

# **APPENDIX B**

**Experimental Logsheets**

**ALR Leach No.** Run 1

**Date :** 28 January 2004

**Conditions:**

Mass of ALR (g) : 240.26

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) 1200

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 50

Agitation Speed (rpm) 400

Fractions Used : TL Feed 3b : 1,5,9,13,& part of 3

Solid : Liquid ratio : 1:5

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Slurry		pH	Filtrate		Comments
					pH	Redox (mV)		Redox (mV)	Temp. (°C)	
1	10.0	150.0	37.5	3.48	0.67	361.6		452.0	23.0	
Wash	-	-	55.0	-	-	-		-	-	
2	10.0	150.0	46.5	2.14	0.68	427.0		445.0	23.0	
Wash	-	-	32.0	-	-	-		-	-	
3	10.0	150.0	48.0	1.25	0.43	635.0		619.0	23.0	
Wash	-	-	28.0	-	-	-		-	-	
4	10.0	150.0	93.0	4.37	0.15	677.0	1.07	615.0	23.0	
Wash	-	-	57.0	-	-	-		-	-	
4.5	10.0	150.0	1955.0	36.12	0.86	680.0	0.86	620.0	23.0	Due to crystallisation, the filtrate and wash were combined and additional water added to give a final volume of 400ml.
Mass Loss = 84.97 %										

**ALR Leach No.**

Run 2

**Date :**

15 June 2005

**Conditions:**

Mass of ALR (g) : 100.70

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60 plus 50 after 5.5 hours

Agitation Speed (rpm) : 400

Fractions Used : 13-2, 13-10

Solid : Liquid ratio : 1:12

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
0	9.4	114.0	16.6	0.34	343.4	29.1	-ve	416.0	15.2	-ve	
1	9.4	153.4	11.8	0.15	382.5	34.3	-ve	430.0	15.9	-ve	
2	9.9	133.8	11.0	0.15	433.0	63.5	-ve	447.0	19.1	-ve	
	-	-	-	-	433.0	37.4	-ve	-	-	-	
3	8.7	154.3	8.0	0.01	459.0	61.4	-ve	473.0	14.5	-ve	
	-	-	-	-	452.0	18.7	-ve	-	-	-	
4	9.2	159.7	10.5	0.01	454.0	53.2	-ve	513.0	8.7	0.14	
	-	-	-	-	456.0	27.5	-ve	-	-	-	
4.5	11.4	158.6	23.8	0.12	428.0	60.0	1.21	485.0	8.4	1.80	
	-	-	-	-	406.0	33.9	1.34	-	-	-	
5	10.0	138.9	22.4	0.22	459.0	81.7	1.30	471.0	8.4	1.75	
Filtrate	-	-	640.0	-	-	-	-	461.0	8.6	1.75	3.82 g of intermediate
Wash	-	-	450.0	-	-	-	-	495.0	28.4	2.01	
0	8.2	118.3	19.6	0.16	438.0	75.8	0.91	502.0	19.3	1.70	53.37g returned with 1200ml of 50 g/l acid
	-	-	-	-	420.0	34.2	1.50	-	-	-	
1	9.8	153.4	13.8	0	511.0	50.8	1.79	503.0	19.2	1.96	
2	11.5	161.4	19.0	0	510.0	50.6	1.16	492.0	19.5	1.54	
3	10.4	152.3	30.0	0.04	641.0	49.9	1.10	630.0	22.3	1.50	
3.5	10.5	148.8	19.0	0	681.0	45.7	1.23	674.0	23.4	1.39	
3.75	9.6	145.5	25.0	0	682.0	42.6	1.20	688.0	20.3	1.62	
4	10.3	144.5	25.0	0	691.0	40.1	1.29	693.0	20.7	1.56	
Final	-	-	750.0	15.3	-	-	-	557.0	13.5	1.69	
Wash	-	-	390.0	-	-	-	-	610.0	13.5	2.38	
Mass Loss = 84.20%											

**ALR Leach No.**

Run 3

**Date :**

11 August 2005

**Conditions:**

Mass of ALR (g) : 100.02

Continue with leach until acid consumption has reached its minimum, then stop leach

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60

Agitation Speed (rpm) : 400

Fractions Used : 13-6, 13-13

Solid : Liquid ratio : 1:12

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
0	7.3	125.4	45.0		340.8	56.7	0.81	385.0	16.9	1.55	
1	9.1	136.9	28.0		370.6	52.4	0.94	411.0	18.6	1.46	
2	9.2	145.2	17.0		399.8	55.5	1.05	419.0	18.7	1.91	
3	9.0	147.6	25.0		402.0	51.9	1.26	412.0	20.3	1.49	
3.5	8.9	146.3	23.0		400.0	44.7	1.28	426.0	18.8	1.51	
Final	-	-	860.0	2.32				451.0	12.5	1.78	
Wash	-		226.0	acid							
			320.0	water							
Final	(Acid washed)			33.85							
Final	(Water washed)			25.35							
				59.20							
Mass Loss = 40.81%			The leach was purposefully stopped at the minimum acid level, therefore poor mass loss is expected.								
Mass Loss = 40.81 %		But run was terminated early on purpose									

**ALR Leach No.**

Run 4

**Date :**

23 June 2005

**Conditions:**

Mass of ALR (g) : 100.41

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 80

Agitation Speed (rpm) : 400

Fractions Used : 13-3 and 13-11

Solid : Liquid ratio : 1:12

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Slurry			Filtrate			
					Redox (mV)	Temp. (°C)	pH	Redox (mV)	Temp. (°C)	pH	
0	9.0	131.9	49.0		339.0	57.4	0.9	339.2	14.3	1.4	
1	8.7	150.3	36.0		342.7	45.2	1.1	394.6	16.6	1.6	
2	9.8	151.6	21.0		365.3	41.3	1.2	415.0	16.5	1.7	
3	9.0	151.6	25.0		389.6	42.1	1.2	412.0	17.5	1.6	
4	13.4	154.6	28.0		408.0	46.4	1.0	413.0	17.8	1.6	
5	13.2	153.8	34.0		442.0	42.0	1.4	426.0	19.2	1.5	
5.5	9.7	151.3	28.0		444.0	41.5	1.1	436.0	18.4	1.30	
6	9.7	151.1	24.0		438.0	40.7	1.0	426.0	19.3	1.4	
6.5	9.7	151.3	23.0		458.0	41.6	1.04	445.0	18.9	1.40	
6.75	9.6	149.9	32.0		470.0	43.0	1.06	450.0	11.9	1.64	
7	8.7	141.0	36.0		467.0	47.6	0.93	450.0	11.8	1.56	
Int. Filtrate	-	-	555.0		-	-	-	400.0	12.0	1.44	Removed by decantation and added 1200 ml of 50 g/l acid
0	8.2	161.2	33.0		517.0	44.4	1.14	488.0	15.5	1.50	
0.5	10.6	137.8	42.0		652.0	52.4	1.20	634.0	16.2	1.46	
1	10.6	149.5	53.0		672.0	52.8	1.02	671.0	16.6	1.47	
1.25	9.7	156.3	32.0		672.0	46.8	1.16	673.0	16.0	1.47	
2.25	9.4	159.6	42.0		720.0	48.1	1.10	681.0	19.0	1.66	
Final	-	-	1080.0	18.6	-	-	-	652.0	14.9	1.70	
Wash	-	-	530.0		-	-	-	-	14.9	2.49	
Mass Loss = 81.48 %											

**ALR Leach No.** Run 5

**Date :** 3 November 2005

**Conditions:**

Mass of ALR (g) : 100.67

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60 plus 50 after 5.5 hours plus ferric sulphate 60 g/l equ. 40 ml of 98% H<sub>2</sub>SO<sub>4</sub>

Agitation Speed (rpm) : 400

Fractions Used : 13-8, 13-16

Solid : Liquid ratio : 1:12

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
0											
0.5	5.4	123.0	39.0	1.83	320.5	56.9	0.28	439.0	30.2		
1.5	7.9	128.5	43.0	1.92	340.5	53.3	0.42	423.0	30.0		
2.5	9.2	154.6	33.0	1.68	342.8	47.7	0.63	418.0	30.1		
3.5	8.9	142.9	42.0	2.29	351.4	47.3	0.50	412.0	30.2		
4	9.1	147.0	35.0	1.50	370.3	45.2	0.54	413.0	30.1		
Intermediat			365.0	0.28				448.0	25.5	0.80	
2 g/l Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>								681.0	24.9	2.4	
08:15	Warm-up										
08:55	4.5	110.5	37.0	0.86	403.0	60.2	0.27	488.0	22.7		
Final			1085.0	9.99				422.0	22.7		
Mass Loss = 89.69%											

**Run was not continued to completion**

**ALR Leach No.** Run 6

**Date :** 23 November 2005

**Conditions:**

Mass of ALR (g) : 100.28

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60 Additional 50 g/l

To add solutions of Fe<sup>3+</sup> at various stages.

Agitation Speed (rpm) : 400

Fractions Used : 5-13, 5-5

Solid : Liquid ratio : 1:12

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
08:10	Started heating										
08:20	7.8	72.6	28.0	1.12	-	-	-	430.0	25.3		
09:00	7.9	142.0	85.0	2	292.3	45.2	0.2	385.3	25.3		An unusually large sample
10:15	8.8	135.9	19.5	3.09	388.1	54.1	0.3	426.0	25.3		
11:00	8.9	149.3	15.0	0.56	396.4	53.1	0.3	428.0	23.4		
12:00	9.6	152.4	22.5	0.64	410.0	47.6	0.5	429.0	23.5		
13:00	9.3	140.3	24.0	0.63	426.0	57.4	0.4	432.0	23.2		
13:20	Add 5 g/l Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>		50.0		660.0						
13:25	10.6	141.4	21.0	0.4	429.0	35.5	0.58	437.0	25.3		
13:40	10.0	146.0	27.0	0.67	416.0	38.3	0.56	417.0	24.7		
13:45	Add 5 g/l Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>		100.0		660.0						
13:50	11.2	144.0	28.0	0.6	414.0	47.1	0.52	427.0	25.2		
15:00	8.8	152.7	27.0	0.49	410.0	53.3	0.36	428.0	25.6		
16:00	Interm		345.0	0.15	457.0	21.2	-	-	-		
08:00	Started heating with 1200 ml fresh 50 g/l acid										
09:00	11.4	141.6	34.0	0.2	422.0	64.4	0.15	405.0	31.5		
10:00	9.6	152.0	30.0	0.23	406.0	55.3	0.34	433.0	25.5		
10:10	Add 5 g/l Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>		100.0		462.0	32.5	0.35	449.0	25.5		
10:15	11.2	142.6	30.0	0.14	400.0	63.6	0.43	408.0	25.5		
11:00	8.9	145.8	28.0	0.14	436.0	64.8	0.19	441.0	25.5		
11:45	9.1	146.0	28.0	0.14	440.0	69.4	0.08	436.0	22.4		

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
11:50	11.4	141.6	26.0	0.08	457.0	69.8	0.08	439.0	27.9		
11:55	Add 5 g/l Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>		100.0								
12:00	10.6	142.1	27.0	0.05	464.4	71.4	0.08	433.0	27.9		
13:00	8.8	144.8	28.0	0.11	540.0	74.6	0.08	493.0	30.5		
13:30	8.7	145.3	26.0	0.03	565.0	64.5	0.41	524.0	31.6		
13:45	8.6	145.5	46.5	0.09	593.0	61.0	0.40	555.0	33.5		
14:00	9.2	145.9	25.0	0.06	615.0	71.6	0.40	578.0	32.3		
14:05	9.1	146.0	30.0	0.05	628.0	75.5	-ve	585.0	35.6		
14:10	9.4	146.2	28.0	0.05	631.0	73.9	0.04	584.0	30.5		
14:20	9.7	146.5	41.0	0.05	634.0	64.3	0.07	604.0	34.2		
Final	0.3		1000.0	17.54				605.0	28.8		Evaporated down to volume
Wash			420.0								
Mass Loss = 82.51%											



**ALR Leach No.**

Run 7

**Date :**

13 December 2005

**Conditions:**

Mass of ALR (g) : 100.24

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60

Addition of Ferric Sulphate at the beginning as a solid = 20.58 g (equivalent to 0.1003 mol Fe<sup>3+</sup>)

Agitation Speed (rpm) : 400

Fractions Used : 5- 9 , 5- 16

Solid : Liquid ratio : 1:12

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
Fe Soln								625.0	20.7		
0.0	0.0	40.0	16.0	0.95	321.0	25.5		383.1	22.0		
1.0	9.3	125.0	68.0	4.16	327.7	53.5		364.7	23.7		
2.0	10.4	164.4	68.0	3.53	313.4	47.0		354.8	25.7		
3.0	9.4	152.4	96.0	4.87	329.4	48.8		353.4	25.9		
4.0	10.4	151.8	49.0	2.3	359.1	49.3		379.2	26.6		
6.0	-	-	640.0	45.67	-	-		414.0	20.0		
Wash	-	-	330.0	-	-	-		-	-		
Mass Loss =	54.4	%									

**ALR Leach No.**

Run 8

**Date :**

16 January 2006

23 January 2006

**Conditions:**

Mass of Pd Sponge (g) : 10.06

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1000

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60

To ascertain whether or not a redox >920 mV is attained insitu

Agitation Speed (rpm) : 420

Fractions Used : Pd Sponge

Solid : Liquid ratio : 1:100

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	
0	4.0	150.0			
4	9.0	150.0	970.0	9.66	
Wash			352.0		
970 final, sampled 100ml and 870 ml boiled down to 530 ml					
0	10.0	150.0		8.49	
6	10.0	150.0	955.0	8.96	
Wash			184.0		
Mass Loss =	3.98	%			
Solution Analysis for Pd = 4.182 mg/l (ICP MS)					
970 ml ~ 4.057 mg					

**ALR Leach No.**

Run 9

**Date :** 26 January 2006

**Conditions:**

Mass of Ag Powder (g) : 1.14

To determine if redox reaches 799 mV readings to dissolve Ag

Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1000

[H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60

Agitation Speed (rpm) : 420

Fractions Used : Ag Powder

Solid : Liquid ratio : 1:1000

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	
0.0				1.14	
6.0	10.0	150.0	955.0	0.35	
Mass Loss=	69.3	%			

**ALR Leach No.** Run 10

**Date :** 22 June 2006

**Conditions:**

Mass of ALR (g) : 90  
 Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1500  
 [H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60  
 Agitation Speed (rpm) : 400  
 Fractions Used : 5/3 and 5/12  
 Solid : Liquid ratio : 1:17

50 ml of 98% H<sub>2</sub>SO<sub>4</sub> into 1450 ml H<sub>2</sub>O

To continue the leach well past end point to determine whether or not the pgms are solubilised from alloy cores.

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	pH	Redox (mV)	Filtrate Temp. (°C)	pH	
0.0	Started heating										
8H30	4.2	49.3	23.0	0.86	248.0	16.3	0.40	275.0	14.6	0.38	Wash = 60ml
10H00	9.8	137.4	49.5	1.3	254.0	29.5	0.46	300.0	17.6	0.42	Wash = 106ml
15H30	10.1	150.9	52.0	0.78	336.0	33.8	0.55	334.0	21.1	0.52	Wash = 41.5ml
17H30	9.6	138.2	50.0	0.76	598.0	15.2	0.66	541.0	10.8	0.58	Wash = 96.0ml
Started cooling to 100 °C for the night @ 16H00						Unblocked jelly type product from oil bath pump					
Intermediate				0.28							
07H00	Started heating to 150 °C, PV T=38.0										
10H30	12.5	145.9	72.5	0.88	396.0	31.2	0.53	380.0	16.0	0.51	Wash = 72.5ml
11H00	Cool and decant		660.0					328.0			Wash = 66.5 ml
11H10	Added 1200ml of 60 g/l H <sub>2</sub> SO <sub>4</sub> and started heating from 50 °C										
12H00	10.0	150.0									
12H30	10.0	134.2	53.0	0.44	392.0	-	-	-	-	-	Wash = 79.0ml
14H30	12.9	139.2	58.1	0.41	440.0	38.9	0.50				Wash = 110.4ml
16H30	0.3	97.0	-	0.25	615.0	-	-	-	-	-	Added back to PV following morning
09H00	Started heating to 150 °C										
10H30	12.9	138.9	85.0	0.55	638.0	13.6	0.53	636.0	12.3	0.45	
13H30	10.9	152.0	1213.0	13.89	718.0	42.3	0.45	719.0	21.5	0.30	Wash = 532ml
	Stopped										
100 g/l								517.0			
80 g/l								517.0			
60 g/l								509.0			
50 g/l								507.0			
Mass Loss = 84.59		%									

**ALR Leach No.** Run 11

**Date :** 07 February 2006

**Conditions:**

Mass of ALR (g) : 116.58  
 Volume of H<sub>2</sub>SO<sub>4</sub> (ml) : 1200  
 [H<sub>2</sub>SO<sub>4</sub>] (g/l) : 60  
 Agitation Speed (rpm) : 400  
 Fractions Used : 5-6 , 5-14, 5-4  
 Solid : Liquid ratio : 1:12

Addition of soluble Rh and Ru at the beginning in acid solution = ~1g/l of each in sulphuric acid  
 To determine whether the soluble Rh and Ru re-precipitate and if possible to establish mineralogically how they precipitate

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Slurry Temp. (°C)	Wash (ml)	Redox (mV)	Filtrate Temp. (°C)	pH accurate	
0.0	No solid sampled only acid + Rh + Ru Solution										
1.5	21.0	150.0	49.0	3.17	252.3		93.0	270.0	22.7	1.46	20.3 °C
2.0	10.0	150.0	45.0	2.91	245.7		88.0	250.0	22.7	1.71	20.3 °C
3.0	10.0	150.0	47.0	1.94	255.0	35.4	55.0	195.0	21.3	1.93	20.3 °C
5.0	10.0	150.0	47.0	5.39	167.0	43.5	120.0	186.0	22.4	2.51	20.3 °C
6.0	10.0	148.0	34.0	15.66	260.0	44.4	95.0	242.0	21.8	3.36	20.3 °C
7.0	10.0	151.0	95.0	9.43	318.0	54.7	218.0	297.0	21.9	3.41	20.3 °C
9.0	10.0	140.0	30.0	14.03	300.0	49.8	108.00	281.0	21.5	2.72	20.3 °C
10.5	10.0	151.0	45.0	9.9	258.0	34.5	91.00	245.0	22.8	3.19	20.3 °C
11.5	-	-	105.0	Boiled down				454.0	21.5	2.50	20.3 °C
Wash	-	-	100.0	Boiled down							
				169.27							