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To W. Muir Date July 23, 1975

From M. Fernandes J. Ark

Subject To Determine the Response of the A.E.X. Ore to Anvil Milling Procedures

Introduction

The initial A.E.X. core samples in early June were split into two composites of 'high' and 'low' grades. Preliminary testwork was carried out to observe the metallurgical performance of the ore using Anvil 'standard' flotation techniques with the present plant reagent scheme. The abnormal oxide content of these samples led to the acquisition of a fresh sample on June 27, 1975.

Summary

Parameters investigated included flotation characteristics using Anvil standard procedures, flotation of lead in lime and ammonia circuits, and grade-recovery features for roughing and cleaner concentrates. An entirely different reagent scheme seems to be required to treat A.E.X. ore in the Anvil circuits. Unusually high concentrations of zinc are seen reporting to the lead circuit, using the present Anvil mineral processing method. Increased reagents (especially Na_2SO_3) to the primary grind produced improved metallurgy, although still substandard to Anvil. The 'regrind - cleaner flotation' tests on the A.E.X. ore resulted in noticeably poor selective lead and zinc concentrate recoveries; prime selective zinc concentrates of over 54% grade were easily produced.

Data

Assays (%) for ore samples used in tests are given below:

	<u>Low Grade Composite</u>	<u>High Grade Composite</u>	<u>Sample of June 27</u>	<u>Anvil Mill Feed of July 7*</u>
Pb	3.20	5.66	5.21	3.92
Zn	5.07	7.68	8.50	5.54
PbO	0.29	0.30	0.35	0.31
ZnO	0.24	0.12	0.37	0.11
Fe	19.0	16.5	14.3	34.4
Pyrrhotite	1.8	2.6	2.6	6.3
Pyrite	17.2	13.9	11.7	28.1
Cu	0.12	0.13	0.06	0.22
Mn	0.07	0.15	0.03	0.14
BaO	1.95	2.81	--	--
Ag (oz/Ton)	1.40	2.65	2.40	--
Oxygen demand in pulp (ppm)	0.2	--	0.2	0.4
Natural pH of ore in water	7.5	7.5	--	6.5

* Anvil was milling crushing stockpiled ore at this period as evidenced by the oxide content and oxygen demand. The oxygen demand for normal Anvil ore is about 2 p.p.m.

Procedure

Standard soda ash laboratory tests were performed on the A.E.X. ore samples with a few variations. An Anvil mill feed sample was also tested in conjunction with the sample of June 27. After the initial batch tests, Anvil 'regrind-cleaner flotation' tests were run on all the samples to determine final concentrate grades possible; in these tests, the combined rougher and scavenger concentrates were reground, and the pulp recleaned four times. (Recoveries were not too emphasized.)

Procedure (Continued)

The oxygen meter was used to determine the oxygen demands of the pulp samples, and hence, the degree of oxidation of the ore.

Results

Test No.	Test Reagents in lbs./ton	pH		Combined Lead Concentrate				Combined Zinc Concentrate				Iron Distribution in Zn ScT	Remarks
		Pb	Zn	Assay %		Dist. %		Assay %		Dist. %			
				Pb	Zn	Pb	Zn	Pb	Zn	Pb	Zn		
<u>Low Grade Ore</u>													
3301- 2	2.0 Na ₂ CO ₃ + 0.2 NaCN	9.8	10.8	13.6	9.3	83.8	30.6	0.9	15.1	6.8	60.4	--	
3309-10	4.0 Na ₂ CO ₃ + 0.25 NaCN	10.3	10.3	13.3	9.4	84.7	37.4	0.8	7.9	10.0	58.5	8.3	
3313-14	4.0 Na ₂ CO ₃ + 1.0 Na ₂ SO ₃ + 0.25 NaCN	10.2	10.1	17.3	11.0	80.8	31.5	1.1	10.4	10.5	63.2	27.5	Na ₂ SO ₃ addition
3315- 6	4.0 Na ₂ CO ₃ + 1.0 Na ₂ SO ₃ + 0.25 NaCN	10.4	10.0	10.7	11.0	80.5	32.4	1.0	7.5	13.3	61.0	19.2	↑CaO to Zn Rgr.
3317- 8	4.0 Na ₂ CO ₃ + 1.0 Na ₂ SO ₃ + 0.25 NaCN	10.4	11.4	19.7	10.5	78.2	25.0	1.6	12.7	14.2	68.2	50.9	↑CaO to Zn Rgrs.
3321- 2	4.0 Na ₂ CO ₃ + 1.0 Na ₂ SO ₃ + 0.3 NaCN	10.2	11.5	17.7	11.7	73.1	31.8	1.6	13.7	10.9	61.3	52.4	↑NaCN
3323- 4	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.2	11.5	18.0	10.6	82.3	29.1	1.3	14.2	10.1	63.8	52.0	↑Na ₂ SO ₃
3325- 6	4.0 Na ₂ CO ₃ + 2.0 ZnSO ₄ + 0.25 NaCN	9.7	11.5	13.7	7.8	87.2	30.6	1.0	13.8	7.1	63.8	42.5	ZnSO ₄ addition
3327- 8	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.3	11.5	17.6	10.1	83.4	28.8	1.1	15.5	8.0	64.9	56.2	Cleaning test Z-11 added in
3329-30	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.3	11.5	17.2	10.4	84.5	30.8	1.2	13.0	9.5	63.5	43.9	Stages to Pb Rgrs.
3331- 2	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.4	11.4	19.6	10.3	76.3	25.2	1.5	13.2	11.9	67.3	52.4	
3333- 4	0.9 NH ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	9.9	11.5	13.3	11.3	85.5	42.4	1.1	13.5	7.1	51.1	45.2	NH ₃ addition
3335- 6	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.4	11.0	25.1	10.8	88.2	32.8	0.9	11.4	5.8	59.4	51.6	Cleaning test
3337- 8	3.0 CaO + 2.0 ZnSO ₄ + 0.15 NaCN	11.7	11.9	33.0	8.1	61.8	9.9	3.7	15.7	30.1	82.4	61.1	CaO Test

Results (Continued)

Test No.	Test Reagents in lbs./ton	pH		Combined Lead Concentrate				Combined Zinc Concentrate				Iron Distribution		Remarks
		Pb	Zn	Assay %		Dist. %		Assay %		Dist. %		In	Zn ScI	
<u>High Grade Ore</u>														
3305- 6	3.5 Na ₂ CO ₃ + 0.2 NaCN	10.2	10.2	23.0	14.6	84.6	39.5	1.9	20.2	6.6	50.8	--		
3307- 8	3.5 Na ₂ CO ₃ + 0.2 NaCN	10.2	10.4	21.1	15.1	85.9	41.8	1.7	20.6	6.0	49.4	--		Cleaning test
3311- 2	3.5 Na ₂ CO ₃ + 1.0 Na ₂ SO ₃ + 0.2 NaCN	10.4	10.2	26.9	15.3	76.9	30.6	3.4	26.5	10.1	56.0	66.6		Cleaning test Na ₂ SO ₃ addition
3319-20	3.5 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.3 NaCN	10.2	10.2	35.0	16.4	69.4	21.5	4.4	31.3	13.3	62.1	79.5		Cleaning test ↑ Na ₂ SO ₃ and NaCN
<u>A.E.X. Sample of 06/27/75</u>														
9187- 8	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.2	11.0	22.8	18.1	80.8	41.4	2.6	18.4	11.6	52.2	47.6		A.E.X. standard
9189-90	2.0 Na ₂ CO ₃ + 0.5 Na ₂ SO ₃ + 0.2 NaCN	9.6	11.0	20.4	16.9	87.3	45.2	1.9	20.2	7.5	49.4	45.0		Anvil Standard scheme
9191- 2	2.0 Na ₂ CO ₃ + 0.5 Na ₂ SO ₃ + 0.2 NaCN	9.7	11.0	20.7	17.4	87.0	45.8	1.9	19.8	7.7	49.8	40.0		
9193- 4	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.2	10.9	21.6	16.9	83.3	44.5	3.0	17.0	13.0	51.1	29.8		
9197- 8	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.3	10.9	20.0	17.7	86.5	47.3	1.7	13.6	9.9	49.3	10.4		Z-11 added in stages to Agns.
9199-200	2.0 CaO + 2.0 ZnSO ₄ + 0.2 NaCN	11.1	11.2	30.2	16.4	75.2	25.2	3.5	19.5	20.3	69.3	43.0		CaO test
9203- 4	4.0 Na ₂ CO ₃ + 5.0 ZnSO ₄ + 0.25 NaCN	8.2	10.9	14.7	12.2	90.7	45.5	1.6	19.8	6.4	48.0	20.3		ZnSO ₄ addition
9205- 6	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.2	10.9	21.1	18.5	85.3	44.2	1.9	22.5	7.4	50.2	47.7		Cleaning test
<u>Anvil Mill Feed of July 7</u>														
9195- 6	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	10.1	10.9	29.7	7.7	89.7	16.1	0.7	35.2	2.3	79.6	84.4		A.E.X. standard scheme
9201- 2	2.0 Na ₂ CO ₃ + 0.5 Na ₂ SO ₃ + 0.25 NaCN	9.7	11.0	27.5	7.8	87.9	17.8	0.8	33.4	2.6	78.0	82.0		Anvil standard scheme

Notes

1. The rougher and scavenger concentrates were combined for the above results.
2. The -200 screen fraction for the Zn ScI averaged:

58% - low grade composite
58% - high grade composite
55% - A.E.X. sample of June 27
66% - Anvil sample of July 7

Results (Continued)'Regrind - Cleaner Flotation' Results

<u>Test No.</u>	<u>Test Reagents in lbs./ton</u>	<u>Lead Final Concentrate</u>				<u>Zinc Final Concentrate</u>			
		<u>Assay %</u>		<u>Rec. %</u>		<u>Assay %</u>		<u>Rec. %</u>	
		<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>
<u>Low Grade Composite</u>									
3327- 8	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	37.6	11.6	56.8	10.6	1.1	46.1	2.0	53.9
3335- 6	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	35.8	12.0	67.9	19.7	1.3	33.1	2.5	54.5
<u>High Grade Composite</u>									
3307- 8	3.5 Na ₂ CO ₃ + 0.2 NaCN	51.2	13.0	51.2	8.9	1.3	54.0	1.1	31.9
3311- 2	3.5 Na ₂ CO ₃ + 1.0 Na ₂ SO ₃ + 0.2 NaCN	57.7	11.5	29.8	4.1	1.6	54.9	1.3	32.1
3319-20	3.5 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.3 NaCN	58.9	12.8	23.1	3.4	1.4	54.7	0.8	20.9
<u>Sample of June 27</u>									
9205- 6	4.0 Na ₂ CO ₃ + 5.0 Na ₂ SO ₃ + 0.25 NaCN	56.8	13.2	28.4	3.9	2.2	48.2	3.2	42.1

Detailed results are given in Appendix I.

Discussion

The A.E.X. ore samples behave differently from Anvil ore in a standard soda ash circuit. Depression of the iron and zinc minerals while floating the lead was a major problem. The usual pyrite and sphalerite depressants (NaCN , Na_2SO_3 , and ZnSO_4) were tried, but with limited success. Higher sulphite additions and higher zinc circuit operating pH's appear to be necessary to keep down flotation of the iron sulphides. The zinc recovery in the lead circuit for the A.E.X. ore is about double that for the Anvil ore. The original Anvil reagent scheme (lime/zinc sulphate), produced the best zinc metallurgy, but with disappointing shortfalls in lead recovery.

Low iron with favourable pyrite/pyrrhotite ratios allowed for easily obtainable zinc concentrate grades of over 54%. The lead concentrate could only be cleaned up to about 55-60%. The selective metal concentrate recoveries were very low. Substantial amounts of collector were required to refloat the lead minerals in the cleaning stages.

There was no variation in both the oxide content and oxygen demand of the high and low grade composites over a period of a month. The A.E.X. sample of June 27 was acquired soon after drilling and analysed immediately for oxides. It seems that the metallic oxides are inherent in the ore. The metallurgical performance of the A.E.X. deposit seems to vary with different ore samples (and possibly depths) as seen from the iron content of the various concentrates floated.

If A.E.X. ore is to be treated in the Anvil circuit, metallurgical testwork is required on preferably core samples approximating the feed grades of ore which may be milled. Future testing should include grinding characteristics and the effect of treating blended Anvil and A.E.X. ore mixtures.

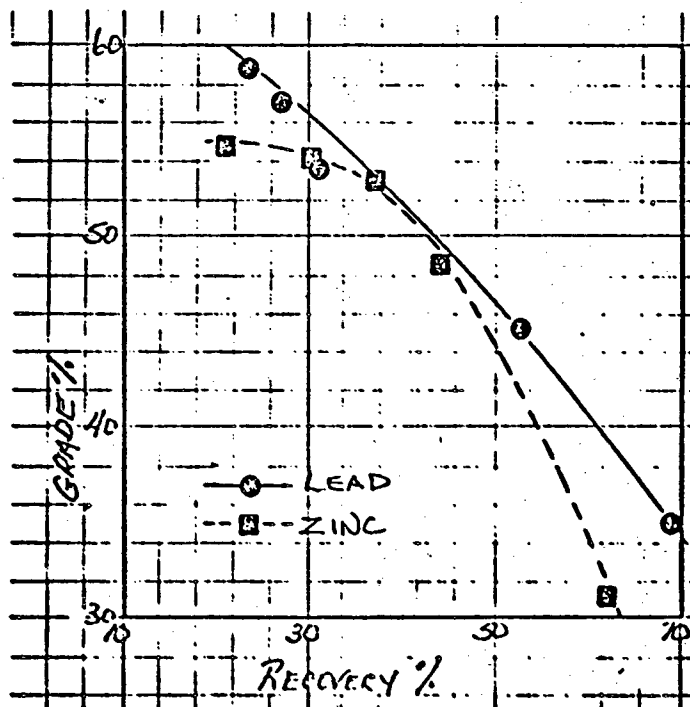
APPENDIX I

A.E.X. Testing - Cleaning Test 3319-20

Cumulative Grades and Recoveries

<u>Product</u>	<u>Wt. %</u>	<u>Assay</u>		<u>Distribution</u>	
		<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>
Pb Final Conc.	2.00	58.9		23.1	
3rd C. Conc.	2.42	57.0		27.0	
2nd C. Conc.	3.03	53.5		31.7	
1st C. Conc.	6.01	45.3		53.2	
Rghr. Conc.	10.14	35.0		69.4	
Zn Final Conc.	2.95		54.7		20.9
3rd C. Conc.	4.38		54.1		30.7
2nd C. Conc.	5.49		53.0		37.7
1st C. Conc.	7.04		48.6		44.3
Rghr. Conc.	15.30		31.3		62.1
Zn Scav. Tail. Heads	74.56	1.2	1.7		
		5.12	7.72		

Grade-Recovery Curve Test 3319-20



Cyprus Anvil Mining Corporation
METALLURGICAL TEST REPORT

Grade-Recovery Curve

Test No.: 9205-6

Date: 7/17/75

Objective: Standard test

Key: Pb ○○○○

Reagents: 4% Na₂CO₃ + 5% Na₂SO₃ + 0.25% NaCN

Zn (F.F.)

