LABORATORY TESTWORK

OREBODY: GRUM

① DATE: 1975-1976

LABORATORY: LAKEFIELD RESEARCH CANADA

LOCKED-CYCLE TEST

		ASSAYS		RECOVERY	
	% wt	Pb %	Zn %	Pb %	Zn %
LEAD CONC	11.0	62.0	5.2	87.8	3.5
ZINC CONC	24.2	1.3	55.6	4.4	90.0
HEAD (CALC)		4.72	10.0		

PILOT PLANT

		ASSAYS		RECOVERY	
	% wt	Pb %	Zn %	Pb %	Zn %
LEAD CONC	11.0	45.2	18.5	73.9	19.1
ZINC CONC	18.7	5.3	36.5	14.4	62.6
HEAD (CALC.		6.89	8.90		

② DATE: 1977-1978

LABORATORY: LAKEFIELD RESEARCH CANADA.

LOCKED-CYCLE TEST

		ASSAYS		RECOVERY	
	% wt	Pb %	Zn %	Pb %	Zn %
LEAD CONC	5.5	64.2	5.2	85.4	4.2
ZINC CONC	9.0	0.5	58.5	1.3	77.6
HEADS (CALC)		4.08	6.71		

PILOT PLANT

		ASSAYS		RECOVERY	
	% wt	Pb %	Zn %	Pb %	Zn %
LEAD CONC	7.0	65.4	9.5	78.1	6.6
ZINC CONC	14.7	2.2	54.5	5.4	79.8
HEADS (CALC)		5.8	10.0		

LABORATORY TESTWORK

ORE BODY: FARO & GRUM

(3) DATE: AUGUST, 1979
LABORATORY: LAKEFIELD RESEARCH CANADA

FARO ONLY		ASSAY		RECOVERY	
	% WT	Pb %	Zn %	Pb %	Zn %
LEAD CONC	3.5	73.1	3.4	86.3	2.8
ZINC CONC	6.8	0.5	49.1	1.2	85.4
HEADS (CALC)		3.15	4.43		
GRUM ONLY					
LEAD CONC	6.9	49.6	10.5	73.0	8.0
ZINC CONC	11.4	0.6	51.8	1.4	66.0
HEADS (CALC)		4.98	9.13		
FARO/GRUM					
LEAD CONC	4.7	68.6	4.6	85.1	3.2
ZINC CONC	8.3	0.5	52.5	1.1	65.9
HEADS (CALC)		4.07	6.78		

grind 75% -74 μm

LABORATORY TESTWORK

DREBODY : GRUM

(4) DATE: MAY, 1982
LABORATORY: KAMLOOPS RESEARCH

BATCH TEST

	% wt	ASSAYS		RECOVERY	
		Pb %	Zn %	Pb %	Zn %
LEAD CONC	8.4	54.8	12.0	87.3	11.6
ZINC CONC	12.0	1.3	58.0	3.1	80.3
HEADS (CALC)		5.25	8.67		

(5) DATE: 1989
LABORATORY : LAKEFIELD RESEARCH

BATCH TEST	% wt	ASSAYS				RECOVERY (%)			
		Pb %	Zn %	Ag g/t	Au g/t	Pb	Zn	Ag	Au
LEAD CONC		60.0		650	5	88		70	41
ZINC CONC			54.0				78		
HEADS (CALC)									
LOCKED CYCLE									
LEAD CONC									
ZINC CONC									
HEADS (CALC)									

kWh = 13/14 /t PK_{80} - 65 μm

FARO DIV — GRUM.

① Mineralogy — carbonaceous quartzite
non-carbonaceous quartzite
massive sulphide

* Massive Sulphide — very fine grained with strong Pb/Zn intergrowth.
- grind to liberate Pb from Zn
-3 stages of grinds for the Pb Circuit
- particle size — Pb Cone 14 μm.
— Zn Cone 18 μm

② Laboratory Testwork (Grum)

Pb Cone	Pb - 68%	@ 83% Rec
	Ag - 850-900 g/t	@ 70-75% Rec
	Au - 6-15 g/t	@ 35-65% Rec
Zn Cone	Zn - 53%	@ 83% Rec.
	Pb - 1.2%	
	Fe - 8-9.2%	
	Ag - 315-525 ppm	

→ FLOWSHEETS. → Regrind —
H.I Load. —
Reagents. —

③ Zn Cone particle size

Faro Pit No. III	28 μm.
Vang	25 μm
Grum	18 μm

Brunswick
Green's Creek
Reed Dog
Snow Lake
McArthur River
} Similar fine grind of Zn cone.

Vang —	Pb Cone	Pb 63%	@ 83% Rec
		Ag 650-800	@ 70% Rec
		Au 5-14	@ 50% Rec
	Zn Cone	Zn 53%	@ 85% Rec
DY —	Pb Cone	Pb 60%	@ 87% Rec
		Ag 1000 g/t	@ 81% Rec
		Au 5 g/t	@ 50% Rec.
	Zn Cone	Zn 57%	@ 90% Rec
		Pb 1.2%	
		Fe 5%	

GRUM METALLURGICAL REVIEW.

1.0 Ore Types

- 2 major descriptive groups
  - massive sulphide zones — 40% of mineral inventory
  - disseminated sulphide zones — 60% of mineral inventory
  - host rock inclusion in ore — quartzite, carbonaceous phyllites & barite

2.0 Mineralogy

- the mineralogical observations that had the greatest effect on the flowsheet were observed in the massive sulphide ore type:
  - the sphalerite is disseminated in the galena matrix.
  - galena liberation requires a grind of 80% passing 10-15 μm
  - sphalerite " " " " 80% passing 15-20 μm

3. History of Laboratory Testwork

a) Noranda (1973-77)

- diamond-drill core
- underground decline sample
- bench and pilot plant test work

	Assay	Recovery
Pb Conc	60-62% Pb (8-10% Zn)	77-80%
Zn Conc	56% Zn (2-2.5% Pb)	81-84%

b) Curragh Inc (1988-89 and 91)

- diamond drill core
- bench testwork - developed a "new" flowsheet

	Assay	Recovery
Pb Conc *	65-68% Pb (5-8% Zn)	83-90%
Zn Conc	53-56% Zn (0.5-1.5% Pb)	83-84%
		An 34-68%
		Ag 69-79%

Why the metallurgical improvement?

- finer regrind
- high intensity conditioning
- reagent (SD 240)
- modified Faro flowsheet.

4. Flowsheets

a) Drum Ore -

- grinding work index 13.2 kWh/t (G)
  12.0 " (F)

b) Pb Circuit

- 3 stages of regrind - P_{80} 25 μm
  " " 15 μm
  " " 12 μm
- SD 200 - to improve the Pb/Zn separation at reduced CN consumption levels.
- 4 stages of cleaning

c) Zn Circuit

- 2 stages of regrind - P_{80} 15 μm.
- 2 stages of cleaning
- 2 high intensity conditioners*

d) Overall flowsheet.

e) Multi element analysis.

5. GENERAL ARRANGEMENT.

6. HIGH INTENSITY CONDITIONERS 8'Ø x 14'
   150 H.P. motor

7. Construction Schedule.

Grum Ore — Metallurgical Testwork

1.0 Composites.

G1, G2, G3

No testwork on G3 (sample in transit to Lakefield)

2.0 Metallurgical Response

Headgrade Range (G1 and G2 only) — Pb 2.8 to 3.7%
Zn 5.1 to 6.3%
Ag 40 to 60 g/t
Au 0.7 to 1.5 g/t

Pb Final Conc. Range — Pb 60 to 62% — @ 83 to 88% Rec
Ag 600 to 700 g/t — @ 68 to 75% Rec
Au 4 to 7 g/t — @ 40 to 42% Rec

Zn Final Conc. Range — Zn 54% ——— @ 75 to 80% Rec

3.0 Grind — Work Index ____ (similar to Fish)

Primary / Secondary Grind 80% passing 65 microns
Regrind — Pb Rghr / Scav Conc 80% passing 20 microns

Grum

Sofia Bulatovic

Sept 18/91

① Hiller in Australia
- 2 stage Pb required
- high intensity cond

Pb Conc 50% Rec → 80% Rec
Zn Conc 60% Rec → 90% Rec
Bulk 40% Rec

② Woodlawn
Hg - Cu Hg - .3% Cu

Cu/Pb/Zn Tlg - .8% Cu
2.0% Pb
4.0% Zn

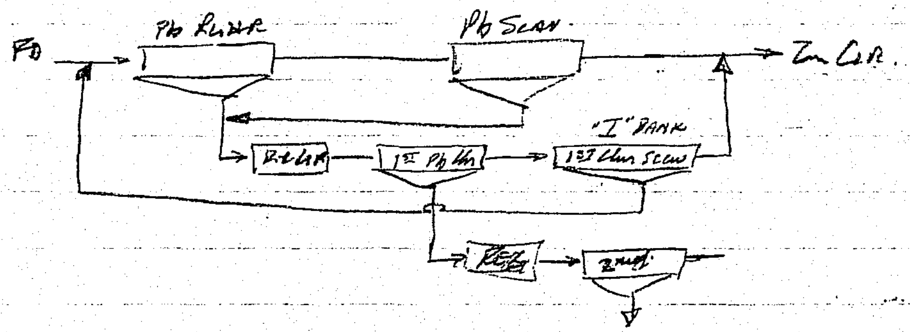
Toliod - prefloat
- bulk conc

③ Ghenomy
a) - Bharti Engineering - what mine in Germany uses paste backfill.
b) - Freezing of conc. - contact Klaus Konigsmann
- procedure
- testing

④ Grum
a) Sample 37063 to 37068 - Pb improv
- Zn poor
b) Sample 3069 - good Pb met.
- poor Zn met.
c) Pb Flotation - finer grind has helped; however may have to regrind the Pb 1st Clnr Conc.;
- reagents for more depression

Tower mill destroys magnetite

Reagents on [illegible]



Standard Test:

Grind - 90% to 95% -200 #
(40 min)
K_{80} - 45 µm

Pb Regrind - K_{80} 13 µm (?)
└ use more CN:SO on regrind
--> CN dissolve some Cu to effect Zn depression.

← Try using 3418A-
← ✓ Lime in Pb pH

Zn Mg - Screen and comparison

Done

screen.

Done.

Upper Ore -
- standard.
- 2 stage Pb Regrind
- new Zn dep.
- improve Zn flotation

Sample		Zone
57063		Upper
64		Upper
65		Upper
66	No Sample.	Upper
67		Upper
68		Upper
69		Upper
70		Mid
71		Mid
72		Mid
73		Mid

→ Need more sample similar to the upper & mid zones.

Report - samples from the decline
- locked cycle on each ore type
- technology change "Stemsay"

Zn Metallurgy
- slow flotation → assay high Zn tailing for ZnOx
- voluminous froth -
- zinc follows in the clue.

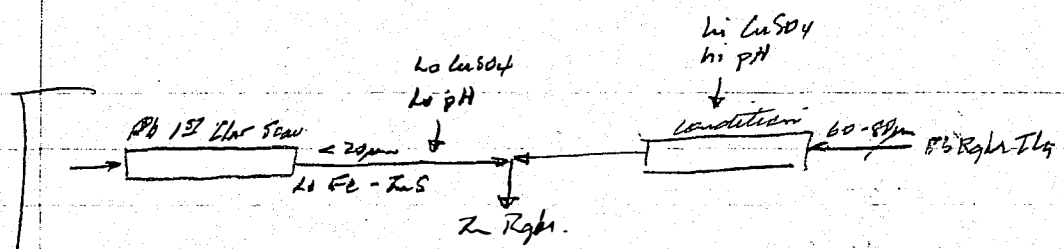
Lab Report # 7 - high oxide Zn

- zinc in Pb conc - low Fe Zinc in Pb float · (depress c CN:SO)
→ try lower pH in zinc (right & clean)
less $CuSO_4$ } as in Gj 3 composite
- make composite with the following samples
37081
83
86
87
37078
78
79
} Do Zn treatment.

2nd DD hole.

a) Pb Met
- zinc in Pb float -
- 64817
19
22
23
24
25
26
31
32
33
34
36
- standard
- 2 stage grinding (regrinding)
- new Zn depressants
- revised Zn flowsheet
} check on Zn O content.

172 216

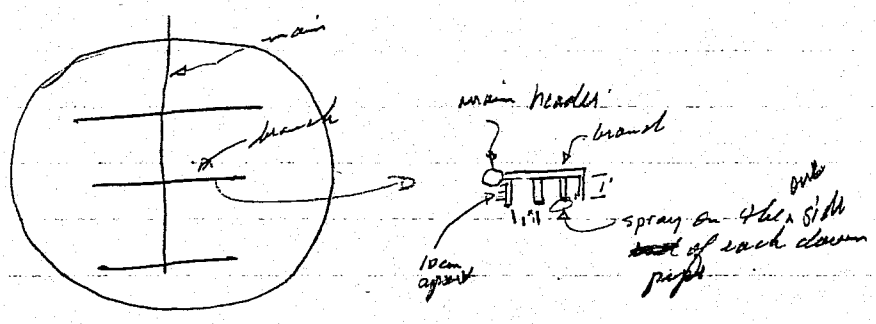


Faro - do same cond. in "I" bank then "I" bank tailings to Zn Rougher feed pump.

Not Required

→ Strm - Cu in the Pb Conc
- SO_2 + steam to destroy collector then float the Cu.

Column



Low pressure water