006958

March 28, 1972

TO: Mr. R. E. Thurmond

FROM: H. Lyall Ames

SUBJECT: Visit to the Anvil Corporation Mill at Faro, March 20 - 23, 1972

C. C.: Mr. R. L. Haffner, Mr. N. G. Cornish and Mr. H. H. Cox

As on previous occasions the main purpose of my visit was to discuss all aspects of the laboratory test work and mill testing programme with the metallurgical staffs and to a lesser extent general milling problems with the operating staff. In addition this time I had several meetings with Peter Taggart and Peter Brown developing general guide lines to be followed in the design of the proposed mill expansion.

1. Current Mill Metallurgy

The average daily metallurgical results for March 1 - 21 were as follows:

Ore Milled	7735 TPD assaying 4.53% Pb and 6.17% Zn.
Concentrate Shipped	Selective Lead - 367 TPD assaying 72.72% Pb.
	Selective Zinc - 547 TPD assaying 51.45% Zn.
	Bulbs - 245 TPD assaying 16.85% Pb and 30.90% Zn.
Recoveries	Lead - Selective 75.19%, Bulk 11.73%, Total 86.93%
	Zinc - Selective 58.58%, Bulk 15.82%, Total 74.40%
Comments	(1) Lead selective concentrate grade is good and metal production is about 17% over the 1972 forecast.
	(2) Zinc selective concentrate grade is within 0.5% of the forecast 52% but it is still a full 1.0% lower than it should be for the current grinding. It is improving slowly. Zinc metal production is 13% below the average daily forecast for this year, largely because the recovery is about 6% too low, about one-half of this being due to high milling rate.
	(3) Bulk concentrate grades and tonnages are pretty well on target.

2. Zinc Metallurgy

Probably the most important immediate problem in the mill is raising the grade of the zinc concentrate to at least 52.5%. The

economics of higher grade is important in itself but also until some free-board in grade can be maintained it is extremely difficult to carry out serious experimentation with recovery.

Although the 52.5% grade is being achieved frequently in the circuit analyses, load-out is currently averaging about 1% lower. The fourth zinc cleaners are being operated in open circuit and their function therefore is merely to split the third cleaner concentrate into two fractions, high grade (selective zinc concentrate) and low grade (constituting most of the bulk concentrate production). Therefore if the third cleaner concentrate can be maintained at 51% zinc as it was in January a final zinc concentrate of 52.5% should be a realistic objective. However, at this time when the mill tonnage rate is consistently high, satisfactory zinc grades are proving difficult to maintain.

In order to obtain further information concerning concentrate grade limits, two laboratory tests were run in which samples of third cleaner concentrate were cleaned nine times by standard procedures with fresh water, lime and occasionally more collector. In both series the final concentrate assayed 53.3% zinc. This figure is not to be taken as ultimate grade as we know that by reverse flotation

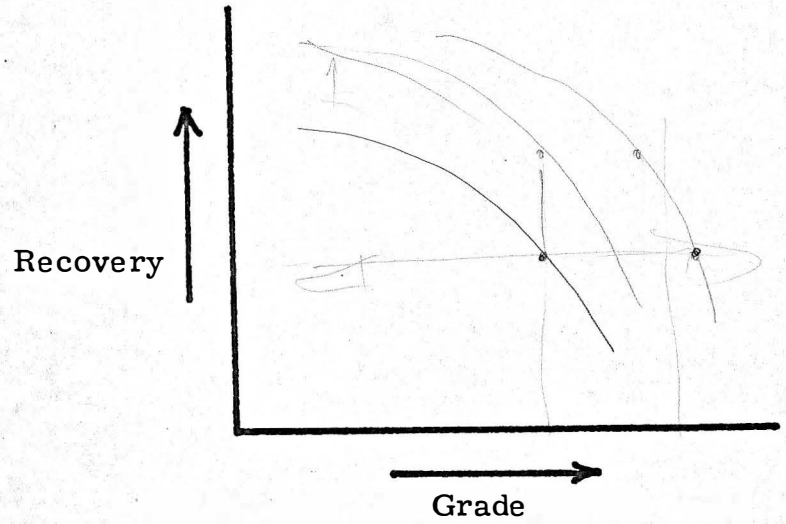
grades of 55% or more can be reached. Unfortunately it does appear however that anything over 53% may be quite costly although not necessarily uneconomic. I think that the best plan of action is to continue the present testing programmes designed to improve zinc grades all along the circuits starting with the rougher section. I like the present scheme of by-passing the overloaded second cleaners with the higher grade fraction of the first cleaner concentrate. Continued testing will likely indicate other circuitry changes from time to time and as the operators become more accustomed to the new fourth cleaners I think that the concentrate grade will gradually improve.

3. Metallurgy of Different Ores

I appreciate only too well the natural differences between ore types and their amenability to the flotation process. I know that it is as easy for Anvil to make a 72% lead concentrate as it is for another mill to make 36%. Also some companies have less difficulty in producing a 54% zinc concentrate than Anvil has a 50%. In spite of this I am concerned that we may be overlooking some small special technique employed by others that might help improve Anvil's metallurgy. I sponser as much interchange of technical know how as may be considered ethical, but this is not sufficient. I feel strongly that Anvil's metallurgical

staff should make simplified flowsheets of the circuitry of as many other mills as possible. They should be made on the same format so that they can be compared and studied more easily. Comparative circuit analysis is also important. I suggest such an idea for a major project and would be pleased to study and comment on it. It is one thing to overlook an idea for testing but it is even more regrettable not to take advantage of a technique already developed and operating in another mill. I realize that there are many published flowsheets of mills but they are usually lacking in important respects. The above project pertains to the fine points of the art.

In comparing other mills with Anvil's and also all internal comparisons of results good grade-recovery curves are essential.



Although all phases of the operation have some effect on the position of the curve they can be classified generally as follows:

Lateral Position

(1) Mineral analysis (iron content of sphalerite)

(2) Mineralization (association and fineness)

(3) Gangue

Vertical Position

(1) Circuitry

(2) Reagents

(3) Grind

(4) Operation

4. Bulk Concentrate

From an economic standpoint bulk concentrate should consist of only mill products which are the most difficult to separate into selective zinc and lead concentrates. Currently most of Anvil's bulk concentrate consists of all the fourth zinc cleaner tailing plus some lead circuit middlings. I appreciate that the grade must be maintained as near as possible to 18.9% Pb and 29.8% Zn but I concur with Peter Brown that there are likely other products somewhere in the circuit that are more refractory than the final zinc cleaner tailing. He carried out some tests while I was there in an attempt to upgrade this product.

An overall circuit analysis was underway when I arrived last week and a careful study of all the assays for both circuits may indicate some refractory products which theoretically should go into the bulk concentrate. Also, as soon as the fourth zinc cleaner operation is stabilized I suggested that it should be tried in closed circuit although I realize that this may present a dilution problem.

5. Sodium Sulphite Tests

Considerable laboratory testing with sodium sulphite as a reagent in primary grinding has been carried out during the past few months and the results are particularly interesting. I have always liked sulphite as an auxilliary reagent to soda ash and cyanide in copper-zinc circuits. I have never seen, however, an ore like Anvil's where in the laboratory, it appears possible to replace all the cyanide with sodium sulphite. However I do not think that this will be the case in the mill. Anyway laboratory results indicate that sulphite improves the differential between the lead and zinc minerals and pyrite which is very important. It should certainly be tested thoroughly and a supply has been ordered for a mill test. I suggested that no attempt be made to eliminate the cyanide or even reduce it in the preliminary mill runs. It should be added as an extra reagent to the soda ash and cyanide as they are. I also mentioned that the relative dosage and points of addition are sometimes critical to the successful use of sodium sulphite.

6. Unit Cell

I concur with the suggestion that a unit flotation cell be considered somewhere in the grinding circuit, probably on rod mill discharge. A large new Sala cell is being installed at the Brunswick Mining and Smelting mill in an attempt to recover coarse lead from one rod mill discharge in the No. 12 section. We can be guided by their experience. I will keep Anvil informed and in the meantime they might run laboratory tests on rod mill products when sodium sulphite is being tested.

7. Mill Expansion

The original mill had a designed capacity of 5500 TPD. The tonnage rate was raised later to a nominal 6600 TPD and a few more flotation cells were installed but space was not available for a sufficient number. Now with a much higher tonnage most of the flotation circuits are overloaded.

In order to maintain production requirements with lower grade ore (9% combined lead and zinc) it is now proposed to increase the milling rate to 10,000 TPD. This would be done by extending the flotation section of the mill and possibly the grinding section.

The following comments are based on the extensive test work which has been done at Anvil over the past year, my experience with similar ores and, more important, discussions with Peter Taggart and Peter Brown during my last visit to the property. These suggestions should be considered as preliminary only as such a major project warrants a much more thorough study.

The overall concept of the expansion with regard to flotation is based on utilizing a major portion of the present flotation section for zinc leaving only the last two stages of lead cleaning intact. The main lead circuits would be in the extension. A table of possible cell changes and additions is appended to this report as a basis for discussion. It is possible that all of the suggested new cells may not be required but I like to begin with a circuit that we think will give optimum metallurgy and then curtail certain areas as the overall economy of the project becomes more clarified. Certainly it would be wise to take this opportunity to strengthen those circuits which operation has shown to be under capacity. Also concentrate grade is becoming more important all the time and it is essential to have sufficient cleaners. If there is any doubt about some new cells, space should be left to install them later.

Actually the foregoing comments regarding flotation cells are intended as a beginning only to the project. There are many other important considerations such as incorporating one or two aerators in the circuit ahead of the lead flotation; the possibility of even a further expansion; grinding requirements; and flexibility to try other circuitry such as regrinding all the cleaner tailings except the first stage as at the Texas Gulf mill or discarding entirely the first cleaner tailing as at this mill and also as at Mattagami Lake.

8. Reverse Flotation

This process consisting of zinc depression and pyrite flotation has been employed at Brunswick Mining and Smelting Co. for increasing zinc concentrate grade for some years. Although it is a relatively costly process it is effective and in their case economic. Because it was another complication I have heretofore not recommended that Anvil give it too serious consideration. However if too much difficulty is encountered, or it proves impossible, to maintain a satisfactory zinc grade of 53% then it may be necessary to explore the idea more carefully. I know that some test work has been done at Anvil with encouraging results. It would be opportune now to make an economic evaluation so that if required the necessary space could be left for the circuit in the extension.

SUGGEST CELLS FOR EXTENSION

Circuits	Rows x Cells		Additional Cells in Circuit	Location and Remarks
	Present	Future		
Lead Roughers	3 x 13	3 x 8	+60% C. F.	New 200 C. F. cells all in extension
First Cleaners	1 x 6	2 x 9	12	Present Pb retreatment + first cleaners + 6 new cells (?)
Second Cleaners	1 x 5	2 x 5	5	Same location back to back
Third Cleaners	1 x 3	2 x 3	3	Same location back to back
Retreatment	1 x 13	2 x 5	(3)	Tail ends at present first cleaners and retreatment
Zinc Roughers	3 x 13	5 x 13	26	2 rows present Zn roughers and 3 rows Pb roughers
First Cleaners	1 x 11	2 x 16	21	Present 1st cleaners + retreatment rows + 10 new cells
Second Cleaners	1 x 5	2 x 8	11	All in extension
Third Cleaners	1 x 5	2 x 6	7	Present 2nd and 3rd cleaners
Fourth Cleaners	1 x 4	1 x 4	-	No change