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Gregory H. Boyce
Director Environmental Affairs

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Kennecott

December 9, 1986

Mr. Calvin Sudweeks
Director
Bureau of Water Pollution Control
Utah Division of Environmental Health
P. O. Box 45500
Salt Lake City, Utah 84145

SUBJECT: Utah Modernization Project
NOI to Relocate Flotation and Molybdenum
Recovery Facilities

Dear Mr. Sudweeks:

Enclosed for your review and approval is Kennecott's Notice of Intent (NOI) to construct flotation and molybdenum recovery facilities at the Copperton grinding plant site. The decision to relocate these facilities to the Copperton site was made by Standard Oil on December 2, 1986, based on recently completed optimization studies. All of the facilities described in this NOI are additional to the facilities approved in your construction permit of August 6, 1986. All of the facilities covered in that construction permit will be constructed as approved and without modification. However, the ore slurry pipeline will be utilized as a tailings pipeline.

Please contact Al Trbovich (801/322-8263) if you require additional information about this NOI.

Sincerely,

Gregory H. Boyce

G. H. Boyce

/mf
Enclosure

cc: L. K. Jacobson, w/enc.
R. J. Ramsey, w/enc.
V. R. Rao, w/enc.
A. M. Trbovich, w/enc.
J. B. Winter, w/enc.

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KENNECOTT

PROJECT OVERVIEW, SURFACE WATER AND GROUNDWATER

COPPERTON FLOTATION AND MOLYBDENUM RECOVERY PLANT

De 1986

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Plan

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Introduction

Kennecott has recently completed an evaluation of several alternatives for modernization of the Utah Copper Division (UCD) flotation and molybdenum recovery facilities to improve productivity and reduce operating costs. The selected alternative involves constructing new flotation and molybdenum recovery units at the Copperton grinding plant site. These new facilities will replace the corresponding sections of the existing Magna and Arthur flotation and molybdenum recovery plants.

The information compiled in this document constitutes Kennecott's Notice of Intent to construct flotation and molybdenum recovery facilities at the Copperton concentrator site. All of the modernized facilities identified in the Bureau's Construction Permit of August 6, 1986, will be constructed as approved and without modification. The ore slurry pipeline will be utilized as a tailings pipeline. This document describes additional facilities to be constructed at the same site.

Section 1

Background Information

1.1 General Overview

The Utah Copper Division (UCD) of Kennecott is a vertically integrated copper operation consisting of the Bingham Canyon Mine, three concentrators (Arthur, Magna and Bonneville), the Utah Power Plant, the Utah Smelter and the Utah Refinery. In mid-1983 Kennecott announced a modernization plan for UCD which included in-pit crushing of ore, conveyor transport of ore to a grinding plant near Copperton, a new 3-line SAG mill/ball mill grinding plant, a gravity flow pipeline to transport ore slurry to the Magna area and a pipeline to return process water from the tailings pond and make-up water from existing Kennecott sources to the grinding plant. Approval to construct these facilities was received from all appropriate government agencies and construction is proceeding on schedule.

Additional Kennecott studies of methods to improve productivity and reduce operating costs at UCD have resulted in a flotation and molybdenum recovery relocation plan. Under this plan, flotation and molybdenum recovery facilities will be constructed at the Copperton grinding plant. The ore slurry pipeline now under construction will be utilized without modification to transport tails to the existing tailings pond near Magna. Copper concentrate will be transported to the existing Utah smelter via a separate pipeline.

1.2 Facility Location

The proposed flotation and molybdenum recovery facilities will be located at the Copperton grinding plant, approximately one mile north of the town of Copperton in the southwest section of Salt Lake County. The site is approximately 25 miles south-west of Salt Lake city and is near Kennecott's Bingham Canyon Mine (Figure 1).

1.3 Schedule

The flotation and molybdenum recovery facilities will be completed to begin operation with the grinding facilities in 1988.

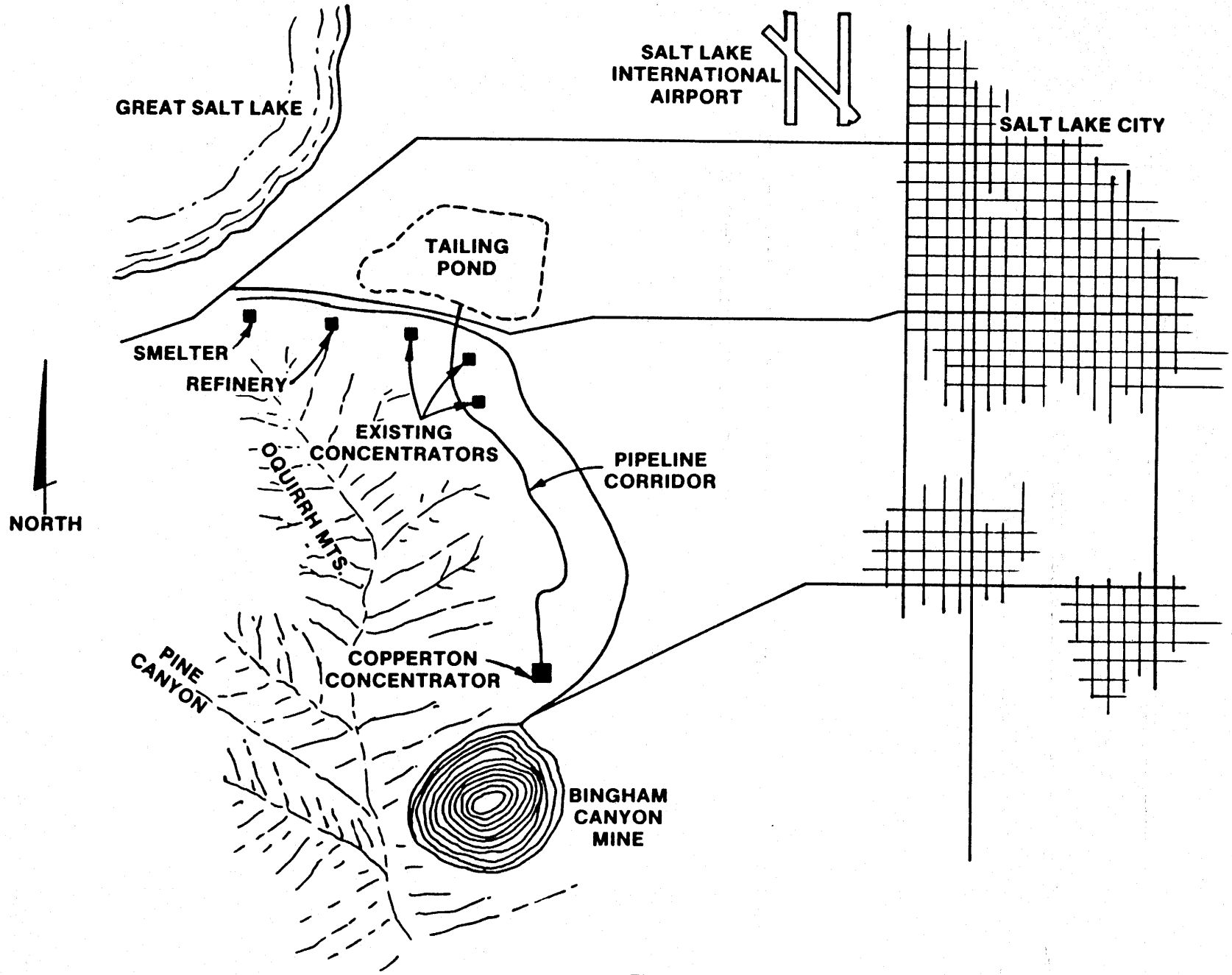

Figure 1

General Layout of Kennecott's Utah Copper Division

Section 2

Facility Description

2.1 General

The existing UCD concentrating operation consists of:

- Unloading the ore by rotary car dumper
- Primary (gyratory) crushing
- Secondary (standard Symons) crushing
- Tertiary (roll or short-head Symons) crushing
- Rod or primary ball milling
- Secondary ball milling
- Flotation
- Molybdenum recovery
- Transporting the copper concentrate to the smelter by rail
- Transporting the tailings to the tailings pond by pipeline

The modernized concentrating operation, when completed will consist of:

- Stacking ore by conveyor and shuttle onto the stockpile
- Reclaiming the ore from the stockpile
- Semi-autogenous grinding
- Ball milling
- Flotation

- Molybdenum recovery
- Transporting the copper concentrate to the smelter by pipeline
- Transporting the tailings to the tailings pond by pipeline

Figure 2 provides a conceptual flow chart of the proposed concentrator.

As explained above, the Bureau has previously approved the facilities relevant to ore stacking, ore reclaiming, semi-autogenous grinding and ball milling. Therefore, only the facilities associated with flotation and molybdenum recovery are described below. The relative position of these new facilities is given on Drawing 712-SKL-346, Full Concentrator Site Plan.

2.2 Flotation

Bulk flotation will be conducted to separate the copper and by-product minerals from the non-value material. Flotation will be conducted in approximately 63 flotation cells, each having a capacity of either 3,000 cu ft, 1,000 cu ft, or 500 cu ft.

The first step of the flotation process, the rougher scavenger circuit, will consist of three rows of eleven 3,000 cu ft flotation cells. Pulp from any of the three grinding lines will be split between the three rows by a distributor. Flotation reagents will be added at the head of the three-way distributor. In any one row, the first four cells will obtain a 16% copper rougher concentrate and the last seven cells will obtain a 2% copper scavenger concentrate.

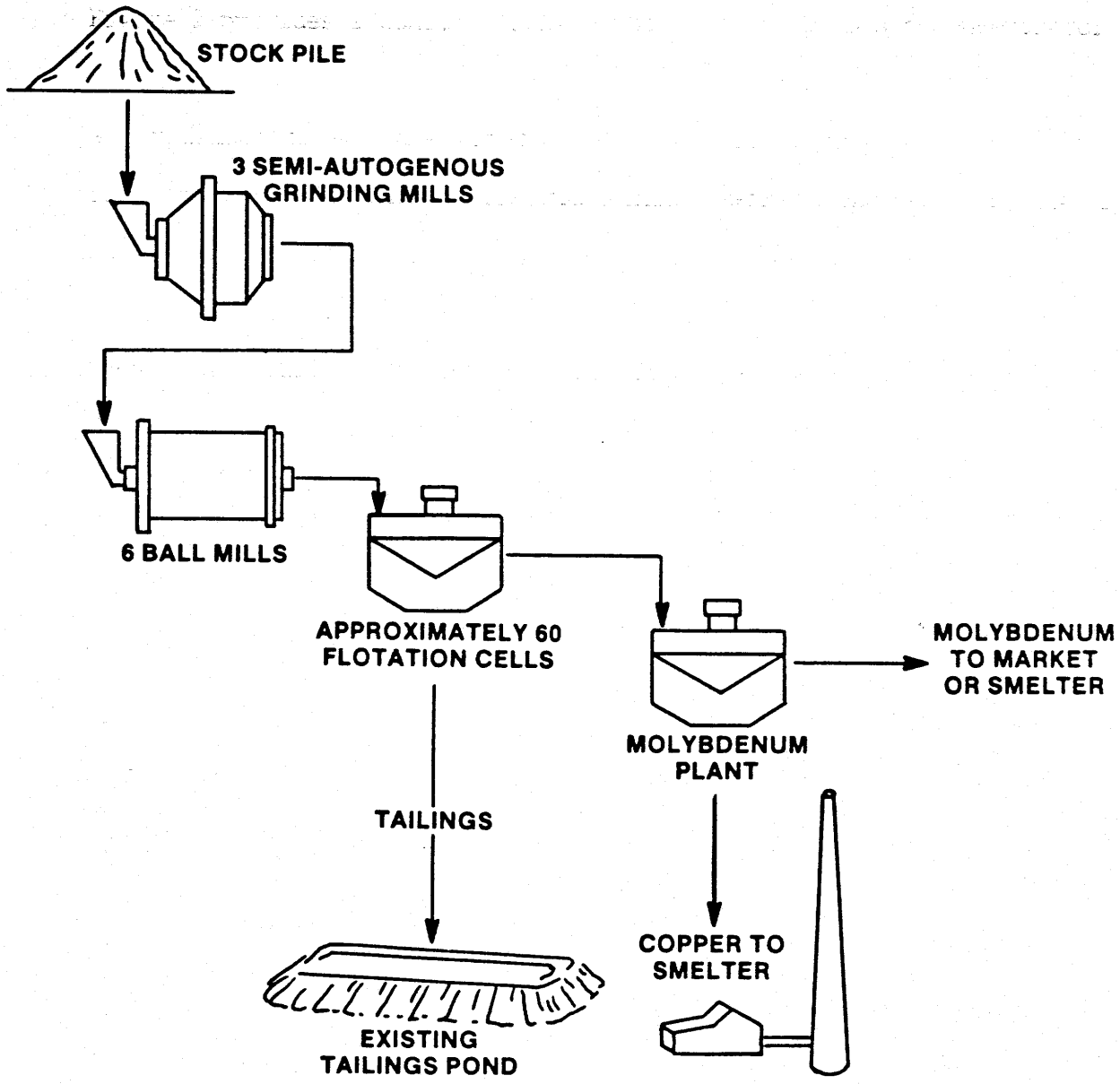

Figure 2

Modernized Concentrator Flow Diagram

Rougher concentrate and scavenger concentrate obtained from the rougher scavenger circuit will be cleaned in separate cleaner circuits. Rougher concentrate will report directly to the rougher cleaner circuit. The two rows of five cells each will produce final copper-molybdenum concentrate without regrinding.

Scavenger concentrate will be combined with rougher cleaner circuit tailings and cleaner scavenger concentrate. The combined stream will be reground in one regrind ball mill. Pulp from the ball mill will be processed through the scavenger cleaner flotation circuit, consisting of two rows of ten cells each. The first two cells of each row will produce final copper-molybdenum concentrate. The last five cells in each row will produce cleaner scavenger concentrate which will be recycled back to the regrind circuit. The remaining three cells in each row are intermediate steps.

Final concentrate from the rougher cleaner and scavenger cleaner circuits will be directed to the molybdenum recovery plant (Section 2.3). Tailings from the rougher scavenger circuit and the scavenger cleaner circuit will be directed to the pipeline facility (Section 2.4).

2.3 Molybdenum Recovery Plant

The copper-molybdenum concentrate entering the molybdenum recovery plant will be thickened and directed to two storage tanks. These tanks will provide surge capacity to minimize flow and density variations. the

stored concentrate will be pumped to an agitated feed conditioner tank for flotation reagent addition. Molybdenite will then be separated from the copper-molybdenum concentrate in one row of four flotation cells. The tailings material from this step represents the final copper concentrate. The molybdenite concentrate will next be processed through a rougher cleaner flotation circuit and thickened in preparation for heat treatment.

The purpose of heat treatment is to burn off reagents and to slightly oxidize the particle surfaces so that insoluble gangue can be separated from the molybdenite. The thickened molybdenite concentrate will be dewatered in disc filters and then "bone dried" in one indirect heated screw drier. The dried material will be heat treated in a rotary kiln.

The heat treated concentrate will be repulped, cooled and floated in two stages of cells for gangue removal. The gangue stream will be scavenged for recovery of any remaining value and then discharged to the copper concentrate thickeners. After removal of the gangue material, the resulting molybdenite concentrate will be recleaned in several flotation steps to produce a final concentrate. The final concentrate will be directed to the cyanide leach circuit.

The object of the cyanide leach circuit is to remove residual copper from the final molybdenum product. Following the leach circuit, the product is washed, filtered, dried and packaged for shipment.

2.4 Tailings Pipeline

Final flotation tailings will be directed by gravity to the tailings pipeline. The tailings pipeline will transport the tailings to the existing UCD tailings pond. The previously approved ore slurry pipeline will be utilized without change as the tailings pipeline.

2.5 Copper Concentrate Pipeline Filter Plant

Copper concentrates slurry will be pumped to the Utah smelter through a five inch steel pipeline. At the smelter, the concentrate will be dewatered in a filter plant and then directed to the existing smelter feed handling system.

Section 3

Environmental Considerations

3.1 Copperton Concentrator Site

The Copperton concentrator site precipitation runoff catchment facilities will be constructed as previously approved. These facilities provide adequate capacity to capture the runoff from a 10-year 24-hour storm event. In addition, the Zone III catch basin possesses adequate capacity to capture any spillage from the grinding, flotation and molybdenum circuits that may occur during an emergency or unexpected shutdown.

The process water reservoir will be constructed as approved.

3.2 Pipeline Corridor

The ore slurry pipeline and the return water pipeline will be constructed as previously approved. However, the ore slurry pipeline will be utilized as a tailings pipeline to transport tails from the Copperton concentrator to the existing tailings pond near Magna. This pond will continue in use.

As previously described, the tailings pipeline facility is designed to prevent catastrophic failure and the associated spill of material. The likelihood of such a failure is very remote. However, Kennecott did

demonstrate that even if such a failure were to occur, the impact to groundwater would be negligible ("Ground Water Impacts of Pipeline Failure, Proposed Ore Slurry Pipeline" Dames and Moore, 1986, previously submitted). Because the chemical composition of ore slurry and tailings differs only slightly due to the addition of reagents in flotation and molybdenum recovery (Table 1), the Dames and Moore demonstration remains valid. A discussion of flotation reagent disposition is provided in Appendix A.

A third pipeline to transport copper concentrate slurry from the Copperton plant to the existing Utah smelter will be constructed in the corridor. This facility will be a buried, five inch diameter steel pipeline.

TABLE 1

UCD Modernization Project
Concentrations For Reagents in Tailings Slurry

Reagent	Description	Use	Estimated Concentration at Head of Pipeline PPM (1) (2)
1. Burnt Lime	Calcium oxide	pH modifier	2.5 to 25 (as CaO)
2. Burner Oil	Fuel oil No. 1	collector	3
3. RECO	Sodium dicrenyl dithio-phosphate $(C_6H_4CH_3)_2$ $P(S)^4S\ Na^2$	collector	2
4. MIBC	Methyl isobutyl carbinol (4 Methyl - 2 Pentanol)	frother	3
5. Sodium Cyanide	NaCN	depressants MoS_2 leach	3
6. Nokes	Complex mixture of sodium thiophosphate, sodium hydrosulfide, and sodium hydroxide 12.5 - 13% phosphorous	depressant	0.1
7. Sodium Hydrosulfide	Sulfur compounds; NaHS	depressant	10
8. Sodium Silicate	$Na_2O \times SiO_2$ $SiO_2/Na_2O \cong 3.22$	depressant	0.5
9. Specialty Oil	Petroleum distillate; hydrocarbon mixture	collector	0.5

Reagent	Description	Use	Estimated Concentration at Head of Pipeline PPM (1) (2)
10. Nalco 7871	Polyacrylamide in a water paraffin oil emulsion; acrylanide polymer	flocculant	0.15
11. Soda Ash	Sodium carbonate Na_2CO_3	rotary kiln gas scrubber	3
12. Sulfuric Acid	H_2SO_4	pH modifier	0
13. Dowfroth 250	Polypropylene glycol methyl ether	frother	0.1
14. Sodium Hydroxide	NaOH	pH modifier; gas scrubber	3

(1) ppm indicates parts per million by weight of water contained in the slurry.

(2) Estimated amount of reagents remaining in aqueous phase.

APPENDIX A

Process Reagents

Froth flotation is the most widely used process to separate minerals from host rocks. It is based upon the utilization of differences in the physiocochemical surface properties in particles of minerals. Differences in surface properties become apparent in the mineral particles' ability to attach itself to a gas bubble after treatment with reagents in an aqueous medium.

For froth flotation to be effective, reagents must be added to the pulp at various stages in the process. Reagents called collectors are adsorbed on the mineral surface rendering them hydrophobic which facilitates their attachment to the bubbles. Another group, the frothers promote stable froths that are capable of leviating the mineralized solids yet will readily break down once it leaves the flotation cell. Regulators are used to control the flotation process and either activate or depress mineral attachment to the bubble. Certain other regulators are used to control the hydrogen ion content (pH) of the slurry. Some reagents are added in dilute solutions while others are added at full strength.

The milling chemistry for molybdenite (MoS_2) concentrate from the Questa deposit is reported in detail by Bhappu, (1967) with their reagents, function, doses and effects in the flotation reagents, but do not quote

reagent concentrations on the concentrate or tailings (solid and liquid). Specific comments concerning the residual reagents contained in the liquid portion of the tailings are:

1. The amount of reagents added to the flotation circuit is very small and kept at a minimum to avoid detrimental effects of excessive amounts of reagents as well as for economic reasons.

2. Most reagents are completely consumed during the course of flotation process due to the adsorption on the mineral surface or complexing with appropriate ions in solution.

3. Trace amounts of organic reagents, such as hydrocarbons (fuel oils), alcohols and esters, remaining in the tailings water, evaporate, decompose or biodegrade. With inorganic reagents, the anionic part adsorbs on the mineral surface and only the cations such as calcium, sodium and potassium remain in the liquid.

Therefore, the limited amounts of both organic and inorganic chemical reagents added to the flotation process are almost completely used up in the process or eliminated with the tailings.

Read and Manser (1975) reviewed the fate of organic reagents in three different flotation circuits. In each type of circuit, they estimate about one-half of the added organic material was discarded in mill tailings water and the other half removed from solutions within the circuit. In one of the mills, only three percent of the organic

material reached the final effluent. The effluents from these three operations were shown to have barely detectable effect on the organic levels in the river system into which they were discharged. They have also determined the biodegradability on fifteen of the most common flotation reagents.

Davis and co-workers (1971) classified reagents into three major categories; collectors, frothers and modifiers. In order to better understand the path and disposition of different reagents, they used the following categories:

I. Reagents which concentrate at the water/mineral interface (Collectors).

II. Reagents which concentrate at the air/water interface (Frothers).

III. Reagents which affect flotation although they remain in the bulk solution (Modifiers).

Reagents that are active in the first category, water/mineral interface, will generally reside with the solids, either concentrate or tailings. Reagents in the second category follow the frother products and final disposition is dependent upon the reagent type. The reagents in the third category will remain in the solution phase and will generally report to tailings.

Collectors generally are adsorbed to the desired mineral and report with the froth product. A major portion of the frother are adsorbed at the collector coated mineral surface and therefore follow the float product. A small fraction of the frother reagents remain in solution. Most inorganic modifiers are soluble and are active at the mineral surface. These salts dissociate in solution and only one species, the cation or anion, is adsorbed in the mineral. The nonadsorbed electrolyte remains in solution and eventually report to mill tailings.

The fate and disposition of reagents used in the flotation process by Canadian mills were reported by Evans and Poling (1975) in their discussion of flotation tailings discharge. They reported approximate fractional distributions (by 1/4 increments) of the reagents in the mill products as: Absorbed on mineral concentrate, adsorbed on tailings solid, is liquid fraction and volatilized. Evans and co-workers (1979) further reported that most of the Island Copper Mine milling chemical reported to destinations other than the "liquid" fraction of the tailings discharge (where "liquid" fraction was defined as the fluid phase, less than 0.45 micron particle size).

Burling and co-workers (1981) in their technical assessment of AMAX/Kitsault tailings disposal into Alice Arm, B.C. reported approximately fifty percent of the milling chemicals (collector oil and frother) are expected to appear in the final discharge. Of this fifty percent, approximately one-third is expected to be associated with the liquid fraction.

Hawley (1977) in his extensive review of mine-mill reagents in the Province of Ontario, Canada, reported that only very rarely do any specific reagents exist in the tailings area effluent in concentrations greater than 5 parts per million. The most common concentration of a reagent in typical tailings area effluent is about 2 parts per million or less. He also confirmed other reports that a substantial quantity of the frothers are volatilized.

REFERENCES FOR THE DISPOSITION OF PROCESS REAGENTS

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2. Read, A. D.; and Manser, R. M. (1975) Residual Flotation Reagents: Problems in Effluent Disposal and Water Recycle, Proc., Int., Mineral Process Conq., 11th 1323-1344 and Water Research, 10, 243-251 (1976).

3. Evans, J. B.; and Poling, G. W. (1975) Discharging Flotation Mill Tailings into a Coastal Inlet, 77th Ann. Gen. Mtg., Can. Inst. of Mining and Metallurgy.

4. Evans, J. B.; Ellis, D. V.; Leja, J.; Poling, G. W.; and Pelletieri, C. A. (1979) Environmental Monitoring of Porphyry Copper Tailings Discharged into a Marine Environment, Thirteenth Int. Mineral Process, Cong., Panst. Wydawn Nauk., Wroclaw, Poland 2, 649-90.

5. Burling, R. W.; McInerney, J. E.; and Oldham, W. K. (1981) A Technical Assessment of the AMAX/Kitsault Molybdenum Mine Tailings Discharged to Alice Arm, British Columbia, Fisheries and Oceans, Government of Canada.

6. Hawley, J. R. (1977) The Use, characteristics and Toxicity of Mine-Mill Reagents in the Province of Ontario, Ontario Ministry of the Environment, Canada.