# Metallurgical Testwork

conducted upon

# Flotation Concentrate from the Peko Tailings Project

for

# Peko Bull Pty Ltd

## Report No. A17394

November 2016

# TABLE OF CONTENTS

## FIGURE



## APPENDICES

# SUMMARY

In August 2016, a defined program of metallurgical testwork was carried out on a flotation concentrate sample generated on testwork from Composite 123 originating from the Peko Tailings Project in the Northern Territory.

The flotation concentrate was subjected to an ultra-fine grind (UFG) to $P_{80}$: 10 µm, followed by an oxidative pre-treatment via LOPOX, atmospheric acid leaching testwork, and direct cyanidation testwork. The tailings slurries from each stage were treated sequentially.

## • LOPOX Testwork

The following tables summarise the conditions of the LOPOX oxidative pre-treatment, as well as the key results from the test.

| CONCENTRATE: LOPOX OXIDATIVE PRE-TREATMENT TESTWORK – LIQUOR ASSAYS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test No. | Test Water Type | Grind Size $P_{80}$ (µm) | POX Conditions | | | Acidic Autoclave Liquor Assay (mg/L) | | | | Sulphide Oxidation (%) |
| | | | Temp. (°C) | Pressure (kPa) | Duration (hrs) | Au | Co | Cu | Fe | |
| **HY4478** | Perth Tap | 10 | 95-100 | 1000 | 3 | <0.005 | 981 | 1374 | 25000 | 64.5 |

| Overall Co Extraction (%) | Residue Co (ppm) | Overall Cu Extraction (%) | Residue Cu (ppm) | Overall Fe Extraction (%) | Residue Fe (%) |
|---|---|---|---|---|---|
| 80.7 | 1200 | 61.5 | 4400 | 23.0 | 42.8 |

Copper and cobalt leaching under the LOPOX conditions were higher than what had previously been observed under atmospheric acid leaching testwork at the same grind size performed in previous testwork (A17129: Cu extraction 5.8% and Co extraction 1.0%).

Gold was not extracted during the test, with the gold solution assays reporting below the detection limit.

The majority of the sulphide minerals were oxidised under LOPOX conditions (64.5%), however, higher results may have been observed had the test duration been extended.

## • Atmospheric Acid Leaching Testwork

Atmospheric acid leaching time series testwork was carried out on the LOPOX tailings slurry in order to determine whether base metal recovery could be increased.

No sulphuric acid addition was required throughout the test, as the natural pH of the LOPOX slurry was ~1.1.

The solution tenors for copper, cobalt and iron did not change throughout the atmospheric leach test, which indicates that all of the leaching for these species occurred during the LOPOX phase of the flowsheet.

Gold was not extracted during the test, with the gold solution assays reporting below the detection limit.

## • Direct Cyanidation Testwork

Direct cyanidation testwork was performed on the atmospheric acid leaching tailings slurry in order to recover gold from the treated flotation concentrate.

The following table summarises the conditions of the direct cyanidation test, as well as the key results from the test.

| CYANIDATION LEACH TESTWORK – ACID LEACH TAILINGS SLURRY | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test | Leach Duration (hrs) | Overall Au Extraction (%) | Residue Au (g/t) | Overall Cu Extraction (%) | Terminal NaCN (%) | NaCN (kg/t) | Lime (kg/t) |
| **MP1086** | 48 | 87.5 | 0.67 | 20.0 | 0.048 | 6.39 | 13.2 |

Gold extraction was ~88% and leach kinetics showed most of the cyanidable gold was leached within 2 hours. Residue grades were low at 0.67 g/t.

The oxidative pre-treatment via LOPOX was successful in increasing the gold extraction of the flotation concentrate when compared to cyanidation under similar conditions, without pre-oxidation at (ALS A17129: Au extraction 63.2%).

Copper extraction amounted to ~20%, with slower leach kinetic trends to gold.

# 1. INTRODUCTION

In August 2016, Mr Rodney Smith, representing Peko Bull Pty Ltd approached ALS to conduct a defined program of metallurgical testwork on a flotation concentrate samples generated from Composite 123 from the Peko Tailings Project located in the Northern Territory.

The project included the following:

- Head assay analysis
- UFG LOPOX low pressure oxidation pre-treatment
- Atmospheric acid leach testwork
- Direct cyanidation testwork.

The testwork program is presented as a flow diagram in Figure 1.

The testwork was controlled by Mr Rodney Smith, on behalf of Peko Bull Pty Ltd, with Mr Matthew Pupazzoni supervising the program on behalf of ALS. Testwork results were communicated to the client immediately when available, which enabled the program to progress on a fully informed basis.

The purpose of this report is to describe the program and present results, together with some brief commentary and recommendations.

**HAMID SHERIFF**
**Group General Manager – Metallurgical Services**

**STEFAN NORGAARD**
**Technical Manager**

**MATTHEW PUPAZZONI**
**Metallurgist**

**JACK SMITH**
**Senior Metallurgist**

# 2. SAMPLES AND SAMPLE PREPARATION

A 1 kg flotation concentrate sample, generated from testwork on Composite 123 was delivered to ALS in August 2016.

Upon receipt, the sample was homogenised and split into 2 x 0.5 kg sub-samples for metallurgical testwork.

A sub-sample was submitted to the ALS assay laboratory for analysis of sulphide sulphur. These results, together with assays obtained from a previous testwork program (ex ALS A17129), are provided in the following table:

| Analyte | Units | Composite 123 Flotation Concentrate |
|---|---|---|
| **Au** | g/t | 4.35 |
| **Cu** | ppm | 9,480 |
| **Co** | ppm | 5,100 |
| **Fe** | % | 46.1 |
| **$S_{TOTAL}$** | % | 22.6 |
| **$S_{SULPHIDE}$** | % | 20.2 |
| **$SiO_2$** | % | 12.0 |

# 3. ANALYTICAL METHODS

All of the assay samples generated during the course of the test program were submitted for analysis to the ALS analytical laboratory at Balcatta.

The following analytical techniques were employed:

| | |
|---|---|
| Gold in solids: | Fire assay/ICP-MS |
| Gold in solution: | Direct ICP-MS |
| Copper, cobalt and iron in solids: | Mixed acid digestion/ICP-OES finish |
| Copper, cobalt and iron in solution: | Direct ICP-OES |
| Sulphide sulphur in solids: | *Sherritt* Digest/*Labfit* CS2000 analyser |

# 4. OXIDATIVE PRE-TREATMENT (LOPOX) TESTWORK

A sub-sample of the flotation concentrate was submitted for hydrometallurgical UFG oxidative pre-treatment (LOPOX) evaluation testwork at an ultra-fine grind size of $P_{80}$: 10 µm.

## 4.1 LOPOX Reaction Chemistry

Under acidic conditions (pH =2), at low temperatures of 95-100ºC and in the low pressure (1000 kPa) presence of oxygen, the pyrite, pyrrhotite and arsenopyrite oxidation reactions are as follows:

$$2FeS_2 + O_2 + 4H^+ \Leftrightarrow 2Fe^{2+} + 4S + 2H_2O$$

$$2FeS \quad + O_2 + 4H^+ \Leftrightarrow Fe^{2+} + 2S + 2H_2O$$

$$2FeAsS + 2O_2 + 3H^+ \Leftrightarrow 2HAsO_2 + 2Fe^{2+} + 2S + 2H_2O$$

In the above reactions, ferrous iron ($Fe^{2+}$) is also oxidised to ferric ($Fe^{3+}$) iron:

$$4Fe^{2+} + O_2 + 4H^+ \Leftrightarrow 4Fe^{3+} + 2H_2O$$

During this low temperature low oxygen over-pressure process (LOPOX), elemental sulphur may be formed rather than sulphate which forms under more aggressive POX conditions.

## 4.2 LOPOX Testwork

### 4.2.1 Test Procedure

The two tests were conducted as follows:

(1) The 500 g sub-sample was ground in a laboratory vertically stirred bead mill targeting a grind size of $P_{80}$: 10 µm. Grind sizes were confirmed via a *Malvern* laser sizer.

(2) The ground solids were transferred to a 3.1-litre *Parr* autoclave, with a sufficient quantity of Perth tap water to establish a % solids of 20% (w/w).

(3) The natural pH and ORP (mV vs SCE) of the pulp were measured.

(4) Sulphuric acid was added to lower the pulp pH to approximately 2.0.

(5) The autoclave was sealed and oxygen was purged through the system at the desired lower pressure (1000 kPa oxygen over-pressure).

(6) The autoclave was heated to a target temperature (100ºC) for 3 hours.

(7) At the termination of the 180-minute oxidation testwork, the autoclave was depressurised and opened to allow the pulp to cool down.

(8) The oxidised pulp pH and redox were measured.

(9) A sub-sample of the acidic, pressure oxidation liquor was analysed for gold, cobalt, copper and iron.

(10) A sub-sample of the oxidised residue was assayed for gold, cobalt, copper and iron.

(11) The remaining LOPOX slurry was submitted for acid leach testwork.

### 4.2.2 Results

Complete LOPOX results are included in Appendix I, whilst a summary is presented in the following tables.

| CONCENTRATE: LOPOX OXIDATIVE PRE-TREATMENT TESTWORK – LIQUOR ASSAYS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test No. | Test Water Type | Grind Size $P_{80}$ (µm) | POX Conditions | | | Acidic Autoclave Liquor Assay | | | | Sulphide Oxidation (%) |
| | | | Temp. (°C) | Pressure (kPa) | Duration (hrs) | Au (mg/L) | Co (mg/L) | Cu (mg/L) | Fe (mg/L) | |
| **HY4478** | Perth Tap | 10 | 95-100 | 1000 | 3 | <0.005 | 981 | 1374 | 25,000 | 64.5 |

| Overall Co Extraction (%) | Residue Co (ppm) | Overall Cu Extraction (%) | Residue Cu (ppm) | Overall Fe Extraction (%) | Residue Fe (%) |
|---|---|---|---|---|---|
| 80.7 | 1,200 | 61.5 | 4400 | 23.0 | 42.8 |

Comments on the above results are as follows:

- Copper and cobalt leaching under the LOPOX conditions were higher than what had previously been observed under atmospheric acid leaching testwork at the same grind size performed in previous testwork (A17129: Cu extraction 5.8% and Co extraction 1.0%).
- Gold was not extracted during the test, with the gold solution assays reporting below the detection limit.
- The majority of the sulphide minerals were oxidised under LOPOX conditions (64.5%), however, higher results may have been observed had the test duration been extended.

# 5. ATMOSPHERIC ACID LEACHING TESTWORK

Atmospheric acid leaching time series testwork was carried out on the LOPOX tailings slurry in order to determine whether base metal recovery could be increased.

## 5.1 Test Procedure

The test procedure was as follows:

(1) The LOPOX slurry was transferred to a 4-litre agitated leaching vessel, together with a sufficient quantity of Perth tap water to establish 20% solids (w/w).

(2) Sufficient sulphuric acid was added to achieve a target pH of 1.5.

(3) The test was performed at ambient temperatures.

(4) At pre-designated intervals of 0.5, 1, 2, 3, 4, 5, 6, 8, 24 and 48 hours the agitators were turned off and the slurry allowed to settle for sampling and pH adjustments to be made.

(5) The leaching sub-sample (liquor only) was taken first, followed by the pH of the bulk leaching slurry readings recorded prior to adding acid to the remaining slurry to achieve the target conditions.

(6) The samples were then submitted for gold, copper, cobalt and iron analysis.

(7) At the end of leaching period (48 hours), the slurry was filtered, final PLS collected and solids washed in a stage wise manner. The solids were initially washed using pH 2 displacement wash water to suppress iron precipitation, then with tap water.

(8) The washed residue was sub-sampled for moisture content analysis and weighed.

(9) The final PLS was subsampled for gold, copper, cobalt and iron analysis.

(10) The wet filter cake of leach residue was utilised for direct cyanidation testwork.

## 5.2 Results

Comprehensive leach results are included in Appendix II, whilst a summary is presented in the following table.

| ATMOSPHERIC ACID LEACH TESTWORK – LOPOX TAILINGS SLURRY | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test | Overall Co Extraction (%) | Residue Co (ppm) | Overall Cu Extraction (%) | Residue Cu (ppm) | Overall Fe Extraction (%) | Residue Fe (%) | $H_2SO_4$ Addition (kg/t) |
| **HY4479** | 79.6 | 1300 | 59.8 | 4640 | 25.4 | 43.1 | 0.0 |

Comments on the above results are as follows:

- No sulphuric acid addition was required throughout the test, as the natural pH of the LOPOX slurry was ~1.1.
- The solution tenors for copper, cobalt and iron did not change throughout the atmospheric leach test, which indicates that all of the leaching for these species occurred during the LOPOX phase of the flowsheet.
- Gold was not extracted during the test, with the gold solution assays reporting below the detection limit.

# 6. DIRECT CYANIDATION TESTWORK

Direct cyanidation testwork was performed on the atmospheric acid leaching tailings slurry in order to recover gold from the treated flotation concentrate.

## 6.1 Test Procedure

The direct leach test procedure for the test performed on the RIP tailings was conducted as follows.

(1) The acid leach tailings filter cake, together with a sufficient Perth tap water to establish 40% solids (w/w), was transferred into a 4-litre plastic leach bottle with a screw on lid, with slurry agitation supplied by mechanical rollers.

(2) Sufficient hydrated lime (60% CaO) was added to establish a slurry pH of approximately 9.5.

(3) Solid sodium cyanide was added to establish an initial nominal cyanide solution strength of 2,000 ppm.

(4) Oxygen was sparged to the head of the bottle to elevate the dissolved oxygen (DO) levels of the slurry.

(5) At regular intervals (2, 4, 8, 24 and 48 hours), slurry pH, DO and solution cyanide concentration were monitored and recorded.

(6) Lime and cyanide were added as required, to maintain target pH (9.5) and the specified cyanide concentration (>1,000 ppm).

(7) All intermediate solution sub-samples were assayed for gold, copper, cobalt and iron.

(8) At the termination of the test (48 hours) the terminal pH, oxygen and solution cyanide levels were determined and a solution sub-sample was assayed for gold, copper, cobalt and iron.

(9) The residual slurry was sub-sampled, with the sub-sample filtered, washed and dried to provide leach residue solids. A residue sub-sample was assayed for gold, copper, cobalt, and iron.

## 6.2 Results

The results of the cyanidation leach test performed on the acid leach tailings are summarised in the table below with detailed data attached as Appendix III.

| CYANIDATION LEACH TESTWORK – ACID LEACH TAILINGS SLURRY | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test | Leach Duration Hrs. | Overall Gold Ext % | Residue Au g/t | Overall Cu Ext % | Terminal NaCN % | NaCN kg/t | Lime kg/t |
| MP1086 | 48 | 87.5 | 0.67 | 20.0 | 0.048 | 6.39 | 13.2 |

Comments on the above data are as follows:

- Gold extraction was ~88% and leach kinetics showed most of the cyanidable gold was leached within 2 hours. Residue grades were low at 0.67 g/t.
- The oxidative pre-treatment via LOPOX was successful in increasing the gold extraction of the flotation concentrate when compared to cyanidation under similar conditions, without pre-oxidation at (ALS A17129: Au extraction 63.2%).
- Copper extraction amounted to ~20%, with slower leach kinetic trends to gold.

# FIGURE

A17394

# FIGURE 1 - METALLURGICAL TESTWORK PROGRAM FLOWSHEET

## PEKO BULL MINING - PEKO TAILINGS

**COMPOSITE 123 FLOAT CON**
**FLOAT CON LEACHING**
Float Con ex A17129 (provided by Lach)
HOMOGENISE AND SPLIT

0.2kg
**HEAD ASSAY**
S-sulphide

0.5kg
**UFG TO: P80: 10µm**

RESERVE

**LOPOX PRESSURE OXIDATION TESTWORK**

* PERTH WATER
* 500g OF SOLIDS @ 20% SOLIDS
* 95-100º C
* 1000kPa TOTAL PRESSURE
* **180 MINUTES DURATION**
* PRE-ACIDIFY (pH ~2.0) with H2SO4

LOPOX RESIDUE
* COLLECT 100mL SLURRY FOR WEIGHT, ASSAY and FILTER

LIQUOR FOR: Au, Cu, Co, Fe
LOPOX RESIDUE (~20g):
Weight, Au, Cu, Co, Fe, S-total, S-sulphide,

REMAINING SLURRY

**ACID LEACH**

- Measure total slurry wt to get pulp density (should be around 20% solids)
- Adjust to pH1.5 - $H_2SO_4$ if required

MAINTAIN pH1.5

- TIME SERIES SAMPLING @ 2, 4, 8, 24, 48 HOURS
- ANALYSE LEACH SOLUTIONS: Au, Cu, Co, Fe

FILTER
KEEP AS MUCH PREGNANT SOLUTION AS POSSIBLE — RESERVE PREG SOLUTION
RESIDUE - SMALL SLITHER DAMP CAKE - DRY / % MOISTURE, ASSAY: Au, Cu, Co, Fe, S
THE REMAINING DAMP FILTER CAKE

**CYANIDATION TIME LEACH**

- 40% SOLIDS (w/w) (Perth Tap water)
- pH : 9.5 [LIME] - BE CAREFUL

MAINTAIN pH > 9.5

- NaCN : 0.2% (w/v)

MAINTAIN NaCN > 0.1%

- OXYGEN SPARGE >25PPM
- TIME SERIES SAMPLING @ 2, 4, 8, 24, 48 HOURS
- ANALYSE LEACH SOLUTIONS : Au, Cu, Co, Fe

FILTER
KEEP AS MUCH PREGNANT SOLUTION AS POSSIBLE
DRY, WEIGH and ASSAY RESIDUE: Au, Cu, Co, Fe, S

ALS

Metallurgy

# APPENDICES

# APPENDIX I

## LOPOX Testwork

## Details and Results

# HY4478 LoPOx

| | | | | | |
|---|---|---|---|---|---|
| **Project** | Peko Bull Mining | **Date:** | 29/08/16 | **Leach Type** | LoPOx |
| **Test No.** | LoPOx | **ALS #** | HY4478 | **Overpressure** | 1000 kPa |
| **Sample** | A17129 Comp 123 Float Con | | | **Temperature** | 95-100 °C |
| **P80** | 10.06 µm | | | **Leaching time** | 180 min |

**PRE-ACIDULATION**

| | | | | | | |
|---|---|---|---|---|---|---|
| Feed solids | Float Con | 549 grams | | | | |
| | | 91 % solids | | | | |
| | | 500 grams | | | | |
| | | 49 grams H2O | | | | |
| Liquor | Perth tap water | 1951 grams | 1951 mL | at | 1.000 SG | |
| | 98% $H_2SO_4$ | 5.0 grams | | | | |
| Weight of pulp at start | | 2500 grams | | | | |
| Pulp density (% solids, w/w) | | 20 | | | | |

| Stage | | | | | | |
|---|---|---|---|---|---|---|
| **Time:mins** | **0** | **5** | **10** | **15** | **30** | **60** |
| pH | 5.64 | 1.98 | 1.95 | 1.99 | 2.00 | 2.01 |

**PRESSURE LEACH**

| | | | | |
|---|---|---|---|---|
| Liquor to autoclave | 2005 grams | 2003 mL | at | 1.001 SG |
| Weight of pulp at start | 2505 grams | | | |
| Pulp density (% solids, w/w) | 20 | | | |
| Pulp weight to autoclave | 2505 grams | | | |
| Pulp weight from autoclave | 2502 grams | 0 % mass loss | | |
| Autoclave impeller speed | 700 rpm | | | |

| Stage | HEAT UP | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time:mins** | **0** | **5** | **10** | **15** | **30** | **60** | **90** | **120** | **150** | **180** | **MAX** |
| Pressure:psig | 0 | 143 | 143 | 144 | 144 | 144 | 144 | 143 | 145 | 144 | 145 |
| Pressure:kPag | 0 | 986 | 986 | 993 | 993 | 993 | 993 | 986 | 1000 | 993 | 1000 |
| Temp:°C | 80 | 97 | 96 | 96 | 97 | 97 | 97 | 97 | 97 | 97 | 97 |

* [Pt electrode, Ag/AgCl reference with Saturated KCl]

**SOLUTION ASSAYS**

| Solution Product | Mass grams | s.g. | pH | mV * | Au mg/L | Co mg/L | Cu mg/L | Fe mg/L |
|---|---|---|---|---|---|---|---|---|
| Start Solution | 2005.0 | 1.001 | 2.01 | 429 | | | | |
| Solution From Autoclave | | | | | | | | |
| 180 min | 108.1 | 1.095 | 1.28 | 469 | 0.005 | 981 | 1374 | 25000 |
| Final | | | | | | | | |
| Waste | | | | | | | | |
| Total leach soln recovered | 108.1 | | | | | | | |

Level is under detection limit

**SOLIDS ASSAYS**

| Solid Product | | Wet Mass grams | Moisture % | Dry Mass grams | Au g/t | Co % | Cu % | Fe % | $S_{total}$ % | $S^{2-}$ % |
|---|---|---|---|---|---|---|---|---|---|---|
| Feed Solids | | 500.0 | 8.9 | 500.0 | | | | | | 20.20 |
| Solids From Autoclave | | | | | | | | | | |
| 180 min | | 29.0 | 33.6 | 19.3 | 4.94 | 0.12 | 0.44 | 42.8 | 15.8 | 9.48 |
| Final | | | | 359.1 | | | | | | |
| Waste | | | | | | | | | | |
| Total leach solids recovered | | 29.0 | | 378.3 | | | | | | |

Sulphide Oxidation: 64.49 %

**EXTRACTION CALCULATIONS (Solution vs Calculated Head)**

| Stage | Time min | Au % | Co % | Cu % | Fe % |
|---|---|---|---|---|---|
| Feed | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 180 min | 180 | 0.52 | 80.73 | 61.54 | 23.04 |

**CALCULATED HEAD GRADE**

| | Au g/t | Co % | Cu % | Fe % |
|---|---|---|---|---|
| | 3.76 | 0.47 | 0.87 | 42.1 |

# APPENDIX II

## Atmospheric Acid Leaching Testwork

## Details and Results

| | |
|---|---|
| PROJECT | A17394: PEKO BULL MINING |
| TEST No | HY4479 |
| SAMPLE | HY4478 LoPOx Slurry |
| GRIND SIZE | P80: 10.08 µm |
| WATER | PERTH TAP WATER |
| DATE | 5/09/2016 |

## SULPHURIC ACID LEACH ON LOPOX LEACH SLURRY

| TIME (hours) | ADDITIONS | | | SLURRY DATA | | SOLUTION DATA | | | | | | | EXTRACTION (incl. LoPOx stage) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample (g) | Water (mL) | 98% H2SO4 (g) | pH | ORP * (mV) | SG | pH | ORP * (mV) | Au (mg/L) | Co (mg/L) | Cu (mg/L) | Fe (mg/L) | Au (%) | Co (%) | Cu (%) | Fe (%) |
| | 355 | 1821 | | | | | | | | | | | | | | |
| 0 | 355 | 1821 | 0.00 | 1.07 | 517 | 1.0953 | 1.28 | 469 | 0.002 | 981 | 1374 | 25000 | 0.52 | 80.73 | 61.54 | 23.04 |
| 0.5 | | 1821 | 0.00 | 1.05 | 511 | | | | | | | | | | | |
| 1 | | 1821 | 0.00 | 1.08 | 515 | | | | | | | | | | | |
| 2 | | 1821 | 0.00 | 1.08 | 516 | 1.0967 | 1.13 | 513 | 0.002 | 944 | 1222 | 26240 | 0.20 | 76.54 | 54.68 | 23.48 |
| 3 | | 1771 | 0.00 | 1.10 | 516 | | | | | | | | | | | |
| 4 | | 1771 | 0.00 | 1.12 | 516 | 1.0986 | 1.15 | 514 | 0.002 | 962 | 1273 | 26750 | 0.20 | 77.96 | 56.89 | 23.92 |
| 5 | | 1735 | 0.00 | 1.11 | 516 | | | | | | | | | | | |
| 6 | | 1735 | 0.00 | 1.12 | 516 | | | | | | | | | | | |
| 8 | | 1735 | 0.00 | 1.16 | 517 | 1.0999 | 1.16 | 512 | 0.002 | 984 | 1323 | 26450 | 0.20 | 79.66 | 59.02 | 23.67 |
| 24 | | 1698 | 0.00 | 1.33 | 514 | 1.1018 | 1.27 | 513 | 0.002 | 936 | 1224 | 28080 | 0.20 | 76.03 | 54.90 | 25.03 |
| 48 | 353 | 1669 | 0.00 | 1.30 | 513 | 1.1017 | 1.30 | 511 | 0.002 | 984 | 1344 | 28470 | 0.20 | 79.60 | 59.81 | 25.35 |

## METAL EXTRACTION CALCULATIONS

| Product | Quantity | Gold | | | Cobalt | | | Copper | | | Iron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Assay (g/t) | Total (µg) | Dist'n (%) | Assay (ppm) | Total (mg) | Dist'n (%) | Assay (ppm) | Total (mg) | Dist'n (%) | Assay (ppm) | Total (mg) | Dist'n (%) |
| Residue (g) | 353 | 5.06 | 1784 | 99.80 | 1300 | 458 | 20.40 | 4640 | 1636 | 40.19 | 431000 | 151947 | 74.65 |
| Solution (mL) | 1669 | 0.002 | 3 | 0.19 | 984 | 1642 | 73.10 | 1344 | 2243 | 55.10 | 28470 | 47510 | 23.34 |
| Sub-Sample | | | 0 | 0.02 | | 146 | 6.49 | | 192 | 4.72 | | 4083 | 2.01 |
| Total Extraction | | | | 0.20 | | | 79.60 | | | 59.81 | | | 25.35 |
| Total | | | 1788 | 100.00 | | 2246 | 100.00 | | 4071 | 100.00 | | 203540 | 100.00 |

**Notes:**

| | | |
|---|---|---|
| 1. Initial Slurry Mass : | 2350.3 | (g) |
| 2. Final Slurry Mass : | 2086.95 | (g) |
| 3. Recovered PLS Mass : | 1567.33 | (g) |
| 3. Recovered PLS SG : | 1.1001 | (SG) |
| 5. Total Wet Cake Mass : | 465.37 | (g) |
| 6. Sub-Sample Wet Mass : | 30.88 | (g) |
| 7. Sub-Sample Dry Mass : | 23.00 | (g) |
| 8. Total Dry Solids Mass : | 346.62 | (g) |
| 9. Total Sulphur Grade of Residue : | 16.2 | (%) |
| 10. Sulphide Grade of Residue : | 9.90 | (%) |
| 11. Waste Solids Mass : | 5.93 | (g) |

12. Test was conducted in a baffled reactor and agitated with an overhead stirrer

# APPENDIX III

## Direct Cyanidation Testwork

## Details and Results

| | |
|---|---|
| **PROJECT** | **A17394: PEKO BULL MINING** |
| **TEST No** | **MP1086** |
| **SAMPLE** | **HY4479 Acid Leach Residue** |
| **GRIND SIZE** | **P80: 10.08 µm** |
| **WATER** | PERTH TAP WATER |
| **DATE** | 5/09/2016 |

**DIRECT CYANIDATION TIME LEACH TESTWORK ON ACID LEACH RESIDUE**

| Time | Additions | | | | Solution Data | | | | | | | Extraction (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (Hours) | Ore (g) | Water (mls) | NaCN (g) | Lime (g) | Oxygen (ppm) | pH | NaCN (%) | Au (ppm) | Co (ppm) | Cu (ppm) | Fe (ppm) | Au | Co | Cu | Fe |
| | 311.3 | 467.0 | | | 2.2 | 7.45 | | | | | | | | | |
| 0 | | 467.0 | 0.93 | 3.90 | 25.0 | 9.20 | 0.200 | 0.00 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | | 437.0 | 0.54 | 0.20 | 20.0 | 9.21 | 0.085 | 2.99 | 20 | 140 | 51 | 84.4 | 2.5 | 4.0 | 0 |
| 4 | | 407.0 | 0.00 | 0.00 | 19.2 | 9.72 | 0.158 | 3.06 | 23 | 180 | 69 | 86.3 | 2.7 | 5.1 | 0 |
| 8 | | 377.0 | 0.00 | 0.00 | 17.0 | 9.56 | 0.118 | 3.08 | 23 | 256 | 106 | 86.8 | 2.8 | 7.0 | 0 |
| 24 | | 347.0 | 0.77 | 0.00 | 19.6 | 9.51 | 0.035 | 3.02 | 26 | 461 | 168 | 85.4 | 3.0 | 11.7 | 0 |
| 48 | | 317.0 | 0.04 | 0.00 | 19.3 | 9.60 | 0.048 | 3.12 | 27 | 850 | 339 | 87.5 | 3.1 | 20.0 | 0 |
| TOTAL | | | 2.28 | 4.10 | | | | | | | | | | | |

**1.** NaCN addition : 7.31 (Kg/t) **4.** Float water used : 1.019 (SG)
**2.** NaCN consum'n (kg/t) : 6.39 (Kg/t) **5.** Water weight to leach : 2167.9 (g)
**3.** Lime consum'n (kg/t) : 13.17 (Kg/t) **6.** Grind size P 100 : 0 (µm)

| Product | Quantity | Gold | | | Cobalt | | | Copper | | | IRON | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Assay (ppm) | Mass (µg) | Dist'n (%) | Assay (ppm) | Mass (µg) | Dist'n (%) | Assay (ppm) | Mass (µg) | Dist'n (%) | Assay (ppm) | Mass (µg) | Dist'n (%) |
| Solids (g) | 311.3 | 0.67 | 207 | 12.52 | 1200 | 373596 | 96.86 | 4200 | 1307586 | 80.04 | 441000 | 137296530 | 99.91 |
| Solution (mls) | 317.0 | 3.12 | 989 | 59.79 | 27 | 8527 | 2.21 | 850.0 | 269450 | 16.49 | 339 | 107463 | 0.08 |
| Solution Samples * | | | 458 | 27.69 | | 3573 | 0.93 | | 56610 | 3.47 | | 22002 | 0.02 |
| Total Extraction | | | | 87.48 | | | 3.14 | | | 19.96 | | | 0.09 |
| Total | | | 1654 | 100.00 | | 385696 | 100.00 | | 1633646 | 100.00 | | 137425995 | 100.00 |
| Calculated Head | | 5.31 | | | 1239 | | | 5247 | | | 441416 | | |
| Assay Head | | 5.06 | | | 1300 | | | 4640 | | | 431000 | | |

* : Intermediate solution samples removed during the test. S Residue: 17.0%