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October 12, 1972

TO: Mr. R. E. Thurmond
FROM: H. Lyall Ames
SUBJECT: Visit to Anvil Corporation Mill - October 5 and 6, 1972
C. C.: Mr. R. L. Haffner, Mr. N. G. Cornish, Mr. H. H. Cox,
Mr. P. Taggart and Mr. P. J. Brown.

The main subjects discussed with the Anvil personnel during this visit were (1) corrective measures which should be tried to improve the lead and zinc metallurgy (the former has been deteriorating for the past four months and the latter for the past six months) (2) status of the mill expansion project with particular consideration to the proposed grinding circuit pulp densities and the installed ball mill power which have been mentioned by Walter Hamilton and Eugene Allen. The 1973 metallurgical forecast and a new ball mill proposal by Dominion Engineering were also discussed briefly.

(1) METALLURGY

A careful study was made of major flowsheet changes which have been made this year to determine any that might be detrimental to the overall metallurgy and any that it would be advisable to "back track". Probably the most significant fact discovered in this regard is

that no changes other than temporary tests have been made in the lead circuit flowsheet and in spite of this the lead metallurgy has fallen off seriously since April. In the case of the zinc some major and more or less permanent changes have been made. The timing of these were also checked and were found not to be responsible for the poor metallurgy since March. Therefore the reason must be general operation, mechanical breakdowns, ore changes or unsatisfactory reagent combinations. Regardless of which of these is responsible or to what extent, the results are equally serious and several ideas were advanced for trial in an attempt to correct them. These are:

(1) Try using rougher concentrate assays in both the lead and zinc circuits for control purposes rather than the feed to the first cleaners which contain circulating loads that mask the effect of ore changes before corrective measures can be taken. It has been my experience that the most important control assay in maintaining the ultimate cleaned concentrate grade at a desired level is that of the rougher concentrate. Sampling of this product on the zinc circuit was started on October 6.

(2) ✓ It is current practice to raise the soda ash and add sodium sulphite when the ore is definitely oxidized, as without these measures practically no differential is possible. In the near future a test will be tried in which 1.0 - 1.5 lb. of sulphite will be added to the rod mill feed

continuously to determine whether or not this would be helpful when the ore is only slightly oxidized and probably not noticed. I have also suggested that they experiment using the soluble soda ash content of the lead circuit feed rather than pH for control.

(3) The most important, and most likely to be successful, is incorporating two of the regrinding ball mills into the primary grinding circuit ahead of the lead flotation, rather than following it. If this does nothing but reduce sanding of the lead cells it should improve the stability of this circuit with resulting better metallurgy. It could even have a beneficial effect on the zinc flotation even though theoretically the fineness in that circuit will be essentially the same. These changes are in the advanced planning stage.

(4) New and better sampling methods are being actively developed and this should help prevent incorrect assays and therefore incorrect conclusions regarding circuit adjustments. These changes will take some time but they are very important. Furthermore this work may be considered preparatory to the ultimate installation of an On-Stream Analyzer, a step, in which I concur with the Anvil staff, that should be instigated at the proper time in the not too distant future.

(5) ✓ We discussed further trials with reagents 242 for lead and Z-200 for zinc. Other mills have found these two reagents to be almost indispensable when used in the proper dosages and locations. I think that better lead recovery and better zinc grade could be achieved if the particular technique could be found, for using them on Anvil ore.

(2) MILL EXPANSION

Several questions have been raised by the Cyprus Technical Services regarding the proposed mill expansion flowsheet. These were discussed briefly with Walter Hamilton and Eugene Allen over the phone. It should be realized that the flowsheets and layouts prepared by Wright Engineering do not represent design engineering for construction purposes. We believe, however, that they are within the accuracy limits required for a Cost Study which is all that we are committed for at this time. As soon as an engineering company is selected and the design engineering is commenced all the details will be finalized. However a few comments are probably in order.

(1) I concur that some of the pulp densities in the W-E flowsheet for the grinding circuit are not too accurate. For example I think that 83% solids is too high to pump and also as a feed to the primary cyclones. As there is considerable fresh water being added to the

secondary cyclones this will permit considerable pre-circuit changes without requiring to change the 45% overflow which is shown. Also I am familiar with two other operations on similar high sulphide ores with similar flowsheets which are operating satisfactorily. The following are actual densities currently being obtained in one mill which has one rod mill followed by two stages of ball milling. The specific gravity of the ore is 3.6 and it is about 85% sulphite. The grind is 81% - 200 mesh.

Primary cyclones:	Feed	75%
	Overflow	64%
	Underflow	85%
Secondary Cyclones:	Feed	66%
	Overflow	49%
	Underflow	80%

The only two of the above densities that are at all out of line are the feed and overflow of the first cyclones which I think can be corrected without upsetting the overall material balance. Tachnequip Limited have been asked for their comments.

(2) Although I think that 2000 H.P. is adequate for the additional mill tonnage and a finer grind on average ore I concur with Walter Hamilton that it might be a little on the light side for the harder ore which Anvil seems to be experiencing more often at the present time. Concurrently and opportunely with the foregoing Dominion Engineering

has offered a 13½ ft. x 22 ft. mill for the same price as the shorter 18 ft. mill except for cost of the slightly larger shell liners. This would require a 2500 H. P. motor instead of the 2000 H. P. and about a five foot extension on the north end of the grinding bay expansion. Theoretically the additional cost would be small for the extra 500 H. P. compared to what the expansion is costing for the 2000 H. P. However its merits will be studied and W-E will be asked to estimate the additional cost of such a change.

(3) METALLURGICAL FORECAST 1973

Metallurgical forecasts are always contentious because they depend on so many variable factors such as ore grade and character, the optimism of those making or using the forecasts and lastly if they are (but should not be unless in particular circumstances) considered as objectives rather than realistic data. I think that the following forecast represents a fair compromise of what we as a group believe to be a reasonable estimate for an average milling rate of 8,000 T. P. D. and for ore assaying lead 4.1% and zinc 6.90%.

Lead total recovery	85%
Selective lead concentrate assay	69%
Zinc total recovery	74%
Selective zinc concentrate assay	51.5%

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CONSULTING SERVICES IN MINERAL PROCESSING

November 23, 1972

TO: Mr. R. E. Thurmond

FROM: H. Lyall Ames

SUBJECT: Visit to Anvil Corporation Mill, November 13-16, 1972

C. C.: Mr. R. L. Haffner, Mr. N. G. Cornish, Mr. H. H. Cox,
Mr. P. Taggart and Mr. P. J. Brown.

The main purpose of this visit was to assist the mill staff in their continuing efforts to improve metal recoveries and concentrate grades. Particular attention was given to developing closer liason and understanding between all those concerned with the flotation of Anvil ore. These include the flotation operators and shift foremen who, after all, are in final control of the circuits and therefore responsible for the last few units of recovery and grade, which are possible under the ore and circuit conditions which prevail at any given time. I concur with several proposals under consideration to promote more interest and understanding between the flotation crew and the laboratory testing engineers whose work provides the necessary basis for progress in flotation techniques in the mill.

Further comments regarding probable means of improving mill results such as general circuit operation, philosophy of mill testing, circuit changes, alkalinity control, the use of Z-200 and activating the zinc conditions are summarized in the following paragraphs.

1. NEW REGRINDING CIRCUIT

On November 9 the regrinding circuit revision which has been under consideration for some months was completed. This change permits all the primary grinding circuit product (primary cyclones overflows) to be reground in the three regrinding mills operating in parallel prior to the lead flotation, the full impact of operating this new circuit is not yet evident but indications are that it will improve lead recovery anyway. Some changes in reagents or continuous operations of the conditioners may be necessary for satisfactory zinc flotation. I think that the ultimate result will be to stabilize the circuits and thus improve metallurgy but it is recognized that one of the three mills may have to be isolated for specific regrinding the zinc middlings or possibly the entire rougher concentrate. Laboratory tests are still inconclusive as to the merits of such regrinding steps.

2. OPERATOR TRAINING COURSE

Several staff meetings were held to discuss a proposed flotation operator training course. I think that the idea is well worth while providing that it is well planned and executed. A number of suggestions were made including the material to be taught, where to get assistance in programming (technical schools, South Bay Mines and manufacturers brochures), the use of flotation demonstrations in the mill laboratory, some elements of surface chemistry in the Faro High School, and ways and means of creating and holding the interest of those participating in the course. The Anvil metallurgical group is well suited to take part actively in this work and they were delegated to investigate in detail the ideas generated at these meetings.

3. OPERATORS MEETINGS

I was asked to give a short talk to two small groups of flotation operators and shift foremen by way of an introduction to the training course being planned. There was considerable information feedback at these meetings and it was apparent that most of them felt that they would be better prepared for mill experimentation if they were advised in advance of the tests. I passed along this information together with several other points all of which I thought warranted consideration.

I concurred with the operators that "bad" ore contributed to lower recoveries and grades but pointed out that it was only one of many factors among which were better reagent control and circuit operation. I emphasized the importance of close teamwork with the metallurgical group.

4. REAGENT CONTROL

For several months now there has been growing concern, certainly on my part with the frequency and magnitude of the reagent changes made directly by the operators. I concur in the present plan to restrict to some extent this method of control. Several meetings were held in an attempt to set up certain reagent dosage parameters which would help stabilize the circuit operation. The difficulty is to make these limits practical and at the same time serve their purpose. However a start is being made in establishing different reagent ranges and I am convinced that it is a step in the right direction.

Along somewhat similar lines I recommended that a serious attempt be made to control the flotation circuits as much as possible by only changing the "physical" controls, the frother in particular, and to do this immediately on the basis of slight visual circuit trends, not waiting for the control assays. I realize that conditions arise where

no set of rules are applicable. The main point is to teach the operators optimum methods of control which they should at least attempt to achieve.

5. MILL TESTING

The metallurgical groups contribution to the growing knowledge of Anvil ore flotation characteristics is commendable. They should of course try seriously to understand the practical complications encountered by the operators in making reagent or flowsheet changes on a large scale. The operators on their part should be carefully instructed as to the vital importance to Anvil's economy of making new and better ideas work by repeated trials and auxiliary changes. Everyone is doing their individual best but I doubt if very many realize the full impact of satisfactory communication on actual mill testing or final metallurgy.

6. ZINC CONDITIONERS

Two of the three conditioners were again placed in service while I was there. Because of all the difficulties experienced in the past with these conditioners there is a general feeling of antipathy against them by the operators. In this atmosphere no one will recognize any improvement in metallurgy short of something spectacular. The operators should realize the value of even fractional point increases

in grades or recoveries. Zinc conditioners may not improve Anvil zinc metallurgy but few if any zinc operators in the country would think of designing a mill without them or discard them until it was absolutely certain that they were not of some benefit.

7. REAGENT Z-200

I have nothing further to add to my comments made in my last report except that I am pleased a sufficient quantity of this reagent is now on hand to run a worthwhile test. Trial dosages were discussed at the reagent control meetings.

8. ALKALINITY CONTROL

We discussed primary grinding circuit alkalinity control and I reiterated that on a high sulphide ore like Anvil's regular soluble sodium carbonate titrations have always been found necessary. Plans are being made to eliminate lime containing solution feedback from the lead cleaning circuits so that a proper sample can be obtained from the primary cyclones for these titrations.

3. MILL EXPANSION

In the near future a contract will be let for the engineering services and probably the construction management for the mill expansion.

Although the work recently completed by Wright Engineers Limited was entitled "Engineering Study and Capital Cost Estimate" I consider that the main purpose of the "study" was to provide data for the cost estimate. Although it was in sufficient detail for this purpose I do not recommend that it be followed specifically in the final design. Regardless of which company is selected a complete and critical review should be made of the proposed flowsheet and major flotation equipment by all concerned.

The first three weeks of design will be critical and I hope that both Peter Taggart and Peter Brown will, by some means, be made available for most of this period.

H. Lyall Ames, P.Eng.