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BLUE METAL INDUSTRIES LIMITED

MIDDLE ARM MINING AND RECLAMATION PROJECT

ENVIRONMENTAL IMPACT STUDY OF THE
TREATMENT OF TAILINGS TO RECOVER GOLD

(REPORT NO. 413)

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1. INTRODUCTION:

This study is the second part of a two part study for the removal, treatment and reclamation of old tailings from Middle Arm, in the lower reaches of the River Tamar estuary within the Port of Launceston.

The first part of the study is entitled "Environmental Impact Study of Dredging and Reclamation" and was prepared for B.M.I. Mining Pty. Limited by the Port of Launceston Authority (August 1975).

This study considers the environmental impact of the proposed treatment plant to be established for recovering residual gold values from the dredged tailings.

2. TREATMENT PROCESS:

The tailings contained in the bed of Middle Arm is the waste from gold mining operations at Beaconsfield around the turn of the Century. The treatment process to be used for the recovery of residual gold from the tailings is the "Carbon in Pulp Cyanidation Process".

Briefly this process consists of the following stages:-

1. Slurrying the tailings with water to produce a pulp of approximately 50% solids consistency.
2. Adjustment of the alkalinity of the pulp to pH 10.5.
3. Addition of dilute cyanide solution to the pulp and agitation for sufficient time to dissolve a maximum amount of the gold content.
4. Addition of granulated carbon to the pulp to absorb the dissolved gold from the cyanide solution.
5. Separation of the carbon from the pulp and desorption of the gold with hot caustic cyanide solution and subsequent deposition of the gold from solution by electrolysis.
6. Pumping the remaining tailings (after treatment to destroy any residual cyanide) to the reclamation area.

DETAILS OF EACH STAGE:

1. Mixing

The recovery and stockpiling of the tailings has been covered in the study by the Port of Launceston Authority. Treatment of the tailings will be undertaken as a batch process.

The stockpiled material will be placed into a hopper by a front end loader and discharged from the hopper to an attrition mixer by a conveyor belt.

At the mixer, water pumped either from the Middle Arm Creek, or recycled from previous processing, will be added to produce a pulp containing 50% solids by weight. This material then passes through a 22 mesh screen before being pumped to one of three Browns tanks, which each have a capacity of 20,000 gallons solution (i.e. 500 tonnes of solids in 50% slurry).

2. Pretreatment

A Browns tank is a simple cone bottomed tank with an air distribution manifold in the base.

This manifold distributes low pressure compressed air which agitates the pulp to prevent settling.

The compressed air also supplies oxygen to the circuit, which is necessary for the efficient dissolution of gold in the solution. Lime is added at the rate of approximately 2 - 6 Kg/tonne to bring the alkalinity to pH 10.5.

3. Cyanidation

Cyanide blocks are added to solution at the rate of 0.3 - 0.5 Kg/tonne and the agitation is continued for sufficient time to dissolve the maximum economic proportion of the gold.

4. Adsorption

Towards the end of the dissolving cycle granulated -6/+16 mesh charcoal is added to the pulp. This adsorbs the gold from the solution.

5. Carbon Recovery

The gold-bearing carbon is then removed by screening the pulp over a 22 mesh screen.

6. Tailings Treatment

The treated tailings will be allowed to settle in the third tank. When settled, the clear liquid will be decanted and returned for re-use.

When this is complete, water from Middle Arm Creek will be added to make a pumpable pulp, probably around 60% solids.

The pulp will be treated with chlorine to destroy any residual cyanide before it is pumped to the reclamation area. The neutralisation plant will be fitted with the necessary instrumentation and controls to monitor and maintain the desired effluent quality. Details of the treatment and testing of the tailings before discharge are set out in section 4.

7. Carbon Desorption

The carbon will be desorbed using the closed cycle "Zadra" process. This process involves the dissolution of the gold from the carbon using hot caustic cyanide solution, followed by electrolysis to recover the gold in metallic form. The carbon and the spent cyanide solution are returned to the circuit for re-use. The carbon after desorption is reactivated by heating to 1100°C in an oxygen free atmosphere for re-use.

All solutions used in the "Zadra" process are continuously recycled. Any spent solution to be discharged will be pumped into the cyanidation circuit.

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8. Cycle Times

Two Browns tanks will be used with the following twenty-four hour cycle with a third tank for tailings treatment.

Charging	3 hours
Preconditioning	1 hour
Cyanidation	18 hours
Charcoal Removal	2 hours

All charging, discharging and tailings treatment will be carried out in daylight hours. Overnight, a silenced compressor will run to continually agitate the pulps

The processing will be carried out seven days per week.

9. Chemical Storage

Cyanide will be used at the rate of 500 kg per day and lime at 3 - 8 tonnes/day.

Cyanide is received in 500 Kg drums in block or briquette form and will be stored in a securely locked shed adjacent to the site.

Lime will be received and stored in 10 tonne bulk containers.

Chlorine will be supplied in standard 2000 lb. (net weight) containers.

A layout plan of the plant, showing all items of equipment to be used, is included as Appendix 2.

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3. ENVIRONMENTAL CONSIDERATIONS:

1. Effluent

Control of the effluent from the reclaimed and treated tailings is the most critical ecological problem for the operator. Any residual cyanide content must be destroyed. (Tolerance levels in most states of the U.S. for total cyanide in potable water is set at 10 ppb. This level is based on the survival tolerance of fingerling trout).

Effective and complete destruction of cyanide residues can be achieved by chlorination and is usually undertaken by adding chlorine (or calcium hypochlorite "bleaching powder") to the leached slurry. Chemically the chlorine rapidly oxidizes the cyanide to cyanate, which itself is destroyed by further oxidation.

It should be pointed out that the cyanide solution used in the plant is very dilute - approximately 0.05% or less. Under normal and properly administered plant conditions, its use and the handling of it by the company's work force is not a hazardous procedure. Similar conditions exist in gold cyanidation plants around the world. The closed-circuit carbon stripping plant uses a small quantity of cyanide of higher (approximately 0.2% NaCN) solution strength.

It is understood that the normal pH of water in the Tamar River averages 8.0, and facilities will be provided to adjust effluent pH to within the range pH 7.5 - 8.0.

2. Dust Fume or Vapour

The process does not result in the release of any fume or vapour. As the operations do not handle dry solids at any stage, there is no possibility of dust being produced.

3. Noise

The operating equipment in the plant will be electrically powered with an air-compressor the noisiest unit. As indicated earlier, this will be effectively silenced. Noise levels will be minimal.

4. Aesthetic

The plant will consist of one main building alongside the group of four main tanks. This building will comprise office, chemical store and a working area enclosing pumps, compressor, mixing tank etc. At the completion of the project, all plant equipment will be removed and the area restored. During the anticipated two-three year project duration, the fenced area will be maintained in reasonable order.

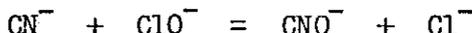
4. THE DISPOSAL OF TAILINGS CARRYING RESIDUAL CYANIDE:

The settled leach residues will contain about 20% by weight of spent cyanide solution assaying 0.05% NaCN at pH 10 - 11. After repulping with water from the Creek to give approximately 0.012% NaCN, it is intended to add firstly chlorine to the slurry and then dilute acid, so that the cyanide will be destroyed and the alkalinity reduced to an acceptable level before discharging the slurry to the settling and drainage ponds.

The proposed process and its instrumentation follows conventional practice for the treatment of cyanide wastes arising in electroplating, metal heat-treatment, gold processing, etc. It is simple, effective and well proven.

1. Chemistry of Process

In the presence of the oxidising agent, chlorine, and alkaline conditions, the cyanide ion oxidises rapidly and irreversibly to form cyanate ion: (Chlorine dissolves to produce the hypochlorite ion - ClO⁻)



The reaction rate increases rapidly with increasing alkalinity. At pH 10.0 (the anticipated pH at Beaconsfield) conversion is complete in less than 5 minutes (30 minutes at pH 8.5).

Cyanate ion is much less toxic than cyanide - of the order of one thousandth. It is relatively stable at pH 10 - 11, but oxidises rapidly at lower values to innocuous carbonate and nitrogen. The conversion is complete in 10 - 15 minutes at pH values of 7.5 - 8.0.

Thus, the treatment is a two stage process, with highly toxic cyanide being destroyed in the first stage, and cyanate destruction occurring concurrently with neutralization in the second stage.

2. Control Systems

In the first stage treatment, chlorine is metered in to react with the residual cyanide using a 'redox' meter-controller. The "oxidation potential" of the pulp is sensed by a platinum-electrode redox meter. This type of electrode does not measure the cyanide content directly, but records the change in oxidation conditions brought about by the cyanide-hypochlorite reaction. The meter will act through a control device to feed just sufficient chlorine to maintain an oxidation level commensurate with total destruction of the cyanide. As there is some lag in response from the platinum electrode, a minimum holding time of 30 minutes is specified.

In the second stage, a similar metering and control circuit is used to feed in acid to adjust the slurry to pH 7.5 - 8.0 for discharge. A standard pH electrode assembly is used - 30 minutes holding time is specified.

3. Recommended Equipment

The following equipment list has been drawn up merely to indicate typical standard equipment which could be used for metering and control. The equipment has been selected from the George Kent - E.I.L. catalogue:

pH/Redox Meters : E.I.L. model 6320

Electrode Systems : pH - 2867 System with 33 - 1912 - 400
glass electrode
: redox - 2867 System with 33 - 1980 - 400
platinum electrode

Dosing valve : E.I.L. model 1630 solenoid operated on-off valve

4. Safety Features

The whole treatment equipment would be designed with the following safeguards:

- a) In the event of power failure, control valves would automatically shut off to prevent the uncontrolled addition of reagents to the spent pulp. At the same time, plant effluent flow would stop in order to prevent the release of untreated material.
- b) The redox meter would be fitted with an alarm system¹ to provide a visual and/or aural warning of low redox values, when incomplete destruction of the cyanide residue may occur.
- c) The redox and pH meters would be standardised daily to ensure proper functioning.
- d) The storage tank for acid would be fitted with a visual low-level indicator, the chlorine tank with a pressure gauge.
- e) The plant would be equipped with the recommended first aid supplies for handling accidents.

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STATEMENT OF ENVIRONMENTAL FACTORSPART ADESCRIPTION OF PROJECT AND EXISTING ENVIRONMENT1. NAME AND ADDRESS OF APPLICANT:

B.M.I. Mining Pty. Ltd.
P. O. Box 42,
Wentworthville, New South Wales 2145.

2. LOCATION AND BOUNDARIES OF PROJECT:

The upstream area of Middle Arm from Scotchman's Point to the road bridge over Middle Arm Creek. (Refer Appendix III, drawing-No. D271-7 in Dredging and Reclamation Study).

3. DESCRIPTION OF PROJECT:

The processing of reclaimed tailings from the bed of Middle Arm to recover residual gold values.

4. COMMUNICATIONS:

- (a) Access to the project will be by existing road.
- (b) Telephone, if required, from Beaconsfield, a distance of 2 km.

5. POWER TRANSMISSION SYSTEMS:

Electric power requirements will be met from existing H.E.C. supply at Beaconsfield, a distance of 2 km.

6. WATER SUPPLIES:

Any water required during the recovery and reclamation will be taken from the Arm and returned in a clean state.

7. WASTE PRODUCTS:

Solid tailings after treatment will be used for reclamation. Liquid wastes after treatment to destroy traces of cyanide and adjust pH to 7.5 - 8.0 will percolate into Middle Arm.

8. DATE SCHEDULED FOR COMPLETION OF PROJECT:

Two years from commencement.

9. EXISTING LAND USE CLASSIFICATION:

Agricultural with a 100 ft. Crown Reserve from high water mark.

10. PROPOSED LAND USE CLASSIFICATION:

Land will revert to its existing classification.

11. DESCRIPTION OF EXISTING SITE:

Sparsely timbered undulating farm land and mud flats between high and low water marks.

12. EXISTING WILDLIFE HABITATS:

Refer to Appendix IV of Feasibility Study.

13. DESCRIPTION OF REGION SURROUNDING THE SITE:

The area is largely undeveloped bush and partially developed farm land.

14. BUILDINGS, MONUMENTS OF FEATURES OF HISTORIC INTEREST ON EXISTING SITE.

No buildings, monuments or features of interest existing on the site or in the vicinity.

*old 1820-30?
LIME KILN
ON E. BANK.*

15. FEATURES OF SCIENTIFIC INTEREST ON EXISTING SITE:

Some fish life. Refer Appendix IV of Feasibility Study.

16. FEATURES OF SCENIC OR RECREATIONAL VALUE ON EXISTING SITE:

At present there is little of scenic value in the operating area, and no current recreational activities.

17. ANY OTHER RELEVANT FEATURES:

The site is presently a derelict and unsightly one.

PART B.EFFECTS OF PROJECT ON ENVIRONMENT18. DISTURBANCE TO PRESENT OCCUPIERS:

- (a) As the surrounding area is rural with no building or residences within sight of the project there will be no anticipated interference.
- (b) Upon completion, all buildings will be removed and the site cleaned up.

19. PHYSICAL CHANGES TO TOPOGRAPHY:

No changes to topography arising from processing.

20. CHANGES TO EXISTING VEGETATION:

There will be no removal of trees or scrub on the Eastern bank and minimal disturbance on the Western Bank where there is very little scrub of very poor quality.

21. EFFECTS ON WILDLIFE:

Wildlife will not be effected. Advice indicates that fish and marine life will quickly return to normal.

22. EFFECTS ON WATER QUALITY:

Water used in the project will effectively return to the creek with the following approximate additional ions in solution:

Na ⁺	500 - 1000	mgm/L
Cl ⁻	500 - 1000	mgm/L
CO ₃ ⁼	500 - 1000	mgm/L
pH	7.5 - 8.0	

23. CHANGES TO HISTORIC FEATURES:

None.

24. EFFECTS ON SCIENTIFIC FEATURES:

None.

25. EFFECTS ON SCENIC OR RECREATIONAL ASPECTS:

None.

26. VISUAL EFFECT OF PROJECT:

A small group of buildings will be erected within the fenced area. These buildings will be removed on completing the project.

27. ESTIMATED NOISE LEVELS AT BOUNDARY OF PROJECT WHEN COMPLETED:

Minimal.

28. VIBRATION EFFECTS AT BOUNDARY RESULTING FROM BLASTING OR MACHINERY OPERATION ON PROJECT SITE:

None.

29. NATURE AND VOLUME OF TRAFFIC GENERATED BY PROJECT:

Resulting from supplies and personnel transport only.

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30. IMPROVED ACCESS TO SURROUNDING REGION:

None.

PART C.

ENVIRONMENT PROTECTION MEASURES

See section IV of the foregoing report.

Signed: *Ronald Butler*
(R. D. Butler, A.R.S.M. B.Sc.)

Position: General Manager
Robertson Research (Australia) Pty. Limited

1st December, 1975

PLANT LAYOUT DIAGRAM

Appendix 2

SCALE: 1 inch to 50 feet

Plan prepared by ROBERTSON RESEARCH (AUST) PTY LTD
to accompany "Environmental Impact Study of Treatment of
Gold Tailings", 3 December 1975

Dr No 538a

