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FARO CONCENTRATOR IN-PLANT STUDIES FOR IMPROVEMENT IN PLANT METALLURGICAL RESULTS

September 29 to October 26, 1996

TRIP REPORT NO. 1.

Project No. L.R. 5013

NOTE:

This report refers to the samples as received.

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Abstract

During the period of September 29 to October 26, 1996, a plant visit to the Faro Concentrator was made with the following objectives: **a) to determine the reason for a decline in plant metallurgical results in recent months, b) to correct metallurgical conditions and, c) to continue to train plant operators.**

A number of changes made since July 1996 have taken place in the plant that have effected metallurgical performance. A breakdown in equipment was a major factor in not achieving stable metallurgical results.

It has been found that significant improvement in the plant metallurgical results can be achieved by correcting several major problems that have occurred in the past several months. Continuous operator training and providing assistance to the operators would result in a more stable operation.

This report makes recommendations for improvements and provides additional information for circuit operating conditions for the different ore types.

Introduction

During the period of September 29 to October 26, 1996 a plant visit to the Faro Concentrator was made to assist in finding solutions for improvement in plant metallurgical results. During the past several months, a decline in plant performance has occurred. The major tasks conducted during the plant visit include the following:

- **Evaluation of the lead circuit**
- **Assessment of the performance of the regrind circuit**
- **Evaluation of the performance of the zinc circuit**
- **Training of operators**

Most of the time was spent in the plant evaluating different circuits and working with the operators.

LAKEFIELD RESEARCH LIMITED

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1. Assessment of the Operation

1.1. Mechanical

During the first two weeks of the visit, constant breakdowns of various equipment occurred, resulting in frequent plant shut downs, which in turn affected metallurgical results. This has been a major problem in maintaining stable results. The metallurgical staff is well aware of these problems and is working to minimize or eliminate major mechanical problems and therefore decrease the number of unplanned shut downs.

Some of the major concerns that have to be addressed include the following:

- **Pulp volumes in various streams are variable and pump capacity calculations are not accurate. There is question as to whether certain pumps have sufficient capacities. An accurate circuit mass balance will be provided early next year. The only capacity pump problem appears to be with the lead first cleaner feed pump.**

- **A number of temporary shut downs have resulted from problems with the rod mill liners, rods breaking, lack of parts for spare pumps, etc.**

- **Flooding of the basement from overflowing pumps from the lead circuit has been another cause for shut downs. This problem is eliminated by introducing a new lead circuit.**

1.2. Metallurgical

1.2.1. Effect of Ore Type on Metallurgical Results

During the four week period, several distinct ore types were treated, including a low iron carbonaceous ore, a light brown talcous ore, a dark brown siliceous ore and a mixture of a massive sulphide and a siliceous ore.

The most problematic ore was the high carbonaceous ore. In order to maintain a high lead recovery, a lower lead concentrate grade had to be produced (i.e. 59-60% Pb). In the zinc circuit, a very high frother consumption was noted. Other ore types, under optimum operating conditions, gave good metallurgical results.

1.2.2. Primary Grinding Circuit

The performance of the grinding circuit was not stable. This is attributed to several major factors, including:

- **differences in hardness of ore**
- **problems in maintaining proper pulp densities in the circuits**
- **charging the mills with steel is not constant**
- **problems with cyclone maintenance**

1.2.3. Lead Circuit

Since optimization of the lead circuit, carried out in May and June, several major circuit changes have occurred which may contribute to changes in the metallurgy. These include:

- **In the regrind circuit, the 15 mm high-chromium balls have been replaced with 15 mm mixed steel slag balls. This increases iron in the cleaner feed pulp, which in turn has an extremely harmful effect on lead flotation and selectivity towards zinc minerals.**

- **The steel slag balls appear to create much more slimes in the circuit than regular balls.**

- **Improvement in classification efficiency has been made which required readjustment in the ball charges to avoid sliming.**

These circuit changes appeared to have negative effects on lead metallurgy. Another problem identified was frequent variation in the recirculation loads which resulted in poor stability of the circuit and variation in results. Commissioning of the OK16 cells as lead first cleaners provided a more stable circuit and controllable recirculation loads.

1.2.4. Zinc Circuit

The major problems associated with the zinc circuit can be summarized as follows:

- **Oversliming of the sphalerite during lead and zinc regrinding**
- **Constant reagent changes by the operators (i.e. $CuSO_4$, xanthate, etc)**
- **Insufficient flotation times for the 1st cleaner which results in difficulties controlling zinc losses in the "J" bank tail.**
- **Changes in ore type which results in different and sometimes high frother requirements.**

2. Operator Training

Emphasis during the visit was placed on operator and shift supervisor training. Although most of the operators recognize problems when they occur in the circuit, but they sometimes cannot determine the causes of the problems. It is therefore essential that operators receive constant help from the metallurgical staff, especially in the area of handling recirculation loads and maintaining levels of reagents as constant as possible.

3. Correction of Circuit Operating Parameters to Stabilize and Improve Metallurgical Results

3.1. Primary Grinding

The following circuit corrections have to be made in order to maintain stable operation of the circuit.

- **In the secondary ball mills, a mixture of 2" balls and 1 1/2" balls has to be used. The following is the ratio:**

  60% 2" balls
  40% 1 1/2" balls

  This is to accommodate variation in the hardness of the different ore types and provide a more efficient grinding medium for the coarse fraction.

- **Implement regular charging of the mills with steel in order to maintain consistent power draw for each mill.**

- **Good maintenance of the cyclones is mandatory for good performance of the circuit.**

- **Maintain constant pulp densities in the grinding circuit. Pulp densities were not stable during the month of October.**

3.2. Lead Circuit

3.2.1. Regrind

In order to provide the required fineness of regrind and avoid sliming of lead, major adjustments in the ball charges are required. The following are the recommended ball types and ball charges:

- **Use only high chromium balls**

- **The ball charge composition for lead regrind No. 1 should be as follows:**

5/8" balls	*80%*
1" balls	*20%*

  The power draw should be maintained at 45 amps.

- **The ball charge for the lead regrind No. 2 should be as follows:**

5/8" balls	*90%*
1" balls	*10%*

  The power draw should be maintained at 45 amps.

- **The ball charge for regrind No. 3 should be 100% 5/8" balls and the power draw should be maintained at 40 amps.**

3.2.2. Lead Roughing

The lead rougher flotation performed well for all ore types and a lead rougher recovery of 85-88% is readily produced. The reagent scheme used in this circuit worked well and for some ore types, collector consumption was relatively low (i.e. 1000 cc/min).

3.2.3. Lead Cleaning

When the regrind circuit is operating properly according to the changes described in Section 3.2.1, the lead circuit will also perform well. With the installation of a new first cleaner and the increase in the cleaning capacities, the operating strategy of the lead cleaning will be somewhat different. These differences are summarized as follows:

- **The lead first and second cleaners should be run slowly to provide maximum selectivity as well as maximum zinc rejection through the lead first cleaner. The "I" bank should be pulled slowly to minimize the amount of pyrite and zinc floated in this stage.**

- **The lead third cleaner should be run fast, while the froth discharge on the fourth cleaner should be adjusted to maintain constant grade.**

- **With respect to reagent additions, the following adjustments have to be made:**

a) *cyanide addition to regrind No. 3 may not be required*

b) *cyanide additions to regrinds No. 1 and No. 2 should be slightly higher than those used previously (i.e. 3800 cc/m regrind 1 and 4000 cc/m regrind 2)*

c) *collector additions should also be as low as possible (i.e. 50-100 cc/min regrind 1 and 100-200 cc/m regrind 3). High collector additions to the regrind should only be used when treating a high carbon ore.*

3.3. Zinc Circuit

One of the major operating problems in the zinc circuit is the unstable froth in the zinc roughing-scavenging stages caused by changes in ore types. The froth consumption changes from 80 to 200 cc/min. This variation is a major cause of the frequent changes in the levels of $CuSO_4$ and xanthate additions. The consequences are a very unstable zinc circuit and difficulties in maintaining a constant zinc concentrate grade.

Another major problem in the zinc circuit is sliming during regrinding. Major modification of the zinc regrind and cleaning is required to improve zinc metallurgical results.

3.3.1. Zinc Regrinding

The following adjustments in the ball charges are required to reduce sliming of the zinc rougher + scavenger concentrates:

5/8" balls	*85%*
1" balls	*15%*

The power draws for both No. 4 and No. 5 mills would be 45 amps. Only high chromium balls should be used.

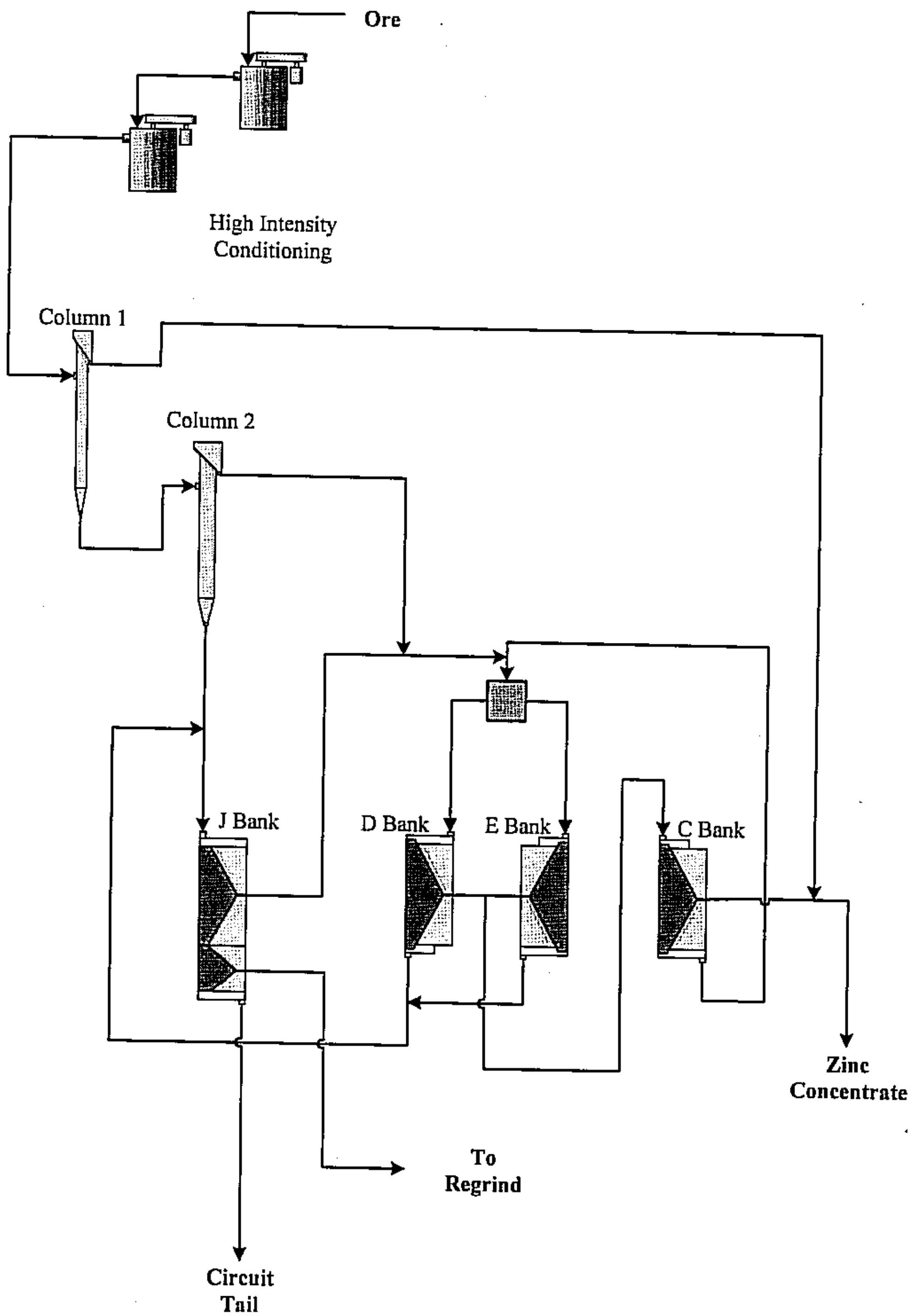
3.3.2. Zinc Roughing

It has been shown that a zinc rougher recovery of about 82% Zn can be readily produced. The problem, however, is the changes in frother requirement, which may be readily detectable by froth dryness. Both $CuSO_4$ and xanthate additions must be kept as constant as possible. The automatic frother addition system must be made available as soon as possible.

3.3.3. Zinc Cleaning

Because of sliming of the zinc during regrinding, fine zinc flotation is slow and high zinc losses in the "J" bank tailing are persistent. Therefore, the flotation time requirement for the zinc first cleaner is too short. It is therefore recommended that spare column No. 2 be used as an extension of the zinc first cleaner (i.e. J bank). The new zinc cleaning configuration is shown in Figure No. 1.

Figure No. 1
Recommended Modification of the Zinc Cleaning Circuit



The operating conditions in cleaning have to be optimized with respect to pH, collcctor addition, and use of silica controlling reagents. Tests with QHS, used in the zinc first and second cleaners, showed improvement in zinc flotation and this depressant should be re-evaluated with the new cleaning circuit.

It should be noted that column No. 2 must be equipped with a frother addition pump and about 25 cc/min should be added to the sparger water.

Note that after installation of the new zinc cleaning circuit, the present zinc cleaning operating strategy has to be re-evaluated with respect to the lime addition to the zinc cleaners.

3.4. Dewatering

3.4.1. Lead Thickeners

No problems were observed in the lead thickeners.

3.4.2. Zinc Circuit Thickening

During the period of October 1st to October 14th, losses of zinc in the thickener overflow were observed. The significance of these losses was not possible to determine. On October 13th, the zinc cleaning circuit was run at a very high pH. This resulted in a dramatic improvement in zinc concentrate thickening. The amount of fines in the thickener overflow, as a function of the thickener feed pH, was as follows:

Thickener Feed pH	*Thickener Overflow Solids*
11.8	**800 mg/L**
10.4	**12,000 mg/L**

It is therefore strongly recommended that lime is added to the zinc concentrate pump to adjust the pH of the zinc thickener feed to 11.8. There are several lime stations which are not used in the lead cleaning area that can be used.

4. Circuit Monitoring

There is no established recording of circuit monitoring observations and data related to reagent additions, pH and metallurgy. It is strongly recommended that such monitoring and evaluation be implemented immediately. Samples of tables for circuit monitoring are shown in Tables 1, 2 and 3. The data should be entered on a daily basis with the average reagent consumptions.

Table No. 3 should contain the unadjusted metallurgical results and should be based on real assays of the specified products. Data from Tables 1, 2 and 3 must be included in the monthly reports.

SAMPLE ONLY

Table No. 1 : Lead Circuit Operating Conditions (24 hour average) **Month** ______________

DATE	REAGENT ADDITIONS, cc/min								pH				Grind + Regr K_{80} µm			
	Grind + Pb Ro			Pb Scav		Pb Regr + Cls			Ro	1st Cl	2nd Cl	3rd Cl	Pb Ro Feed	1st Regr	2nd Regr	3rd Regr
	NaCN HQS	SIPX	MIBC	SIPX	MIBC	NaCN HQS	SIPX	MIBC								

SAMPLE ONLY

Table No. 2 : Zinc Circuit Operating Conditions (24 hour average) **Month** ________________

DATE	REAGENT ADDITIONS, cc/min								pH				Grind K_{80} µm	
	Condition & Zn Ro			Zn Scav		Zn Regrind + Cl			Zn Ro	Zn Column	Zn J Bank	Zn C Bank	Zn Ro Feed	Column Feed
	$CuSO_4$	SIPX	DF1012	SIPX	DF1012	$CuSO_4$	SIPX	DF1012						

SAMPLE ONLY

Table No. 3 : Plant Metallurgical Results

Date	Feed Assays %				Lead Concentrate Assays %				Zinc Concentrate Assays %				Circuit Tailing Assays %			% Recovery Pb Circuit		% Recovery Zn Circuit	
	Pb	Zn	Fe	Cu	Pb	Zn	Fe	Cu	Pb	Zn	Fe	SiO_2	Pb	Zn	Fe	Pb	Zn	Pb	Zn