

Copy sent to JFD
4/1/71

006934

February 15, 1971
Technical Services

RECEIVED
FEB 17 1971

TO: R. E. Thurmond
FROM: W. A. Hamilton
SUBJECT: Metallurgical Testing - Anvil
Further to Memo Dated January 15, 1971

ANVIL MINERAL CORPORATION
LIMITED

From our phone conversation apparently interest in the grind and investigation of new reagent combination seems to be developing.

As you may recall the Cyanamid results quoted in the above memo are very interesting in that they indicate relatively coarse grinds will suffice to free lead mineral and relatively fine grinding is required to free Zn. minerals.

As a compromise I suggested in my memo that the best solution might be to stay with the original grind of about 40% + 200 mesh and work out the fines problem in the lead by flotation and work out the Zn. recovery problem by working on both regrind and flotation. I still feel the above has merit.

I have attached a list of proposed tests which may offer some solutions or clues leading to solutions.

In brief I have listed a number of fairly simple tests on lead flotation which may indicate a direction to follow. With reference to the zinc metallurgy I would propose initially a study of:

- 1- Cycloning the Zn. rougher tails, regrinding the plus 200 mesh and refloating for recovery.
- 2- Cycloning and flotation and regrind of float product.

2800 tons/des?

I would appreciate having the reaction to the proposals listed, possibly much of the above has been suggested by Mr. Ames.

Use of soda ash, which is normally also a dispersant, may create further problems in the Pb. concentrate thickener.

W. A. Hamilton

W. A. Hamilton

WAH/dt
Attachment

cc: P. W. Allen

Proposed Initial Testing Program - Anvil

A - Sample

- 1- Collect sample (about 200#) over one week. Rod mill feed. ^{No}
- 2- Air dry at room temperature. (Avoid dust contamination).
- 3- Crush to all minus 20 mesh.
- 4- Mix and riffle into standard test changes 600 or 1000 grams.
- 5- Place in individual bags.

B - Grind

- 1- Establish grinding time and condition to meet original grind specs - use as standard grind. ^{Complete}

C - Effect of Reagents

- 1- Reagents to be studied. Calcium sulfite, sodium sulfite, lime and soda ash. ✓ ✓ ✓ ✓

Both sodium carbonate and lime are pH regulators. However, sodium carbonate will generally create a dispersed condition while lime is a flocculant. Soda ash should create a condition where the collectors can more readily fasten onto the mineral surface but may need excess flocculant for concentrate thickening.

- a- Standard test - standard reagents.
- b- Calcium sulfite, lime to grind, NaCn, collectors froth normal, no $ZnSO_4$. pH normal.
- c- Same but eliminate NaCn.
- d- Repeat above b and c with soda ash and repeat at various pH.
- e- Repeat above b and c with sodium sulfite.
- f- Repeat d with sodium sulfite.
- g- Keep temperature, grind and collectors same all tests. Frother as needed.

NOTE: Carry out Pb. flotation only.

D - Effect of Water Temperature and Quality

- 1- Standard test in mill water and mill temperature.
- 2- Standard test in mill water at 40°, 50°, 60°, 70° and 80° F.
- 3- Standard test in distilled water 40°, 50°, 60°, 70° and 80° F.

NOTE: Pb. flotation only.

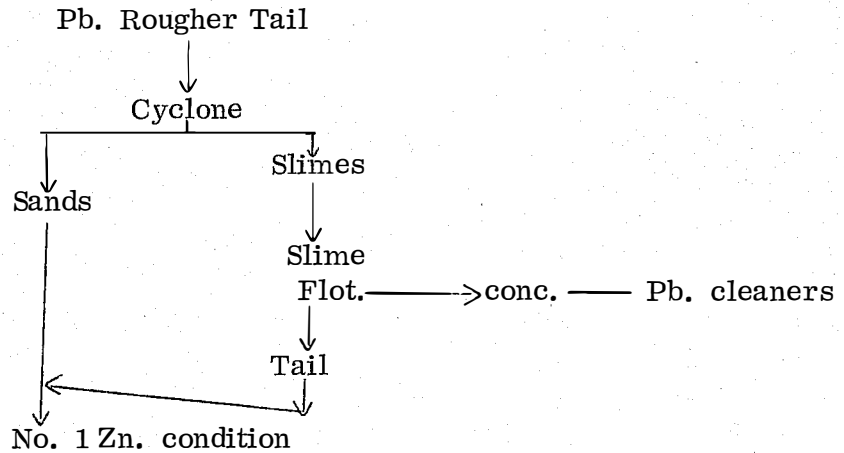
E - Effect of Flotation Time

- 1- Standard test.
- 2- Standard test + 1 min.
- 3- Standard test + 3 min.
- 4- Standard test + 5 min.
- 5- Standard test + 10 min.

NOTE: Pb. flotation only.

F - Effect of Cycloning

- 1- Standard test (normal reagents).
- 2- Standard test - Simulate cycloning by siphon off fines and sizes from rougher tailing. Refloat slime only. This is to simulate the following flocculant :



NOTE: Pb. flotation only.

G - Zinc Flotation

As a start on the Zn. problem I would suggest the following.

- 1- Grab sample of present Zn. rougher tailing.
- 2- Deslime.
- 3- Re grind sands and float using Zn. standard test.
- 4- Repeat above except float deslimed sands and re grind and re float this concentrate.

January 15, 1971
Technical Services

R. S. BROWN, Faro
RECEIVED

JAN 20 1971

TO: R. E. Thurmond
FROM: W. A. Hamilton
SUBJECT: Comments on Anvil Mill Results

ANVIL MINING CORPORATION
LIMITED

The results of mill operation over the past three months appear to indicate that two of the primary targets, tonnage throughput and reasonable concentrate grades, appear to be within reach. The third target, metal recoveries, is still elusive.

Although the summarized data in the mill reports is not complete enough to permit detailed analysis, some items appear to be noteworthy. The following comments are made in the hope they may be helpful in steering the operation toward improvements.

Grinding

The original grind was specified at 20% retained on 110 micron which is about 150 mesh Tyler. This corresponds to about 40% on 200 mesh Tyler. It would be interesting to insert a 150 mesh screen in the weekly or monthly composites to check this relationship.

Aside from the above all of the reported screen analysis almost invariably show a hump in the plus 80 mesh size fraction. This could be true tramp oversize or it could be due to the presence of a fraction of the hard, white, barren material I observed in the orebody last spring. If the excess oversize is tramp then this could be a factor in tailing losses. If it is predominately due to the presence of the barren material mentioned above then the grind and classification is okay. Since there is no point in spending money to grind barren waste beyond the size required to get rid of it through the machines and launders.

In any case assayed screen analysis of the concentrates and the Pb and Zn rougher tailings at regular intervals are a must to indicate grinding and classification effects and the size range of the metal losses and recoveries. Is this being done ?

Temperature and Water Quality

These two items have never, to my knowledge, ever been evaluated with

respect to Metallurgy.

It is note worthy that the coldest months of the year are also the period during which the mill water quality is the poorest, because it is during these months when the reservoir draw down is greatest and when the dilution with N. Rose Creek water is the least. The reservoir water can contain a respectable amount of organic matter and by-products from vegetation decay all of which are generally adverse to flotation.

Since both concentrate grades and recoveries are lower in early December than in previous months I wonder if the effect of temperature and water is a major factor in Metallurgy.

I recall that some laboratory work performed at Anvil with treated boiler water and at room temperature last summer showed much better results than the mill was making.

Has anything been done along these lines ? Some lab work here could indicate the economics of some water treatment and a little heat.

Flowsheet

You may note that the original mill specs were to grind 122 dt/hr per rod mill with a final ball mill grind of 80% minus 110 microns. This corresponds to the 5856 dst/day.

With the concept of the bulk concentrate production it was expected that the projected 7000 dt/day rate would result in a coarser primary grind and hopefully the free mineral would report in the respective concentrates and the abstraction of middlings through the bulk concentrate production would preserve the metal recovery.

It was not contemplated that an approximate 20% increase in tonnage could be handled with 100% selective concentrate production and with preservation of comparable concentrate grades and recoveries.

The above seems to be borne out where November - December results are compared with the results obtained during earlier periods when bulk concentrates were being produced.

On this basis then it is possible that the non-operation of the bulk circuit in November - December was a major factor in the indifferent Metallurgical results obtained in November - December when the tonnage was comparatively

high and the bulk concentrate circuits were inactive.

American Cyanamid Report

This report dated September 21, 1970 contains much interesting data. The work was performed on samples submitted in June 1970 when the mill operation was quite sporadic in comparison to what it is now but the general results and conclusion should be valid.

The report indicates that the association, degree of dissemination and other physical characteristic of galena versus sphalerite-marmatite are vastly different.

- Pb Concentrate

This sample showed that only a reasonable **fine** grind was required to free the galena sufficient to make a satisfactory grade of concentrate. The plus 325 mesh fraction assayed 58.40% Pb while the minus 20 micron fraction assayed 76.70% Pb.

- Pb Scavenger Tailing

The work on this sample showed that 50% of the lead reporting in this tailing product was in the minus 20 micron size range. This could indicate a dilemma wherein good recovery is attained only with a coarse grind. This may not be completely valid since there was a considerable recirculation of fines from the lead concentrate thickener overflow which would contain not only original flotation fines but also a fraction of dust returned from the dryer which would probably not respond too well in the secondary flotation.

- Lead Flotation

In achieving best success in the lead circuit it would appear most beneficial to:

- a- solve the thickener overflow problem and reduce or eliminate this recirculation of fines.
- b- decrease the dependency on the lead regrind mill for concentrate grade requirements and depend more on the bulk productions to control middlings. Flotation conditions should be studied to speed up the slow floating fine lead fraction.

Zinc Concentrate

The assayed screen analysis of this product was in sharp contrast to the results shown for the Pb concentrate. In the zinc concentrate all screen fractions assayed almost the same and consequently the amount of Zn in each fraction was roughly proportioned to the amount of each screen fraction.

This lack of zinc content change between screen sizes is almost certain to be due to marmatite. This conclusion is strengthened by the fact that the microscopical examination indicated that most of the zinc mineral was dark brown to dark amber in color indicating iron in solution and very few light colored grains of more pure sphalerite were observed. Much of the mineral was locked with other minerals such as pyrite and pyrrhotite but there were also numerous grains of "apparently free" pyrite.

In any case the lack of variation of zinc content in any of the screen sizes indicates that production of high grade (over 50 - 52% Zn) may be literally impossible on the type of ore represented.

Zn Rougher Tailing

The zinc rougher tailing assay screen analysis is in complete contrast to the lead scavenger tailing. Whereas in the lead tailing about 50% of the Pb was in the finest or minus 20 micron product the zinc tailing showed that almost 80% of the lost mineral was in the plus 200 mesh size range.

- Zinc Flotation

In achieving best success in the zinc circuit it would appear that better recovery of middlings in the rougher circuits followed by intensive regrind and cleaning stages are required for both concentrate grade and recovery.

Summary and Conclusions

Primary Grind

There appears to be some evidence that coarse grinding (on a relative basis) might be beneficial to Pb recovery but harmful to zinc recovery. The optimum mill grind for both minerals cannot be established from the data I have.

Regrind

The lead minerals do not appear to be as intimately associated with other minerals and as a consequence the Pb regrind operation is a lesser factor in achieving Pb concentrate grade than in the zinc circuit.

In the zinc circuit both grade and recovery may be closely associated with efficient operation of the Zn regrind mills because of the much more intimate association of zinc minerals and consequent middling problem.

Flotation General

In the lead circuit the middling problem appears to be reasonable and satisfactory grades of concentrate appears to present no major problems. With respect to lead recovery the problem seems to be unsatisfactory recovery of lead mineral in the finer sizes. The problems in the lead circuit therefore appears to be primarily in flotation. Proper flotation conditions, choice of reagents and all the other factors directly applicable to flotation would appear to be the direction in which investigation in this area should proceed.

In the zinc circuit both grinding and flotation problems exist. In order to achieve satisfactory recovery of zinc the rougher flotation must be improved to recover zinc middling grains. In order to produce best grades of concentrate the zinc regrind circuit must operate at high efficiency and the zinc cleaners must perform.

In general the lead circuit might eventually operate with relatively minor regrind requirements and comparatively light circulating loads. Good results on zinc will almost certainly require efficient regrinding, more middling recovery in the roughers and comparatively high circulating loads in the zinc circuit.

Bulk Flotation

It would appear to be theoretically very difficult, if not impossible to maintain a high recovery of Pb and Zn without activating the bulk flotation circuits.

It is my feeling that the above is less true in the lead circuit than in the zinc circuit where the regrind and circulating load requirement to produce 100% selective concentrate could soon get well beyond the present equipment capabilities.

It is also my feeling that eventually the use of the bulk float in the lead

circuit will result in both production of very high grade selective lead concentrate and with excellent overall Pb recovery. This end result will be much more difficult to attain in the zinc circuit but bulk production is essential at high tonnage rates.

Metallurgical Investigations

This area seems almost limitless in scope both in the mill and in the laboratory. Investigation in all areas appear open. One area is the patient plodding and daily routine of methodically recording all of the scraps of mill data from which eventually patterns and trends develop. The other area is the laboratory where the trends are checked and where new methods or variations of the old are investigated.

I am assuming that a good daily mill log is being kept so that all facets of the operation can be reviewed periodically for potential improvements.

With respect to the laboratory work fertile fields of investigation would appear to be :

- 1- Development of optimum grinding data.
- 2- Water quality and temperature effects
 - a- Flotation
 - b- Thickening, filtering and drying (pulp temp.).
- 3- Reagent combinations.
- 4- Flotation conditions.

Time, density, pH, additives, conditioning etc.
- 5- Effect of Aeration - Ames in his reports had some good ideas on this.

W. A. Hamilton
W. A. Hamilton

WAH/dt

cc: E. S. Allen