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Pressure leaching characteristics of a magnetically enhanced concentrate with specific refrence to the precious metal components

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APPENDIX B

Experimental Logsheets

ALR Leach No. Run 1 **Date :** 28 January 2004

Conditions:

Mass of ALR (g) : 240.26
Volume of H_2SO_4 (ml) 1200
$[H_2SO_4]$ (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	Slurry Redox (mV)	Filtrate pH	Filtrate Redox (mV)	Filtrate Temp. (°C)	Comments
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_2SO_4 (ml) : 1200
$[H_2SO_4]$ (g/l) : 60 plus 50 after 5.5 hours
Agitation Speed (rpm) : 400
Fractions Used : 13-2, 13-10
Solid : Liquid ratio : 1:12

					Slurry			Filtrate			
Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Temp. (°C)	pH	Redox (mV)	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
	-	-	-	-	420.0	34.2	1.50	-	-	-	of 50 g/l acid
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
Volume of H_2SO_4 (ml) : 1200
$[H_2SO_4]$ (g/l) : 60
Agitation Speed (rpm) : 400
Fractions Used : 13-6, 13-13
Solid : Liquid ratio : 1:12

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

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Slurry Redox (mV)	Slurry Temp. (°C)	Slurry pH	Filtrate Redox (mV)	Filtrate Temp. (°C)	Filtrate 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_2SO_4 (ml) : 1200
[H_2SO_4] (g/l) : 80
Agitation Speed (rpm) : 400
Fractions Used : 13-3 and 13-11
Solid : Liquid ratio : 1:12

					Slurry			Filtrate			
Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	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
0	8.2	161.2	33.0		517.0	44.4	1.14	488.0	15.5	1.50	added1200 ml of 50 g/l acid
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_2SO_4 (ml) : 1200
$[H_2SO_4]$ (g/l) : 60 plus 50 after 5.5 hours plus ferric sulphate 60 g/l equ. 40 ml of 98% H_2SO_4
Agitation Speed (rpm) : 400
Fractions Used : 13-8, 13-16
Solid : Liquid ratio : 1:12

					Slurry			Filtrate			
Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Redox (mV)	Temp. (°C)	pH	Redox (mV)	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 $Fe_2(SO_4)_3$								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_2SO_4 (ml) : 1200
$[H_2SO_4]$ (g/l) : 60 Additional 50 g/l To add solutions of Fe^{3+} 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)	Slurry Redox (mV)	Slurry Temp. (°C)	Slurry pH	Filtrate Redox (mV)	Filtrate Temp. (°C)	Filtrate 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 unusaully 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 $Fe_2(SO_4)_3$		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 $Fe_2(SO_4)_3$		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 $Fe_2(SO_4)_3$		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)	Slurry Redox (mV)	Slurry Temp. (°C)	Slurry pH	Filtrate Redox (mV)	Filtrate Temp. (°C)	Filtrate 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 $Fe_2(SO_4)_3$		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_2SO_4 (ml) : 1200
$[H_2SO_4]$ (g/l) : 60 Addition of Ferric Sulphate at the beginning as a solid = 20.58 g (equivalent to 0.1003 mol Fe^{3+})
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)	Slurry Redox (mV)	Slurry Temp. (°C)	Slurry pH	Filtrate Redox (mV)	Filtrate Temp. (°C)	Filtrate 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_2SO_4 (ml) : 1000
$[H_2SO_4]$ (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 bolied 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
Volume of H_2SO_4 (ml) : 1000
$[H_2SO_4]$ (g/l) : 60
Agitation Speed (rpm) : 420
Fractions Used : Ag Powder
Solid : Liquid ratio : 1:1000

To determine if redox reaches 799 mV readings to dissolve Ag

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_2SO_4 (ml) : 1500
$[H_2SO_4]$ (g/l) : 60
Agitation Speed (rpm) : 400
Fractions Used : 5/3 and 5/12
Solid : Liquid ratio : 1:17

50 ml of 98% H2SO4 into 1450 ml H_2O

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

Time (Hours)	Pressure (Bar)	Temp. (°C)	Volume (ml)	Mass (g)	Slurry Redox (mV)	Slurry Temp. (°C)	Slurry pH	Filtrate Redox (mV)	Filtrate Temp. (°C)	Filtrate 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 H2SO4 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_2SO_4 (ml) : 1200
$[H_2SO_4]$ (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)	Filtrate Redox (mV)	Filtrate Temp. (°C)	pH accurate	
0.0	No solid sampled only acid + Rh + Ru Solution							617.0	22.7	-0.18	20.3 °C
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							