotation	Pb conc	1.31	0.32	23.24	6.56	18.48	0.3	44.8	1.0	6.6
		+	Cl tail	3.75					27.9	22.8	3.5	26.3
		Cu-Pb Separation	Pb ro tail	92.07	0.13	0.20	8.83	0.95	8.5	2 6.5	94.9	2 3.8
		(Flowsheet 3A)	Feed (calcd)	100.00	1.36	0.68	8.56	3.68	100.0	100.0	100.0	100.0

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Comparison of Results for Copper and Lead Flotation Using the Three Schemes on F-7 Sample

Test	Scheme	Product	Wt		Assay	<i>i</i> s			Distrib	ution 7	0
No			70	Cu	·Pb	Zn	Ag	Cu	Pb	Zn	Ag
	Cu-Pb Separation	Cu conc	0.81	29.06	2.44	5.04	83.19	42.8	0.9	0.5	25.2
39	of Bulk Conc,	Pb conc	4.34	0.35	36.83	3.24	14.80	2.7	270.5	1.6	24.1
	(Disharan at a mathe T	Cl tail	5.43					43.7	18.5	6.0	28.2
	(Dichromate method	Cu-Pb ro tail	89.42	0.07	0.26	8.79	0.67	10.8	10.1	91.9	22.5
		Feed (calcd)	100.00	0.55	2.27	8.56	2.67	100.0	100.0	100.0	100.0
		Cu conc	1.44	25.04	4.33	2.16	40.88	60.8	2.7	0.4	20.5
37	Selective	Pb conc	3.15	0.09	50.17	5.84	21.68	0.5	68.0	2.1	23.7
	Flotation	Cl tail	2.49					10.5	15.0	2.9	18.3.
		Pb ro tail	92.92	0.18	0.36	8.78	1.16	28.2	14.3	94.6	37.5
		Feed (calcd)	100.00	0.59	2.32	8.62	2.88	100.0	100.0	100.0	100.0
	Selective	Cu conc	1.58	24.94	13.95	2.59	54.45	64.1	9.7	0.5	28.6
31	Flotation	Pb conc	2.49	0.20	45.04	5.96	16.32	0.8	49.4	1.7	13.5
	+	Cl tail	4.03	÷		•		23.4	.27.2	4.7	26.3
	Cu-Pb Separation	Pb ro tail	91.90	0.08	0.34	8.85	1.04	11.7	13.7	93.1	31.6
·	(Flowsheet 3A)	Feed (calcd)	100.00	0.61	2.27	8.74	3.01	100.0	100.0	100.0	100.0

With the exception of Test 30 on the F-2 sample and Test 31 on the F-7 Sample, acceptable grades of copper and lead concentrates were made using each of the three schemes. In Test 30, lead concentrate grade was low because of a high pyrite content, while in Test 31, the lead content of the copper concentrate was too high. If Flowsheet 3B(initial flotation of all the copper with deleading of the copper concentrate) had been used in Test 31 instead of Flowsheet 3A, it is believed that the lead content in the copper concentrate would have been reduced to an acceptable level.

The main difference in results was the lower losses of copper, silver and lead in the tailing when bulk flotation was employed.

Results of Zinc Flotation

Zinc results obtained on the various samples are summarized in Table 6.

TABLE 6

-	Test No	Zinc Ro	ugher F	lotation	Zi	nc Clear	ing
No.	and Flowsheet	Conc grade % Zn	Tailing % Zn	Zn Recovery %	Conc grade % Zn	Zn Distn,	Cleaner % Stages
F-1	3-1 4-1 14-2 15-2	51.44 53.64 52.73 54.27	0.55 0.58 0.48 0.48	87.1 89.8 88.6 88.1	57.83 58.32	54.0 37.4	2 2
F-2	19-1 34-1 22-2 23-2	55.89 53.48 51.70 53.24	0.81 0.69 0.35 0.43	85.9 87.8 90.9 89.9	5 9. 86	63.3	1
F-7	39-1 33-2 31-3A	54.05 50.36 51.45	0.76 0.39 0.54	85.1 91.1 88.3	58.77	77,5	1

Summary of Zinc Flotation Results

Generally, the zinc results obtained were fairly consistent and did not depend on either the ore sample or scheme used for the preceding copperlead flotation step. Only one or at most two stages of cleaning was required to produce a high-grade zinc concentrate in the 58-59% zinc range.

In the initial tests using the selective flotation scheme, zinc loss in the tailing was high probably because of the severe depressing action of sulphur dioxide on sphalerite but this problem was overcome by the simple expedient of increasing copper sulphate addition from 1.0 to 2.0 lb per ton. Copper-Lead Bulk Flotation

A comparison of results for copper-lead bulk flotation employing various schemes is shown in Table 7, while Table 8 gives reagents and conditions for these tests along with the separation efficiencies achieved. Separation efficiency,* which is a quantitative measure of the extent of separation between the various minerals, is calculated by subtracting the per cent recovery of the unwanted constituents in the concentrate from the per cent recovery of the metals or minerals concentrated.

Conclusions as to the effectiveness of the various flotation schemes are as follows:

(1) Alkalinity Regulator and Depressants

The combination of soda ash along with sodium sulphite and cyanide as zinc and pyrite depressants gave the best results (Tests 4, 35 and 40). Lime in combination with zinc sulphate and cyanide gave inferior selectivity towards zinc and pyrite, as evidenced by the lower separation efficiencies obtained (Test 8, 18 and 32). In some tests it had an adverse effect on lead and silver recoveries (Tests 18, 20 and 32).

Optimum cyanide addition appears to be about 0.1 lb/ton. In the initial tests (1 and 3), cyanide addition was only 0.05 lb/ton. This resulted in poorer zinc depression than was obtained in subsequent tests in which cyanide was increased to 0.1 lb/ton. An increase to 0.15 lb/ton (Test 40), however, did not result in any appreciable changes in results.

*"Separation Efficiency" by N. F. Schultz, SME Transactions, Vol. 247, March 1970.

TABLE	7
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Comparison of Results for Copper-Lead Bulk Flotation

Sample	Test		Assa	ys of c	opper-lea	d rough	er conc		Disti	ibutio	n in coppe	r-lea	d rougher	conc %
No.	No.	%	Cu	Pb	Cu FeS ₂ +PbS	Zn	Fe/ FeS	Ag	Cu	Pb	CuFeS ₂ + PbS	Zn	Fe/ _{FeS}	Ag
	1	6.66	9.61	13.83	43.7	11.88	14.4	47.74	86.4	88.1	87.1	8.6	4.5	80.0
F-1	3	8.27	7.87	10.97	35.4	9.43	18.0	38.05	87.5	88.1	87.9	8.5	6.9	81.1
	4	5.75	11.74	16.13	52.6	8.55	11.0	57.60	90.9	85.5	89.0	5.3	2.9	81.5
	8	5.36	11.38	16.10	. 51.5	6.23	13.6	55.53	86.5	82.8	85 .2	3.9	3.4	79.2
	18	6.74	18.48	7.56	62.1	4.71	11.4	38.96	89.1	76.7	87.2	3.8	3.4	72.8
	19	9.05	14.50	6.37	49.3	6.12	16.0	33.07	94.0	84.8	92.6	6.7	6.3	81.6
F-2	20	5.96	19.67	7.27	65.2	7.13	8.1	40.56	83.9	67.1	81.3	5.4	2.1	69.6
	21	8.75	14.95	5.73	49.8	5.51	16.3	30.68	94.2	80.3	91.9	5.7	6.2	77.5
	34	8.94	14.29	5.94	48.2	5.96	15.5	30.71	93.3	80.8	91.3	6.2	6,1	81.1
	35	9.27	13.64	5.54	45.8	5.90	17.0	30,26	95.1	81.3	93.0	6.3	6.9	79.5
	32	7.86	5.24	25.22	44.3	7.30	15.1	24.38	70.2	88.4	80.9	6.5	4.5	65.8
F-7	39	10.58	4.64	19.28	35.7	6.62	20.3	19.57	89.2	89.9	89.7	8.1	8.2	77.5
	40	9.93	4.95	21.21	38.8	7.64	19.6	20.28	90 . 1	90.1	89.8	8.6	7.4	76.3
F-2+F-7 Comp	36	12.10	7.52	10.86	34.3	7.62	20.0	20.54	95.5	90.4	93.5	10.6	9.8	81.3

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Comparison of Separation Efficiencies Achieved Using Various Copper-Lead Bulk Flotation Schemes

Sample No.	Test No.	. Reage	nts to Grind	lb/ton	Condition	ning	Promoter	Separation Efficiencies CuFeS ₂ +PbS from			
•	·				Aeration	pН		Zn	Fe/FeS	All of Feed	
	1	2.0 lime	0.5 ZnSO ₄	0.05 NaCN	No	10.8	C x 51	78.5	82.6	83.2	
F-1	3	3.0 lime	11 II	11 11	Yes	10.3	1 11	79.4	81.0	82.4	
	4	$3.0 \operatorname{Na_2CO_3}$	$1.0 \text{ Na}_2\text{SO}_3$	0.10 NaCN	11	9.5	11	83.7	86.1	86.2	
	· 8	1.5 lime	0.5 $ZnSO_4$. 11 11	No	10.1	11	81.3	81.8	82.5	
	18	17 11	tt 11	11 11	11	11	11	83.4	83.8	84.5	
	19	4.0 Na_2CO_3	1.0 Na ₂ SO ₂	tt 11	Yes	9.5	208 + 242			87.8	
F-2	20	2.0 lime	0.5ZnSO_{4}	11 11	No	1	C x 51	75.9		79.1	
	21		$1.0 \operatorname{Na}_2 \operatorname{SO}_3$	11 11	11	•	208 + 242			87.3	
	34*	tt ti	ii ii	IT IT	п	ti -	11 11	85 . I			
	35	11 11	11 71	, tr - 11	tr .	t t	11 11	88.8	88.2	87.7	
	32	1.5 lime	0.5 ZnSO4	1 11 11		9.2	11 11	74.4	76.4	76.3	
F-7	39		$1.0 Na_2 CO_3$	11 11	n in	9.8	1 · · · ·	81.6		82.6	
、 	40	3.0 Na_2CO_3		0.15 NaCN	11	9.6	1	81.2		83.5	
	36	4.0 Na ₂ CO ₃	. 11 1	0.10 NaCN		9.7	11 11	82.9	83.7	85.2	

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*30 min grind vs 45 min grind in all other tests.

(2) <u>Aeration</u>

Intense aeration of the pulp in a lab aerator prior to bulk flotation did not offer any advantages over conditioning in a lab flotation cell without air. (Compare separation efficiencies in Test 3 and 8 and Tests 19 and 21.)

(3) Promoters

None of the tests were specifically designed to compare the effectiveness of amyl xanthate or a combination of Aerofloat 208 and Aerofloat 242 as copper-lead promoters. Amyl xanthate gave satisfactory results when used on the F-l sample (Test 4), while results equally as good were obtained with a combination of Aerofloat 208 and Aerofloat 242 on the other samples investigated.

Copper-Lead Bulk Concentrate Cleaning

Generally, the bulk rougher concentrate could be upgraded satisfactorily by multi-stage cleaning without the addition of depressants. In tests on the F-7 sample, however, it was found difficult to reject pyrite during the cleaning operation. Sodium cyanide was tried as a pyrite depressant in the first cleaner in Tests 39 and 40, but its use resulted in severe depression of chalcopyrite.

In two tests (18 and 20) in which lime was used as an alkalinity regulator in copper-lead bulk flotation the depressing effect of lime on galena was carried over into the cleaners. As a result, the rejection of galena to the cleaner tailings was such that the lead content in the cleaner concentrate was lower than in the rougher concentrate.

C pper-Lead Separation

Tables 9 and 10 summarize results of copper-lead separation using the cyanide method on bulk concentrate produced from the F-l and F-2 samples, while Table 11 gives a comparison of results obtained using the dichromate and sulphur dioxide-starch methods on bulk concentrate produced from the F-7 sample.

In these tables the separation efficiency of the initial roughing operation (% recovery of metal floated minus % recovery of other metal in rougher concentrate) is used as the criterion in comparing the effectiveness of the separation methods employed.

Summary	of Results of Copper-Lead Separation Using Cyanide Method
	On Bulk Concentrate Produced from F-l Sample

Test No. and Remarks	Product	Wt %		Assays		D	istributi	on %	Rougher Sep
		. /0	Cu	Pb	Ag	Cu	Рb	Ag	Eff. %
	Cu conc	46.1	23.20	8.42	60.25	73.8	19.4	39.8	
8	Pb conc	17.4	0.37	56.98	44.90	0.4	49.5	11.2	
Initial test, pH 11.7	Pb cltail	36.5	10.22	17.06	93.91	25.8	31.1	49.0	54.4
	Feed	100.0	14.49	20.06	69.80	100.0	100.0	100.0	
	Pb ro conc	53.9	7.02	30.03	77.99	26.2	80.6.	60.2	
9	Cu conc	63.9	22.90	6.98	73.65	92.2	20.1	60.4	
Repeat of Test 8	Pb conc	17.9	0.55	65.68	56.15	0.6	53.0	12.9	
but boiled Cu-Pb conc	Pb cl tail	18.2	6.24	32.76	114.27	7.2	26.9	26.7	72.1
slurry prior to separation	Feed	100.0	15.83	22.26	77.93	100.0	100.0	100.0	
· · ·	Pb ro conc	36.1	3.42	49.08	85.45	7.8	79.9	39.6	
. 10	· ·								
Similar to Test 9 but	Cu conc	39.4	22.00	2.46	42.50	69.6	5.7	30.3	
floated a greater weight	Pb ro conc*	60.6	6.25	26.66	63.44	30.4	94.3	69.7	63.9
of lead conc	Feed	100.0	12.46	17.13	55.19	100.0	100.0	100.0)
36**	Cu conc	49.3	21.70	2.11	27.02	74.0	5.2	36.3	
Added soda ash to	Pb conc	26.8	.0.86	55.50	49.62	1.6	75.2	36.3	:
separation, pH 11.3	Pb cl tail	23.9	14.77	16.24	41.88	24.4	19.6	27.4	6 8. 8
also added NaCN to lead cleaners	Feed	100.0	14.45	19.81	36.64	100.0	100.0	100.0	
	Pb ro conc	50.7	7.42	36.99	45.97	26.0	94.8	63.7	

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* Not cleaned

** Feed to this test was a 1:1 composite of F-2 and F-7 samples.

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Summary of Copper-Lead Separation Results Using Cyanide Method On Bulk Concentrate Produced from F-2 Sample

Test No. and Remarks	Product	Wt		Assays		Di	stributi	on %	Sep
		%	Cu	Рb	Ag	Cu	РЪ	Ag	Eff. %
Test 21	Cu conc	66.8	27.92	1.60	27.20	79.7	13.1	40.0	
Standard test, i.e. with	Pb conc	9.5	1.62	46.61	98.80	0.7	54.7	20.7	66.6
ZnCN compound, pH 11.5+	Pb cl tail	23.7	19.49	11.07	75.42	19.6	32.2	39.3	
and Cu-Pb conc slurry	Feed	100.0	23.42	8.13	45.43	100.0	100.0	100.0	
boiled prior to separation	Pb ro conc	33.2	14.35	21.29	82,15	20.3	86.9	60.0	
Test 29	Cu conc	67.5	26.60	1.10	16.34	83.1	8.5	22.7	
NaCN and $ZnSO_4$ added	Pb conc	16.6	3.97	39.37	180.10	3.0	74.8	61.5	74.6
separately in place	Pb cl tail	15.9	18.82	9.14	48.18	13.9	16.7	15.8	
of Zn CN compound, pH 9.6	Feed	100.0	21.62	8.74	48.61	100.0	100.0	100.0	
<i>.</i>	Pb ro conc	32.5	11.26	24.60	115.63	16.9	91.5	77.3	
<u>Test 34</u>	Cu conc	59.9	28.33	1.23	18.15	72.1	7.9	21.7	
Repeat of Test 29 but	Pb conc	13.7	4.07	48.40	200.50	2.4	71.5	55.1	64.2
with primary grind	Pb cl tail	26.4	22.71	7.26	44.03	25.5	20.6	23.2	
coarsened to 75%	Feed	100.0	23.52	9.30	50.03	100.0	100.0	100.0	
-200 m from 83%200 m	Pb ro conc	40.1	16.33	21.35	97.62	27.9	92.1	78.3	
Test 35	Cu conc	72.4	27.41	1.18	23.02	87.4	10.0	34.4	
Standard test but	Pb conc	12.4	0.26	47.22	154.60	0.1	69.3	39.5	77.4
with soda ash	Pb cl tail	15.2	18.54	11.56	83.24	12.5	20.7	26.1	
added to conditioning	Feed	100.0	22.70	8.52	48.46	100.0	100.0	100.0	
pH 11.6	Pb ro conc	27.6	10.34	27.79	115.27	12.6	90.0	65.6	

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Comparison of Copper-Lead Separation Results Using Dichromate and Sulphur Dioxide - Starch Methods on Bulk Concentrate Produced from F-7 Sample

Test No. and Remarks	Product	Wt	A	ssays		Di	stributic	n %	Sep
		%	Cu .	Pjb	Ag.	Cu	Pb	Ag	Eff. %
<u>Test 32</u> Dichromate	Cu conc Cu cl tail	22.0 8.8	29.10 2.89	3.38 30.14	73.95 40.45	94.2 3.8	2.3 8.0	53.4 11.7	
	Pb conc Feed	69.2 100.0	0.20 6.81	42.88	15.44 30.54	2.0	89.7	34.9	87.7
	Cu ro conc	30.8	21.62	11.01	64.39	98.0	10.3	65.1	1
<u>Test 39</u> Dichromate at pulp temp of 55°C	Cu conc Cu cl tail Pb conc	14.7 6.8 78.5	29.06 _ 8.29 _ 8.35	2.44 36.01 36.83	83.19 55.79 14.80	83.6 11.0 5.4	1.1 7.7 91.2	44.2 13.7 42.1	85.8
	Feed	100.0	5.10	31.73	27.63	100.0	100.0	100.0	÷ ·
	Cu ro conc	21.5	22.48	13.06	74.51	94.6	8.8	57.9	
<u>Test 40</u> Sulphur dioxide-starch pH 3.8	Cu conc Cu cl tail Pb conc	12.8 5.2 82.0	26.75 7.61 0.49	4.47 37.15 42.16	95.61 76.15 16.39	81.0 9.5 9.5	1.5 5.3 93.2	41.2 13.5 45.3	•
•	Feed	100.0	4.22	.37.08	29.65	100.0	100.0	100.0	- • •
·	Cu ro conc	18.0	21.17	14.00	89.93	90.5	6.8	54.7	l 1

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Cyanide Method

Effect of Boiling Bulk Concentrate Slurry

Boiling of the bulk concentrate slurry to remove collector coatings prior to the separation step resulted in a more selective separation between galena and chalcopyrite as evidenced by the increase in separation efficiency from 54.4% to 72.1% (Tests 8 and 9, Table 9). It was therefore adopted as standard practice for all subsequent separation tests using the cyanide method.

Effect of pH_

A lowering of the pH from about 11.5 to 9.6 resulted in an improvement in separation efficiency (compare Test 21 with Test 29 in Table 10). Also more silver was recovered in the lead concentrate at the lower pH. This indicates that the high pH has a depressing effect on the freibergite (silver-bearing tet rahedrite).

Effect of Soda Ash Addition

The addition of 2.0 lb/ton soda ash to copper-lead separation along with the zinc-cyanide compound (Test 35) resulted in an improvement in separation efficiency even greater than that obtained when the pH was lowered.

Effect of Coarser Grind

The purpose of coarsening the grind to 75% minus 200 mesh from the standard 83% minus 200 mesh was to determine whether the formation " lesser amounts of galena slimes would have a beneficial effect on copperlead separation. Instead of improving results, the coarser grind resulted in poorer selectivity as evidenced by the lower separation efficiency attained (64.2% for the coarser grind in Test 34 against 74.6% in the comparison Test 29). It did not, however, appear to have any effect on grades and recoveries for bulk copper-lead flotation (compare results of Tests 21 and 34 in Tables 7 and 8).

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Dichromate and Sulphur Dioxide-Starch Methods

The best results were achieved using the dichromate method (Test 32). Note that in Test 32 there was an increase in separation efficiency from 87.7% for copper rougher flotation to 91.9% after cleaning (94.2% – 2.3%). This is due to the fact that the rejection of lead in the cleaning operation was greater than the loss of copper. The difference between these two figures (8.0% - 3.8% = 4.2%) is equal to the increase in separation efficiency. It would be advantageous, therefore, to combine the copper cleaner tailings with the lead concentrate rather than recirculating as is the normal practice. When this is done the calculated assays of the resultant product are 0.50% copper and 41.44% lead.

There was no advantage in heating the pulp in conjunction with the dichromate method (Test 39).

Selective Flotation Directly from the Ore

In the initial tests using this method, it was found that it was not possible to lower the pH of the pulp to the desired value of about 5.5 even though excess amounts of sulphur dioxide were added. For example, in Test 6, the addition of 10 lb/ton sulphur dioxide resulted in only a drop in pH from 8 to 6.3. After copper flotation, 12 lb/ton soda ash was required to increase the pH to 7.3 for lead flotation. Despite the high consumption of reagents, some promising results were obtained when amyl xanthate was used as the copper collector.

In one test (11) sulphuric acid and caustic soda were added in conjunction with sulphur dioxide and soda ash in order to reduce the consumption of these reagents. This scheme was unsuccessful. Poor selectivity was obtained in the copper float (excessive amounts of iron sulphides floated) and this was accompanied by a high loss of copper and silver in the tailing.

Aerative conditioning as a means of reducing sulphur dioxide consumption was tried in Test 13 and proved to be successful. It was found that the addition of 4 lb/ton sulphur dioxide along with 20 minutes aeration in a 4-inch-diameter aerator, resulted in a decrease in pH to 5.6. However, when amyl xanthate was again employed as the copper collector, poor selectivity was obtained between chalcopyrite, galena, and pyrite. A selective copper float was again achieved when the copper promoters Minerec "A", Aerofloat 194 and Z-200 were substituted for amyl xanthate.

Copper Flotation

A comparison of copper rougher flotation results using the various collectors is given in Table 12 followed by Table 13, which compares the effectiveness of lime and sulphur dioxide as depressants in the copper cleaners.

The copper promoter Minerec "A" gave the best results in tests on the F-l sample but it was not as effective as Z-200 in tests on the F-2 sample. As was mentioned previously, amyl xanthate gave poor selectivity when the pulp was aerated prior to copper flotation (Test 13) but gave satisfactory results when aeration was not employed (Test 6). The difference in results may, to some degree, be related to the different pH's (6.3 in Test 6 vs 5.6 in Test 13).

From the comparison of results in Table 13, it can be seen that lime was not an effective depressant for galena and pyrite when cleaning copper rougher concentrates floated from the F-1 sample. In fact, better results were obtained when lime was not added to the cleaners (Test 15). In tests on the F-7 sample, lime was found to be an excellent depressant for pyrite (Test 33) but it did not depress galena as effectively as sulphur dioxide.

Lead Flotation

The main problem encountered in floating a lead concentrate from the copper rougher tailing was the depression of pyrite. Also, lead losses in the tailing were appreciably higher than when copper and lead were floated together (bulk flotation).

Table 14 gives a comparison of results for lead rougher flotation using lime and soda ash as alkalinity regulators. From the results, it can be seen that the pyrite depression problem is related to the very high ratio of iron sulphides to galena in the feed. Even though better than 97% of the

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TABLE 12

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Comparison of Results for Copper Rougher Flotation

Test No	Rea	gents a	nd (Condi tions		1			Assay			Di	stribut	ion 7	1 ₀ .	Sep
and Sample	SO ₂ lb/ton	Aera-		Collector	Product	Wt %	Cu	Рb	Zn	Ag	Fe/ FeS		РЪ	Zn		Eff % Cu from Pb
6	10.0	No	6.3	C X 51	Cu ro conc	2.99	17.84	1.24	4.73	76.42	12.1	75.4	3.0	1.8	62.4	72.4
F-1					Cu ro tail	97.01	0.18					24.6	· · · · ·			
13					Cu ro conc	11.21	5.86	5.61	4.68	26.00	31.6	88.9	49.3	5.6	73.7	39.6
F-1	4.0	Yes .	5.6	C X 51	Cu ro tail	88.79	0.09	<u> </u>				11.1			<u> </u>	
15	11	11	11	Minerec	Cu ro conc	4.70	13.44	1.42	6.92	54.39	20.7	82.0	5.7	3.6	63.1	76.3
F-1				"A"	Cu ro tail	95.30	0.15					18.0				
16			<u> </u>	AF	Cu ro conc	2.38	18.21	1.08	5.00	75.72	16.0	59.5	2.1	1.3	45.7	57.4
F-1	11	11	11	194	Cu ro tail	97.62	0.30				<u> </u> 	40.5				· · ·
22				Z-200*	Cu ro conc	7.95	15.96	1.40	4.90	27.93	17.8	89.4	17.7	4.6	61.7	71.7
F-2			5.3	1 1 -	Cu ro tail	92.05	0.16	1	+	<u> </u>		10.6				
23				Minerec	Cu ro conc	7.18	17.51	2.21	5.45	32.86	15.5	89.1	25.5	4.6	64.5	63.6
F-2	11	11	11	"A"	Cu ro tail	92.82	0.16			1		10.9				

- 3U ~

* 2/3 added to grind

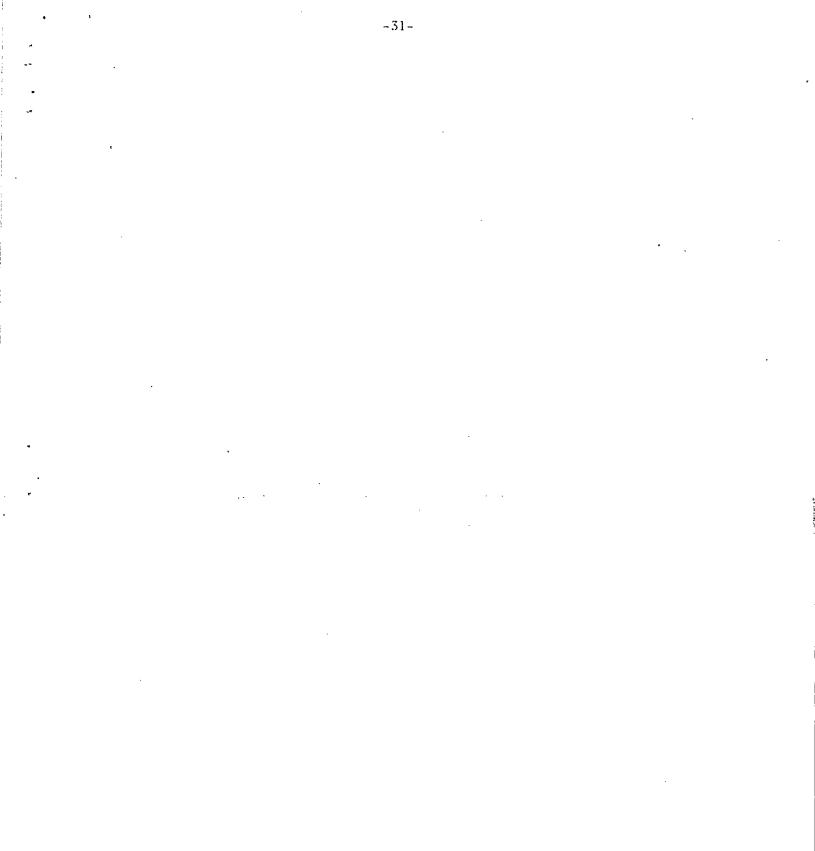


TABLE 13

Test No and	Reagents ad	dded 1b/ton	en e	Wt %	
Sample	lst Cleaner	2nd Cleaner	Product		
15 F-1	none	none	Copper conc 1st stage Cu cleaner conc Copper rougher conc	44.2 65.9 100.0	
17 F-1	lime 0.6 pH 11.4	none pH 10.3	Copper conc lst stage Cu cleaner conc Copper rougher conc	68.6 80.0 10 0 .0	
33 F-7	lime 0.6 pH 11.6	none pH 10.6	Copper conc Copper rougher conc	43.9 100.0	
37 F-7	SO ₂ 0.5 pH 3.3	SO2 0.25 pH 3.6	Copper conc Copper rougher conc	66.7	

Comparison of Results Using Lime and Sulphur Dioxide as Depressants in Copper Cleaners

iron as iron sulphides is distributed in the tailing, the remaining portion which floats with the galena is enough to appreciably lower the grade of lead concentrate. The same is true of sphalerite, although it does not contaminate the lead concentrate to the same extent as pyrite. 1

Note that appreciably better selectivity between galena and pyrite was achieved on the F-7 Sample, which has a lower ratio of iron sulphides to galena in the feed. (Tests 33 and 37).

A high pH with lime (Test 13) did not result in better pyrite depression nor did the addition of a high amount of soda ash (Test 16) bring about an improvement in lead recovery. The galena was effectively depressed by sulphur dioxide during the initial copper flotation step and no reagent combination could be found which would reactivate it completely to its natural, readily floatable state.

	A	ssays				Di	stribu	tion %		Separ	ation Ef	ficlen y
			i							Co	opper fr	om
Cu	Рb	Zn	Ag	Fe/FeS	Cu	Рb	Zn	Ag	Fe/FeS	Pb	Zn	Fe/Fe3
23.15	1.08	4.38	89.20	11.7	76.2	33.7	28.0	72.6	25.0	42.5	48.2	51.2
18.12	1.16	5.41	70.91	17.5	88.9	53.9	51.6	86.0	55.9	35.0	37.3	33.0
13.44	1.42	6.92	54.39	20.7	100.0	100.0	100.0	100.0	100.0			
17.04	1.76	6.76	60.00	16.2	95.0	76.3	74.3	80.7	50.6	18.7	20.7	44.4
15.04	1.71	6.52	53.88	19.0	97.7	86.8	82.9	84.5	69.1	10.9	14.8	28.5
12.33	1.58	6.26	51.08	22.0	100.0	100.0	100.0	100.0	100.0			
25.78	11.50	4.76	45.78	5.1	85.6	62.3	39.1	71.4	9.0	23.3	46.5	76.6
13.24	8,10	5.03	28.16	24.9	100.0	100.0	100.0	100.0	100.0			
25.04	4.33	2.16	4 0. 88	-	89.1	-			37.3	37.2	49.1	51.8
18.72	5.56	3.82	34.50	15.2	100.0	100.0	100.0	100.0	100.0			

The addition of cyanide to the cleaners, or a combination of lime and cyanide (Test 17), did not depress pyrite and sphalerite to the extent desired. Generally, on the F-1 and F-2 samples, it was possible to clean the rougher concentrate to a grade of only about 40% lead. On the F-7 sample from which higher grades of rougher concentrates were produced, cleaner concentrate grades of 50% or better were achieved (Tests 33 and 37).

Selective Flotation Augmented by Copper-Lead Separation

Table 15 gives a summary of procedure used in tests employing this scheme.

TABLE 14

Test No.	Reage	nts and Co	onditions		• ,
and Sample	Alkalinity regulator lb/ton	рН	Collector	Product	Wt %
13 F-1	Lime 4.0	11.0	AF 242 + C X 51	Pb ro conc Pb ro tail Feed (calcd)*	2.22 97.78 100.00
14 F-1	Lime 3.0	9.7	AF 242 + C X 51	Pb ro conc Pb ro tail Feed (calcd)	1.92 98.08 100.00
15 F-1	Soda ash 4.0	7.3	AF 242	Pb ro conc Pb ro tail Feed (calcd)	3.21 96.79 100.00
16 F-1	Soda ash 5.0	7.6	AF 242	Pb ro conc Pb ro tail Feed (calcd)	3.51 96.49 100.00
22 F-2	Lime 3.0	9.6	AF 242	Pb ro conc Pb ro tail Feed (calcd)	1.33 98.67 100.00
23 F-2	Soda ash 5.0	8.7	AF 242	Pb ro conc Pb ro tail Feed (calcd)	2.38 97.62 100.00
37 F-7	Lime 3.0	9.5	AF 242	Pb ro conc Pb ro tail Feed (calcd)	5.03 94.97 100.00

Comparison of Results for Lead Rougher Flotation

TABLE	14

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	A	ssays				Di	stribu	tion %	•	Sep.Eff.7
Cu	Pb	Zn	Ag	Fe/FeS	Cu	РЪ	Zn	Ag	Fe/FeS	Pb from Fe/FeS
0.15 0.09 0.09	15.60 0.39 0.73	10.66 9.85 9.87	10.68 0.95 1.17	20.4	3.6 96.4 100.0	52.4	97.6	79.7	2.9 97.1 100.0	44.7
0.18 0.14 0.14	17.54 0.23 0.56	13.15 9.91 9.97	13.31 0.93 1.17		2.5 97.5 100.0	59.9 40.1 100.0	97.5		97.8	57.4
1.18 0.11 0.14	26.67 0.30 1.15	9.72 9.09 9.11	0.94		26.3 73.7 100.0	25.3	3.4 96.6 100.0	57.9	2.7 97.3 100.0	72.0
2.57 0.22 0.30	25.17 0.40 1.27	9.09 9.60 9.58		22.4	29.8 70.2 100.0	30.4	3.3 96.7 100.0		3.1 96.9 100.0	66.5
0.89 0.15 0.16	28.59 0.19 0.57	8.33 8.66 8.66	30.62 1.10 1.49	23.5	7.4 92.6 100.0	33.0	1.3 98.7 100.0	72.7	1.1 98.9 100.0	65.7
0.61 0.15 0.16	14.44 0.16 0.50	6.58 8.86 8.81	11.25 1.04 1.28	29.0 23.3 23.4	9.0 91.0 100.0	68.8 31.2 100.0	1.8 98.2 100.0	79.1	2.9 97.1 100.0	65.9
0.43 0.18 0.19	38.01 0.36 2.25	7.72 8.78 8.73		3	11.2 88.8 100.0	84.8 15.1 100.0	95.6		2.8 97.2 100.0	82.0

TABLE 15 Summary of Procedure for Tests Employing Selective Flotation Augmented by Copper-Lead Separation

. Test No. and Sample	Flowsheet	Copper Flotation Reagents	Lead Flotation Reagents	Remarks
			1(04g01115	
24 F-2	3A	Lime, ZnSO ₄ , NaCN Z-200		Preliminary test, did not float lead conc
25 F-2	3A	Na ₂ CO ₃ ZnSO ₄ , NaCN AF 238	l.	Copper flotation only - test products not assayed
27 F-2	3A	Lime, ZnSO ₄ , NaCN Z-200	AF 242	Copper-lead separation not carried out.
28 F-2	3A	Lime, ZnSO ₄ , NaCN AF 238	AF 242	Repeat of Test 28 but with AF 238 replacing Z-200.
30 F-2	3A	Lime, ZnSO ₄ , NaCN Z-200	AF 242, AF 208	Similar to Test 27 but with copper-lead separation.
31 F-7	3A	As above	As above	Repeat of Test 30 on F-7 Sample
38 Comp	3B	Na ₂ SO ₃ Z-200	Na_2CO_3 , NaCN AF 242, AF 208	

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As indicated in the above table several tests were carried out before copper-lead separation of the lead concentrate was attempted (Flowsheet 3A). Since this scheme depended on the initial flotation of a finished, low-lead copper concentrate containing most of the copper in the ore, it was necessary to establish reagents and conditions to achieve this end before proceeding further.

Of the two selective copper promoters tried, Z-200 proved to be superior to Aerofloat 238. It not only gave better selectivity between chalcopyrite and galena but also a higher copper recovery in the copper rougher concentrate (refer to Tests 27 and 28 in appendix). Aerofloat 238 was also tried with soda ash replacing lime as the alkalinity regulator (Tests 25 and 26). Normally, aerofloat promoters function more effectively in a soda ash circuit. However, in both tests a heavily mineralized, non-selective copper froth was obtained; therefore, the tests were discontinued and test products discarded.

Only one test was carried out using Flowsheet 3B(38). In this test 24.5% of the lead was recovered in the copper rougher concentrate which assayed 12.9% copper and 5.7% lead. When the rougher concentrate was cleaned, most of the lead (19.8%) was rejected to the cleaner tailing to give a cleaner concentrate assaying 22.0% copper and 2.2% lead. Since this can be considered to be a finished grade of copper concentrate, deleading of the concentrate, as was done in this test, is not necessary. The cocedure employed in this test, therefore, could be used as a method for the selective flotation of copper and lead concentrates directly from the ore.

It should be noted that the reagents used in conjunction with Flowsheet 3A and 3B are essentially the same as those employed for bulk copper-lead flotation. The only difference was the order of addition of reagents and the use of Z-200 and Aerofloat 238 as copper promoters.

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CONCLUSIONS

Marketable grades of copper, lead, and zinc concentrates with good recoveries can be produced from this ore by flotation at a grind of 83% minus 200 mesh.

Flotation of a bulk copper-lead concentrate followed by copperlead separation was found to be the most efficient technique for producing copper and lead concentrates. The cyanide separation method was effective on the high-copper, low-lead, F-2 sample, whereas the dichromate method gave excellent results on the low-copper, high-lead, F-7 sample. The cyanide method was also successfully applied on bulk concentrate produced from a composite made up of equal weights of the F-2 and F-7 samples.

Selective flotation of copper and lead concentrates directly from the ore gave acceptable grades of copper and lead concentrates, but copper, lead and silver recoveries were appreciably lower than those obtained by bulk flotation. Reagent consumption was also higher. There was no particular advantage in employing a combination of selective flotation and copper-lead separation techniques.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of the following members of the Mineral Sciences Division: Mr. R. G. Pinard who carried out the mineralogical examination of the ore and Mr. D. P. Palombo who did the spectrographic analysis of the head sample. A grateful acknowledgement is also extended to Mr. W. Hyndman, Chief Chemist and his staff at Mattagomi Lake Mines Limited who carried out the chemical analyses of all the test products.

APPENDIX

45 min	Rod Mill Grind o	on F-1 Sample
Tyler	Wt	Cumulative
Mesh Size	%	Wt %
+100	0.6	• 0.6
+150	1.8	2.4
+200	14.7	17.1
+325	28.7	45.8
-325	54.2	100.0
Total	100.0	
30 min F	lod Mill Grind or	n F-2 Sample
+100	0.6	0.6
+150	3.2	3.8
+200	21.6	25.4
+325	27.9	53.3
- 325	46.7	100.0
Total	100.0	

Screen Analyses of Primary Grinds

Treatment Scheme	(Ore Sample	and Test N	10.
	F-1	F-2	F-7	Comp
Bulk flotation followed by copper-lead separation of bulk concentrate	1,2,3,4 8,9,10	18,19,20 21,29,34 35	32,39,40	36
Selective flotation of copper and lead concentrates directly from the ore	5,6,7,11 12,13,14 15,16,17	22,23,	33	
Selective flotation augmented by decoppering of lead concentrate-Flowsheet 3A		24,25,26 27,28,30	31,37	
Selective flotation augmented by deleading of copper concentrate-Flowsheet 3B				38

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Classification of Tests According to Treatment Schemes Employed and Ore Sample

	Abbreviations Used in Flotation Test Reports
RM	Rod mill
CX 51	Potassium ethyl xanthate (Canadian Chemical Co.)
DF 250	Dowfroth 250 - Dow Chemical Co. frother
NaAF	Sodium Aerofloat-American Cyanamid Co. promoter.
Fe/Fes	Iron present as iron sulphides.
·Z-200	Trade name for Dow Chemical Co. selective copper promoter.
AF 194,208 238,242	American Cyanamid Co. Aerofloat promoters.
Min A	Minerec A - Minerec Corp. selective copper promoter.
ZnCN	$Na_2 ZN (CN)_4$
Dich	Sodium dichromate
CS	Caustic Starch-aqueous solution of caustic soda and starch in in the ratio 1:2.

AS:RWB/ec

MINES BRANCH FLOTATION TEST REPORT 5hect 1 of 2

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				- 8-	on Lake									-11, 19		
DBJECT OF TEST: To fl	oat co	opper-	lead a	nd zi	nc conc	entrate	es usin	g the	combina	ation				2000 g		
		$\frac{1}{4} + N$											TED E	Y <u>15</u>		
OPERATION	Time	%	рН		Unit		Reagents. Ib per ton									
	min	Solids		<u>`</u>	used	Lime	ZnSO	NaCN	CX51	DF250	<u>Cuso</u>	NaAF			: ==	
Grinding	45*	64		7 x	14 RM	2.0	0.5	0.05	<u> </u>			·				
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Copper-lead rougher		ļ								ļ						
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" 2	1/2		<u> </u>				<u> </u>		0.01							
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'' 4	2		ļ			· · · · · · · · · · · · · · · · · · ·			0.02	0.005		+				
Conditioning	10	ļ	11.1			1.0	<u></u>	 	ļ	ļ	1.0					
Zinc rougher		ļ	<u> </u>	<u> </u>	·			 	ļ							
Stage 1	1		1					<u> </u>		<u> </u>		0.05				
" 2	1			<u> </u>	~				<u> </u>	0.005		0.05				
'' 3	2	<u> </u>	1	<u> </u>				1		0.005	<u> </u>	0.05				
		T			ANA	LYSIS	%			1	D	ISTRI	BUTIC	N %		
PRODUCT	%	6	Cu	Pb	Zn	Fe	Inso1	Ag	Fe/Fe	S Ci	ı F	Ъ	Zn	Ag		
								1								
opper-lead conc**	2.	. 85 18	.28 2	20.63	5.75	22.2	0.8	87.61	5.4	70	.3 5	56.2	1.8	63.2		
opper-lead cl tail No.3	0.	.67 6	.71 1	4.45	13.65	27.2	3.2	29.20		i 1	1	9.3	1.0	4.9		
π " " No.2	0.	.78 4			17.76		4.6	24.10		11	.5	8.5	1.5	4.8		
" " " No.1		.31 1		6.37	17.20		9.5	12.94	4	11		4.1	4.3	7.6	}	
inc rougher conc		.77 0		0.38	55.14	8.4	2.2	1.89				5.0	81.6	6.6		
inc rougher tail		62 0		0.09	1.15	 		0.64				6.9	9.8	12.9	 	
eed (calcd)	100.	.00 0	. /4	1.05	9.30			3.95			. () 1(<u></u>	00.0	100.0	<u> </u>	
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TEST NO. 2 SAMP				Sturgeon Lak							DATE		. 14,	
				pulp aerated	befor	e copp	er-						2000-g	
lea	ad flot	ation.									TEST	ED BY	: A.S	•
OPERATION	Time	%	нą	Unit				Rea	agents,					
OFERATION	min	Solids	ргі 	used	Lime			CX51	DF250	CuSO4	NaAF			
Grinding-as in Test 1	_													
Conditioning	20		9.1	Aerator				0.02						
Copper-lead rougher				1000-g cell					<u> </u>					
Stage 1	1/2							0.01	0.02				<u> </u>	
" 2	1 <u>2</u>							0.01				-		
" 3	1							0.02	0.005					
·· 4 ·	2							0.01						
Conditioning	10		11.6		3.0					1.0				
Zinc rougher														
Stage 1	1/2							0.02			0.05			
" 2	1/2							0.01	0.005		0.05			
" 3	3										0.05			
	W	т		ANAL	YSIS	%	·····			DI	STRIB	JTION	1 %	
PRODUCT	%	5												
Copper-lead ro conc	25.	55						1						
Zinc rougher conc	15.													
Zinc rougher tail	58.		ļ											
	100.	00	1											
·														
• • ·													1	
• • • · · · · ·							· ·				ł			-
							•							
													1	
		1		11			1	1	1					
		-		pyrite float										
Zinc float				h at end - a			nthate	addit	ion rea	quired	at sta	rt to	float	
			alerit	<u>e (see Test</u>	l rema	rks)								
PRODUCTS NO)T ASSA	YED												

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MINES BRANCH FLOTATION TEST REPORT Sheet 1 of 2

TEST NO. 3 SAMPLE: Mattagami - Sturgeon Lake F-1 DATE: Jan. 15, 1970 CHARGE 2000 g. OBJECT OF TEST: Repeat of Test 2 but added more lime to increase pH of copper-lead float from 9.1 to 10.3 TESTED BY: A.S. Reagents. Ib per ton Time % Unit OPERATION рH used min Solids DF250 CuSO4 NaAF Lime CX51 Grinding - as in Test 1 10.3 Aerator 1.0 Conditioning 20 0.02 1000-g cell Copper-lead rougher - as in Test 2 11.6 2.0 1.0 10 Conditioning Zinc rougher 3 0.02 0.05 Stage 1 2 ł 0.01 0.005 0.05 П 1/2 0.005 3 11 4 23 0.05 DISTRIBUTION % WΤ ANALYSIS % PRODUCT % Insol Fe/FeS Pb. . Cu Рb Zn Fe Ag Cu Zn Ag 3.71 15.50 18.98. 70.43 68.3 2.6 67.4 23.8 Copper-lead conc 6.50 1.3 9.4 77.3 13.45 33.7 2.0 0.6 Copper-lead cl tail No.3 0.59 2.70 5.35 8.76 36.3 3.3 2.1 3.1 17.50 27.9 11 11 11 11 No.2 0.85 1.80 5.93 10.85 31.6 5.0 2.1 4.9 1.0 3.8 11 81 11 11 7.9 No.1 3.12 1.43 3.89 12.65 29.9 9.5 9.80 27.1 6.0 11.8 4.3 58.63 i.3 8.54 0.17 0.16 6.9 0.3 0.99 1.9 54.0 2.2 Zinc conc Zinc cleaner tail No. 2 1.8d 0.35 0.67 54.01 8.6 1.6 2.48 2.0 0.8 1.2 10.5 1.1 37 11 TT No. 1 5.36 0.35 0.68 39.12 14.4 9.8 2.57 9.5 2.6 3:5 22.6 3.6 12.0 Zinc rougher tail 76.03 0.07 0.08 0.55 0.61 7.2 5:9 4.4 100.00 0.74 1.03 Feed (calcd) 9.27 100.0 100.0 100.0 100.0 3.88 REMARKS: Copper-lead float - increase in pll resulted in depression of pyrite Zinc float - similar to Test 2 but "gummier" especially at end of float

. 7

MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

TEST NO. 3 SAM	PLE: M	attaga	ni -	Sturge	on Lake	F-1				-		DAT	TE: Jar	n. 15, 1	.970
OBJECT OF TEST:		. <u> </u>										CHA	RGE:		
						r						TES	TED B	Y:	
	Time	%		1	Jnit	1			Reag	ents, l	b per	ton			
OPERATION		Solids	рH	1	used	Lime	1			DF250					1
							1								1
Copper cleaners	13		8.7	500	g cell										
<u>No. 1</u> No. 2	12		8.6		g cell										
No. 3	1	•	8.4		11	-	1								1
Zinc cleaners	+		<u> </u>					r							+
No. 1	2		11.7	500	g cell	1.0		r							
No. 2	11/2		11.6		11	0.75	1			0.01			_		1
			<u> </u>					;		•					1
															1
	1	<u> </u>					1								1
	1						1	1				1			1
			<u> </u>				1								1
		τ	1	<u> </u>	ANA	LYSIS	%	<u> </u>		1	DI	STR	BUTIO	N %	
PRODUCT	%	, 11		Pb	r · · · · · · · · · · · · · · · · · · ·		Insol		Fe/FeS	Cu	<u> </u>	b		· · · · · · · · · · · · · · · · · · ·	·-·
Calculated assays		° C		PD	Zn	re	INSOL	Ag	re/res	<u> u</u>		<u>.p. </u>	Zn	Ag	
Copper-lead cl conc						<u>_</u> !	-								
2nd stage	4.	31		17.11	6.81	25.52		62.61		79.4		.4	3.2	69.4	
lst stage	5.			15.27	7.48	26.52	1	55.17	15.2	81.5		.3	4.2	73.2	
Copper-lead ro conc """ tail	8.			10.97	9.43	27.78	4.92	38.05	18.0	87.5			8.5	81.1	
	91.	11	.10	0.13	-7 00	7 00	0.50	0.80		12.5	11		<i>(</i>) <i>г</i>	18.9	
lst stage zinc cl conc	10.1	13	.20		57.83 51.44		0.53	1.25	0.3	2.7		.5	64.5	3.3	
Zinc rougher conc	12.		. 45	0.40	D 1. 44	9.00	3.69	1.70	3.5	5.3	6	.0	87.1	6.9	
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	11	1	ļ			1		1	1	1)	i	1			

Sheet 1 of 2

TTOT NO. / LONG				0.											1070
				-	eon Lak									$\frac{1.15}{2000}$	
					inc con ₃ + NaC								RGE:		
Con	DINALI			- Na250	3 + Nac.	N along	, WILL	aeraci					ED BY	<u>Y:</u> A.S	•
. OPERATION	Time	%	pH		Jnit .		.	•		igents;	•				
	min	Solids	s		used	Na ₂ CO3	Na2SO3	NaCN	CX51	DF250	Lime	.CuSO4	NaAF		· ·
Grinding	45	65		7x14	RM	3.0	1.0	0.10							
Conditioning	20		9.5	6 Aera	tor	1	1		0.02						
Copper roughers				1000	-g cell										
Stage 1	1/2									0.02					
?	1									0.02		- Service			
." 3	312														
Conditioning	10		11.7	7							4.0	1.0			
Zinc roughers											•				
Stage 1	1/2								0.03				0.05		
	1				•		·		0.01				0.05		-
" 3	2				•				0.01	0.02			0.05		
	W	т			ANA	LYSIS	%			1	D	ISTRIE	UTION	N %	
PRODUCT	9	6	Cu	Pb	Zn	Fe	Insol	Ag	Fe/Fe	S Cu		РЪ	Zn	Ag	
Correr lead one +															
Copper-lead conc * Copper-lead cl tail **	14	.46 17 .29 3	.10	22.78	6.50 11.65	21.3 23.7	2.0 2.0	84.67		11		2.6	2.4	72.1 9.4	
Zinc conc			.11	0.13	58.32	7.3	0.3	1.14		14		0.7	37.4	1.7	-
Zinc cleaner tail No. 2	11	£ 7	.14	0.25	55.35	8.5	1.4	1.28	•				15.2	0.8	• • • • • •
" " " No. 1	12	11	.14	0.36	49.08	10.7	5.1	1.32		51		2.3	37.2	2.3	
Zinc rougher tail	11	11	.06	0.15	0.58			0.71		- N	1	0.9	4.9	13.7	
Feed (calcd)	100	.00 0	.74	1.09	9.30			4.06		100		0.0 1	100.0	100.0	
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•														t	
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														۰	
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													•	:	
REMARKS: Copper-lead	float	- ver	v 9110	mv at	start -	"weeni	ng" at	end	effect	of ev		inda as			
Zinc float															
					d of flo		ce opu		. came	ap ru	5000	ورهما معها راماه			
* Au assay, 0.14 oz/to															

Au assay, U.14 oz/ton. ** No. 1 and 2 combined.

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TEST NO 4	SAMPI	_E:	Matca	gami	- Stu	rgeon La	ke F-1						DA'	TE: J	an. 15,	1970
OBJECT OF TEST:													CHA	ARGE:		
•													TES	STED E	SY:	
		Time	%			Unit	1			Rea	gents,	lb per	ton			
OPERATION		min	Solids	рH		used		1			DF250	Lime	1		1	
Copper cleaners																
No. 1		$1\frac{1}{2}$			500	-g cell					0.01		1			
No. 2		$1\frac{1}{2}$			11	<u> </u>					0.004					
Zinc cleaners																
No. 1		2		~ 12		-g cell					0.01	1.0		•		
No. 2		$1^{\frac{1}{2}}$		11	11	11 11					0.01	0.75				
													<u> </u>			
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				l	1								1			
PRODUCT		W.	11			ANA	LYSIS	%				DI	STR	IBUTIC	N %	
		%	6 (Cu	РЪ	Zn	Fe	Inso1	Ag	Fe/FeS	5 C	u P	'b	Zn	Ag	
Caclulated assays																
Copper-lead to con		5.	75 1	1.74	16.13	8.55	22.25	2.00	57.60	11.0	90	.9 8	5.5	5.3	81.5	
Copper-lead ro con """ tai	11	94.		0.07	0.17		22.25	2:00	0.80					210	0215	
lst stage zinc cl	conc	85.	1	0.12	0.17	57.43	7.66	0.63	1.18	0.9	1	.4	1.3	52.6	2.5	
Zinc rougher conc		15.	56	0.13	0.25	53.64	9.04	2.66	1.24	2.7	2	.7	3.6	89.8	4.8	
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REMARKS:	······															•
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Sheet 2 of 2

TEST NO. 5 SAMPI	_E: M	lattaga	ami —	Sturg	eon Lake	F-1					DA	TE: Fet		
OBJECT OF TEST: To f	loat	соррез	c, lead	d and	zinc co	ncentr	ates u	sing SC	as			ARGE:	2000 و	-
					ith Z-20				ŕ.			STED B	Y: A.5	S
OPERATION	Time	%	рН	1	Jnit				Reage	ents, It	per ton			
		Solids		·	sed	so	<u>z-200</u>	CX 51						
Grinding	45	65	8.0*	1	14 RM									
Conditioning	5		6.1	100	0-g cell	9.0	0.04	0.02	·					
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PRODUCT	WT WT				ANAL	YSIS	%.			L	DISTR	RIBUTIO	N %	· · · · · · · · · · · · · · · · · · ·
	%								•		<u> </u>			
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REMARKS: Could not lot		bolor	, 6 0 .		tondod d		the a	ddition	of big	h amou	nts of (so 7-	-200 0	74 9
Darren, effervescent frot	h but	chalo	v u.u a nonvrii	as in te car	lenueu d Te un ve	rv ani	chlv m	non add	ition b	f CX 5	nus vi d 1 - test	2 - 2 - Vas te	≥oo sav ≥rminate	ed at `
this point.						-3 Art								
* After dilution in cell	•													

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Sheet 1 of 2

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TEST NO. 6 JAME	PLE:	Matta	agami	- Stu	rgeon L	ake F-1					•	DAT	r ei	. 10,	1970
OBJECT OF TEST: As	in Test	5 but	t subs	stitut	e CX 51	as cop	per pro	omoter				СНА	RGE:	2000 g	
	place o					F	F F					TES	TED B	Y: A.S.	
	Time	%			Jnit				Rea	gents,	Ib per	rton			
OPERATION	min	Solids	рН		used	SO2.	CX 51	DF250	Na ₂ CO ₃	NaCN	AF242	Lim	e CuSO	+ NaAF	
Grinding	45	65		7 x	14 RM										
Conditioning	10		6.3	3	-g cell	10.0	0.02								1
Copper rougher	1		·	·		:		0.02				1			1
Copper scavenger	1		·												1
Conditioning	10		7.3	3					12.0			1	•		
[]	5			-				0		0.10					
73	5										0.02				
Lead rougher	1														
Conditioning	10		11.7	7								8.0	1.0		
Zinc rougher, stage 1	1						0.02							0.10	
¹¹ ¹¹ ¹¹ 2	1						0.01							0.05	
" " 3	2									_				0.05	
	w-	г			ANA	LYSIS	%			1	D	ISTRI	SUTIOI	N %	
PRODUCT	%	, ,	Cu	РЪ	Zn	Fe	Ag	Fe/FeS	3	Cı	1	Pb	Zn	Ag	
Copper conc		45 25			3.90		101.21	4.9		11		1.1	0.7	40.1	•
Copper cleaner tail	1		3.65 2.20		5.92	29.2	40.20	20.9		11		1.1	0.5	8.1 14.2	
Copper scavenger conc Lead conc			0.07		6.38 6.54	28.4 12.9	65.00 21.60	16.9 12.1				9.2	0.0	5.6	
Lead cleaner tail	11	11	0.34		9.13	24.4	12.84)	1	11	ì	6.5	1.4	4.8	
Zinc rougher conc	11		0.70		51.85	9.6	2.97	2.9		1		3.8	66.3	8.9	
Zinc rougher tail	83.		0.11		3.05	5.0	0.80			11		7.5	29.8	18.3	
Feed (Calcd)	100.			1.21	8.58		3.66				0.0 10		100.0	100.0	
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REMARKS: Looked 11						4. 1	• •	· · ·	1 -			1 1	1	···	
Looked II				111	ad iloa	t but p	yrite :	ln evid	lence i	n iroi	th in	both	cases.		
Zinc float	: was b	right	and o	lean.											

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MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

TEST NO. 6	SAMP	LE: M	attaga	mi -	Sturge	on Lake	e F -1								. 10, 19	970
OBJECT OF TEST:									•					RGE:		
													TES	TED B	Y:	
OPERATION		Time	%	рН		Jnit	1			Rea	gents	, Ib I	per ton			
OPERATION		min	Solids		. u	sed		CX51	DF250]	NaCN	_				ļ
Copper cleaner	,	1 N			250-	g cell		0.001	0.007							·
						<u> </u>							•			
Lead cleaner		1			11	11					0.10)				
				•												
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					1			<u> </u>			10			<u> </u>		1
PRODUCT		w ⁻		· · · · · · ·	· · · · · · · · ·		LYSIS			1	_		DISTR		·····	
			<u> </u>	u	Pb	Zn	Fe	Ag	Fe/FeS		<u>A</u> ı	1	РЪ	Zn	Ag	
Calculated assa	ays								1				1 1 M			
Copper rougher cor	nC	2.	19 19	.94	1.24	4.59	28.3	80.59	10.3		6	L.6	2.2	1.2	48.2	*
Copper ro + scav o	conc		99 17			4.73	28.4	76.42			11	5.4	3.0	1.8	62.4	
Lead rougher conc				.23	29.13	8.06.	19.7	16.44	18.5			0.7	55.7	2.1	10.4	
Lead rougher tail		94.	70 0	.18	0.53			1.05			2.	3.9	41.3		27.2	
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REMARKS:									÷							
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TEST NO. 7 SAMPLE: Mattagami - Sturgeon Lake F-1 DATE: Feb. 10, 1970 OBJECT OF TEST: To try copper-lead-zinc selective float as in Tests 5 and 6 but with CHARGE: 2000 g (1) lower SO₂ addition and (2) AF238 and AF242 as copper and lead promoters TESTED BY: A.S. Reagents, Ib per ton Time % Unit OPERATION' pН min Solids used AF238 CX51 DF250 NaCN AF242 NazCO SO_2 Grinding 60 65 7x14 RM Conditioning 6.9 1000-g cell 5 2.5 \$ 11 5 0.02 0.01 Copper rougher 1 3.0 Copper scavenger 1 Conditioning 5 7.4 0.100.02 5 11 0.03 Lead rougher 1/2 Stage 1 1/2 Stage 2 0.02 WT ANALYSIS % DISTRIBUTION % PRODUCT % Copper rougher conc 5.22 Copper scav conc 1.40 Lead rougher conc 1.94 Lead rougher tail 91.44 Feed 100.00 REMARKS: Copper float not as selective as Test 7, excessive amounts of pyrite floated. Not too much galena floated in lead float, therefore test terminated at this process

MINES BRANCH FLOTATION TEST REPORT

PRODUCTS NOT ASSAYED

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MINES BRANCH FLOTATION TEST REPORT Sheet 1 of 2

TEST NO. 8 SAME	PLE: M	attag	ami -	Sturg	eon Lake	e F-1								. 11, 1	
OBJECT OF TEST: To t									.ng ZnC	N comp	lex			2x2000	-
as copper depressant (copper	-lead	rough	er flo	o <mark>at simi</mark>	lar to	Test 1	.).				TE	STED E	Y: A.S	
OPERATION	Time	%	на	1	Unit		;	· · · · · · · · · · · · · · · · · · ·	Rea	gents,	lb pe	er ton	•		
	min	Solid	s		used	Lime	ZnSO/	NaCN	CX51	DF250			·		
Grinding	45	65		7xl	4 RM	1.5	0.5	0.10							1
Conditioning			10.1	1000	0-g cell				0.02				·		
Copper-lead rougher	·											1.		·	
Stage 1	1.	·								0.02					
Stage 2	1.2						1		0.02			•			1
Stage 3	1									0.01					1
Stage 4	1						1		0.02						1
Stage 5	1								0.01		·				1
Copper-lead cleaners															1
No. 1	1^{1}_{2}			250.	-g cell		·								1
No. 2	$1\frac{1}{2}$	•	1	11	11										
No. 3	112			tt	. 17								· .		1
PRODUCT	W		,		ANA	LYSIS	%				C	DISTR	RIBUTIC	N. %	
	%	6 (Cu	Pb	Zn	Fe	Ag	Fe/FeS		Cu		РЪ	Zn	Ag	
Copper conc	1 1	.74 23	3.20	3.42	3.90	26.7	60.25	5.8		57.	3 1	4.1	0.8	27.9	
Lead conc			0.37 5		• •	10.1	44.90	9.2		0.		36.1	4	7.9	1
Lead cleaner tail No. 2	0	.34 3	3.05 2	2.30	8.36	25.6	77.00	21.9		1.		7.3	0.3	7.0	1
n n n No.1		.03 12	2.60 1.	5.32	6.04	25.7	99.52	13.9		. 18.	4.	15.1	0.7	27.2	
Copper-lead cl tail No.	3 0	.50	5.14	3.58	9.24	28.9	27.00	23.3		3.	6	4.1	0.5	3.6	
it if if if No.	2 0	.46	4.43	7.92	8.54	26.7	25.60	21.8		2.	9	3.5	0.5	3.1	
TT TT TT	11	11	2.82	4.32	9.11	24.9	14.64	21.3		2.	5	2.6	0.7	2.5	
Copper-lead ro tail				0.19	8.79		0.83			13.	5]]	7.2	96.1	20.8	
Feed (calcd)	100	.00 (0.70	L.04	8.65		3.76	1		100.	0 10	0.0	100.0	100.0	
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REMARKS: Two 2000 g:	ram ba	tches	float	ed seg	parately	- cop	per-lea	ad roug	her co	ncentr	ates	comb	ined fo	r clean	ing
and copper	-lead	separa	ation.	Brig	ght, lea	dy fro	th in c	copper-	lead s	eparat	ion	DUT C	патсору	rice	
"Lurking"												••			

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MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

TEST NO. 8	SAMP	LE: M	attaga	mi -	Sturge	on Lak	e F-1						DA	TE: Feb	. 11, 1	970
OBJECT OF TEST													СН	ARGE:		
	_							•					TE	STED B	Y: _	
OPERATION		Time	%		ι	Jnit				Rea	igents	, lb pe	r ton			······
- OPERATION		min	Solids	рH	ι ι	ised	Lime				DF250	ZnCN	AF2	42		
Copper-lead separ	ation															
Conditioning		5		11.7	250-2	cell	0.1	1				1.7	5			
Lead rougher	·	ŀ			11	ft										
Lead cleaner No.	1	1/2		11.0) ប្	ŭ						Τ				
II II NO.	2	1			ч	ម					0.004		0.0	02 -		
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PRODUCT		W	i			ANA	LYSIS	%				ב	ISTR	IBUTIO	N %	
		%	° C	u	Pb	Zn	Fe	Ag	Fe/FeS		Cu		РЪ	Zn	Ag	Fe/FeS
Copper conc		46	1 23	.20	8.42	3.90	26.7	60.25	5.8	1	73	.8	19.4	35.4	39.8	26.5
Lead conc		11		.37	56.98	4.96	10.1	44.90			n –		49.5	17.0	11.2	15.9
Lead cleaner tail	No. 2		11	.05	22.30	8.36	25.6	77.00	1			1	10.1	15.0	10.0	19.8
87 ft tt	No. 1	27	.4 12	.60	15.32	6.04	25.7	99.52			23	1	21.0	32.6	39.0	37.8
Feed (calcd)*		100	.0 14	.49	20.06	5.07	23.4	69.80			100		0.00	100.0	100.0	100.0
Calculated ass			l.				i									
lst stage lead cl				•28	45.19	6.11	15.4	55.81			11	,	59.6	32.0	17.4	35.7
Lead rougher conc	:	53	.9 7	.02	30.03	6.07	20.6	77.99	13.7		26	.2	30.6	64.6	47.5	73.5
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Snown						nce for	copper	-lead s	separat	ion.	,					
*Copp	er-lead	d clea	ner _. co	ncent	rate.											
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MINES BRANCH FLOTATION TEST REPORT ______ Sheet 1 of 2

					on Lake	and the second se	<u>.</u>				•		· · · · · · · · · · · · · · · · · · ·	. 12, 1	
OBJECT OF TEST: Repea	t of ?	Test	8 but	boiled	l copper	-lead o	conc s.	lurry f	Eor 5 m	inute	S ·			2 x 2 00 0	
prior to separation ste	p to	desoi	rb xan	thate :	rom mir	neral s	urface	5.					STED B	Y: A.S	•
OPERATION	Time	%	Ha	, , , t	Jnit			·····	Rea	gents	, іь	per ton			
	min	Solid	Is	(used	ZnCN '	AF242	CX51	DF250		1				
Grinding] as												· .			
Copper-lead rougher in											•	1	•		
Copper-lead cleaners Tes	t 8	•				1									
			_												
Copper-lead separation								<u> </u>							
Desorption*					•							<u> </u>		· ·	
Conditioning	5			250-	g cell	0.33	0.01	0.001	5						
11	3					0.08									
Lead rougher	12										ŀ				
Lead cleaner	1 :			250-	g_cell		· .		0.004						
					• • •										
										·	1			-	
	W W	г			ANA	LYSIS	%				-	DISTR	IBUTIO	Ň %	
PRODUCT	%	1	Cu	Pb	Zn	Fe	Ag	Fe/Fe	s	С	ù	Pb	Zn	Ag	
														, ,	· ·
Copper conc	2.0		2.90	6.98		27.7	73.6				8.7	13.9	0.8	42.0	
Lead conc	0.	11	0.55	65.68		6.8	56.1	r		1 1	0.5	36.8	0.3	9.0	
Lead cleaner tail	0.0		6.24	32.76	7.10	17.8		11.5		14	5.4	18.7	0.5	18.7	st i t
Copper-lead cl tail No.3		11	4.50		10.30	30.0		24.8		11	3.3	3.1	0.6	2.7	
11 11 11 11 No.2	14	11	4.69 3.17	7.98 4.92		26.9		21.7		11	3.7	4.2	0.6	3.9	
Copper-lead ro tail	94.9	11	0.11		9.20 8.78	24.1	10.20	1		11	3.5 4.9	ł	96.4	20.3	
Feed (calcd)	100.0		0.70	1.05	the second s		0.60					100.0	100.0	100.0	
	-	<u> </u>	0.70	1.00	0.05			1			0.0	100.0	100.0	100.0	
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REMARKS: *Copper-lead	conce	entra	te wa	s filte	ered, wa	shed or	nce wit	h fres	sh wate	r, re	pulp	ed and	boiled	for 5	
minutes. After boiling,															
							•								

Bright, leady colour in both lead rougher and cleaner - clear, barren froth at end in both cases.

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MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

TEST NO. 9 SAMPI	E: M	attug	;ami -	Sturge	eon Lak	e F-1					DA	TE: Feb	. 12, 1	.970
OBJECT OF TEST:											СН	ARGE:		
											TE	STED B	Y:	
	Time	%			Jnit				Reage	ents, Ib	per ton			
OPERATION	min		p⊢ Is	r 1	used	· ·								
														+1
														+
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·····														
								· ·						· ·
						-	1							
	W	T			ANA	LYSIS	%				DISTR	RIBUTIC	N %	
PRODUCT	%	14.	Cu	Pb	Zn	Fe	Ag	Fe/FeS	[Cu	Pb	Zn	Ag	Fe/FeS
				1									· · · · ·	+ 1
Copper conc	11		22.90		3.34	27.7	.73.65	7.2		92.2	1		79.9	59.6 · 13.2
Lead conc	19	.9		65.68	4.80	6.8	56.15	5.7		0.6	1	20.0	1	27.2
Lead cleaner tail		.2		32.76	7.10	17.8	114.27	11.5			100.0		100.0	100.0
Feed (calcd)* Lead rougher conc (calco				49.08	5.96	12.3	85.45	8.6		7.8		50.2	39.6	40.4
Lead rougher conc (caree	1 50	• -	5.42	47.00	3.70	12.0	101.10	0.0		,		50.2	0000	
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REMARKS: Shown above	_!!			1	·		······································		<u> </u>	·/				
			-			r coppe	r-read	separa	Lion.					
*Copper-lead	стеа	mer (Loncer	ILLALE.										i

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Sheet 1 of 2

TEST NO. 10 SAM	PLE: N	iattag	;ami -	Sturge	eon Lak	e F-l					1		ch 4, 19	
OBJECT OF TEST: Repe	eat of	Test	9 but	skimme	ed lead	roughe	r conc	longer	(in 4	incremen	its)CH	ARGE: 2	2x2000 g	
in an attempt to reduce	elead	conte	nt in	copper	conce	ntrate		-	•		TES	STED B	Y: A.S.	
	Time	%	1.	1	Jnit				Reag	ents, Ib	per ton			
OPERATION	1	Solic	s pH		used	ZnCN	AF242	CX51						
Grinding) as											• • •			. [
Copper-lead rougher (in												· ·		
Copper-lead cleaners Te	st 9										19 - A	- <u>.</u>		
Copper-lead separation	1	1		·										
Desorption*	1			· ·			•							
Conditioning	5	1.		250-9	g cell	0.33	0.01	0.0015			·.			
Lead rougher No. 1	1/2				<		1							
11 11 No. 2	1/2						1				·			
11 11 No. 3	3	1					0.01							
11 11 No. 4	13	·					0.01							
Cleaning of					•									
lead rougher conc No.1	1	1. 1		50 - g	cell					· · ·	·			1 N N
	l w	Τ			ANA	LYSIS	%			1	DISTR	BUTIO	N %	
PRODUCT	9	6	Cu	Pb	Zn	Fe	Ag	Fe/FeS		Cu	Pb	Zn	Ag	
Copper conc	· 1	.80 2	2.00	2.46	8.48	27.88	42.50	7.6		57.4	4.0	1.7	21.5	
Lead conc		.01	1.85	51.10	6.92	13.43	65.20	11.0		2.7	46.7	0.8	18.6	
Lead cleaner tail	11	.78	8.65	11.00		29.29	46.70	20.7		9.8	7.8	0.8	10.3	
Lead rougher conc No.	2 0	.50	8.37	19.07	8.52	25.05	:72.70	16.7		6.1	8.6	0.5	10.2	
11 11 11 No. 2	3 0.	.29	8.73	10.10	9.51	28.58	73.30	19.8	ł	3.7	2.6	0.3	-6.0	
ti ti ti No. d			.0.25		10.02	29.49	83.30	19.3		2.8	1.2	0.2	4.5	
Copper-lead cl tail No		.39	4.25		15.61	24.64	26.10	19.1		2.4	3.0	0.7	2.9	
ir ir ir No		.48	3.60		15.42	23.33	24.60	18.3		2.5	3.5	0.8	3.3	
II II II II NO	11	.69	1.76		16.78	23.03	10.80	19.5		1.8	2.2	1.3	2.1	
<u>Copper-lead ro tail</u>		.87	0.08		8.95		0.78	ļ	ļ	10.8	20.4	92.9	20.6	
Feed (calcd)	1200	.00	0.69	1.11	9.03		3.55		· · · · · · · · · · · · · · · · · · ·	100.0	100.0	100.0	100.0	•
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REMARKS: *See remark	rs Ter	st 9	Sheet	1.							(eds.)	ļ.		
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Sheet 2 of 2

TEST NO. 10 SAME	LE: Matta	a_ami -	Sturged	on Lake	F-1		·				DA	TE: Mar	ch 4, 1	970
OBJECT OF TEST:										•	CH.	ARGE:		
											TES	STED B	Y:	
	Time	%	. [1	Jnit				Reag	ents,	Ib p	per ton			
OPERATION .	min Sc			used										
						+								+
						· · ·								+
														+1
														++
														+
													_	
······································														
PRODUCT	WT	1		ANA	LYSIS	%			1		DISTR	BUTIO	N %	
	%	Cu	РЪ	Zn	Ag	Fe/FeS			Cu	· ·	Pb	Zn	Ag	Fe/FeS
Copper conc	39.4	22.00	2.46	8.48	42.50	7.6			69	.6	5.7	40.2	30.3	23.3
Lead conc	22.0		51.10	6.92	65.20	11.0			11	.3	65.6	18.3	26.0	18.8
Lead cleaner tail	17.1	8.65	11.00	8.69	46.70	20.7			11	. 9	11.0	17.9	14.5	27.5
Lead rougher conc No. 2	11.0	8.37	19.07	8.52	72.70	16.7			7	.4	12.2	11.3	14.5	14.3
11 11 11 No. 3	6.3	8.73	10.10		73.30	19.8			4	.4	3.7	7.2	8.4	9.7
17 11 11 No. 4		11		10.02	83.30	19.3			91	3.4	1.8	5.1	6.3	6.4
Feed (calcd)☆	100.0	12.46	17.13	8.31	55.19				100	0.0	100.0	100.0	100.0	100.0
Calculated assays													1]
Lead ro conc No. 1	39.1	41	1	ſ						5.2	76.6	36.2	40.5	46.3
" " No. 1+2	50.1	11			60.53	1	·		11	2.6	88.8	47.5	55.0	60.6
" " No. 1+2+3	56.4	LT	28.12	t	61.96	1			16	.0		54.7	63.4	70.3
" " No. 1+2+3+	4 60.6	6.25	26.66	8.19	63.44	16.3			30	.4	94.3	59.8	69.7	76.7
												-		
REMARKS: Shown abov	o is mot	alluraia	al hal	nco fo		r. 1 c c d								
*Copper-lea				ince to	r coppe	r-read	separat	10n.					•	1
"Copper-lea	u creanei	L concen	crace.											

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Sheet 1 of 2

er-lead-z wer the p % Solids 65 8. 6. 6. 6. 6. 6. 8. 8.	DH in co 1 1 1 2 7x14 6 1000 6 1000 0 1 2 2	njuncti Unit used	on with H ₂ SO ₄	s0 ₂ .	CX51	Reag	jents. It [a ₂ C0 ₃]		ton	ED B	2000 $\dot{\gamma}$: A.S	•
% p⊢ Solids p⊢ 65 8. 6. 6. 6. 7.	1 U 2 7x14 6 1000 6 0 2	Unit used RM	H ₂ SO ₄	S02	CX51				ton			•
65 8. 65 8. 6. 6.	1 U 2 7x14 6 1000 6 0 2	RM	1.6		CX51					DF250	<u>}</u>	·
65 8. 65 8. 6. 6. 6.	2 7x14 6 1000 6	RM	1.6		CX51	NaOH N	[a ₂ C0 ₃]	NaCN	AF242	DF250)	
6. 6. 6. 7.	.6 1000 .6 			4.		· ·						
6. 6. 7.	.6 1000 .6 			4.							1	1 .
6.	0			2.5	├──── <u>├</u>		1	· ·		1		+
7.	2								· · ·	1	· · · ·	1
7.	2			1	0.02		· · ·			1		1
7.	2		· · ·						.:	0.02	· • · · · · · · · · · · · · · · · · · ·	+
7.	2				0.01				•			1
	and the second s		· ·			0.85			······	1		1
	~	• •			+		2.0	0.10	· · ·			
1								t	0.02	1	1	1.
												1
									0.02			1
	·								•	1		· .
1		ANAL	YSIS	%			11	DIS	STRIB	UTION	v %	
Cu	РЪ	Zn	Fe	Ag	Fe/FeS		Cu	P	,	Zn	Ag	
			36.66	34.10	31.7		13.8	_	.3	0.3	14.9	
64 5. 45 58 0.64	8.16		40.80	6.27	4 0 .0		0.6		.5	0.1	1.0	
19 0.21	0.62		41.91	4.07	41.5		2.3		.1	1.5	7.8	•
02 0.31	S 1	1		33.20	12.3		0.5		. 1	1.1	9.1	- 1 - 2
79 3.84				50.10	14.0		4.7	1	(0.9	10.6	•
87 1.40	1 1	1	8.08	4.87	0.4	· ·	12.7	.3	.9	35.2	7.7	
30 1.72	í į	1	9.70	6.03	2.4		16.7				10.2	•
61 0.41	0.31	3.21		1.89			48.7	21	.8	26.7	38.7	<u> </u>
00 0.65	1.09	9.20		3.74			100.0	100	.0 1	00.0	100.0	
								-				
							N .		¥			
								1			Ì	
			•									
							<u> </u>	<u> </u>		<u>l</u>	<u> </u>	
ary froth	at eta	rt of 7	inc cor	ndition	ing				· · ·			
-LY LLUCH	at sta	IG UL 2.			·5 •			· · · .				
			· · · · · · · · · · · · · · · · · · ·			•						. · · ·
	79 3.84 37 1.40 30 1.72 51 0.41 00 0.65	79 3.84 14.49 37 1.40 0.72 30 1.72 0.66 51 0.41 0.31 00 0.65 1.09	79 3.84 14.49 10.15 37 1.40 0.72 55.24 30 1.72 0.66 49.93 51 0.41 0.31 3.21 00 0.65 1.09 9.20	79 3.84 14.49 10.15 18.58 87 1.40 0.72 55.24 8.08 80 1.72 0.66 49.93 9.70 51 0.41 0.31 3.21 50 0.65 1.09 9.20	79 3.84 14.49 10.15 18.58 50.10 87 1.40 0.72 55.24 8.08 4.87 80 1.72 0.66 49.93 9.70 6.03 51 0.41 0.31 3.21 1.89 00 0.65 1.09 9.20 3.74	79 3.84 14.49 10.15 18.58 50.10 14.0 37 1.40 0.72 55.24 8.08 4.87 0.4 30 1.72 0.66 49.93 9.70 6.03 2.4 51 0.41 0.31 3.21 1.89	79 3.84 14.49 10.15 18.58 50.10 14.0 87 1.40 0.72 55.24 8.08 4.87 0.4 80 1.72 0.66 49.93 9.70 6.03 2.4 61 0.41 0.31 3.21 1.89 1.89 00 0.65 1.09 9.20 3.74 3.74	79 3.84 14.49 10.15 18.58 50.10 14.0 4.7 87 1.40 0.72 55.24 8.08 4.87 0.4 12.7 80 1.72 0.66 49.93 9.70 6.03 2.4 16.7 61 0.41 0.31 3.21 1.89 48.7 100.0 00 0.65 1.09 9.20 3.74 100.0	79 3.84 14.49 10.15 18.58 50.10 14.0 4.7 10 87 1.40 0.72 55.24 8.08 4.87 0.4 12.7 3 80 1.72 0.66 49.93 9.70 6.03 2.4 16.7 3 61 0.41 0.31 3.21 1.89 48.7 21 00 0.65 1.09 9.20 3.74 100.0 100	79 3.84 14.49 10.15 18.58 50.10 14.0 4.7 10.5 87 1.40 0.72 55.24 8.08 4.87 0.4 12.7 3.9 80 1.72 0.66 49.93 9.70 6.03 2.4 16.7 3.8 61 0.41 0.31 3.21 1.89 48.7 21.8 00 0.65 1.09 9.20 3.74 100.0 100.0 14.0	79 3.84 14.49 10.15 18.58 50.10 14.0 4.7 10.5 0.9 37 1.40 0.72 55.24 8.08 4.87 0.4 12.7 3.9 35.2 30 1.72 0.66 49.93 9.70 6.03 2.4 16.7 3.8 34.2 51 0.41 0.31 3.21 1.89 100.0 100.0 100.0 00 0.65 1.09 9.20 3.74 100.0 100.0 100.0 100.0 1.00.0 1.00.0 1.00.0 1.00.0 1.00.0 1.00.0	79 3.84 14.49 10.15 18.58 50.10 14.0 4.7 10.5 0.9 10.6 87 1.40 0.72 55.24 8.08 4.87 0.4 12.7 3.9 35.2 7.7 80 1.72 0.66 49.93 9.70 6.03 2.4 16.7 3.8 34.2 10.2 61 0.41 0.31 3.21 1.89 48.7 21.8 26.7 38.7 00 0.65 1.09 9.20 3.74 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0

Sheet 2 of 2

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	SAMP	LE:	Matta	gami-	Sturg	geon Lake	F-1						<u> </u>		rch 5,	1970
GEJECT OF TEST:													CHAF	RGE:		
								<u> </u>		·····			TEST	ED B	Y:	
OPERATION		Time	%	pH		Unit				Reag	gents.	lb pe-	ton			
		min	Solid	s P'		used			CX51	DF250		NaCN	AF242	Lim	e CuSO4	NaAF
Conditioning		10		11.	7									4.0	I.0	· · · · · · · · · · · · · · · · · · ·
Zinc rougher, Stage	1	1/2						•	0.03	1				1		0.10
11	2	1/2													1	0.05
11	3	1/2							0.01							
	4	2														0.05
Copper cleaner No.		11/2		· .	25	50-g cell				0.002		· · · · · · · · · · · · · · · · · · ·				
" " No.		<u>2</u> ·				50-g cell			ļ	0.001						
Lead cleaner No. 1		1	<u> </u>			50-g cell						0.10	0.004			
" No. 2 Zinc cleaner		2		11.		0-g cell 0-g cell		·		0.01						
Zinc cleaner				- 11.	9 50	-g ceri				0.01				1.0		
														ļ		
			1						l				<u> </u>			
PRODUCT		W		<u> </u>		ANA	LYSIS	%				DI	STRIB	UTIO	N %	
		%	b	Cu	РЪ	Zn	Fe	Ag	Fe/Fe	S	Cu	1	?Ъ	Zn	Ag	
Calculated Assays																
Copper rougher cond	^	0	41	1.15	1.9	6 1.85	40.93	9.44	39.7		16.	-		1 0		
Copper rougher tail		90.		0.60	1.0		40.95	3.14	39.1		10.	1 10	5.9	1.9	23.7	
Lead rougher conc		11	11	1.85		9 9.95	15.85		38.8		5.	2 5	3.6	2.0	19.7	
Lead rougher tail	•	88.		0.57	0.3	6		2.38								
Zinc rougher conc		12.	17	1.57	0.6	9 52.49	8.92	5.47	1.4		29.	4 7	7.7	69.4	17.9	
-																
										· · ·						
REMARKS:		<u></u>	!!			1	<u> </u>	l	l	1	<u>_! </u>		<u> </u>		!	
NEWANNO:																•
										•						

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OBJECT OF TEST: To try copper-lead-zinc flotation directly on the ore using Z-200 as CHARGE: 2000 g. a copper promoter without any specific galena depressant. TESTED EY: A.S. OPERATION Time % PH Unit Reagents. Ib per ton OPERATION Time % PH Unit Reagents. Ib per ton Grinding 9.4 O.009 O.009 Grinding 9.4 O.009 O.009 Copper rougher 0.009 O.009 O.009 Stage 1 O.009 O.009 O.009	
a copper promoter without any specific galena depressant.TESTED EY: A.S.OPERATIONTime min% SolidspHUnit usedReagents. Ib per tonGrinding45657 x 14 RM2.50.50.10Conditioning9.40.0091Copper rougher1111	
OPERATION min Solids pH used Lime ZnSO4 NaCN Z-200 DF250 I Grinding 45 65 7 x 14 RM 2.5 0.5 0.10 I I Conditioning 9.4 0.009 I I I I	· · · · · · · · · · · · · · · · · · ·
min Solids used Lime ZnSO4 NaCN Z-200DF250 Grinding 45 65 7 x 14 RM 2.5 0.10	
Conditioning 9.4 0.009 Copper rougher 0.009 0.009	
Conditioning 9.4 0.009 Copper rougher Image: Copper conditional states of the state of the states of the states of the state of t	
Stage 1 0.009 0.02	·
WT ANALYSIS % DISTRIBUTION %	
PRODUCT % DISTRIBUTION %	
	1
	•
	• . * 1

REMARKS Z-200 did not work, it gave a dirty, depressed, effervescent, froth. Some CX51 was added in an attempt to float chalcopyrite but all of the sulphides floated, therefore test was terminated.

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TEST NO. 13 SAMP	LE: Ma	attagami	-Sturge	on Lake	F-2	ŗ					:	TE: Apr		1970
OBJECT OF TEST: Coppe	r-lead	selecti	ve flot	ation u	sing SO	in con	njuncti	on wit	h		CH	ARGE:	2000 g	
aeration of the pulp pr	ior to	copper	flotati	on.		2					TE	STED B	Y: A.S	·
	Time	0/	1	Unit				Rea	gents	ib rei	r ton			
OPERATION	min S	olids	-	used	SO2	CX51	DF250	Lime	NaCN	AF242		1		
Grinding	45	65	7 x	14 RM										1
Conditioning	20	5	.6 Aera	tor	4.0	0:02		······································			1			
Copper rougher No. 1	1		1000	-g cell			0.02							
	1					0.005								
" " No. 3	1					0.005					T			
Conditioning .	5	11	.0			1		4.0	0.10		1			
Lead rougher #1, Stage 1	2					0.01				0.01				
11 11 11 11 2	11/2					0.01								
Lead rougher #2,Stage 1	1/2					0.02			•					
" " 2	1/2					0.02								1
	1/2					0.02					1			
											1		•	
PRODUCT	WT			ANA	LYSIS	%				D	ISTR	IBUTIO	N %	
FR0D001	%	Cu	Pb	Zn	Fe	Ag	Fe/FeS	5	Cu	1	РЪ	Zn	Ag	
Copper rougher conc No.1	L 6.12	2 9.06	2.48	4.60	37.9	36.95	29.4	1	75.	0 1	1.9	3.0	57.2	,
No.2		5 2.64	7.97	4.66	37.9	14.38	35.1		10.		8.4	1.5	10.7	
" " " No.3		4 1.17	11.33	4.91	34.5	10.73	36.1		3.	,	9.0	1.1	5.8	
Lead rougher conc No. 1	1.15	5 0.10	18.12	10.52	27.4	10.93	26.1		0.	2 1	.6.3	1.3	3.2	
" " No. 2	0.82		12.06	10.87	27.9	10.32	26.4		0.		7.8	1.0	2.1	
Lead rougher tail	86.82			9.85	21.6	0.95			10.		6.6	92.1	21.0	
Feed (calcd)	100.00	0.74	1.28	9.29	23.5	3.95	ļ		100.	0 10	0.0	100.0	100.0	
Calculated Assays														
Copper rougher conc (com					1									
	1) 11.21		5.61	4.68	37.25	26.00	3.2	ł	88.	9 4	9.3	5.6	73.7	
Copper rougher tail	88.79	0.09	0.73			1.17								
Lead rougher conc (com-							•							
bined	1.97	0.15	15.60	10.66	27.61	10.68	26.4		0.	4 2	4.1	2.3	5.3	
										·				
			<u> </u>	<u> </u>				<u> </u>		<u> </u>				
REMARKS: Active cop	Der fle	hat but		donross	od pu	too hir	rh?							

Active copper float but galena depressed, pH too high?

TEST NO. 14 SAMPL	E: Mat	tagami-	Sturge	on Lake	F-1		•				_		il 15,	1970
OBJECT OF TEST: Repeat	of Tes	t 13 bu	t (1) (combined	coppe	r rough	er con	icentra	tes ar	nd '		RGE:	2000 g	
cleaned twice, (2) employe	d a low	<u>er pH i</u>	n lead	flotati	on, (3) float	ed a z	inc co	nc.		TES	TED B	Y: A.S	•
	fime 9	6		Unit				Rea	gents.	lb pe	r ton			
UPERALIUN	min So	″° pH lids∣	1	used	CX51	DF250	Lime	NaCN	AF242	CuS04	NaA	F	1	
Grinding ¿as in										<u> </u>				
Copper roughers) Test13											_			
Conditioning	5	9.	7 1000	D-g cell			3.0	0.10		1				
Lead rougher #1, Stage 1	12								0.01	· ·				
11 11 11 2	12					1.			0.01					·
Lead rougher #2	2				0.02									+
	10					· ·	2.0			2.0				1
Zinc rougher, Stage 1	2				0.02	0.02					0.1	0		-
¹¹ ¹¹ ¹¹ 2	3					1			· · · · ·		0.0	5		
Copper cleaners					-									
No. 1	11/2		250-	-g cell							•			
No. 2	1/2		11	11 11							ľ		1. J. J.	•
PRODUCT	WT			ANAL	YSIS	/SIS % D						BUTIO	N %	
	%	Cu	РЪ	Zn	Fe	Ag	Fe/FeS	5	Cu	1	Pb	Zn	Ag	
Copper conc	7.82	6.37	4.60	2.00	38.0	29.05	32.2		66.	5 3	1.7	1.7.	57.5	
Copper cleaner tail #2	3.72		4.42	3.52	39.1	12.56	36.4		12	· ·	4.5	1.5	11.8	
11 11 11 #1	3.56		3.69	5.47	36.6	6.22	35.2		4.		1.6	2.2	5.6	
Lead rougher conc #1	0.85			13.34	24.9	13.23	23.3		П о.		6.2	1.3	2.8	
₩ ₩ ₩ ₽ 2	0.78		13.12		22.0	13.40	20.3		o.	.3	9.0	1.1	2.6	
Zinc rougher conc	15.12			52.73	8.6	1.98	2.1		6.		7.5	88.6	7.6	
Zinc rougher tail	68.15		0.16	4	0.0	0.70			9	1	9.5	3.6	12.1	
Feed (calcd)	100.00		1.14			3.95			100			100.0	100.0	
Calculated Assays	1		<u> </u>				t			<u> </u>				
1st Stage Copper cleaner			•						· .			•		
conc	11 54	5.14	4 54	2.49	38.4	23.73	33.5		79.	3 4	6.2	3.2	69.3	
Copper rougher conc	15.10		4.34		37.9	19.60	33.9		83	1	7.8	5.4	74.9	•
Copper rougher tail	84.90	1	0.56	5.19	51.5	1.17	55.5					J•+	17.2	
Lead rougher conc (com-	04.90	0.10	. 0.00			1.1	·				·].			
Lead rougher conc (com- bined)	1 69	0.10	17.54	12 15	23.5	13.31	21.8		0.	1 0	5.2	2.4	5.4	
Lead rougher tail	83.27	0.18	0.23	13.13	23.3	0.93	21.0			.4 2		4.4	ي.4	
	!!				•		L		!!	1				
REMARKS: Lead float si	milar t	o Test	13 desp	oite red	uction	in pH.				• •	. •		· .	
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TEST NO. 15	SAMF	PLE:	Matt	agami-	Sturgeo	n Lake	F-1								cil 16,	1970
OBJECT OF TEST:	Сорт	per-le	ad-z	zinc se	lective	flotat	ion wit	th aera	tion o	f the r	oulp		CH	ARGE:	2000	
						and Min							TE	STED E	Y: A.S	•
		Time	1 9	6 .		Jnit				Rea	gents.	lb pe	r ton			
OPERATION		4	Sol	° pH lids		used	SO ₂	Min A	DF250	Na ₂ CO ₃	NaCN	AF24	2			
Grinding		45	65	5	7 x	14 RM						[
Conditioning		1		5.6	Aera		4.0	0:011								
Copper rougher			1		1000	-g cell		1								
Stage 1		1	1					1	0.02							
" 2		1						0.011								
······································		1	1					0.011								
Conditioning		5	7.	.3						4.0	0.10					
Lead rougher																
Stage 1		1										0.02				
" 2		2						·				0.02				
								1								
		1														
			/T	1		ANA	LYSIS	%			1	C	ISTR	IBUTIO	N %	
PRODUCT		- 11	%	Cu	Pb	Zn	Fe	Ag	Fe/Fe	S	C	u	РЪ	Zn	Ag	
Copper conc			.08	23.15	1.08	4.38	32.6	89.20	11.7		62	.5	1.9	1.0	45.8	
Copper cleaner tail	No.	11		7.87	1.33	7.52		33.60	29.3	1	33	.4	1.2	0.8	8.5	
ี้มี 11 11	Nc.	1 1	.60	4.36	1.91	9.84		22.39	26.8		9	.1	2.6	1.7	8.8	
Lead conc			.82	1	38.40	8.73		23.67	13.8		11		20.3	1.7	10.6	
Lead cleaner tail			24		9.28	11.01		16.11	24.1		53	1	10.1	2.5	4.9	
Zinc rougher conc		11	• 77		0.66	54.27	8.73		2.2		F1	.2	8.4	88.1	6.2	
Zinc rougher tail			.47		0.23	0.48		1			H		$\frac{15.5}{20}$	4.2	15.2	
Feed (calcd)		1100	.00	0.77	1.16	9.10	23.4	4.05			100	.0 1 1	00.0	100.0	100.0	
															1	
							l	ł	ł						1	
•							•									
REMARKS:						······										
	ec A	gave	a fi	ine-gra	ined. b	rittle	froth.									
		0				-										

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TEST NO. 15 SAM	PLE:	Mattag	gami-	Sturge	on Lake	F-1						DAT	E: Api	ril 16,	1970
OBJECT OF TEST:													RGE:		•
		· · · · · · · · · · · · · · · · · · ·							· · · ·			TES	TED BY	7:	
OPERATION	Time	%	на	l	Jnit				Rea	gents,	lb pe	r ton			
	min	Solids	рп	1	used			DF250		NaCN		Lim	e CuSO	CX51	NaAF
Conditioning	10	1	10.9									4.0	2.0		
Zinc rougher															
Stage 1	1				. <u>.</u>		•					•		0.02	0.10
" 2	1					<u>.</u>	-	0.02							
¹¹ 3	1					!				х.	. •	-			0.05
" 4	2													•	0.05
Copper cleaners	ļ					:									
No. 1	1			250	-g cell										
No. 2	1			11				0.004							
Lead cleaner	1			11			·			0.10					
												N		-	-
	. W	т			ANA	LYSIS	%				D	ISTRIE	JUTION	1 %	
PRODUCT	9	6 0	u	РЪ	Zn	Fe	Ag	Fe/FeS		Ci		РЬ	Zn	Ag	<u>.</u>
Calculated Assays															· ·
lst Stage Copper cleaner conc		10 18	10	1 16	5.41	24 1	70 01	17 6					1 0		· ·
Copper rougher conc		70 13			6.92	33.3	70.91 54.39			72.		3.1	1.8 3.5	63.1	•
Copper rougher tail			.15	1.15		55.5	1.57			02.	0	5.7	5.5	03.1	
Lead rougher conc			.18		12.62	28.2	20.61			4.	7 .	70.4	4.2	15.5	2.5
Lead rougher tail		11	.11	0.30			0.94				1				•
-														· .	• .
	·							1				· ·		· · .	
		.							•		•				· · .
•									•					· · · ·	
· · ·															
REMARKS:	Щ	<u> </u>								-11					
REMARKS:					4								•		*. -
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			.										·		
											•				

TEST NO. 16 SAMP	LE: 1	Motta	gami-	Sturged	n Lake	<u>F-1</u>								ril 16,	
OBJECT OF TEST: Repea	at of T	Test	15 bu	t used	Aerof1	oat 194	as cor	per pr	omoter			<u></u>		2000 g	
	lace_of							r r				TES	TED B	Y: A.S	
	Time	%			Jnit	1			Rea	gents.	Ib per	ton			
OPERATION	min	Solid	s pH	L	used	SO2	AF194	DF250	Na ₂ CO ₃	NaCN	AF242			1	
Grinding - as in Test15												1			1
Conditioning	20	<u></u>	5.0	5 Aera	tor	4.0	0.0085	3				<u> </u>			1
Copper rougher, Stage 1)-g_cell			0.02				1			
" " " " ?	1		1		للتعبيني		0.0085				· ·				
" " 3	1						0.0085								1
Conditioning	5		7.0	5					5.0	0.10		+			
Lead rougher, Stage 1	1										0.02				1
" " 2	1		+				1				0.01				1
" " 3	1										0.01	1			1
Copper cleaner	1				g cell			0.004							1
Lead cleaner No. 1	1			11	11 11					0.10					1
" No. 2	1			11	11 11			0.004							
	TW	r II			ANA	LYSIS	%			11	DI	STRI	BUTIO	N %	
PRODUCT	%	,	Cu	РЪ	Zn	Fe	Ag	Fe/FeS	5	Cu		РЪ	Zn	Ag	
Copper conc	1	.68 2	3.54	0.87	3.66	33.2	94.70	12.0		54.	3	1.2	0.7	40.3	
Copper cleaner tail		11	5.40		8.23	31.0		25.3	-	5		0.9	0.6	5.4	
Lead conc	11	11	1.23	37.27	ļ	21.4		19.3		3.		7.4	1.8	16.0	
Lead cleaner tail No. 2	0.	.54	5.81	10.75	8.56	28.1	28.07	22.0		4.	.3 4	4.6	0.5	3.8	
" " No.1			3.49		10.04	24.2	25.57	19.9		4.		5.2	1.0	6.1	
Lead rougher tail			0.22		9.60	23.7	1.19			28.		9.7	95.4	28.4	
Feed (calcd)	100.	.00	0.73	1.27	9.47	· · · · · · · · · · · · · · · · · · ·	3.94			100.	0 10	0.0	100.0	100.0	
Calculated Assays											_				
Copper rougher conc		.38 1			5.00	32.6	-	16.0	•-	-59.	5 3	2.1	1.3	45.7	
Copper rougher tail	97.	.62	0.30	1.27			2.19								·
1st stage lead cleaner conc	2	10	2.22	31.52	8.73	22 0	31.35	19.9		7.	6 6	2.0	2.3	19.8	
Lead rougher conc			2.22	25.17	9.09	23.2		19.9		12	•	8.2	3.3	25.9	
Dead rougher conc		• • •		22.27	2.02	20+2.		12.0					5.5	23.5	
												ĺ			
							<u> </u>	<u> </u>	1	<u> </u>		1			
REMARKS:						,									
				ar to t											

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$\begin{array}{c c c c c c c c c c c c c c c c c c c $		D	ATE: M	lay 26,	1970									
OBJECT OF TEST: Repe	at of	Test	15 Ъ	ut lime	e added	to both	coppe	r and			C	HARGE:	2000	g
1ead	clean	ers f	or p	<u>vrite d</u>	lepressi	on.					Τ.	ESTED E	3Y: A	.s.
OPERATION			n H	,	Unit				-	jents, Ib	per to	n		
	F TEST: Repeat of Test 15 bit lead cleaners for py RATION Time % min Solids pH as in gher/Test 15 ger aners 1 10.3 er 1 10.3 ers 1 10.9 aners 1 10.9 0DUCT WT	<u> </u>	used	DF250	NaCN	Lime	AF242				· ·			
Grinding as in	OF TEST: Repeat of Test 15 but lime lead cleaners for pyrite d min Solids ERATION Time min Solids pH d as in													
Copper rougher/Test 15										· ·		•		
Lead rougher)														
Copper cleaners		·												
No. 1	11/2		11.	4 250-	g cell	0.01		0.6			. :			
No. 2	1		10.	3 "	ft ft .									
Lead cleaners								· ·						
OBJECT OF TEST: Repeat of Test 15 but line added to both copper and Lead cleaners for pyrite depression. CHARGE: 2000 % TESTED BY: A.S. OPERATION Time % min Solids PH Unit used Reagents. Ib per ton														
OBJECT OF TEST: Nepeat of Test 15 but line added to both copper and lead cleaners for pyrite depression. CHARGE: 2000 g CHARGE: 2000 g TESTED BY: A.S. OPERATION Time % TESTED BY: A.S. CHARGE: 2000 g COPERATION TESTED BY: A.S. Copper cleaners. CHARGE: 2000 g Copper cleaners Copper cleaners Copper cleaners No. 1 10.3 Copper cleaners MUT ANALYSIS % DISTRIBUTION % Copper cone Copper cone <th "="" %="" 0.01="" 0.1="" 0.11="" 1="" 10.3="" 10.9="" 12="" 250-g="" <="" <th="" analysis="" cell="" colspan="2" iii.4="" no.="" product="" td="" wt=""><td></td><td>1</td><td></td><td>11</td><td></td><td></td><td>1</td><td>· ·</td></th>	<td></td> <td>1</td> <td></td> <td>11</td> <td></td> <td></td> <td>1</td> <td>· ·</td>			1		11			1	· ·				
		11						-		11				
OBJECT OF TEST. Repeat of Test 15 but line added to both copper and lead cleaners for pyrite depression. CHARGE: 2000 g TESTED BY: A.S. OPERATION Time % pH Unit used DF250 NaCN Line AP242 Image: Charge for pyrite depression. Crinding as in Solida pH Unit Reagents. berton Copper rougher/Test 15 Image: Charge for pyrite depression. DF250 NaCN Line AP242 Image: Charge for pyrite depression. Copper cleaners Image: Charge for pyrite depression. DF250 NaCN Line AP242 Image: Charge for pyrite depression. No. 1 19/2 11.4 250-g cell 0.01 0.6 Image: Charge for pyrite depression. Image: Charge for pyrite depression. No. 1 10.9 250-g cell 0.01 0.6 Image: Charge for pyrite depression. Image: Charge for pyrite depression. No. 1 10.9 250-g cell 0.10 0.3 Image: Charge for pyrite depression. Image: Charge for pyrite depression. Image: Charge for pyrite depression. No. 1 1 10.9 250-g cell 0	•													
Lead cleaner tail #2			1		1 1		•	24.7		11	1 .			
	11	11				(•	25.9		3.3	12.2	1.8	· .	
Lead rougher tail	11				8.91					10.2	15.0			
	100.	00 0).71	1.03	8.78					100.0	100.0	100.0		
Calculated Assays														
1st Stage copper cleaner														
conc	3.	94 15	5.04	1.71				-	1	1				
	11	11	1		6.26	33.6		22.1		85.3	7.6	3.5		
	95.	08 ().11	1.00										
lst stage lead cleaner								0.01 -		1	65 0	1 1 0		
conc Lead rougher conc	23:	97 8	3:82	32:24	8:79	23:2		24:7		4:5	97:4	3:7		
		<u> </u>				1					<u>.</u>			<u>.</u>
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TEST NO. 18 SAN	1PLE:	Matta	ami -	- Sturg	eon Lak	e F-2						DAT	E: N	íay 27,	1970
OBJECT OF TEST: Pr	elimin	ary tes	st on	new F-	2 samp1	e - to	float	copper	-lead a	and zir	IC	СНА	RGE:	2000	3
concentrates using	the c	ombina	tion [lime +	$ZnSO_4 +$	NaCN						TES	TED E	Y: A.	5.
OPERATION	Tim	e %		,] (Jnit				Rea	gents,	lb per	ton			
OPERATION	mir	n Solid	s pH		used	Lime	ZnS04	NaCN	CX51	DF250	CuSO ₄	NaAF	-		
Grinding	45	65	1	7 x	14 RM	1.5	0.5	0.1							1
Conditioning	10		10.1		-g cell		· ·		0.02						
Copper-lead ro, Stage 1	1/2									0.02	· · · ·				+
¹¹ ¹¹ ¹¹ ¹¹ 2	12						1		0.01				-		
<u> </u>	1								0.01						
11 11 11 11 <u>4</u>								· ·	0.01			·			
11 11 11 11 5			+				1		0.01			<u> </u>	-		
Conditioning	10		11.6	5		2.0	1	1			1.0	 			
Zinc rougher, Stage 1	12								0.02			0.05	1		
1 1 2	1,		1		····	· · ·	·]		0,01			0.05			-
11 11 3	1 1					-	1					0.05			1
11 11 11 <u>4</u>	11/2						+					0.05			
<u> </u>		NT		1		LYSIS	94	l		<u></u>				N 97	
PRODUCT		%	0		·			177 /77				······		·	
			Cu	Pb	Zn	Fe	Ag	Fe/Fe	5	Cu			Zn	- Ag	
Copper-lead conc		3.31 29	64	4.21	1.72	27.8	56.16	1.6		70.	2 2	1.0	0.7	51.5	
Copper-lead cl tail No		0.49 16		13.71	5.32		33.23	10.8		5.		0.1	0.3	4.5	
		0.60 8		14.50	7.16	27.0	26.24	19.0		3.		3.1	0.5	4.4	
		2.34		9.24	8.17		19.08	23.2		9.		2.5	2.3	12.4	
Zinc conc		7.32 0).40	0.25	58.22	6.7	2.03	-		2.	1 :	2.8	50.2	4.1	
Zinc.cleaner tail	.	6.00 0).57	0.42	48.68	10.9	3.01	9.1		2.	4	3.8	34.4	5.0	
Zinc rougher tail	7	9.94 ().11	0.14	1.24		0.82		N	6.	4 1	6.7	11.6	18.1	
Feed (calcd)	10	0.00	L.40	0.67	8.49		3.61			100.	0 10	0.0	100.0	100.0	
	1		1						·						
	1						<u> </u>	1	<u> </u>						
REMARKS: Copper-lead	l roug	he r - ł	right	. clea	n coppe	r froth	n at st	art bu	t pvrit	e appe	ared :	in fr	oth at	end of	-
		j	loat.		-				19	·					
Zinc rough	er - c	oarse s	ohale	erite f	loated	in Stag	ze 2.								

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TEST NO. 18 SAMP	LE:	Mati	agami	-Stur	geon La	ke F-2		•		•				ay 27, 1	1970
OBJECT OF TEST:					0	· · · · ·		. <u> </u>					ARGE:		
						•						TES	STED B	Y:	
OPERATION	Time	%	pН		Jnit .	· ·		· · · · · · · · · · · · · · · · · ·				erton			
OFERATION	min	Solids			used	Lime				DF250					
Copper-lead cleaners		1		·		:•		·							
No. 1	11/2	1		250-	g cell							:. ¹			
• No. 2	11/2			11	11 11					0.004					
No. 3	1			11	TT TT		-								
Zinc cleaner	2		11.9	500-	g cell	1.0							·		
		<u> </u>								<i></i>					_
	•	ļ		ļ	*******	_									
		ļ		<u> </u>	·										
		ļ		<u> </u>			_ <u></u>								
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		<u>.</u>			······										
	· · · · · ·	<u> </u>		 			<u>l.</u>								
PRODUCT	W				γ·	LYSIS	·····						IBUTIO		
	9	6 (Cu	РЪ	Zn	Fe	Ag	Fe/FeS	3	<u> </u>	<u>u</u>	Pb	Zn	Ag	
Coloristad Associa											•				
Calculated Assays											ŀ				
Copper-lead cleaner conc														56.0	
2nd Stage	3.			5.44		27.6		2.7		76		31.1	1.0 1.5	56.0 60.4	an e servicio
lst Stage Copper-lead rougher conc	4.		4	6.67 7.56	2.86		49.53	5.0		89		44.2 76.7	3.8	72.8	
Copper-lead rougher tail				0.17	4./1	20.1	1.06	11.44		10		23.3	J•.0	27.2	
Zinc rougher conc	13.			0.33	53.92	8.6	2.47	1.9			.5	6.6	84.6	9.1	
			·												
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REMARKS:	<u> </u>							+ <u></u>							
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TEST NO. 19 SAM	PLE:	Matta	agami-S	turgec	n Lake	F-2					·	DATI	E: May	y 27, 19	70
OBJECT OF TEST: To	float	coppe	er-lead	and z	inc con	centrat	tes usi	ng the	combi	nation		CHAI	RGE:	2000 g	;
$Na_2CO_2 + Na_2SO_2 + NaCN$	along	with	aerat	ion an	d Aerof	loat 20	08 and	242 as	coppe	r and	lead	TEST	red e	3Y: A.S.	
				1											
OPERATION	1)	ds pH	1		Na2CO	3Na2SO3	NaCN	AF208	AF242	DF250	Lime	e CuSO	04 CX51	NaAF
Grinding	45	65		7 x	14 RM	4.0	1.0	0.1							
Conditioning	20			Aera	itor		·		0.02						
Copper-lead rougher				1000	-g cell										
Stage 1	2		9.5							0.01	0.02				
Stage 2	1										0.01				
Stage 3	1								0.01	0.01					
Conditioning	10		11.3									4.0	1.0	0	
Zinc rougher	1														
OBJECT OF TEST: To float copper-lead and zinc concentrates using the combination Na2C03 + Na2S03 + NaCN along with aeration and Aerofloat 208 and 242 as copper and lead Dromoters.CHARGE: 2000 TESTED BY: A.SOPERATIONTime min SolidspHUnit usedReagents. ib per tonOPERATIONTime min SolidspHUnit usedReagents. ib per tonConditioning45657 x 14 RM4.01.00.1Conditioning20Aerator0.02ImeCuso4Stage 129.5Ime0.010.01ImeStage 31ImeIme4.01.00.01Conditioning1011.3ImeIme4.01.0				0.02	0.05										
Stage 2	1									·	0.01				
Stage 3	3					1					0.01				0.05
															1
	I w	/T ·			ANA	LYSIS	%			1	DI	STRIE	UTIO	N %	
PRODUCT.	9	%	Cu	Pb	Zn	Fe	Ag	Fe/Fe	S	Cu	P	b	Zn	Ag	
Copper-lead cl tail No. """"No. """"No. Zinc conc Zinc cleaner tail Zinc rougher tail	3 1 2 0 1 1 8 4 78	.03 .96 .25 .87 .02 .06	3.55 3.02 2.45 0.15 0.22 0.08	1.81 1.58 1.05 0.09 0.21 0.11	7.88 8.33 9.07 59.86 47.14 0.81	35.0 33.4 29.7 6.1 10.0	10.09 8.62 6.38 1.27 1.59 0.64	31.0 29.7 26.4		2 2 2 1 0 4	.6 .1 .2 .0 .6 .4 1	2.7 2.2 1.9 1.2 1.2 2.8	1.0 1.0 1.4 63.3 22.6 7.4	2.8 2.3 2.2 3.1 1.7 13.6	
											hout f	loat.		<u> </u>	

Sheet 2 of 2

	CHARGE: TESTED BY: CHARGE: TESTED BY: TION Time % min Soids pH Unit used Reagents. Ib per ton Light colspan="2">DF250 Lime 11/2 0.001	1970													
OBJECT OF TEST:	$\begin{array}{c c c c c c c c c c c c c c c c c c c $														
	·····												TED. B	Y:	
	Time	%		1	Jnit										<u> </u>
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				used					DF250	Lime				
Copper-lead cleaners	EST: ION Time $\%$ pH min Solids pH eaners 1 ¹ / ₂ 1 1 ¹ / ₂ 1 2 \sim 12 CT $\%$ Cu I ays eaner conc 6.84 18.31 8. 7.80 16.43 7. ugher conc 9.05 14.50 6. 90.95 0.09 0.			1											·
No. 1	EST: ION Time % pH min Solids pH eaners 11/2 p 11/2 1 11/2 1 11/2 1 11/2 1 2 \sim 12 2 \sim 12 0			250-											
No. 2	EST: ION Time % pH min Solids pH eaners 1 $\frac{1_2}{2}$ 1 $\frac{1_2}{2}$ 1 $\frac{1_2}{2}$ 1 $\frac{1_2}{2}$ 12 2 ~ 12 ICT WT Cu ays eaner conc 6.84 18.31 8 7.80 16.43 7 ugher conc 9.05 14.50 6 ugher tail 90.95 0.09 0									0.004					
No. 3	EST: ION Time % min Solids F eaners 1 ¹ / ₂ 1 1			tt	11 11										
Zinc cleaner	EST: ION Time % pt min Solids pt Leaners 1 $\frac{1_{2}}{1_{2}}$ 1 $\frac{1_{2}}{2}$ 2 $1^{\frac{1}{2}}$ 2 $1^{\frac{1}$			500-	g cell					0.01	1.0			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	$\begin{array}{c c c c c c c c c c c c c c c c c c c $														
	DF TEST: IRATION Time % pH Unit used ad cleaners 1 ^{1/2} 250-g cell 1 ^{1/2} 250-g cell 1 ^{1/2} 7" " " ner 2 1/2 500-g cell 1 ^{1/2} 7 1 1/2 7 1 1 1/2 7 1 1/2 7 1 1/2 7 1 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/2 7 1/				_										
	TOF TEST: CHARGE: TESTED_RATION Time min % Solids pH Unit used Reagents. Ib per tor DF250 Lime -lead cleaners 11/2 250-g cell 0.01 1 1 2 11/2 11/2 0.01 1 1 2 11/2 11/2 0.01 1 1 2 11/2 11/2 0.01 1 1 2 11/2 11/2 0.01 1.0 1 2 11/2 11/2 0.01 1.0 1 2 11/2 11/2 1 1 1.0 1 2 11/2 11/2 1 0.01 1.0 1 Leaner 2 1/2 500-g cell 1 0.01 1.0 1 2 12 500-g cell 1 0.01 1.0 1 1 2 1/4 12 100-g cell 1.0 1.0 1 1 1 2 1/4 1/4 1.0 1.0 1.0 1.0 1 1														
·	DF TEST: CHARGE: TESTED BY: IRATION Time min % Solids pH Unit used Respents. ib per ton Idz 250-g cell 0.01 1 Idz 250-g cell 0.01 1 Idz 0.01 1 1 Idz 0.01 1 1 Idz 0.01 0.01 1 Idz 0.01 1.0 1 Idz 0.07 1.0 1.0														
· · · · · · · · · · · · · · · · · · ·	CHARGE: TESTED.BY: TION CHARGE: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TESTED.BY: TE														
	CT OF TEST: CHARGE: TESTED CHARGE: TESTED.EX: OPERATION Time % TESTED.EX: OPERATION Time % TESTED.EX: OPERATION TESTED.EX: Image: Destination of the second colspan="2">DESTED Line Image: Destination of the second colspan="2">OPERATION Image: Destination of the second colspan="2">OPERATION CHARGE: Image: Destination of the second colspan="2">TESTED.EX: Image: Destination of the second colspan="2">Classical destination of the second colspan="2">TESTED.EX: Image: Destination of the second colspan="2">TESTED.EX: OPERDUCT WT AnALYSIS % DISTRIBUTION % <th c<="" td=""></th>														
	PF TEST:RATIONTime % min SolidsPFd cleaners1 $\frac{1}{2}$ 11 $\frac{1}{2}$ 11er2 \sim 1o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11o11 <td> </td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>· · ·</td> <td></td>			<u> </u>										· · ·	
PRODUCT	TEST: ATION Time % min Solids cleaners 11/2 11/2 1 11/2 1				ANA	LYSIS	%				DI	STRI	BUTIO	N %	
	TEST: TEST: TIME $\%$ pF Cleaners 1 ¹ / ₂ 1 ¹ / ₂ 1 ¹ / ₂ 1 ¹ / ₂ r 2 \sim 1 1 ¹ / ₂ r 2 \sim 1 1 ¹ / ₂ r 2 \sim 1 0 0 0 0 0 0 0 0 0 0 0 0 0				Zn	Fe	Ag	Fe/FeS		Cu	P	ъ	Zn	Ag	· · ·
Calculated Assays	CHARGE: TESTED BY: RATION Time % min Solids pH Unit used Reagents lb per ton CHARGE: TESTED BY: RATION Reagents lb per ton 11/2 0.001 Immediate the per ton 11/2 0.004 Immediate the per ton 11/2 0.004 Immediate the per ton Immediate the per ton Immediate the per ton ODUCT WT ASSAYS														
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lst Stage	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $														
Copper-lead rougher cond	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	х.													
Copper-lead rougher tail	$\begin{array}{c c c c c c c c c c c c c c c c c c c $														
Zinc rougher conc		$ \begin{array}{c c c c c c c c c c c c c c c c c c c $													
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REMARKS:	PRODUCT WT ANALYSIS % DISTRIBUTION % red Assays														
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TEST NO. 20 SAMPL	E: Matt	tagami ·	- Sturge	eon Lake	F- 2							ne 4, 19	
OBJECT OF TEST: Repeat	of Tes	st 18 wi	th dele	eading o	of copp	er-lead	conce	ntrate		СН	ARGE: 2	2 x 2000) g
							•			TE	STED B	Y: A.S.	•
	Time	% pl	,	Unit				Reag	ents, lb	per ton	·····		
OPERATION	min So	olids		used	Lime	ZnCN	AF242	DF250					1
Cuinding on in Tost 19													1
	10	10.	4*		0.5	-							
									•,				
			500	g cell									1
				11 11									
Copper-lead separation													1
	9								-				
Conditioning			250.	g cell		0.88			;				1
Lead rougher, stage 1	1			<u>Q</u>		1	0.01	· .					
11 11 11 2	1						0.005						
Lead cleaner No. 1	1		250-	g cell				0.004					1
11 11 No. 2	1		11	11 11			0.01						1
	I WT	1		ANA	LYSIS	%			1	DISTR	IBUTIO	N %	_1
PRODUCT	%	Cu.	Pb	Zn	Fe	Ag	Fe/Fe	d	Cu	РЪ	Zn	Ag	
	<u> </u>	1	1					<u></u>					
Copper conc		2 29.07	1.40			32.16			58.6	6.1		26.1	
Lead conc	CT OF TEST: Repeat of TestOPERATIONTime minng - as in Test 18ioning10-lead rougher - as in Test-lead cleaner No.11½'''' No.2-lead separationption - as in Testptioning5rougher, stage 1'''' 2½cleaner No.1''No.2'''' 2½cleaner No.1''No.2'''' 3'''' 10.2'''' 10.2'''' 10.2'''' 10.2'''' 10.2'''' 10.2'''' 10.2'''' 10.1'''' 10.1'''' 10.1'''' 10.1'''' 10.1'''' 10.1-lead cl tail No.2'' 10.00'''' '' No.1-lead rougher tai1'' 94.04calcd)'' 100.00)		218.03			0.7	15.2		11.9	
Lead cleaner tail No. 2		L 18.46		4.18		130.71			1.5	3.5		4.1	
		5 25.50	9.26			1			10.0	7.9 12.9	1	12.2 6.3	
			12.28	11.25 11.93		19.43			7.4	21.5		9.0	
				8.05	20.2	1.12			16.1	32.9		30.4	
Feed (calcd)						3.47			100.0		100.0	100.0	
										•			
	Ш		<u> </u>	<u> </u>		l		1		<u> </u>	l		
copper-lead separation.	*Ha d	intend	ed to u	se same	pH as	Test 18	(10.1) but p	H readir	ig at si	tart of	condit:	ioning
was only 9.6, therefore a	dded a	ddition	al lime	which r	esulte	d in an	incre	ase in	pH to 10).4.			

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TEST NO. 20 SAMP	LE: M	attaga	mi-S	turgeon	n Lake	F-2					D	ATE: J	une 4, .	1970
OBJECT OF TEST:										·····	. CI	HARGE:		
· · · · ·								•			Т	ESTED E	3Y:	
OPERATION	Time	%	Ha	1	Jnit		•		Reag	gents, l	b per to	<u>ר</u>		
	min	Solids	рп	1	used			· · [1	
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PRODUCT	ר א	1			ANA	LYSIS	%					RIBUTIC	DN %	
	%	C	u ·	Pb	Zn	Fe	Ag	Fe/FeS	3	Cu	Pb	Zn	Ag	Fe/FeS
Metallurgical Balance														
for Copper-Lead Separatic	, III													
· · · · · · · · · · · · · · · · · · ·					1	00.0	00.74						100	
Copper conc Lead conc	76. 5.			1.40 51.58	4.29 4.22	28.6 8.6	32.16			82.			48.0	64.5 .6.5
Lead cleaner tail No. 2				20.68	4.18		130.71	5.3	1	2.			7.8	5.2
" " No. 1	14.			9.26	4.19	27.8	76.76	1		14.			22.4	23.8
Feed.(calcd)*	1	00 26			4.27	27.2	51.42			100.	0 100.0	100.0	100.0	100.0
Calculated Assays														· ·
1st Stage Lead cl conc	R	20 9	87	40.09	1 20	13.6	185.55	4.4		3.	57.2	8.1	29.6	11.7
Lead rougher conc				20.16	4.20		115.23			17.			52.0	35.5
			•					•						
												-		
REMARKS: * Copper-lea	d olo			a trate	•			,			• • • •			
. Cobber-tes	ia cre	aner C	once	uctate		÷.								
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						ation	and wit	h dele	eading			СН	ARGE:	2 x 20	00 g
of a	copper	-1ea	d conc	entrate	2							TE	STED E	3Y: A.S	•
OPERATION	Time	%	5		Jnit				Rea	igents.	lb per	ton	•		
	min	Soli	ds ^p	·	used	Na ₂ CO	$_{3}Na_{2}SO_{3}$	NaCN	AF208	AF242	DF250		1	1	
Grinding	45	65		7 x	14 RPM	4.0	1.0	0.1	1						
Conditioning	10		9.	7 1000)-g cell		•		0.01	0.01	· · · · · ·	1			
Copper-lead rougher										·		1			
Stage 1	1										0.02				
" 2	1	1									0.01				
" 3 .	2				<u>_</u> _	1			0.01	0.01	•				
Copper-lead cleaners												1			
No. 1	oning 10 lead rougher 1 '2 1 '3 2 lead cleaners 1 1 1 ¹ / ₂ 2 1 ¹ / ₂ 3 1 ¹ / ₂ clead separation 1 n Test 20 VVT % % conc 3.41 onc 0.49 eaner tail No. 2 0.39 ""No. 1 0.81			500-	g cell						0.02	1			
No. 2	J Z -lead cleaners 1 1 1 ¹ / ₂ 2 1 ¹ / ₂ 3 1 ¹ / ₂ -lead separation 1 n Test 20 W				g cell						0.005	5			
No. 3	ECT OF TEST: Repeat of Test of copper-lead OPERATION Time % ding 45 65 itioning 10 er-lead rougher tage 1 1 " " 2 1 " " 3 2 er-lead rougher tage 1 1 " " 3 2 er-lead cleaners o. 1 1 ^{1/2} / ₂ 0 o. 2 1 ^{1/2} / ₂ 0 o. 3 1 ^{1/2} / ₂ 0 er-lead separation 1 1 in Test 20 WT % PRODUCT WT % er conc 3.41 0.49 cleaner tail No. 2 0.89 0.39 " " No. 1 0.43 0.43 " " No. 1 2.33 er-lead rougher tai1 91.25 (calcd) 100.00 100.00 100.00			11 11						0.01					
Copper-lead separation	BJECT OF TEST: Repeat of Test 19 bu of copper-lead conce OPERATION Time min % Solids pH inding 45 65				1		1								
as in Test 20															
PRODUCT	31	11			ANAL	YSIS	%			1	DI	STR	IBUTIO	N %	
FRODUCT	RECOLLCT				Zn	Fe	Ag	Fe/FeS	3	Cu	I	РЪ	Zn	Ag	
		11	07.00	1 (0	0.40		07.00		-						
	1½ separation t 20 DDUCT % 3.41 0.49				3.43	30.5 12.1	27.20	5.6		68		8.7	1.4	26.8 14.0	
					6.27	24.4	115.30					2.6	0.3	14.0	
	Image: Second separation Image: Separation Test 20 VT PRODUCT WT % % conc 3.41 nc 0.49 caner tail No. 2 0.39				3.55	28.7	56.22			13		8.7	0.3	13.1	
				4.21	7.51	33.5		27.0		11		2.9	0.4	2.3	
ii. II II No.					7.43	33.5		28.1				5.1	0.8	3.8	· ·
n n n No.			1.77	1.53	7.98	32.6	6.74	30.1		3	.0	5.7	2.2	4.5	
Copper-lead rougher tail	. 91	.25	0.09	0.13	8.60		0.86			5	.8 1	.9.7	94.3	22.5	
Feed (calcd)	100	.00	1.39	0.62	8.33		3.46			100	.0 10	0.0	100.0	100.0	
									· .						<u>,, ,, ,, , , , , , , , , , , , , , , ,</u>
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						1	<u> </u>		<u> </u>	<u> </u> ·			, <u></u> ,		
						separa	tely, r	ougher	conce	ntrate	s comb	ined	1		
for cleaning	and	сорр	er-lead	l separ	ation.										

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TEST NO. 21	SAMPL	E: 1	Mattag	ami-	Sturged	on Lake	F-2		,			DA	ΤE: Jι	ine 8, 1	1970
OBJECT OF TEST:			•									СН	ARGÉ:		
							•				•	TE	STED E	BY:	
	<u></u> г	ime	%	· .	τ.	Jnit				Reag	ents, Ib	per ton			
OPERATION		min	Solids	рН	1	sed		T						1	· ·
											·				
														·	
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PRODUCT		WT				ANA	LYSIS	%				DISTR	IBUTIO	N %	
•		%		<u>.</u>	Pb	Zn	Fe	Ag	Fe/FeS	3	Cu	Pb	Zn	Ag	Fe/FeS
Metallurgical Bala	nce										·		×		
for Copper-Lead Se															
Copper conc		66.8	83 27	.92	1.60	3.43	30.5	27.20	5 6		79.7	13.1	59.1	40.0	50 7
Lead conc		9.5		. 62	46.61	5.68	12.1	98.80			0.7	54.7	14.0	}	53.7 13.7
Lead cleaner tail H	No. 2	7.6		.42	20.10			115.30			3.4	19.0	12.4		16.0
11 11 11	No. 1	15.9		. 86	6.72	3.55	28.7	56.22			16.2	13.2	14.5	1	16.6
Feed (calcd)*		100.0	23 00	.42	8.13	3.88	28.0	45.43	7.0		100.0	100.0		100.0	100.0
Calculated Assays															<u> </u>
lst Stage Lead cl (conc	17.2	22 5	54	34 70	5 94	17 59	106.16	12 0		4.1	73.7	26.4	40.2	29.7
Lead rougher conc		33.1	L7 14	.35	21.29		22.93	82.15			20.3	86.9	40.9		46.3
					•					· .				00.0	
															r I
REMARKS:				·											

* Copper-lead cleaner concentrate.

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TEST NO. 22 SAN						eon Lak					·				ine 9,	
OBJECT OF TEST: . To										on th	e ore	using		ARGE:		g
the SO ₂ method with Z-2	200	as th	he co	pper	promot	er (add	led to g	grind).		······································			TE	STED E	<u>3Υ: Α.</u>	<u>s.</u>
OPERATION	T	ime	%	Hq	,	Jnit	T			Rea	agents,	lb pe	r ton		<u></u>	
OPERATION		min S	Solids	pri s		used	Z-200	so,	DF250	Lime	NaCN	AF24	2			
Grinding		+5	65			14 RM	0.018								•	
Conditioning	2	20		5.2			:	4.0								
Copper rougher					1000	-g cell	.									
Stage 1		1							0.02							
Stage 2	-	2				. <u> </u>	0.009)					-			
Conditioning		5	v	9.6	5			-		3.0	0.1					
11		5									1	0.0	2			
Lead rougher	-			1									-			
Stage 1	-	1/2		1			1					1				
Stage 2	1	1		1							1	0.0	1			
· · · · · · · · · · · · · · · · · · ·																_
,				1	1	···										
		WT	-	1			LYSIS	•/	<u></u>		<u>I</u>	· Γ	ISTE	RIBUTIC	N %	l
PRODUCT		%		Cu	Pb	Zn	Fe	Ag	Fe/Fe	c	C		РЪ-	Zn		1
															Ag	
Copper conc		3.7	11	7.24	1.07	3.64	1	33.15	5.6		72	I	6.4	1.6		
Copper cleaner tail No.				2.52		7.01	L	36.70	20.7		12	1	6.1	1.2	14.6	
NO.	1	•	11	2.29	1.20	5.53		16.21	33.3	1	II II	.4	5.2	1.8		
Lead conc Lead cleaner tail		0.6			39.07 15.19	7.55		30.56	15.9		11		42.6	0.6	5.9 4.6	
Zinc rougher conc		14.6	*	0.32		51.70	9.3	2.37	3.0		14		10.0	90.9	1	
Zinc rougher tail		76.1	- 11	0.12	0.14	0.35	5.5	0.86	1 5.0		11		16.7	3.3	1	
														1		+
Feed (calcd)		100.0		L.42	0.63	8.35	•	3.60			100	.0 1	00.0	100.0	100.0	
										1						1
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		}					1							1		
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		1	11		1	I	ł	1	1	1	11	•		1	L	1

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TEST NO. 22	SAMPL	_E:	Mattag	ami-S	turged	on Lake	F-2					· · · · · · ·	DAT	E: Jun	e 9, 19	70
OBJECT OF TEST:									• "				СНА	RGE:		
							•						TES	TED BY	<u>.</u>	
	- -	Time	%		1	Jnit				Rea	gents	, lb pe	er ton			
OPERATION			Solids	pН	}	used			DF250	Lime	NaCN	AF24	2 CuSO	+ CX51	NaAF	
Conditioning		10		11.5			·			3.0			2.0			
Zinc rougher	1				1							1	•		· ·	
Stage 1		1				· · · · · · · · · · · · · · · · · · ·								0.02		
" 2		1													0.10	
" 3		2					• •		0.02				11 - A	. 4	0.05	1 - 20
Copper cleaners																
No. 1		2		11.1	250-	g cell			0.005	0.6		1.14				
No. 2		1		10.2	11	ii ti										
Lead cleaner		1/2		11.5	11	11 11-				0.3	0.10	0.0	1		-	
· · · · · · · · · · · · · · · · · · ·	·				ļ		· · ·	<u> </u>								
·									ļ		· · ·	ļ				
					<u> </u>								· ` [· · ·	. L .	1	·
PRODUCT		W	11		• •		LYSIS	%				۵		BUTION	1 %	, · · ·
		%	6 C	u	Pb	Zn	Fe	Ag	Fe/Fe	\$	C	u	Pb	Zn	Ag	
Calculated Assays																
lst stage Copper cl	l conc	5.	20 23	.19	1.51	4.66	30.6	34.13	9.7		85	.0	12.5	2.8	49.3	
Copper rougher cond			95 15		1.40	4.90	32.4	27.93	+			1	17.7	4.6	61.7	
Lead rougher conc					28.59	8.33	20.5	30.62	18.7		Ó		55.6	1.2	10.5	
Lead rougher tailin	ng	90.	82 0	.15	0.19			1.10			9	.8	26.7		27.8	
							•				·					·
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		<u> </u>	<u> .</u>					l	<u> </u>				<u> </u>	· <u> </u>		
REMARKS: Lead cl	leaner	depr	essed	before	addi	tion of	AF 24	2 - thi	is ttar	robab	ly du	e to	high li	me alka	elinicv	•
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Sheet 1 of 2

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TEST NO. 23 SAMPL	E:	Matta	gami	- Stur	geon Lak	te F-2								ne 9, 1	970
OBJECT OF TEST: Copp							in Tes	st 22 b	out use	d Mine	rec	· •	ARGE:	<u>2000 </u>	
as copper promoter in p	Lace	of Z-	200 (similar	to Tes	st 17)								Y: A.S	•
OPERATION	Time	%	Hq		Jnit					genis.	· · · · · · · · · · · · · · · · · · ·			·····,······	
	min	Solic	s		used	SO2	Min A	DF250	Na ₂ CO ₃	NaCN	AF24:	2			
Grinding	45	65			14 RM	4.0					[
Conditioning	20		5.	3 Aera	ator		0.018								
Copper rougher				1000) <u>-g_cell</u>										
Stage 1	1/2							0.02							
	1						0.009								
" 3	1/2						0.009								_
	1					· · ·	0.009								
Conditioning	5		8.	7					5,0	0.10					
Lead rougher		ļ													-
Stage 1	1										0.0	1			
2	1										0.0	1			_
			<u> </u>			·									
PRODUCT	WT ANALYSIS %									1	Ľ	DISTR	IBUTIO	N %	
FRODUCT	%	ó	Cu	РЪ	Zn	Fe	Ag	Fe/FeS		Cu		РЪ	Zn	Ag	
Copper conc	1	110	4 21	1 (0	2 21	21 (26.05	0.0					1	40.7	
Copper cleaner tail No. 2		.41 2 .07		1.69 3.46	3.31 7.08		36.25	9.9		11	.0	12.0 5.9	1.7	43.7 9.1	
No. 1		.70		2.77	9.97		25.18	23.1		f 1	.6	7.6	2.0	9.1 11.7	
Lead conc			0.20	25.05	6.42		20.95	25.9				39.5	0.7	5.6	
Lead cleaner tail No. 2			1.10	9.61	7.26		14.01	29.6			.2	4.8	0.3	1.2	
" " No. 1	11	11	0.88	4.76	6.52		11.78	32.1		0	.6	7.0	0.7	3.0	
Zinc rougher conc	11		0.33	0.26	53.24	9.5	1.97	3.0		3	.4	6.0	89.9	7.8	
Zinc rougher tail	76	.14	0.12	0.14	0.43		0.86			6	.6]	17.2	3.8	17.9	
Feed (calcd)	100	.00	1.41	0.62	8.57		3.66			100	.0 10	0.0	100.0	100.0	
					1		<u> </u>								
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	11	1					1 ·	1	4				1	1	

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TEST NO. 23 SAMP	LE:)	Mattag	ami -	Sturg	eon Lak	e F-2						DATE	: June	9,19	70
OBJECT OF TEST:											•	CHAF	RGE: 2	.000 g	
												TEST	ED BY	: A.S.	
OPERATION	Time	%	рН	· (Jnit				Reag	gents,	lb pèr	ton			
OFERATION	min	Solids	рп	1	used		·	DF250		NaCN	AF242	Lime	CuSO ₄	CX51	NaAF
Conditioning	10		11.3			· .	1					6.0	2.0		
Zinc rougher												1.			
Stage 1	1													0.02	0.10
¹¹ 2	1 .													0.01	0.05
" 3	2					đi.		0.02							0.05
Copper cleaners					•		1								
No. 1	11/2		11.4		g cell			0.01		•		0.6			
No. 2	1		10.3	11	11 11		•	•							
Lead cleaners									•]		
No. 1	1		10.9	250-	g cell					0.10		0.3	<u> </u>		
No. 2	3/4		9.6	11	88 88						0.005				
	W	<u>т </u>			ANA	LYSIS	%			1.	DI	STRIB	UTION	%	
PRODUCT	9/	6 (Cu	Pb	Zn	Fe	Ag	Fe/FeS		Cu	E	ъ.	Zn	Ag	
Calculated Assays											. ~.		` .		
lst stage Copper cl cond				2.03	4.05	32.2	35.25	13.0				.9	2.6	52.8	
Copper rougher conc	7.			2.21	5.45		32.86	15.5				.5	4.6	64.5	
lst stage Lead cl conc	1.			21.34	6.62		19.28	26.7				.3	1.0	6.8	
Lead rougher conc Lead rougher tail	2.1			14.44 0.16	6.58	30.3	11.25	29.0	. 5			.3	1.7	9.8	· ·
Lead Iougher Call	190.0			0.10			1.04				.0 2.			2.5.7	
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REMARKS:										• . •	•			. •	1
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TEST NO. 24 SAM	PLE: M	attag	ami-St	urgeo	n Lake F.	-2								g. 13,	
OBJECT OF TEST: To f	loat o	ff a	low-le	ad co	pper cond	c dire	ctly fr	om the	e ore b	у				2000-g	
utilizing the selectiv	ve prop	ertie	s of Z	-200.									STED B	Y: A.S	•
	Time	%	рН		Unit				Rea	.gents,	lb p	er ton			
OPERATION	min	Solid	spn		used	Lime	ZnS0,	NaCN	Z-200	DF250					
Grinding	45	65			4 RM	1.5	0.5	0.1							
Conditioning	5		9.7	100	0-g cell				0.008				•		<u> </u>
Copper rougher								 		· · ·					ļ
Stage 1	1/24									0.01					
Stage 2	2								0.012						
Copper cleaner .	11/2		1	250	-g cell					0.002					
						1	-								
	1					1									
						1									
	1	WT ANALYSIS %												NI 92	_ <u>_</u>
PRODUCT	PRODUCT WT						· · · · · · · · · · · · · · · · · · ·	1						,	
		°	Cu	Pb	Zn	Fe	Ag	Fe/FeS	;	Cu		Pb	Zn	Ag	
				o 01		<u> </u>	15 01				2	1 5		15.5	
Copper conc		.28 3		0.81	1.50		45.31	2.4		17	.3	1.5 3.5	0.2	9.3	•
Copper cleaner tail		.97 1		2.49	5.80	25.0	35.76	9.0			.6	95.0		75.2	
Copper rougher tail		.75		0.67	8.47		3.73	 		100			100.0		
Feed (calcd)	1100	.00		0.69	3.36		41.20	5.5		11	.4	5.0		24.8	
Copper rougher conc (calco		2	5.01	1.54	00.0		41.20	1.5		40	•4	5.0	0.9	24.0	
(calco															
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REMARKS:															

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					geon Lak				•					ust 14,	
OBJECT OF TEST: As also replaced lime + Z	in Tes nSO/+	t 24 b NaC	ut em N wit	ploy 1 Na	ed AF 2: $CO_{2} + N$	38 as t 12.50	the sel + NaC	lective N	coppe	r pro	moter	CHA	RGE:	2000	
		%				$\frac{\alpha_2 \cos 3}{1}$			Raa	aents	, lb per				
OPERATION	Time min	% Solids	pН		Unit used	Na,CC	Na SO	NACN	DF250	-	-			<u> </u>	T
Grinding	45	65		7 x	14 RM	4.0	1.0	0.1			1 .	1			
Çonditioning	5		9:9					0.1	0.2		+				
Copper rougher								1				· · ·			
Stage 1	1					1		· ·				1.2			
¹¹ 2	2	•								0.0	2				
Conditioning	<u>2</u> 5				· · · ·			0.1			0.04				
								<u> </u>							
				<u> </u>		· · · ·				· · · · · · · · · · · · · · · · · · ·					
				<u> </u>			· · · ·	<u> </u>							
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	·			<u> </u>	•	<u> </u>	<u> </u>	<u> </u>	<u> </u>						
PRODUCT	· WT		i		ANAL	.YSIS	%				<u>, D</u>	ISTRI	BUTIO	N %	<u></u>
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REMARYS Bright heavily-mineralized froth after grinding, therefore ided additional cyanide to copper conditioning. Pyrite in evidence during lead conditioning - test term and at this point because action selectivity and test products discarded.

TEST NO. 26	SAMF	LE: N	Aattaga	ami-	Sturge	eon Lal	ce F-2					DA	TE: Au	gust 14	1, 1970
OBJECT OF TES	T: Rep	eat of	Test	25 to	confi	rm res	ults						ARGE:		
	- /												STED B	Y: A.S	5.
OPERATIO	N	Time		pН		Jnit			F	Reag	ents, Ib	per lon		· ·····	
		min	Solids	, 	l	used									
Grinding	<u>) as in</u>			.											
) <u>Test</u>	 	, 	·											
Copper roughe	r) 25	ļ !				·									
					<u> </u>										
1								<u> </u>							
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PRODUC		W	т			ANA	LYSIS	%			1 .	DISTR	IBUTIO	N %	
PRODUC	1	%	6												
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REMARKS: Rea	sults sin	nilar	to Tes	t 25	- test	produc	cts dis	carded							
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					n Lake				•					3.18, 1	.970
							copper			d float	ed	f		2000-g	<u>`</u>
for a longer period	- also	floa	ted o	ff a co	opper-1	ead co	nc with	AF 24	·····		·		STED B	Y: A.S	
OPERATION	Time	%	ρH	-	Jnit			· · · · · · · · · · · · · · · · · · ·	Rea	gents.	lb per	ton			
	min	Sölids	5	L	used	Lime	ZnSO,	NaCN_	Z-200	DF250	A <u>F24</u> 2				
Grinding	45	65		7x14	RM	1.5	0.5	0.1	0.012	· ·					
Conditioning	5		10.2	1000	-g cell				0.008			1 1			1
Copper roughers												· ·			1
No. 1, stage 1	1						-			0.004	- · · · ·				1.
11 2	1						-	1	0.012			1			1
No. 2	1		1					1	0.012	· · · · · · · · · · · · · · · · · · ·	·····				+
No. 3	1	1	1					1	0.012			1		-1	1
Conditioning	5		9.5								0.02				1
Copper-lead ro, stage 1	1 Jo														1
11 11 11 11 2	1		1		· ·				· · · · · · · · · · · · · · · · · · ·		0.02	[1.
Copper-lead cleaner No.1	1		1	250-9	g cell					0.004					1
$\frac{11}{11} \frac{11}{11} \frac{11}{11} \frac{11}{11} \frac{10.2}{10.2}$			· ·	11	11					0.004					1.
	W.	т <u> </u>	<u></u>			LYSIS	0/	L				STD		N %	<u> </u>
PRODUCT	%	. 11	Cu	РЪ	Zn	Fe		Fe/Fe	el	Cu		· · ·	Zn	*****	
	_			FD		re	Ag	rerre				u I		Ag	
Copper rougher conc No.	1 2.	35 20	5.16	1.19	3.27	28.5	49.05	5.1		42.	.3	4.4	0.9	31.9	
n n No.		95 19		1.47		27.0	37.28	9.4	1	12		2.2	0.7	9.8	
tt tt VNO.			1.97	1.46			24.16	12.4		10		3.0	1.3	8.5	
Copper-lead conc.	1.		3.04	21.65		22.9	63.25	10.7		11.	8 4	5.2	0.9	23.1	
Copper-lead cl tail No.	11	47 1:			7.28	28.0	19.09	16.4		4.		7.8	0.4	2.5	
II II II NO.	11	11	1.49		10.27	25.4	11.49	14.1		5		8.1	0.9	2.4	
Copper-lead rougher tail	·· H · · ·	11	0.20	0.20			0.85			12		9.3	94.9	21.8	
Feed (calcd)	100.		1.45	0.63	8.55		3.62			100.		0.0	100.0	100.0	· · ·
Combined copper rougher						·	+								
conc (calcd)	4.	58 20	0.77	1.33	5.31		39.65	8.1		65	4	9.6	2.9	50.2	
-						. ,						· ·			
	· .										1.				
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	11												· ·		
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	e se %	lectiv	e copp	pper con er promo				conc as	s in			ARGE:	<u>. 18, 1</u> 2000-g	••••••
Time min	%			er promo	stor in	-								
min					JCEL II	n place	of Z-2	200			TE	STED B	Y: A.S.	
	Soli		1	Unit				Rea	igents.	lb pe	r ton			
45		ds		ușed	Lime	ZnSO4	NaCN	AF238	DF250	AF242				
	65		7x14	RM	1.5	0.5	0.1	0.015						1
5	L	10.	3 1000	-g cell		-		0.02	0.02					
	 			·										
1														
1								0.02						
2								0.02						1
5										0.02				
														1
1/2														1
										0.02				
1			250-	g cell					0.004		1			
1			- 11	11										1
W	г∥			ANAI	YSIS	%			1	D	STR	IBUTIO	N %	· ·
%		Cu	Рb	Zn	Fe	Ag	Fe/Fe8	3	Cu	P	Ъ	Zn	Ag	
, 11 ,	= -	01 11	2 50	1.01	26.4		7 /				- 0	0 7		
				1 i										
2 0.	49 🛛 🗄			t 1		22.38	16.0							
1 0.	66	5.36	6.80	9.63	25.4	14.13	19.6		2.	.6	6.5	0.7	2.4	
					24.9	1.57			38.	5 2	9.8	95.9	38.4	
100.	00	1.37	0.69	8.70	24.8	3.84			100.	0 10	0.0	100.0	100.0	
														· .
4.	15 1	16.90	3.67	5.60	24.8	39.46	9.3		51.	1 2	2.0	2.6	43.7	
													1	
]]													
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MINES BRANCH FLOTATION TEST REPORT Sheet 1 of 2

				Sturgeo									<u>3.19,</u>	
						ing cya		ith ZnS	50_4 adde	ed to	[2 x 200	
reduce pH to ~9.5	5 (copp	per-1	ead fl	otatio	n as ir	1 Test 2	21)					STED E	Y: A.S	•
OPERATION	Time	%	Hq		Jnit				Reag	ents, Ib	per ton		•	
	min	Soli	ds		used	NaCN	ZnSO4	AF242						
rinding					<u> </u>		1					· ·		
	as in	1								•			· ·	
	Test				· · ·						· .			
opper-lead cleaners											•			
opper-lead separation						1		ľ				·		
Desorption(as in Test)													
Conditioning	10		*	250-	g cell	0.8	0.66		-	·				
Lead rougher, stage 1	1/2													
<u>11 11 11 2</u>	1							0.005						
Lead cleaners			•											
No. 1	1			250-	g cell			0.005				<u> </u>		
No. 2														
PRODUCT	W	Т			ANA	LYSIS	%				DISTR	IBUTIO	N %	
	%	6 T	Cu	Pb	Zn	Fe	Ag	Fe/FeS	S	Cu	РЪ	Zn	Ag	
opper conc	3	.63	26.60	1 10	4.04	30.0	16.34	1		71.0	5.9	. 1.7	15.7	
ead conc		.89	3.97	39.37		16.4	180.10	1	•	2.6	51.4	0.8	(· · ·	• • •
ead cleaner tail No. 2	11	11	12.45			26.2	70.68	1		2.9	1 .	0.3	1	
11 11	11	.54	22.67		4.39	28.6	35.14	1		9.0	4.7	0.3	5.0	1.5 F 1
ombined Cu-Pb cl tail	2.	.70	3.89	2.76	8.65	32.7	11.72	28.3		7.7	10.9	2.6	8.4	• • • •
opper-lead rougher tail		.92	0.10		9.07		0.93			6.8		94.3	22.5	
eed (calcd)	100.	.00	1.36	0.68	8.83		3.78	1		100.0	100.0	100.0	.100.0	
														•
: .			•				•	·.		· .				
		· .									10			
· .		· ·												·
				•							1. 4. 1		1.00	
	1						• .	:		· · · ·		1 · ·		
· · · · · · · · · · · · · · · · · · ·														
				· .				· ·		<u> </u>	<u> </u>	<u> </u>	<u> </u>	,
REMARKS: Two 2000-g														

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NINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

TEST NO. 29 , SAMPL	E: Ma	ttagami-	Sturged	on Lake	e F-2					. DA	TE: Au	ģ.19,	1970
OBJECT OF TEST:										СН	ARGE:		
· · · · · · · · · · · · · · · · · · ·										TE	STED E	3Y:	
OPERATION	Time	%		Unit				Reag	ents, lb	per ton			
OPERATION	min S	iolids pl		used							<u> </u>	1	1
				•••••••••••••••••••••••••••••••••••••••		-							
				· · · · · · · · · · · · · · ·									
· · · · · · · · · · · · · · · · · · ·													
		·											
· · · · · · · · · · · · · · · · · · ·													
	I WT			Δ N1	ALYSIS	0/	L		l		IBUTIO	<u> </u>	
PRODUCT	%		1	1		·····		F	ll		r	r	
		Cu	Pb	Zn	Fe	Ag	<u>Fe/FeS</u>	 	Cu	РЪ	Zn	Ag	Fe/FeS
Metallurgical Balance								1	, ,				
for Copper-Lead Separati	dn											1	
Copper conc	67	5 26.60	1 10	4.04	30.0	16.34	6.2		83.1	8.5	55 6	22.7	53.3
Lead.conc	16.		39.37		16.4	180.10	12.0		.3.0		27.1		25.4
Lead cleaner tail No. 2		9 12.45			26.2	70.68	14.4		3.4		8.3		10.8
11 11 II No. 1		0 22.67			28.6	35.14	8.2		10.5			r	10.5
Feed (calcd)*	100.		8.74	4.80	27.4	48.61	7.8			100.0		100.0	100.0
Calculated Assays	1										 		
1st stage lead cl conc	22.		32.87			151.41			6.4		35.4	70.1	36.2
Lead rougher conc	32.	5 11.26	24.60	6.69		115.63	11.3		16.9	91.5	44.4	77.3	46.7
										•			
			ł										
: 	<u>} </u>				<u> </u>								
REMARKS: *copper-lea	d clea	ner conc	entrate										
								•					

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Sheet 1 of 2

E: Mat	ttaga	mi-St	urgeor	ı Lake	F-2	•					.DA	TE: Se	pt. 16,	, 1970
loat a	low-	lead	copper	conc	with Z-	200 fo	llowed	by cor	per-		CH/	ARGE:	2 x 200)0 g
								- J - L	.	_				
Time	%		1 1	Jnit				Rea	agents,	lb per	ton			
min S	Solids	рн		used '	Lime	ZnS04	NaCN	Z-200	DF250	AF242	AF20	8		1
45	65		7 x 1	4 RM	1.25	0.5	0.1	0.015					·	
5		9.2	1000-	g cell		1		0.005			+			
			11	11 11										1.
· 1						•			0.004		20 1	· ·	• • •	
1								0.005	ľ		1	.		
1	•							0.005			. ·	•	•	
1						-	-	0.005				,	**	
5		8.9								0.02	0.0)2		
											N			
_1	·													•
1				•						0.02	···	<u> </u>	· ·	
				•••					· .					<u> </u>
WT	WT ANALYSIS %									D	STR	IBUTIO	N %	
%	C	u	РЪ	Zn	Fe	Ag	Fe / Fe	S ·	Cu	1	Pb	Zn	Ag	
2.30	9 30	.62	1,52	1,58	28.4	44,31	1.3		53.	6	5.3	0.4	28.8	1
11					1				11			0.4	8.9	· · .
	11		3.64	7.60	25.1	27.84	13.4		14.	.1	8.4	1.4	11.9	
0.48	8 27	.69	0.83	3.66	28.2	111.00	3.4		9.		1	0.2	14.5	1 .
11	- 11		9.93	8.11	29.8		1		11	-				•
11	11				1				11				1	
	10				1		1				· • [1	
					27.2		1						(
	and the second se	and the second se						<u> </u>						·
μυο.ο(<u>u 1</u>	.36	0.68	8.56		3.68	·		1100.	0 10	0:0	T00.0	100.0	
1 2 2	7 30	12	1 40	1 03	28 /	55 46		· .	62	3	5.9	06	43 3	
2.0	/ 50		1.40	1.95	20.4	55.40			05.			0.0	-3.5	·
									· · ·			1 g.d. 1		
		•			1									
atches	oron	nd an	$\frac{1}{d}$ floa	ated se	paratel	v - roi	icher i	('ncent	TATAS	c mbi	ried f	or cle	aning	and
					• •						•			
	loat a n_and Time min \$ 45 5 1 1 1 1 5 1 1 1 5 1 1 1 1 1 1 1 1	loat a low- n_and separ Time % min Solids 45 65 5 1 1 1 1 5 1 1 5 2.39 30 0.70 21 1.57 12 0.48 27 0.16 8 1.31 0 0.47 1 0.48 1 92.07 0 100.00 1 2.87 30 atches groused a separation.	loat a low-lead n and separation Time % pH 45 65 9.2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	loat a low-lead coppet n and separation using Time % pH U 45 65 7 x 1 5 9.2 1000- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1.57 12.28 <td>Or and separation using the d Time % pH Unit Min Solids PH Used 45 65 7 x 14 RM 5 9.2 1000-g cell 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</td> <td>Note: Second with Z-in and separation using the dichroma Time % pH Unit Lime 45 65 7 x 14 RM 1.25 5 9.2 1000-g cell 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2.39 30.62</td> <td>n and separation using the dichromate meth Time % pH Unit 45 65 7 x 14 RM 1.25 0.5 5 9.2 1000-g cell </td> <td>loat a low-lead copper conc with Z-200 followed n and separation using the dichromate method. Time $\frac{\%}{N}$ PH Unit used Lime ZnSO4 NaCN 45 65 7 x 14 RM 1.25 0.5 0.1 5 9.2 L000-g cell</td> <td>loat a low-lead copper conc with Z-200 followed by cop n and separation using the dichromate method. Time % pH Unit used Rec Time % pH Unit used Ime ZnS04 NaCN Z-200 45 65 7 x 14 RM 1.25 0.5 0.1 0.015 5 9.2 1000-g cell 0.005 0.005 1 0 0.005 0.0055 0.0055 1 0 0.005 0.0055 0.0055 1 0 0 0.005 0.0055 1 0 0 0.005 0.0055 1 0 0 0.005 0.0055 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 2.39 30.62 1.52</td> <td>Note a low-lead copper conc with Z-200 followed by copper- n and separation using the dichromate method. Time % pH Unit Reagents. Time % pH Unit Image 2000 pressore 45 65 7 x 14 RM 1.25 0.5 0.1 0.015 5 9.2 1000-g cell 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005</td> <td>Observe on and separation using the dichromate method. Time % PH Unit used Reagents, 1b per min \$Solids Time % PH Unit used Reagents, 1b per min \$Solids 5 65 7 x 14 RM 1.25 0.5 0.1 0.005 0.005 5 9.2 1000-g cell 0.005 0.005 0.005 0.005 1 0.0005 0.005 0.005 0.005 0.002 1 0.0005 0.005 0.002 0.002 1 0.005 0.005 0.002 1 0.005 0.002 0.002 1 0.005 0.002 0.002 1 0.002 0.002 0.002 1 0.002 0.002 0.002 1 0.002 0.002 0.002 1 0.002 0.003 0.002 2.39 30.62 1.52 1.58 28.4 44.31 1.3 53.6 0.70 21.88 4.05 4.32</td> <td>WT Analysis PH Unit Reagents, lb per ton Lime Reagents, lb per ton 0.005 Reagents, lb per ton 0.005 1 0 0 0.005 0 0 0.005 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Order to an and separation using the dichromate method. CHARGE: TESTED E Time % pH Unit Reagents, ib per ton Time % pH Unit Reagents, ib per ton Time % pH Unit Reagents, ib per ton Time % PL 200 DF250 AF242 AF208 45 65 9.2 1000-g cell 0.0005 I 0.0005 1 0.0005 I 0.0005 I One for 0.005 I 0.002 O.02 I I O.002 I O.002</td> <td>CHARGE: 2 x 200 CHARGE: 2 x 200 Time % PH CHARGE: 2 x 200 TIME % Reagents. Ib per ton Solids PH Classing for the second of the sec</td>	Or and separation using the d Time % pH Unit Min Solids PH Used 45 65 7 x 14 RM 5 9.2 1000-g cell 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Note: Second with Z-in and separation using the dichroma Time % pH Unit Lime 45 65 7 x 14 RM 1.25 5 9.2 1000-g cell 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2.39 30.62	n and separation using the dichromate meth Time % pH Unit 45 65 7 x 14 RM 1.25 0.5 5 9.2 1000-g cell	loat a low-lead copper conc with Z-200 followed n and separation using the dichromate method. Time $\frac{\%}{N}$ PH Unit used Lime ZnSO4 NaCN 45 65 7 x 14 RM 1.25 0.5 0.1 5 9.2 L000-g cell	loat a low-lead copper conc with Z-200 followed by cop n and separation using the dichromate method. Time % pH Unit used Rec Time % pH Unit used Ime ZnS04 NaCN Z-200 45 65 7 x 14 RM 1.25 0.5 0.1 0.015 5 9.2 1000-g cell 0.005 0.005 1 0 0.005 0.0055 0.0055 1 0 0.005 0.0055 0.0055 1 0 0 0.005 0.0055 1 0 0 0.005 0.0055 1 0 0 0.005 0.0055 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 1 0 0 0.005 0.005 2.39 30.62 1.52	Note a low-lead copper conc with Z-200 followed by copper- n and separation using the dichromate method. Time % pH Unit Reagents. Time % pH Unit Image 2000 pressore 45 65 7 x 14 RM 1.25 0.5 0.1 0.015 5 9.2 1000-g cell 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005 1 0.005 0.005 0.005 0.005	Observe on and separation using the dichromate method. Time % PH Unit used Reagents, 1b per min \$Solids Time % PH Unit used Reagents, 1b per min \$Solids 5 65 7 x 14 RM 1.25 0.5 0.1 0.005 0.005 5 9.2 1000-g cell 0.005 0.005 0.005 0.005 1 0.0005 0.005 0.005 0.005 0.002 1 0.0005 0.005 0.002 0.002 1 0.005 0.005 0.002 1 0.005 0.002 0.002 1 0.005 0.002 0.002 1 0.002 0.002 0.002 1 0.002 0.002 0.002 1 0.002 0.002 0.002 1 0.002 0.003 0.002 2.39 30.62 1.52 1.58 28.4 44.31 1.3 53.6 0.70 21.88 4.05 4.32	WT Analysis PH Unit Reagents, lb per ton Lime Reagents, lb per ton 0.005 Reagents, lb per ton 0.005 1 0 0 0.005 0 0 0.005 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Order to an and separation using the dichromate method. CHARGE: TESTED E Time % pH Unit Reagents, ib per ton Time % pH Unit Reagents, ib per ton Time % pH Unit Reagents, ib per ton Time % PL 200 DF250 AF242 AF208 45 65 9.2 1000-g cell 0.0005 I 0.0005 1 0.0005 I 0.0005 I One for 0.005 I 0.002 O.02 I I O.002 I O.002	CHARGE: 2 x 200 CHARGE: 2 x 200 Time % PH CHARGE: 2 x 200 TIME % Reagents. Ib per ton Solids PH Classing for the second of the sec

Sheet 2 of 2

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DEJECT OF TEST:														
							· ·				СН	ARGE:		
									·····		TE	STED B	Y:	
	Time	%			nit	1.			Rea	gents, Ib	per ton			
OPERATION	min	Solids	pH	u	sed	Lime			z-200	DF250		Dic	n	
Copper cleaners A						-	1							
No. 1	11/2		11.0	500-8	g cell	0.2				0.004				
No. 2	1		11.2	2 250-	g cell	0.1				0.002				
Copper-lead cleaners														
No. 1	1		1	250-9	g cell					0.004				
No. 2	1			11 1						0.002				
Copper-lead separation														
Conditioning	5		5.8	3 250-8	g cell					0.004		0.	3	
Copper rougher B	1			11 :	7 11									
Copper cleaner B	1			11 1	1 11				0.005	0.004				
· · ·		<u> </u>			. <u>.</u>		<u> </u>							
	W	T			ANA	LYSIS	%				DIST	RIBUTIC	N %	
PRODUCT	9	6	Cu	РЪ	Zn	Fe	Ag	Fe/FeS		Cu	РЪ	Zn	Ag	Fe/Fe
						, ,					1.			
Calculated Assays Lst Stage copper cl con	a 1 3	.09 28	64	2.09	2.20	28.0	44.89	2.6	1	64.8	9.5	0.8	37.7	
Copper rougher conc A		.66 23		2.09	4.02	20.0	39.14	1		78.9		2.2	49.6	
Copper-lead ro conc		.27 5		1.56	7.46	28.4	29.89	,		12.6		2.9	26.6	
· ·			• / -		7.40	2014	23.05	22.15		1 12.0	55.0		20.0	
<pre>fetallurgical Balance f Copper-Lead Separation</pre>	or													
Copper conc B		. 59 27	60	0.83	3.66	28.2	111.00	3.4		88.4	1.2	15.1	62.0	4.1
Copper cleaner tail B		.41 8		9.93	8.11	29.8	51.38			8.9	5.0	11.4	9.8	8.9
Lead conc		.00 0		23.24	6.56	27.6	18.48			2.7	93.8	73.5	28.2	87.0
Feed (calcd)*		.00 7		6.61	5.98	27.9	44.00		+		100.0	100.0	100.0	100.0
Copper rougher conc B(c				3.15	4.79	28.6	95.81			97.3		26.5	71.8	13.0
c	d)		l											
					•		•				.		l	
						. <u> </u>			<u> </u>			1	<u> </u>	1

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Sheet 1 of 3

TEST NO. 31 SAMP	TEST Repeat of Test 30 on F-7 sample CHARGE: 2 x 2000 g TESTED EV: A.S. TATION Time % PH Unit Reagents. 1b per for TESTED EV: A.S. ATION Time % PH Unit Reagents. 1b per for TESTED EV: A.S. ASTION % 0.02 Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2" Colspan="2" Colspan="2"														
OBJECT OF TEST: Rep	eat of	Test	± 30 c	n F-7	sample							СНА	RGE:	2 x 20	00_g
							•					TES	TED E	SY: A.	5.
ODERATION	Time	%			Jnit .	· ·			Rea	igents,	lb per				
OPERATION	min	Solic	ls pH			Lime	ZnS04	NaCN	Z-200	DF250	AF242	AF20	8	1	
Grinding	45	65		7 x	14 RM	1.25	0.5	0.1	0.02	· · ·		<u>+</u>			
Conditioning	10		9.5	1000	-g cell				·			·			
Copper rougher A							·					1.			
Stage 1	1/2									0.004		ŀ.		·	· .
" 2	1								0.01						
Conditioning	5										0.02	0.0	2		
Copper-lead rougher			_						· · ·			1	-		
Stage 1	BJECT OF TEST: Repeat of Test 30 on F-7 sample CHARGE: 2 x 2000 g TESTED BY: A.S. OPERATION Time % min Solids pH Unit used Example Reagents, ib per ton TESTED BY: A.S. OPERATION Time % min Solids pH Unit used Lime ZnSOL 1.000 NaCN Z-200 DE2SO AF242 [AZ20] Image Ar20 Additioning 10 9.5 1000-g cell 0.5 0.01 0.02 Image Ar20 Image Ar20 Stage 1 ½ Image Ar20 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Stage 1 ½ Image Ar20 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Stage 1 ½ Image Ar20 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Y 1 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Y 1 1 2 1 Image Ar20 Image Ar20 Image Ar20 Image Ar20 Y 2 1 1														
" 2	1/2					_		······································	•		0.02	1		·	1.
" 3	• 1			•			· ·				0.02	· ·			-
						2	1								1
													-	_	
PRODUCT	W	гΙ	· · · · · · · · · · · · · · · · · · ·		ANA	LYSIS	%				DI	STRI	BUTIO	N %	
FR000001	%		Cu	РЪ	Zn	Fe	Ag	Fe/Fe	S	Cu		РЪ	Zn	Ag	
	1 -	11 /	24.70	1(20	2 02	9 0'0	10 15	0.0			_		0.2	17.0	
A A										11				1	
$\frac{1}{11} \frac{1}{11} \frac$	0.												1	1	. ×
Copper conc $B**$	0					4			· · ·	11				1	
					1 · 1	1			the second						
Lead conc	11	11	,		, ,					11				ł .	
Copper-lead of tail No "						1				41	1	1		•	
ii ii ii No.	1 1.	11	1						•			1			a ser estas
Zinc rougher conc	17					1				. 11	1	1			
Zinc rougher tail	76.	90	0.06				0.88			7.	1			22.5	
Feed (calcd)	100.	00	0.61				3.01		1	100.	.0 10	0.0			
Combined copper conc											· .			· · · · ·	•
A+B (calcd)	1 1.	58 2	.4.94	13.95	2.59	24.1	1.8	54.45	5	64.	.1	9.7	0.5	28.6	. *
														· · ·	
·														• • •	••••
				1 (7				1	1					<u> </u>	
· · · · · · · · · · · · · · · · · · ·		-	· · · · · ·	a tioat	ted sepa	arately	- roug	sher co	ncenti	ates o	combin	ed to	r cles	ining -	:
				o oco •	aith ∖_'	200				•	•	-	•	•	
he for a family of the second s															

Copper conc from copper-lead separation of bulk copper-lead conc.

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TEST NO. 31 SAMF	PLE:	Matta	gami-	Sturged	n Lake	F-7							pt. 17,	1970
OBJECT OF TEST:												ARGE:		
												STED B	Y:	
OPERATION	Time	%	рН	ι	Jnit				Reag	ents, Ib	per ton			
OFERATION	min	Solid	s pri	L	sed	Lime			Z-200I	F250		CuSO	4 NaAF	
Conditioning	10		11.	5 1000-	g cell	2.5			1			1.0		
Zinc rougher				11	11 11		· ·							
Stage 1	1 .	•									·		0.05	
¹¹ 2	1												0.05	
" 3	1												0.05	
" 4	1												0.05	
Copper cleaners A														
No. 1	1	1	11.2	2 250-8	cell	0.15			0.005					
No. 2	1		10.2											
Copper-lead cleaners														
No. 1	$1\frac{1}{2}$; cell									
No. 2	1			11 11	1 11					0,004				
PRODUCT	W	T			ANA	LYSIS	%				DISTR	RIBUTIO	N %	
FRODUCT	9	6	Cu	РЪ	Zn	Fe	Ag	Fe/FeS	5	Cu	Pb	Zn	Ag	Fe/FeS
Calculated Assays			1											
1st stage copper cl conc	A 1	.61 2	0.80	19.11	3.23	21.3	45.63	2.6		54.5	13.6	0.6	24.4	
Copper rougher conc A		.32 1		18.74	5.05	20.8	39.75	5.9		61.7	19.2	1.3	30.6	
Copper-lead ro conc	5	.78	2.83	26.39	8.50	20.2	19.67	16.7		26.6	67.1	5.6	37.8	
 Metallurgical Balance fo	r													
Copper-Lead Separation]]]				,
Copper conc B	13	. 83 2	5.41	8.35	3.94	27.0	68.61	4.2	:	86.2	3.0	9.6	35.6	4.2
Copper cleaner tail B	13	.03	3.20	31.08	6.00	14.6	40.40	11.1		10.2	10.6	13.8	19.7	10.5
Lead conc		.14		45.04	5.96	17.0		16.1		3.6	86.4	76.7	44.7	85.3
Feed (calcd)*	100	0.00	4.07	38.15	5.69	18.1	26.69	13.8		100.0	100.0	100.0	100.0	100.0
Copper rougher conc B														
(calcd)	26	.86 1	4.64	19.38	4.94	21.0	54.92	7.6		96.4	13.6	23.4	55.3	14.7
								1						
•											<u> </u>	1		

* Copper-lead cleaner conc.

Sheet 3 of 3

TEST NO. 31 SAMP	LE: ·	Mattag	ami-St	urgeo	n Lake	F-7					DAT	E: Sept	t. 17,	1970
OBJECT OF TEST:						•					<u> </u>	RGE:		
					•			 · -				TED BY		
OPERATION	Time	%	pН		Jnit 👘	· · · · · · · · · · · · · · · · · · ·	·	 Reag		lb per	ton			·
	min	Solids		L	sed	· · ·	`	נם <u></u>	F250				·	Dich
Copper-lead separation											• • •			
Conditioning	5			250-	g cell				•					0.3
Copper rougher B	1			<u> </u>				<u> </u>	.004					L
Copper cleaner B	1/2			11	11 11		•••				۰.			<u> </u>
					<u></u>	6				•	<u> </u>		<u>.</u>	· · ·
				· · · · ·						·	· ·		<u> </u>	
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				<u> </u>	·····	<u> </u>	<u> </u>	 l				<u> </u>		
PRODUCT	W		····		ANAL	_YSIS	%		·	D		BUTION	%	
	9	6				<u>``</u> .		 				<u> </u>		
REMARKS:	· .		~				•	 · · · · · ·				 . <i>.</i>		· · · · · · · · ·
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Sheet 1 of 2

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TEST NO. 32	SAM					eon Lake		<u></u>			·			DA	TE: Se	pt. 18,	1970
OBJECT OF TEST:	Copp	er-lea	ad bulk	: flo	tation	on F-7	sample	with c	copper-	·lead						2×20	
	sepa	ration	using	; the	dichro	omate me	thod.	_	•						STED E	· · · · · · · · · · · · · · · · · · ·	
OPERATION		Time	%	рН		Unit				Rea	ıge	nts, II	o per	ton			
		min	Solid			used	Lime	ZnS04	NaCN	AF 242	AF	208DI	F 250)		1	
Grinding		45	65		7x14	i RM	1.5	0.5	0.1	0.02	0.	02					
Conditioning		5		9.2	2 1000)-g cell		•		0.01	0.	01		1			
Copper-lead roughe	r	<u> </u>			11	ft 11	,							1			
Stage 1		1/2										0.	.004	1			
2		1								0.01	0	01		1		_	
" 3		1								0.01							
" 4		1								0.02							
Copper-lead cleane	<u>~s</u>	1															
No. 1		11/2			500-	g cell											
No. 2		1			11	11 11			1						-		-
									1								
				1													
22021107		l w	'Т <u></u>			ANAL	YSIS	%	· · · · · · · · · · · · · · · · · · ·	1	1		DI	STRI	BUTIO	N %	
PRODUCT		9	6	Cu	Pb	Zn	Fe	Ag	Fe/Fe	s ·		Cu	P		Zn	Ag	
Copper conc		1 1	.11 2	0 10	3.38	3.16	26.9	73.95				55.0		.7	0.4	28.2	
Copper cleaner tail	1 No.	11			29.82	7.50	14.5	57.41	1			1.1		.9	0.4	20.2	
		14			30.29	5.46	11.2	32.24	1 -			. 1.]		.0	0.2	3.3	
Lead conc					42.88	5.64	17.2		16.4			1.2		.5	2.2	18.4	
Copper-lead cl tail	1 No.	2 1			15.58		23.0		18.8			6.4	ſ	.5	1.3	6.7	
	No.				8.67		23.8	10.72	20.8			5.4	6	.8	2.3	6.4	
Copper-lead ro tail	1				0.29			1.09				29.8			93.5	34.2	
Feed (calcd)		100	.00	0.59	2.24	8.78		2.92				100.0) 100	.0	100.0	100.0	
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	•			•													
																	•
				Í													
REMARKS' THE 200		at che	0 070		d £1-	Lon	i		-1.								
REMARKS: Two 200 and cop	g i		s grou	uu an io-	a rroa	iceu sepa	racely	- rou	gner c	oncenti	rat	es co	mbin	ed f	or clea	aning	
and cop	per-1	icau S	eparat	1011.						•							

Sheet 2 of 2

TEST NO. 32 SAMP	LE:	Matta	gami-	Sturge	eon Lake	F-7						DAT	E: Ser	ot. 18,	1970
OBJECT OF TEST:				¥	······································						.		RGE:	······································	
							•	•			Ī	TES	TED B	Y:	· · ·
OPERATION	Time	%	pH		Unit	Ĭ			Reag	ents, l	b per	ton			
OPERATION	min	Solids	рп		used]	DF250	Dic	h	1	
Copper-lead separation			1				·								
Conditioning ·	5			250-	-g cell					·		0.3	· ·	•	÷[
Copper rougher	11/2			17	17 17					1	0.004				
Copper cleaners							-				· .	41 1.			
No. 1	1			11						1	0.004	0.1			
No. 2	1			11	11 11-					. (0.002				
					· · · · · · · · · · · · · · · · · · ·										
		· · · · · · · · · · · · · · · · · · ·								· .					
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			<u> </u>	<u> </u>				· · ·		· · ·	<u> [</u>				1 - 1 - 12
PRODUCT	W				ANA	LYSIS	%			·	DIS	STRI	BUTIO		n in
	%	> (Cu 🔤	Pb	Zn	Fe	Ag	Fe/FeS	5	Cu	Pb.		Zn	Ag	Fe/FeS
Metallurgical Balance															
for Copper-Lead Separatio	рф П														
Copper conc		04 20	1 10	3.38	3.16	26.9	73.95	1.0		94.2		2.3	12 6	53.4	1.8
Copper cleaner tail No. 2				29.82	7.50		57.41			94.2			4.2		2.2
" " No.]	5.			30.29		11.2	32.24			1.9		5.4	6.3		4.2
Lead conc	69.	16 (0.20	42.88	5.64	17.2	15.44	16.4		2.0		.7		34.9	91.8
Feed (calcd)*	100.	00 6	5.81	33.05	5.14	18.9	30.54	12.4		100.0	D 100	0.0	100.0	100.0	100.0
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									· ·						
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			•			:									
							•								: · ·
REMARKS: *Copper-lead	<u></u>	or													
wcobber-tesq	crean	er COL	.c.								5	•	• •	· ·	
			•		•							• :			
		,													
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Sheet 1 of 2

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TEST NO. 33 SAM	PLE:	Matt	agami	-Sturg	eon Lake	F -7	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·			· ·	DA	TE: No	v. 3, 1	.970
OBJECT OF TEST: Sele	ctive	flota	tion	direct	ly on th	e ore i	using S	50, and	Z-200)		СН	ARGE:	2000-g	
– re	peat o	f Tes	t 22	<u>on F-7</u>	sample							TE	STED E	Y: A.S.	
OPERATION	Time	%	Ha		Unit					-	, lb pe				
	min	Solid	s		used	Z-20	so,	DF250	Lime	NaCN	AF 24	2		1	1
Grinding	45	65		7 x	14 RM	0.02						1			-
Conditioning	20		5.	6 Aer	ator		4.0								
Copper rougher)-g_cell	· · · · · · · · · · · · · · · · · · ·									
Stage 1	1														
Stege 2	2					0.01									
Conditioning	5		9.	7					2.5	0.10	1				
13	5										0.02				
Lead rougher															
Stage 1	1/2														
Stage 2	1/2	· · · · · · · · · · · · · · · · · · ·					<u> </u>				0.02				
Stage 3	1										0.01				
· · ·]						1			
PRODUCT	W				ANAL	YSIS	%			1	D	ISTR	IBUTIO	N %	
	%		Cu	РЪ	Zn	Fe	Ag	Fe/FeS		Cı	1	РЪ	Zn	Ag	
Copper conc	1.	67 25	5.78	11.50	4.76	28.4	45.78	5.1	1	71.	4	8.1	0.9	27.7	
Copper cleaner tail No.	2 0.	52 6		8.30	1 1	36.7	24.22	30.0	1	11		1.8	0.5	4.6	
i " No.			2.36	4.50			11.15	43.7		6.	.3	3.1	0.9	6.5	
Lead conc			0.06	57.60		10.1	20.91	9.4		14		8.3	1.5	18.1	
Lead cleaner tail No. 2).21	31.75	9.94	17.9	14.41	16.5	1	11	1	3.8	0.3	1.5	
• • • • •		03 (20.90		19.1	20.32	17.5	•			9.1	1.3	7.6	
Zinc rougher conc Zinc rougher tail		.31 (19 (0.28	50.36	9.6	2.49	3.4				6.6	91.1	13.8	
Feed (calcd)		00 0			8.47		0.73			100		9.2 0.0	3.5	20.2	
	1200.			2.50	0.4/	······	2.70		<u> </u>	-11-00.	0 10	0.0	100.0	100.0	
			•					•	1						
· ·						,				;					
REMARKS:													·····	<u> </u>	

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Sheet 2 of 2

TEST NO. 33 SAMP	PLE: M	lattaga	mi-St	urgeon	Lake F	-7		•.				DATE	E: Nov	3, 19	970
OBJECT OF TEST:											· .	CHAF	RGE:	· · · · · · · · · · · · · · · · · · ·	
:						•					•	TEST	ED BY	:	
	Time	%	<u> </u>	τ	Jnit			· · ·	Rea	gents,	lb per	ton			
OPERATION			рн				2	DF250	Lime	NaCN	AF242	CuS04	CX 51	NaAF	
Conditioning	10		11.3	1000	-g cell	· ·			3.0			2.0			
Zinc rougher	N Time min N Time min 10 10 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 <			11	71 11							· · .			
Stage 1	EST: ION Time min 10 10 10 11 12 2 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1									<u>`</u>		l'	0.02		
Stage 2	EST: TION Time min S 10 10 10 1 1 1 2 ers 1 1 1 1 1 1 1 1 1 1 1 1 1					1					·			0.10	
Stage 3	EST: FION Time min Sc 10 10 1 1 2 TS 1 1 1 2 TS 1 1 1 1 1 1 1 1 1 1 1 1 1							0.02						0.05	· · · ·
Copper cleaners			<u> </u>								· · · · ·			ļ. <u> </u>	
	DF TEST: RATION Time min ing 10 her 1 1 2 1 3 2 eaners 1 1 1 ners 1 RODUCT W CODUCT W CODUCT W CODUCT S d Assays copper cl conc ugher tail 96 lead cl conc her tail 92.							0.004	0.6		· · · · ·		· ·	· · · · ·	
	1		10.6				<u> </u>			•					
Lead cleaners	CHARGE: CHARGE: TESTED BY: TESTED BY: OPERATION Time % PRODUCT CHARGE: TESTED BY: OPERATION TESTED BY: TESTED BY: OPERATION 2.0 Ime Mack AF242 CuS04 CX 51 NaAF Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"C														
			9.5							0.10					
NO. 2	<u>⊥</u>			250-	g cell	·					0.00				
		<u> </u>	1	<u> </u>			1	[]		11				<u> </u>	
PRODUCT	11	. 11								_		<u>``</u>			
	ATION Time min ng 10 er 1 1 2 aners 1 2 aners 1 1 2 aners 1 1 1 2 aners 1 1 1 2 aners 1 1 1 2 aners 2 aners 1 1 1 2 aners 2 aners 1 1 2 aners 2 aners 2 aners 2 aners 1 1 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 aners 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 3 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 anor 2 3 anor 2 anor 2 anor 2 3 3 anor 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3		u	РЬ	Zn	<u>Fe</u>	Ag	Fe/FeS		<u> </u>			<u></u>	Ag	
Calculated Assays	ATION Time min Se 10 10 1 1 2 ers 1 2 ers 1 1 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5														
	min Sol 10 10 1 1 1 1 2 1 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>- 11</td><td></td><td></td><td>3</td><td>1</td><td>•</td></t<>									- 11			3	1	•
	1 1 2 ers 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				5.05	21.T ³¹⁶	1 76	24.9		ု ၀၃	4 1	2.0	2.5	20.0	• • • •
			ſ		5.77	10.9		10.1		0.	.3 6	2.1	1.8	19.6	
Lead rougher conc													1		
Lead rougher tail	92.	50 0	.10	0.40			1.02					··· .			•. •
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REMARKS			-	÷ •		-		• • •						··· ·· ·	
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Sheet 1 of 2

4 2 × 3

					Lake F									ember 4	_
OBJECT OF TEST: Copp								the c	yanide	metho	od as	s C⊦	IARGE:	2 x 2000)-g
in Test 29 but primary	grindi	ng tim	e reć	uced f	rom 45	to 30 r	nin.					TE	STED E	3Y: A.S.	
	Time	%		1	Jnit							per tor			
. OPERATION	min	Solids	рH	1	used	Na, CO.	Na2SO3	NaCN	AF 208	AF 242	ZLime	≥ CuS	04 CX 5	1 NaAF	DF 25
0	30	65			1/ D1/			0.1			+				
Grinding Conditioning	10		9.8		<u>14 RM</u>)-g cel		1.0	0.1	0.01	0.01					
Copper-lead rougher-as		- 21	9.0		-g cer	L			0.01	0.01					<u> </u>
Conditioning	10		11.2								4.() 1.	0		
_													<u> </u>		
Zinc rougher			<u> </u>	11000)-g cel:	<u> </u>					╂				
Stage 1	13 12				 ,								0.0	1 0.05	· ·
Z	3						·								0.02
" 3	2						ļ							0.05	0.02
					<i>.</i>		ļ								<u> </u>
			<u> </u>				ļ				ļ				
			1	_											
			<u> </u>						•						
PRODUCT	w w	г			ANA	LYSIS	%			1	•	DISTE	RIBUTIO	N %	
	%	c C	u	РЪ	Zn	Fe	Ag	Fe/FeS		Cı	1	РЪ	Zn	Ag	
Copper conc	2.7	73 0	8.33	1.23	3.04	29.7	18.15								
Lead conc	0.6	31		48.46	6.40	11.6	200.50				5.4 L.9	5.1 1.9	1.0	14.6	
Lead cleaner tail No.2	0.3	71		12.40	5.94	26.8		12.1		11	+.1	4.1	0.5	6.7	
" " No.1	0.8	- 11	5.56	5.12	3.16	28.4	35.38				5.9	15.9	0.2	8.9	
Copper-lead C1 tail No.		11	6.74	4.40	8,80	30.9		24.0		11	2.8	2.8	0.6	2.8	
ii ii ii ii No.			5.33	3.99	8.56	31.5		25.8			3.5	3.5	0.9	3.7	
17 13 11 11 NO.			4.10	1.55	8,06	30.8		26.3		11	3.7	8.7	2.7	7.1	
Zinc rougher conc	14.2	25	0.22	0.18	53.48	8.9	1.29			11	2.3	2.3	87.8	5.4	
Zinc rougher tail	76.8		0.08	0.13	0.69		0.59			H .	+.4	4.4	6.0	13.5	
Feed (calcd)	100.C		1.37	0.66	8.68		3.38			100	0.0 1	100.0	100.0	100.0	
Copper-lead ro tail(calc	d)91.0)6	0.10	0.14			0.70								
]]		:											
									1	_					
REMARKS: Screen analy	vsis of	30 m	in er	ind. 7	4.6% mi	nus 200) mesh	as aga	inst al	bout 8	3% ==	inite	200 mes	h for	
45 min. grind.			0-								- /0 11	تن شا د د بد .	200 mc3.	L LUL	

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Sheet 2 of 2

	'LE:Mat	tagam	i-Stu	irgeon	Lake F	-2	····	•				1		ember 4	, 1970
OBJECT OF TEST:											•	f	RGE:	<u> </u>	
											······	TES	TED B	<u>Y:</u>	
OPERATION	Time	%			Jnit				Reag	jents,	lb per	ton	· · ·		
OFERATION	miń	Solids	pH	1	used			NaCN	· A	F 242		· · · ·			ZnS04
Copper-lead cleaners - a	s in 1	est 2	1												
Copper-lead separation															
Desorption(as in Test 9)															
Conditioning	5.		9.9	9 250	-g cell	•	•	1.2			•				1.0
Lead rougher		,			11- 11-							1			-
Stage 1	1/2											1			· · · ·
11 2	1									0.005					
Lead cleaners					······································										
No. 1	1			250	-g cell			0.2		0.005		1 .			
No. 2	1			11	11.		· ·	0.2		0.002			`		
							1			:					
· ·							· ·								
	W	F	1	1		LYSIS	0/	I	ł	l			BUTIO	<u> </u>	
PRODUCT	%				r				<u>.</u>			· · · · · · · · · · · · · · · · · · ·			Fe/FeS
			Cu	Pb	Zn	Fe	Ag	Fe/FeS		Cu		<u>РЪ</u>	Zn	Ag	re/res
Metallurgical Balance															
for Copper-Lead Separati				•											
Copper conc	11			1.23		29.7	18.15			14		7.9	48.6		47.0
Lead conc				48.40	1	11.6	200.50			11 .		1.5	23.5		17.9
Lead cleaner tail No. 2	11			12.40	ſ	26.8	64.76			14		0.4	12.3		16.9
11 11 No. 1			5,56		3.16	28.4	35.38		· · · · · · · · · · · · · · · · · · ·	20		0.2	15.6		18.3
Feed (calcd)*	100.	00 2	3.52	9.30	3.75	26.7	50.03	5.6		100	.0 100	0.0	100.0	100.0	100.0
Calculated Assays													0.5	(
1st Stage Lead cl conc	11			35.40		17.1	151.47					1.9	35.8		34.7
Lead rougher conc	40.	12 1	6.33	21,35	4.81	22.3	97.62	7.4		27	•9 92	2.1	51.4	78.3	53.0
				,						· ·					
									••						
				,											
									· · ·	8				-1	
								s.					· ·	·	
REMARKS: Copper-lead					· · · · · · · · · · · · · · · · · · ·		<u></u>		1	11			<u> </u>		· · · · · · · · · · · · · · · · · · ·
REMARKS: Copper-lead	l clear	ner co	nc	· .		· ·									•
												· ·			•
	••• <u>•</u> •••••••				****								·		

Sheet 1 of 2

2 v

					n Lake F					······································		DATE: No		-
OBJECT OF TEST: To det	ermin	e the	effect	c of a	adding s	oda as	h to c	opper-1	.ead se	paratio		CHARGE		
												TESTED	BY: A.	S.
OPERATION	Time	%	На		Jnit					igents, l	b per t	ton		
	min	Solids			used	DF250	ZnCN	Na ₂ CO3	AF242	NaCN				
Grinding) ₂₅	in			1										
	t: 21			1			-							
Copper-lead rougher)				1		3								
Copper-lead cleaners)														
Copper-lead separation				1										
Desorption(as in Test 9)							1						
Conditioning	10		11.6%	250)-g cell		0.88	2.0						
Lead rougher	1			1					0.005					
Lead cleaners														
No. 1	1							1	0.005	0.2				
No. 2	3/4					0.004	1							
						1								
PRODUCT	W-	г		_	ANAL	YSIS	% .	<u>.</u>			DIS	TRIBUTI	<u> </u>	
PRODUCT	%	C	u	РЪ	Zn	Fe	Ag	Fe/FeS	1	Cu	PE		Ag	1
Copper conc	3.	51 2	7.41 1	19	3.22	29.4	23.02	4.9		72.	4 6.	6 1.3		
Lead conc	0.0		0.2647		·	•	154.60	1		0.		3	1 .	
Lead cl tail No.2	0.		2.7820		1		114.90	10.8		1.	-			
11 11 11 No.1	0.	11	0.33 8		1	27.2	73.42	8.8		8.	1			
Copper-lead cl tail No.3			7.88 4			31.6	21.40	1		4.				
" " No. 2	0.8		5.69 3			33.1	15.82			3.	2	0 0.8		
"" " No. 1	2.	78	1.97 1	27	8.42	33.2	5.74	1		4.				
Copper-lead ro tail	90.		0.07 0		8.96		0.79			4.	9 18.	7 93.7	20.5	l
Feed (calcd)	100.0	00	1.33 0	.63	8.68		3.52			100.	0 100.	0 100.0	100.0	1
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		1												
											·			
	<u></u>						-	l			<u> </u>			1
REMARKS:* pH 11.7 befo	re ado	lition	of So	da as	h									

MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

CHARGE: CHARGE: OPERATION Time No. % PH Unit Used Reagents. Ib per ton TestED BY: OPERATION Time Solids % PH Unit Used Reagents. Ib per ton Image: Solids <	TEST NO. 35 SAMPI	LE: Ma	ittaga	mi-Si	turgeon	Lake H	F-2					DA	TE: Nov	ember 5	, 1970
OPERATION Time min % Solids pH Unit used Reagents, lb per ton Image: Solids Image: Soli	OBJECT OF TEST:											СН	ARGE:	·· ·· ·· ·	
OPERATION min Solids pH used Image: Solids pH used Image: Solids												· TE	STED B	Y:	· •
OPERATION min Solids PH used Image: Constraint of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system of the system o		Time		<u> </u>	1 τ	Jnit	T			Reag	ents, Il	o per ton			·
PRODUCT WT ANALYSIS % DISTRIBUTION % VT ANALYSIS % DISTRIBUTION % VT % Qu Pb Zn Fe Ag Fe/FeS Qu Pb Zn Ag Fe/FeS Qu Pb Zn Ag Fe/FeS Qu Pb Zn Ag Fe/FeS Gu Pb Zn Ag <	OPERATION	1	-	pH	1			1						•	
PRODUCT WT ANALYSIS % DISTRIBUTION % VT ANALYSIS % DISTRIBUTION % VT % Qu Pb Zn Fe Ag Fe/FeS Qu Pb Zn Ag Fe/FeS Qu Pb Zn Ag Fe/FeS Qu Pb Zn Ag Fe/FeS Gu Pb Zn Ag <		=		1											
PRODUCT WT ANALYSIS % DISTRIBUTION % Metallurgical Balance Image: State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State S				1					-						
PRODUCT WT ANALYSIS % DISTRIBUTION % Metallurgical Balance Image: State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State State S	· · · · · · · · · · · · · · · · · · ·														
PRODUCT WT ANALYSIS % DISTRIBUTION % % Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation 72.42 27.41 1.18 3.22 29.4 23.02 4.9 87.4 10.0 63.5 34.4 55.8 Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead conc 12.38 0.26 43.2 27.2 73.42 8.8 10.5 12.0 13.7 17.6 16.1 " " " No. 1 11.6C 20.33 8.76 4.32 27.2 73.42 8.8 10.5 12.0 <	·							· .							
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PRODUCT % Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation Metallurgical Balance No.									•						
PRODUCT % Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation Metallurgical Balance No.								1							
PRODUCT % Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation Metallurgical Balance No.						• •		· ·							•
PRODUCT % Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation Metallurgical Balance No.															
PRODUCT % Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation Metallurgical Balance No.						•••									
% Cu Pb Zn Fe Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Metallurgical Balance for Copper-Lead Separation Ag Fe/FeS Cu Pb Zn Ag Fe/FeS Copper-Lead Separation 72.42 27.41 1.18 3.22 29.4 23.02 4.9 87.4 10.0 63.5 34.4 55.8 Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead cleaner tail No. 2 3.60 12.78 20.60 5.16 22.6 114.90 10.8 2.0 8.7 5.1 8.5 6.1 " " No. 1 11.6C 20.33 8.76 4.32 27.2 73.42 8.8 10.5 12.0 13.7 17.6 16.1 Feed (calcd) 100.0C 22.70 8.52 3.67 26.8 48.46 6.4 100.0 100.0 </td <td>BBODUCT</td> <td>TW </td> <td>r </td> <td></td> <td></td> <td>ANA</td> <td>LYSIS</td> <td>%</td> <td></td> <td></td> <td>1</td> <td>DISTR</td> <td>BUTIO</td> <td>N %</td> <td>•</td>	BBODUCT	TW	r			ANA	LYSIS	%			1	DISTR	BUTIO	N %	•
for Copper-Lead Separation 72.42 27.41 1.18 3.22 29.4 23.02 4.9 87.4 10.0 63.5 34.4 55.8 Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead cleaner tail No. 2 3.60 12.78 20.60 5.16 22.6 114.90 10.8 2.0 8.7 5.1 8.5 6.1 " " No. 1 11.66 20.33 8.76 4.32 27.2 73.42 8.8 10.5 12.0 13.7 17.6 16.1 Feed (calcd) 100.00 22.70 8.52 3.67 26.8 48.46 6.4 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0	FRODUCT	%	С	u	Pb	Zn	Fe	Ag	Fe/FeS		Cu	Pb	Zn	Ag	Fe/FeS
for Copper-Lead Separation 72.42 27.41 1.18 3.22 29.4 23.02 4.9 87.4 10.0 63.5 34.4 55.8 Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead cleaner tail No. 2 3.60 12.78 20.60 5.16 22.6 114.90 10.8 2.0 8.7 5.1 8.5 6.1 " " No. 1 11.66 20.33 8.76 4.32 27.2 73.42 8.8 10.5 12.0 13.7 17.6 16.1 Feed (calcd) 100.00 22.70 8.52 3.67 26.8 48.46 6.4 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0	Matalluraiaal Balanaa														
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Lead conc 12.38 0.26 47.72 5.26 12.1 154.60 11.3 0.1 69.3 17.7 39.5 22.0 Lead cleaner tail No. 2 3.60 12.78 20.60 5.16 22.6 114.90 10.8 2.0 8.7 5.1 8.5 6.1 """No. 1 11.60 20.33 8.76 4.32 27.2 73.42 8.8 10.5 12.0 13.7 17.6 16.1 Feed (calcd) 100.00 22.70 8.52 3.67 26.8 48.46 6.4 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 <td></td> <td>-11</td> <td>1.2 2</td> <td>7 1.1</td> <td>1 19</td> <td>3 77</td> <td>20 1</td> <td>23 02</td> <td>4.9</td> <td></td> <td>87.</td> <td>4 10.0</td> <td>63-5</td> <td>34.4</td> <td>55.8</td>		-11	1.2 2	7 1.1	1 19	3 77	20 1	23 02	4.9		87.	4 10.0	63-5	34.4	55.8
Lead cleaner tail No. 2 3.60 12.78 20.60 5.16 22.6 114.90 10.8 2.0 8.7 5.1 8.5 6.1 """"No. 1 11.60 20.33 8.76 4.32 27.2 73.42 8.8 10.5 12.0 13.7 17.6 16.1 Feed (calcd) 100.00 22.70 8.52 3.67 26.8 48.46 6.4 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 1									1			4			
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Ist Stage Lead c1 conc 15.98 3.08 41.61 5.24 14.5 45.66 11.2 2.1 78.0 22.8 48.0 28.1	Feed (calcd)	100.	.00 2	2,70	8.52	3.67	26.8	48.46	6.4		100.	0 100.0	100.0	100.0	100.0
												1 70 0		100	10 1
Lead rougher conc $27.58 10.34 27.79 4.85 19.8 115.27 10.1$ $12.0 90.0 50.5 05.0 44.2$			98						1		11				
	Lead rougher conc	27.	1 80	0.34	-27.79	4.85	19.0	115.27	10.1		12.	0 90.0		0.00	
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	REMARKS:						: ;			• •	•		·. · .		

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Sheet 1 of 2

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TEST NO. 36 SAMP	LE: N	Mattag	ami-S	turgeo	n Lake I	<u>F-2+F-7</u>	Compos	site (l	:1)		DA	TE: Dec	ember 2	, 197
OBJECT OF TEST: Repeat	of Te	ast 35	on F	'-2 + F	-7 comp	nsite	•					IARGE:2	<u>x 2000</u>	<u>l-g</u>
											TE	STED E	BY: A.S	•
OPERATION	Time	% Solids	рН	1	Jnit used	· .	1		Reag	ents, Ib	per tor			
		501103											·	
rinding)as			<u></u>											
Conditioning)in						i								
Copper-lead rougher)Test	21								·					
Copper-lead cleaners		· ·			- <u></u>								· ·	
No. 1	12			500	<u>-g_cell</u>									
No. 2	11/2			11	11					·				
No. 3	11/2			250	<u>-g cell</u>									
No. 4	11/2	1		11										
· · · · · · · · · · · · · · · · · · ·														
		1	1											
		1	1											
•	11			1						<u>l</u>				
PRODUCT	W	[]	<u> </u>	·		LYSIS	1	r	1		· · · · · · · · · · · · · · · · · · ·		T %	1
		6	Cu	РЪ	Zn	Fe	Ag	Fe/FeS		C11	Pb	Zn	Ag	
	1 2	.79 2	1.70	2.11	5.24	30.4	27.02	10.8		63.5	4.0	1.7	24.7	
Copper conc . Jead conc	11	11		55.50	5.32	10.6	49.62	9.2		1.4	58.0	0.9	24.7	
Lead cleaner tail No. 3				24.24	7.60	22.6	50.10			2.3	5.7	0.3	5.6	}
" " No. 2	11			18.57	5.66	24.0	44.71	11.0		5.9	5.1	0.3	5.8	1
11 ¹¹ ¹¹ No. 1	11			10.37	4.84	24.0	35.57	8.6		12.9	4.4	0.3	7.2	1
Copper-lead cl tail No.	11	11	1.36		8.80	34.7	6.69	32.5		1.1	1.8	0.8	1.7	
" " " No.	14		2.43		8.12	32.8	8.71	29.9		2.7	3.2	1.0	3.0	
11 11 11 11 NO.	23	41	1.63	3.48	9.12	31.8	7.04			3.4	1	2.1	4.6	
n n n n No.	11	11	0.83	1.90	10.78	27.9	4.75	•		2.3	3.4	3.2	4.0	
Copper-lead ro tail	- 11		0.05		8.84		0.65			4.5		89.4	18.7	
Seed (calcd)	100		0.95	1.46	8.69		3.06				100.0	100.0	100.0	
							+			+			1	
								-						
													1	
	1										ľ		1	

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TEST NO. 36 SAMP	LE: M	attaga	ami-St	urgeon	ı Lake F	-2 + F	-7 Con	posite	(1:1)		•	DA	TEDecer	mber 2,	1970
OBJECT OF TEST:					·····							СН	ARGE:		
									•	•		TE	STED B	Y:	•
	Time	%	1	ι ι	Jnit	1	· · · · · · · · · · · · · · · · · · ·			gents,	lb pe	r ton		. ·	
OPERATION		Solid	pH s		used	DF250	ZnCN	Na ₂ CO3	AF242	NaCN					
Copper-lead Separation						-			· · · · · · ·						1
Desorption(as in Test	9)									•		· ·			
• Conditioning	5		11.3	250-	g cell		0.88	2.0							
Lead rougher				· 11	11						•				
Stage 1	1/2			1	······································	Ŷ.						2 1.5 2	•		
" 2	12 Z	· ·			•				0.005			1			
¹¹ 3	3/4		· · · · · ·	-	•••••••				0.005		· · · · · · · ·				
Lead cleaners	· -													•	
No. 1	1			250-2	g cell	0.002	5	· · · ·		0.2					
No. 2	1	·	1.	11	11	0.002	5			0.2					
No. 3	1			TT	11	0.002	\$			0.1					
	W.	т			ANA	LYSIS	%			1	C	ISTR	IBUTIO	N %	
PRODUCT	%	6	Cu	Pb	Zn	Fe	Ag	Fe/FeS		Cu]]	?Ъ	Zn	Ag	Fe/Fe
Metallurgical Balance			1			,				-		1.1			
for Copper-Lead Separat	idh											х. 			
Copper conc		.25	21.70		5.24	30.4	27.02	10.8	1	. 11	.0	5.2	47.9		(
Lead conc	26	.83	0.865	5.50	5.32	10.6	49.62	9.2	- F			75.2	26.5		
Lead cleaner tail No. 3	5	.95		4.24	7.60	22.6	50.10	1	1			7.3	8.4	8.1	9.2
17 17 17 No. 2	7		14.051		5.66	24.0	44.71	11.0			•9	6.6	7.4	8.6	7.4
11 11 11 No. 1	10			10.37		26.6	35.57				.9	5.7	9.8		8.9
Feed (calcd)*	100	• 0Q	14.45	19.81	5.39	23.8	36.64	10.5	5	100	•01	00.0	100.0	100.0	100.0
Calculated Assays						·····		· ·				· · ·			
2nd Stage Lead cl <onc< td=""><td>32</td><td>.78</td><td></td><td>49.83</td><td></td><td></td><td>49.71</td><td>10.5</td><td></td><td>11</td><td></td><td>82.5</td><td>34.9</td><td></td><td></td></onc<>	32	.78		49.83			49.71	10.5		11		82.5	34.9		
1st " " " "	11	.83		44.29			48.82	1				89.1	42.3		
Lead rougher conc	50	.75	7.42	36.99	5.53	17.3	45.97	10.1	-	26	.0	94.8	52.1	63.7	49.1
												· .			
	11										1	•		•	
								1							
								<u> </u>	<u> </u>]		<u> </u>

REMARKS: * Copper-lead cleaner conc

Sheet 1 of 2

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TEST NO. 37 SAMP	PLE: Ma	attaga	mi-St	urgeon	Lake F	r <u>-</u> 7						DA	TE: Dec	ember 3	, 1970
OBJECT OF TEST: Copper									eased	skimm	ing	CF	ARGE:	2000-g	
time for copper rougher	and in	ncreas	ed sl	cimming	; time f	for lead	l rough	ner				TE	STED E	BY: A.	S.
	Time	%		1	Unit .	1			Re	agents	, 1b p	er tor)		
OPERATION	min	Solide	рH		used	z-200	S02	DF 250	Lime	NaCN	AF24	2			
Grinding	45	65		7 x	14 RM	0.01									-
Conditioning	20	1	5.5	5 Aera	tor	0.01	4.0			1	1				
Copper rougher	$1\frac{1}{2}$			1000	-g cell			0.01		1					1
Conditioning	5	1	9.5	5					3.0	0.1					1
11 11	5										0.	02			
Lead rougher			1	1000	-g cell		1			1					
Stage 1	1		1				1	1		1	-				· ·
11 2	1/2		1				1			1	0.	02			-
11 3	1		1		· · · · · · · · · · · · · · · · · · ·		1			1	0.	02			
11 4	1		1			_					0.	02			1
					· ····································										
	^		1				1			1					
PRODUCT	W	11			ANA	NALYSIS %							RIBUTIC		
	%	6 C	u .	Pb	Zn	Fe	Ag	Fe/FeS		C	u	Pb	Zn	Ag	
Copper conc	1.4	44 2	5.04	4.33	2.16	31.0	40.88	8.5		· 6	0.8	2.7	0.4	20.5	
Combined copper cl tail	0.	11	6.08	8.02	7.14	34.0	21.73	1		4.4	7.4	2.5	0.6	5.4	ĺ
Lead conc	3.	15	0.09	50.17	5.84	13.6	21.68	12.8			0.5	68.0	2.1	23.7	ĺ
Lead cleaner tail No. 2	0.1			19.08		23.2	15.32			11	0.4	2.5	· 0.4	1.6	
· 11 11 11 No. 1	1.4			15.82		20.8	2205	18.5		- 11	1 -	10.0	1.9	11.3	
Lead rougher tail	92.9			0.36			1.16					14.3	94.6	37.5	
Feed (calcd)	100.0	00	0.59	2.32	8.62		2.88			10	0.01	00.0	100.0	100.0	
Calculated Assays			0 70		2 22		0/ 50	1.5.0				- 0	1 1 0	05.0	
Copper rougher conc	2.	11		5.56 38.01	•	32.0 16.3	34.50	1		11	8.2	5.2 80.5	1.0	25.9 36.6	
Lead rougher conc	4.	92	0.43	30.UL.	1.12	10.3	21.40	15.0			3.0	6U•0	4.4	20.0	ĺ
										1					í.
		.													
-															
REMARKS:								<u>.</u>	•	<u>, 1</u>	I		·	L	<u> </u>

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MINES BRANCH FLOTATION TEST REPORT Sheet 2 of 2

	'LE: <u>Ma</u>	ttagam	i-Stur	geon]	Lake F-	7	<u></u>						E: Decen	nber 3	, 197
OBJECT OF TEST:								•		· ·		·	RGE:		<u> </u>
													TED BY	·	·.
OPERATION	Time	%	pН		Init						, lb per		· · · · · · · · · · · · · · · · · · ·		
	min	Solids		u u	sed		so ₂	DF250	•	NaCN	AF 24	4			
Copper_cleaners						· .			•			· .		<u> </u>	
No. 1	1		3.3	250-	<u>g cell</u>		0.5	0.004		· ·		1		ļ	<u> </u>
No. 2	3/4		3.6	11	11		0.25	0.004		[ļ	
Lead cleaners						•									
No. 1	1			500-	g cell	ř.				0.1	0.01				· .
No. 2	1			250-	g cell						0.005				
							·								
		1			•						·				
······································		1							•			1			
					·					1		1.			1
· ·		1		1		2	1		· · · · · · · · · · · · · · · · · · ·		1	1	•	<u>.</u>	
· · · · · · · · · · · · · · · · · · ·	l w	T			ANA	LYSIS	%	<u>.</u>		1	D	STRI	BUTION	%	
PRODUCT	9							· · ·	1.			<u> </u>			
· · · · · · · · · · · · · · · · · · ·															
		. ∥ • .		• •						•]]	· .			•	
· · · · · · · · · · · · · · · · · · ·		· ·													
	- · · ·					- 1 B					·		· · · [
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				·					· ·		Y I				
		· .													: .
							· · · ·							• :	· .
• • • • • •	- 1 - N					1. A (1.	· · · ·	4 4						1.1.1.1	
			·•-**			1				- 					12 I I
				· · ·	•					· · · ·					. • .
						1. 1. 1. 1. 1.	. • -	1.22				3 - F			
• • • • •	·			:			•						· .	· .	· · ·
•						·]									•
	<u> </u>		· .							<u> </u>					
REMARKS:	• • • •					•				• •					
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Sheet 1 of 2

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TEST NO.38 SAME	PLE: Ma	ttaga	mi-St	urgeon	Lake F	-2 + F-	7 Comp	osite (1:1)	·		DATE	E: Dec	ember 1	5, 19
OBJECT OF TEST: Selec	tive c	opper	-lead	flota	tion wi	th Na ₂ S	03 add	ed to t	he gri	nd and	1	CHAF	RGE:	2 x 2000) g
Z-200 as copper promote	r foll	owed	by co	pper-1	ead sep	aratior	of the	e coppe	er conc	:		TEST	ED E	Y: A.S.	
OPERATION	Time	%	рн	1	Unit	Τ,			Rea	gents,	lb per				
OFERATION	min	Solid	spri		used	Na ₂ SC	Z-200	DF2501	Na2CO3	NaCN	AF242	AF208	3	1	1
Grinding	45	65		7 х	: 14 RM		0.01					<u> </u>	-		
Conditioning	5	1	7.	6 1000	-g cell		0.02	0.02					1		
Copper rougher	2	1		11	11	i)						1			
Conditioning	5		9.	4					3.0	0.1			1		
Lead rougher A		1											+		
Stage 1	1/2	1									0.01	0.01			
11 2	1	1									0.02	1			
" 3	12	1	1								0.01				
Copper cleaners			1										+		
No. 1	11/2		1	500-	g cell								+		
No. 2	1	1	1		g cell						· · · · · · · · · · · · · · · · · · ·				
					8										
PRODUCT	W	т			ANA	LYSIS	%				DI	STRIB		N %	
	9	6	Cu	РЪ	Zn	Fe	Ag	Fe/FeS	5	Cu	P	Ь	Zn	Ag	
Final copper conc*	2	.99 2		1.14	2.00	31.8	20.84			69.		2.2	0.7	18.3	
Copper cleaner tail No.			6.41	8,06	4.76	33.0	19.68			11	-	5.1	0.5	5.6	
11 11 11 No.	1 2.		2.05	9.95	6.96	30.2	12.49			11		4.7	1.8	8.3	
Lead conc B**	0.	19	7.22	16.35	3.64		211.30			11	1	2.0	0.1	11.8	
Lead cleaner tail B	11		9.32	4.21	2.46	30.0	56.90	1		11		0.5	0.1	3.2	
Lead conc A***				33.63	6.46	21.8	18.11	20.9		13	i	1.4	1.7	12.4	
Lead cleaner tail No.2-	41		0,49	8.33	9.32	31.6	11.54			1.	.0	5.1	2.1	8.9	
" No.1-	11		0.88		10.20	27.0	13.56	25.0	1	0.	.9	4.5	1.2	4.0	
Lead rougher tail Feed (calcd)	100.				8.92		1.05		<u> </u>	12.			91.8	27.5	
reeu (caicu)	1200.	00	1.00	1.53	8.70		3.41			100.	0 10	0.0 1	00.0	100.0	
											.				
REMARKS Two 2000- ~ bo	tchoc		l	£1/					1				l		
REMARKS: Two 2000-g ba copper-lead separation.	CCHES	groun	u and	rioat	ed separ	rately	- rough	ner con	icentra	tes co	mbine	d for	clean	ing and	
			tor .	6	••• • • • •	o to t									
* Tailing from copper-1	eau se	parat	101 0	L COPP	er conce	entrate	•								-

""Lead conc from copper-lead separation of copper concentrate

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······································	PLE: Ma	ttagam	i-Stu	irgeon	Lake F	<u>-2 + F</u> -	7 Conpo	osite (.	1:1)				TE: Dec	ember 1	5,1970
OBJECT OF TEST: .													ARGE:		
							·	•					STED B	Y:	
OPERATION	Time	%	На		Unit						lb per				
	min	Solids			used					NaCN	AF 242		ZnSO	4	1
Lead cleaners A		1	1				•	[]				1			
No. 1	1		1	500	-g cell					0.1					-
No. 2	1				-g cell					0.05		1.			-
Copper-lead separation						1						-			Ð.,
of copper conc		<u> </u>												- <u> </u>	
Conditioning	5	1	9.	5 250	g cell		1			0.8		1	0.6	5 .	
Lead rougher B	1/2			17	11		· ·				· ·				1.1
" cleaner B	1			11	11			•			0.005	1			· .
			1				1					1			1
•												1 · ,	· · ·		1
				1					· · ·		·				
			1							· · ·		1			
								D	STR	TRIBUTION %					
PRODUCT	%	6	Cu	Pb				Fe/FeS	1	Gi			Zn		Fe/FeS
Calculated Assays			<u></u>		<u> </u>	<u> </u>	<u> </u>	1.611.60							1 0/1 00
Copper rougher conc	6.	60 1	2.90	5.70	4.68	31.1	24.33	19.3		8	5.2 2	4:5.	3.2	47.2	
Lead rougher conc A	11	11		29.71	11.34		46.35	22.7		51		2.0	5.0	25.3	
Combined lead conc A+B	2.	53	0.65	32.33	6.25	21.8	32.62	20.5			L.7 5	3.4	1.8	24.2	
		· ·												• •	
Metallurgical Balance				· · · ·			, i								· · ·
for Copper-Lead Separat															
Final copper conc	88.			1.14	2.00		20.84		1.1			6.7	83.9	. 55.1.	86.3
Lead conc B	11			16.35	3.64		211.30					2.5	9.7	35.4	7.6
Lead cleaner tail B Feed (calcd)*	100.		9.32		2.46	30.0 31.2	56.90		· ·		+.9 <u>1</u>		6.4 100.0	9.5 100.0	6.1 100.0
Feed (carco)*	100.		2.04	2.17	2.12	31.2	33.56	11.0	ļ		-0110	0.0	T00.0	100.0	100.0
													1. A.	•.	
							1							·•.	
							1								
•								•							
DEMARKO					1	l	1	L	1]]	<u> </u>	1	(1
REMARKS: * Copper co	ncentr	ate		· .	• •	. *		•							• •
		•				×,						÷ *	•	· · ·	525

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Sheet 1 of 2

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					eon Lal						·			bruary $2 \ge 200$	
OBJECT OF TEST: Copp	er-le	ad se	parat	ion usi	ng the	aichro	mate n	netnoc	i in co	njunct	lon				
with a hot pulp													STED B	<u>Y: A.</u>	S
OPERATION	Time		PH	-	Jnit		ht do	NT (0) T		gents.				1	
	min	Solid	s	L	ised	NazCO	$_{3}$ $Va_{2}SO_{3}$	NaCN	AF208	AFZ4Z	LH250	CuS	O ₄ Lim	e Z-20	UNAAI
Gringing	45	65		7 x	14 RM	4.0	1.0	0,1							
Conditioning	10		9.8	3 100	0-g_cel	ų			0.01	0.02					
Copper-lead rougher														·	<u> </u>
Stage 1	1					_					0.004	1			
" 2	1								0.01	0.01	0.004	1			
11 3	2					1				0,02					
Conditioning	10		10.	9					-			11	06.	0	
Zinc rougher						 									
Stage 1	1/2													0.0	1
2	1										0.02				
. 11 3	2										0.02				
<u>п 4</u>	1														0.0
PRODUCT	W	Т			ANAL	YSIS	%				D	ISTR	IBUTIO	N %	
PR05007	9	6	Cu	Pb	Zn	Fe	Ag_	Fe/Fe	es	Cu	P	<u>b</u>	Zn	Ag	
Copper conc	0	. 81 2	29.06	2.44	5.04	26.9	83.19	0.8		42	. 8	0.9	0.5	25.2	•
Copper cleaner tail No?	2 0	1.107				,									
11 11 11 11	11	11.5	8.29	36.01	9.60	1.40	55.79	5.6		5	.7	6.0	0.4	7.9	
Lead conc	11	.34	1	36.83			14.80	1		2	.7 7	0.5	1.6	24.1	
Copper-lead cl tail No.	11	.68	1	8.08	1		14.70	(10		2.4	0.7	3.7	
" " " " No.	11	80	1	7.47	1 1	29.1	12.89	1	1	18		5.9	2.1	8.7	
" " " No.		. 57	1.91			31.5	8.20	4	ŧ	11		4.2	2.8	7.9	
Zinc conc	11	.29	0.12		58.77	7.3	0.93	1	1	11	1	0.9	77.5	3.9	
Zinc cleaner tail	11	19	0.35			17.0	2.43	1		11		1.4	7.6	2.0	
Zinc rougher tail	- H	94	0.05		0.76	1,.0	0.58	į.		11		7.8	6.8	16.6	
Feed (calcd)). 0d	0.55		8.56		2.67			100	.0 10	0.0	100.0	100.0	
- REMARKS:	1	<u> </u>					<u> </u>						 	<u> </u>	

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TEST NO. 39 SAME		Matta	amı-	Sturg	eon Lak	<u>te F-7</u>						TE: Fe	<u>b. 23.</u>	<u>1971</u>
OBJECT OF TEST:											C⊦	IARGE:		
	-											STED B	Y:	
OPERATION	Time	1	Ha		Jnit		· · · · · · · · · · · · · · · · · · ·		Rea	gents, Ib	· · · · · · · · · · · · · · · · · · ·			
· · · · · · · · · · · · · · · · · · ·	min	Solids		<u> </u>	used	Dich		NaCN		DE	250	Lim	e Z-20	19
Copper-lead cleaners						•.								1
• No. 1	1 1/2		·	500)-g cell			0.05						·
	$1 \frac{1}{2}$			11	11							•	0.00	5
No. 3	1 1/2	Ì		250)-g_cell	. Š				0.	002			
Zinc cleaner	. 2	•	11.1	1000)-g cell					0.	02	1.0)	
Copper-lead separation				•				· .						
<u>Conditioning*</u>	5	[ļ	250)-g cell	0.3								
Copper rougher								· ·						
Stage 1	1		ļ						·	0.	002	·		
Stage 2	1/2		<u> </u>		······································								0.01	
Cleaner No. 1**	1 1 /2	ļ	ļ		· ·	<u></u>		ļ			002			
<u>"No. 2</u>	1	<u> </u>				.l				0.	002	·		<u> </u>
PRODUCT	W	т [[ANA	YSIS	%	· · · · · · · · · · · · · · · · · · ·		1	DIST	RIBUTIO	N %	
	9	6	Cu_	Pb	Zn	Fe	Ag	Fe/Fes	5	Cu	Pb	Zn	Ag	Fe/Fes
Metallurgical Balance	•	· //												
for Copper-Lead							1	ļ						
Separation						5						А. С. А.		
Copper conc	14	.68 2	9.06	2.44	5.04	26.9	83.19	0.8	· .	83.6	1.1	18.8	44.2	0.8
Copper cleaner tail No.	2 1	.76]]	;						1			·	•	
11 11 No.	14	.04)	8.29	36.01	9.60	14.0	55.79	5.6		11.0	7.7	16.6	13.7	2.4
Lead conc	78	.52	0.35	36.83	3.24	19.9	14.80	19.2		5.4	91.2	64.6	42.1	96.8
Feed (calcd)	100				3.94		27.63	15.6		100.0	100.0	100.0	100.0	100.0
Copper ro conc (calcd)	21	.48 2	2.48	13.06	6.48	22.8	74.51	2.3		94.6	8.8	35.4	3.2	57.9
				Ì	•									1
			•											
													·.	
)			[•			1	{{				
	!!			<u> </u>			<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u>}</u>		
REMARKS						· · ·					· ·		· · ·	
														•
* Temp 56°C, ** Tem	1 55°	Cinh	orh c	leaner	9								رم المصمحين	
- Temp 20 C' Tem				1001101	2						•		-	

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Sheet 1 of 2

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					eon Lal							I	TE:Feb		
DBJECT OF TEST: Cop	per-lea	ad sepa	ratio	on usi	ing the	SO ₂ - S	tarch 1	nethod		•			ARGE:		
										agents.			STED B	YA	5
OPERATION	Time	%	pН		Jnit Jsed		NG CO	NACNA		<u> </u>			00	<u></u>	
		Solids							E 200	AF 242	<u>F 6</u> :	50 2 - 2			-
Grinding	45	65			14 RM		1.0								
Conditioning	10	ļļ	9:6	1000	<u>-g cell</u>				0.01	0.01					
Copper-lead roughers						:	<u> </u>		·······						
Stage 1	1/2 .								· · · · · · · · · · · · · · · · · · ·	+	0.0				
11 2	<u><u></u></u>			ļ						0.01	0.0	04			_
11 3	1			. <u> </u>			<u> </u>			0.01					
	1				·······					0.01					
Copper-lead cleaners	1 1/2			500											
No. 1	1 1/2	!		500	-g cell			0.025			<u> </u>	02/0_0	05		
No. 2	2	 									0.0	02 0.0	<u> </u>		
No. 3	1 1/2			250	-g cell			<u> </u>							
	<u> </u>	1 1		<u> </u>			<u> </u>			<u> </u>			<u> </u>		
PRODUCT	W	11.				ALYSIS %							BUTIO		
	9	6 . Ci	u .	Рb	Zn	Fe	Ag	Fe/Fes		Cú		РЬ	Zn	Ag	
Copper conc	0	61 26	75	4 47	4.56	27.7	95.61	3.7]	29.	9	1.2	0.3	22.1	
Copper cleaner tail	11	.25 7.	i				76.15	1		11	5	4.0		7.2	
Lead conc	11				1		16.39			11	5	70.8		24.4	
Copper-lead cl tail No	11	.71, 7.	1		F [14.24	1		11	1	2.7	(3.8	
" " " No			1		8.54			1 '		23.	- F	4.5		7.7	
u u u u No	1 2				9.44					20.	1	6.9		11.1	
Copper-lead ro ther	19	.07 0.			8.89	J U • 1	0.69			11	9	9.9	•	23.7	
tail	1 70		00	0.20	5.97					/.	1	/• /	/ *		
Feed (calcd)	100	.od 0.	55	2 34	8.77		2.64			100	0	100.0	100.0	100.0	
reeu (carcu)				.	0.11		L.07								
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	!	II			<u> </u>		l	i]	<u> </u>			اير ا		

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Sheet 2 of 2

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TEC NO. 40 EAMP					. 24, 1	971.									
OBJECT OF TEST:												CHA	ARGE:		
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OPERATION	Time	%	pН	ι ι	Jnit	·			Reag	ents,	lb pe	r toņ			
	min	Sclids		<u> </u>	sed	_]	DF25()Z-2	00 CS	SO2	
Copper-lead separation						·	Ì								
Conditioning No. 1	5		-		g cell							1.5	0.02		
11 11 No. 2	5		3.8	ļ		_								0.05	·
Copper rougher	2			ļ		· · · · ·						0.0	1		
Copper cleaner	1/2		3.3	150-	g cell	ly.	1		·	K	0.002	2		0.035	· · · · ·
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			- <u></u>					 ·							
	Tw	-		1		LYSIS	.L	<u> </u>		<u>_</u>		ICTD	IBUTIO	<u> </u>	1
PRODUCT	%	19	17	Pb	Zn	Fe		Fe/Fes		Cu		Pb	Zn		Fe/Fes
Metallurgical Balance		=		<u> </u>			5								. 0/1 00
for Copper-Lead											·	94. 1			
Separation															
Copper conc	12.	77 26	5.75	4.47	4.56	27.7	95,61	3.7		81.	0	1.5	9.4	41.2	3.2
Copper cleaner tail	11				8.05					11	5	5.3		13.5	
Lead conc	- D									14		3.2	1	45,3	•
Feed (calcd)					6.19		29.65						the second second second second second second second second second second second second second second second s	100.0	
Copper ro conc (calcd)					5.58		89.93			90.	5	6.8	16.2	.54.7	5.9
		1				1.1									
	1														
		ii.												1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	
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	11			l				<u>L</u>	1	11		1			
PEMARKS.			• •		· · · -	•	• •		· · · ·	• • • •	·.			· · · · · · · · · · · · · · · · · · ·	
5 5												• •			. :