

006935

February 11, 1971

TO: Mr. R. E. Thurmond
FROM: H. Lyall Ames
SUBJECT: Visit to the Anvil Corporation Mill at Faro, Feb. 1- 5, 1971.

c. c. Mr. Herbert H. Cox

The original purpose of this visit was (1) to check the progress made in developing a "Standard Test" procedure in the laboratory to use as a bench mark for practically all flotation testing. (2) suggest mill tests as a follow-up to any interesting leads developed in the laboratory and (3) to determine the reasons for the bulk concentrate production being so far behind schedule.

It soon became apparent that no analyses of the above points or mill operation could be made without becoming involved in the zinc retreatment 'circuitry' and the dewatering sections.

General Comments

I did not spend any time in the head end of the mill but I am satisfied that there were no serious bottlenecks or maintenance problems in the crushers, bins and grinding units. As an example of the corrective measures taken since last September they have done an excellent job of zincing in the rod mill liners. Actually everything through to the end of lead flotation looks quite fair including the lead metallurgy. Although I think lead recoveries can be improved somewhat the circuit is operative and is in a condition that can be developed. At this point, unfortunately, troubles start and plague all the rest of the mill. For short periods operations are just sufficiently satisfactory to encourage the hope that corrective measures envisioned would iron out the difficulties. To date I have been reluctant to recommend any radical or costly changes or equipment installations as I too have been hopeful but I think the time has arrived where it would not be in the interest of the company to delay any longer.

At this time I am optimistic that the use of sodium carbonate as a flotation reagent and the addition of a dryer might have a major impact on the economics of the whole milling operation. These will be discussed later in this report.

Standard Tests

Within the last month some progress has been made in developing a specific routine procedure of laboratory testing. It is not yet completely satisfactory but it is getting closer. I have discussed this work at length with Corwin Likins and Peter Brown, and have worked directly in the laboratory with Harry Craige on a sufficient number of tests to be satisfied that they can be carried out in a capable manner. The three technicians also appear much more inquisitive and interested than on other visits.

At this time the "Standard Tests" being run in the laboratory are giving lead recoveries of 65%-67% in a 53% Pb rougher concentrate. The zinc recoveries are about 69% in a 28.5% Zn rougher concentrate. The appearance of the froth in the zinc float is particularly bad--as it is in the mill. Satisfactory metallurgy will never be attained with this slimy froth condition. I am certain that with sufficient test work and stubbornness this can be corrected in the laboratory and with the full cooperation of the operating staff the technique can be taken into the mill. This is the basis for my continued emphasis on laboratory work. Soda ash may be the answer.

Bulk Concentrate Production

The insignificant production of bulk concentrate produced to date has been disappointing. Logically with a fine grained complex ore such as Anvil's the idea of routing say 250 TPD of true middling product out of the flotation circuit is nothing short of a millman's dream. Some progress was made in January and it would appear that more is being made in February regarding the proper products, and ratios of each, to send to bulk - 6 last cells of the zinc retreatment circuit, 4 last cells of the first zinc cleaner, and the last 3 cells of the lead retreatment circuit. These have to be adjusted frequently to maintain the proper lead to zinc ratio, roughly 30% zinc and 18% lead. This is not easy, particularly keeping the lead content down but it can be done. The main reason for not making a satisfactory amount and grade of bulk concentrate to date has been continuing troubles with the bulk and lead thickeners which have caused very unsatisfactory operation of the bulk concentrate system. In January a total of only 3255 tons of bulk concentrate was produced and dried. The total for the month of December was only 1,025 SDT. I think the objective for February is 200 TPD. An example of the troubles encountered occurred on February 4 when the lead thickener became full with concentrates and this concentrate therefore had to be diverted to the bulk thickener. With the amount of lead that will have to go

into this thickener straight selective zinc concentrate will later have to be added to make the proper lead-zinc ratio. This not only means getting less value for both selective concentrates but also completely upsets the bulk system.

Thickeners

Some months ago I calculated the capacity capability of all the thickeners based on other mill operations and they appeared adequately sized for at least average tonnages of concentrates. The fact that they keep building up with solids and having extremely dirty overflows (up to 3% solids) is easy to understand. Disregarding such things as broken valves, which can be corrected, the thickeners are between the flotation circuits on one side and the filter-drying operation on the other. No amount of operating will keep them functioning satisfactorily if the solid tonnage being discharged to the filters is not kept reasonably close to the tonnage going in. Thickeners are not intended or designed to be storage tanks for concentrate and will not operate in that capacity. They will accept surges but will never be relatively care-free unless they are operated as thickeners. Diaphragm pumps are on order for discharges. These will help regulate the discharge but in themselves will not correct the problem.

Measurements taken in December, 1970 indicate that in the order of 1000 DST of combined zinc and lead in terms of metal may have overflowed the different thickeners and been lost to tailings. In terms of recovery this means that at times an 80% recovery of lead in the flotation circuits is reduced to 71% by mechanical losses. With zinc the corresponding recoveries at times are in the order of 68% down to 63%.

Dryers

The filters appear adequate but the dryers are not capable of drying the surge tonnages which are inevitable with a complex and variable head such as Anvil's. I doubt very much if they can handle even an average load. They appear to be undersized and although some corrective measures are being taken such as tightening the air seals, I think there is very little hope of solving the capacity problem with the existing dryers. I have not actually analyzed the theoretical capacities of the dryers but I have the necessary data and will give it some thought. However, I have discussed the operation with Corwin and Peter Taggart and recommend that consideration be given immediately to the installation of another dryer. Certainly if we make the improvement in metal recoveries that we expect, the existing drying systems will be inadequate to handle the additional quantity of concentrates. They will continue to be the source of

major trouble causing serious mechanical losses of all concentrates in dirty thickener overflows (which have to be held back when the dryers cannot handle the tonnage required) and just as important this disrupts the flotation circuits which are then of necessity operated to suit the thickeners. I think that a new dryer about twice the capacity of the present ones which would take all the zinc concentrate is the best idea. Two of the existing four would then be available for lead, one for bulk, and one held as spare. All the existing dryers are 5-ft. in diameter by 40-ft. long. Design called for one dryer to dry 18.2 STPH of lead concentrate from 15% to 6% moisture, two dryers to dry 15.25 STPH from 19% to 6% moisture, and one dryer for the bulk concentrate. This last one has to be used quite frequently to take excess load from the lead dryer.

Two other types of dryers - spray and fluid bed - were discussed with Corwin and Peter Brown. I could not recommend either on the basis of my experience and investigations. The main thing at this time, however, is to decide to investigate without delay the dryer situation with a new dryer in mind.

Zinc Middling Circuit

Any inter-circuit thickener is always a source of trouble even if it can be operated steadily. This has been my experience.

in plants that I have either operated or visited. When such a thickener has to be used as a catch-all in emergencies for other than the intended flotation products then it is impossible to operate it satisfactorily.

They have tried many schemes in the zinc retreatment circuit at Anvil to alleviate the situation. At one time the retreatment tailings were discarded to mill tailings but the loss was excessive and so it was routed to the middling thickener along with a portion of the first cleaner tailing. The thickener underflow was then pumped to the regrind cyclones along with the zinc scavenger concentrate. At this date the retreatment tailing is being sent to the zinc conditioner at the head of the main circuit. Also, another idea is being tried of bypassing the thickener with the first cleaner tailing and sending the retreatment tailing to the head of the zinc scavenging circuit.

If at all possible this middling thickener should eventually be eliminated from the circuit. I do not know the best way to achieve this but it should be an objective. I have suggested that they try returning the first zinc cleaner tailing to the head of the zinc roughing circuit. I appreciate that this would add volume to the cells and might overload them but it is a customary method in most mills. A better and more recent method of handling the first cleaner tailings is

to treat them in a "first cleaner scavenger circuit" and discard the tailings. This simply means using a short flotation circuit as a dewatering step instead of a thickener. When the bulk concentrate production becomes stabilized at a reasonable rate say 200-250 TPD then it may be possible to pull this circuit fast enough to make a discardable tailing. If not, laboratory tests should be made to determine whether or not the metal content of this tailing is actually being recovered when it is recycled. It may be better to discard it in the first place even if its assay is relatively high. After all, the lead middling thickener was taken out of a similar circuit without adversely affecting the lead metallurgy. I realize that the situation is somewhat different but at least it is indicative. Most of these possibilities have been suggested by the mill staff or at least we have discussed them.

Metallurgical Statistics

The following metallurgical results, some revised, have been reported since my memorandum dated July 10, 1970.

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average 1970	Jan. 1971	F. O. B. Objective
Ave. DTPD Ore	4760	5550	4960	5930	6640	6226	5370		
<u>Mill Heads</u>									
% Pb	4.9	4.95	5.09	5.35	5.35	4.7	4.4		
% Zn	6.9	6.53	6.95	7.25	7.05	6.6	6.4		
Combined	11.8	11.48	12.04	12.65	12.40	11.3	11.8		
<u>Concentrate Grade</u>									
Sel. % Pb	68.2	65.2	63.1	66.8	64.5	62.4	66.2		65
Sel. % Zn	50.4	44.3	49.1	48.1	49.2	49.1	49.3		51
Bulk % Pb			22.5	14.5	45.7		22.1		18.9
Bulk % Zn			27.7	31.0	14.3		27.8		29.9
<u>Recoveries %</u>									
Selective Pb	80.2	81.7	74.8	54.5	75.6	73.9	74.8	70.9	70.6
Selective Zn	69.4	62.4	60.4	58.3	60.5	67.4	65.3	57.5	63.9
Bulk Pb			5.2	3.0	3.3		1.2	2.7	15.5
Bulk Zn			4.7	4.9	.8		1.0	6.0	16.4
Total Pb	80.2	81.7	80.0	57.5	78.9	73.9	76.0	73.6	86.1
Total Zn	69.4	62.4	65.1	63.2	61.3	67.4	66.3	63.5	80.3

NOTE: Recoveries for October were reduced by 19.6% lead and 4.20% zinc to adjust for stockpile waste.

The 1971 Metallurgical and Production objectives are as follows:

Selective Zinc Concentrate 600 TPD (51% Zn)

Selective Lead Concentrate 345 TPD (65% Pb)

Bulk Concentrate 255 TPD (18.9% Pb and 29.9% Zn)

TOTAL 1200 TPD (350 days)

Recoveries

Lead Selective - 70.6%
Bulk - 15.5%
Total - 86.1%

Zinc Selective - 63.9%
Bulk - 16.4%
Total - 80.3%

Soda Ash

Substitution of sodium carbonate for lime in the primary grinding mills should receive top priority over all other test work not specifically being required in connection with the day by day operation of the mill. This premise is based on the results of several individual laboratory tests and the series conducted on February 3 at Anvil when I was there, and also on all my experience with high sulphide ^{ore} ~~over~~ containing considerable pyrite, and some phrrhotite and magnetite. In all cases there is a better differential between the sulphides. In rare cases the extra cost of the soda ash is not justified. From what I have seen of Anvil ore I do not have any doubts concerning the economics.

I have discussed future laboratory work with the Anvil staff and I understand from Peter Brown that further work is progressing. This should include many series of tests alternating the alkalis and using various amounts. When the optimum dosage has been determined cycle tests will give overall metallurgy which can be expected in the mill.

Cyanide must be used in conjunction with the soda ash as the soda ash itself is not a depressant of pyrite. Also it is almost always advantageous to utilize aeration conditioning between the grinding

and flotation. Although some idea of the necessity of aeration can be obtained in the laboratory it may have to be checked in the mill.

I recommend that a sufficient quantity of soda ash be purchased immediately to run a one day test in the mill even before the laboratory investigation is complete. This would be done without aeration as this step is fairly complicated and would require considerable planning. The mill test could be run as follows:

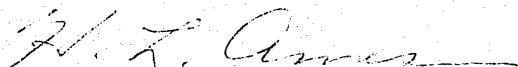
1. Consumption of soda ash will likely be in the order of 2.0 lb. per ton but could be as low as 1.7 or as high as 3.5. About 80% of this should be added to the rod mills and the remainder to the main grinding circuit ball mills. For a test this can be done by hand--a small measured container of so many pounds added to the ore at intervals of 5 to 10 minutes. I think that the pH in the lead circuit should be 9.1 - 9.2 or better still an acid titration should show about 0.9 lb. per ton of solution. Always keep in mind that from a metallurgical standpoint the upper limit of soda ash is not critical but the lower one is.

2. The amount of cyanide added to the grinding mills will have to be determined in the laboratory but I would expect it to be 0.25 - 0.50 lb. per ton of ore.

3. Lime should be added to the zinc conditioners about the same as now. The pH in the zinc roughers should be about 10.4. I also suggest that extra lime be added to the first zinc cleaners to raise the pH to about 12.

4. As soda ash is a dispersant more flocculants may be necessary in the thickeners. It is also possible that the circulating loads in the grinding circuits will increase but in this case it is advantageous. The zinc circuit should look different than it does now and a somewhat different operating technique may be necessary.

The following table is a record of the series test with soda ash and lime referred to at the beginning of this section.



H. Lyall Ames
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SODA ASH vs LIME (Feb. 3-4 at Anvil)

Product	% Wt.	Assay %		Units		Distribution	
		Pb	Zn	Pb	Zn	Pb	Zn
<u>LIME</u>							
Pb Con	10.5	36.7	10.0	385	105	83.9	16.9
Zn Con	12.1	2.9	33.0	35	400	7.6	64.6
Tail	77.4	.5	1.5	39	116	8.5	18.7
Head		4.59	6.21	459	621		
Pb	13.5	28.5	10.0	385	135	88.3	24.5
Zn	10.7	2.6	31.0	28	332	6.4	60.4
Tail	75.8	.3	1.1	23	83	5.3	15.1
Head		4.36	5.50	436	550		
Pb	15.4	25.8	11.5	397	177	88.8	31.1
Zn	13.5	1.6	24.8	22	335	4.9	58.9
Tail	71.1	.4	.8	28	57	6.3	10.0
Head		4.47	5.69	447	569		
<u>SODA ASH</u>							
Pb	12.2	34.0	6.5	415	29	88.7	13.6
Zn	13.5	1.7	34.6	23	467	4.9	80.1
Tail	74.3	.4	.5	28	37	6.4	6.3
Head		5.66	5.83	566	583		
Pb	12.2	33.2	6.9	405	84	89.8	14.0
Zn	13.6	1.8	34.6	25	470	5.3	78.5
Tail	74.2	.3	.6	22	45	4.9	7.5
Head		4.47	5.99	452	599		
Pb	10.9	35.8	6.9	390	75	85.7	13.2
Zn	13.5	2.6	34.8	35	470	7.7	82.7
Tail	75.6	.4	.3	30	23	6.6	4.1
Head		4.55	5.68	455	568		
<u>LIME AVERAGE</u>							
Pb		30.3				87.0	
Zn			29.6				61.2
Tail							
Head							
<u>SODA ASH AVERAGE</u>							
Pb		34.3				88.1	
Zn			34.7				80.4
Tail							
Head							