019846 FEB 21 1978

MATTAGAMI LAKE MINES LIMITED

Matagami, Que.

Grum

14 F

I.D.B. A.P.C. P.V.C.

JB

FILE

INTER-OFFICE MEMORANDUM

FROM K. V. Konigsmann

TO J. K. Carrington

DATE February 17, 1978

COPY TO R. L. Coleman

SUBJECT

COPY TO B. P. Wallace

D. J. T. Carson

This memo summarizes results of two investigations which were carried out in parallel to flowsheet development with Grum ores.

The first was to establish the effect of many-fold recirculation of effluents on flotation behaviour.

In the second the characteristics of waste rock were observed in crushing, grinding and flotation.

to item 1, see appended report of Jan. 19, 1978.

Twenty-seven flotation tests (rougher flotation only) were carried out in succession over a period of three months with the same type of ore. The water required for each test was taken from a laboratory tailings pond, into which tailings pulps and concentrate filtrates from these tests were deposited. After three months of closed-circuit operation, conditions were still stable, the series was terminated.

Samples of two types of waste

The following observations are note-worthy:

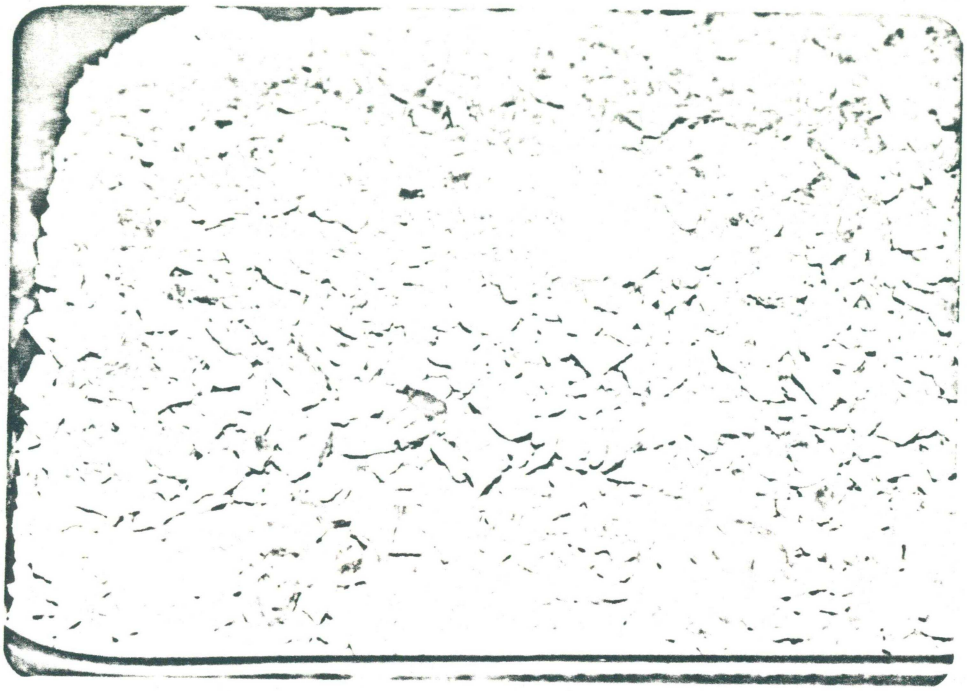
- The thiosalt generation during the tests was low (see page 5 of the report). Thiosalts oxidized quickly, depressing the pH of effluents from 10+ at the end of tests to about pH 8 in the pond.

- The fluctuation in results was quite acceptable. The changes which did occur - decrease in rougher concentrate grade with corresponding increase in recovery - are primarily due to some drifts in procedure. The usage of effluents even after 3 months recirculation did not have noticeable ill effects.

In summation, the results of the test series support the conclusions on effluent utilization as contained in our report on pilot plant testing of Grum ores.

to item 2, see appended report of February 9, 1978

Two samples of waste were tested by themselves and in mixtures with Grum ore in varying proportions. Both waste samples appeared to be metamorphosed rocks of sedimentary origin, layers being clearly visible in all samples. The darker colour of one type may be due to carbonaceous components.



Crushed waste dry and under water

Both types of waste crushed well, producing a fair percentage of fines in one pass (15-20% passing 100 mesh).

The waste samples have a grinding work index of about 15 KWH/T. While this is high in comparison to Grum ores, it is quite low when compared to the hardness of non-sulphidic, siliceous wastes encountered elsewhere. The dark waste crushed into slaty, thin fragments.

Both samples contained high silica, 48-57%.

When exposed to water for days or weeks the wastes did not absorb any. There was no indication of increasing stickiness caused by the presence of clay components or the like. The rocks appeared quite stable during the time span (weeks) of observation.

When added to the ore, flotation would not suffer more than one would expect from 10 to 50% dilution. The contents of CaO and MgO increased slightly in the rougher concentrates but only in proportions which could be explained by much reduced base metal content of the flotation feed.

If the two samples of waste are representative of the non-sulphidic waste rock at Grum, one could not expect unusual difficulties from this dilution.

K. Kun.

MATTAGAMI LAKE MINES LIMITED
CONCENTRATOR LABORATORY

Use of tailings effluent in GRUM Pb-Zn Flotation

Michel Garon
January 19, 1973

Summary

Twenty seven laboratory batch tests were conducted from the 20 September 1977 to the 4 January 1978 with Grum ore (composite no.2) substituting tailings effluent from a laboratory tailings pond for FRESH raw water, in order to know the particular effects it could have on lead and zinc flotation.

According to the results obtained it did not influence the flotation performances. A more frothy zinc flotation was observed after several tests but it did not do any damage. Results are summarized below for the seven last tests and for the three main flotation products.

	Analyses (% or oz/t)			% Distribution		
	Ag	Pb	Zn	Ag	Pb	Zn
1° Pb rougher conc	12.22	28.98	10.48	80.2	85.0	15.6
1° Zn rougher conc	0.98	0.71	38.18	8.0	2.6	71.6
Zn rougher tails	0.12	0.44	0.45	3.2	5.2	2.7
Head	2.04	4.56	8.99	100	100	100

...2

Laboratory work and results

From the 20 September 1977 to the 4 January 1978, flotation tests were performed with Grum ore (composite no. 2), substituting tailings effluent from a small laboratory tailings pond for raw water.

A certain amount of fresh flotation tailings were poured into the experimental pond and then, the following procedure was applied for each test:

1. Before the test, measure the temperature, the pH and the $S_2O_3^=$ concentration of the water in the tailings pond.

2. Float the lead and the zinc according to figure-1, using tailings effluent whenever water is required (to wash the rods of the grinding mill, to raise the pulp level in the cell, etc...).

3. At the end of the test, measure the temperature, the pH and the $S_2O_3^=$ concentration of the water in the cell.

The flowsheet used is shown in figure-1. One thousand gr. of ore were ground to about 80-85% -200 mesh with the reagents indicated and then, aerated for 15 minutes before flotation. Three lead rougher

...3

concentrates were floated and analysed for Ag, Pb and Zn. Following a conditionning of 5 minutes, Zn was also floated in three concentrates and assayed for the same elements. A small cup with a long handle was used to sample the zinc rougher tails at the end of the tests, directly in the cell while being agitated, and they were assayed. The tails (solids + water) were put into the pond as well as the filtrate of each zinc and lead concentrate.

Table-1 demonstrates the temperatures, pH's and $S_2O_3^=$ concentrations of the water before and after each test. After each test those measurements were made in the cell.

...4

FIGURE-1

LABORATORY FLOWSHEET

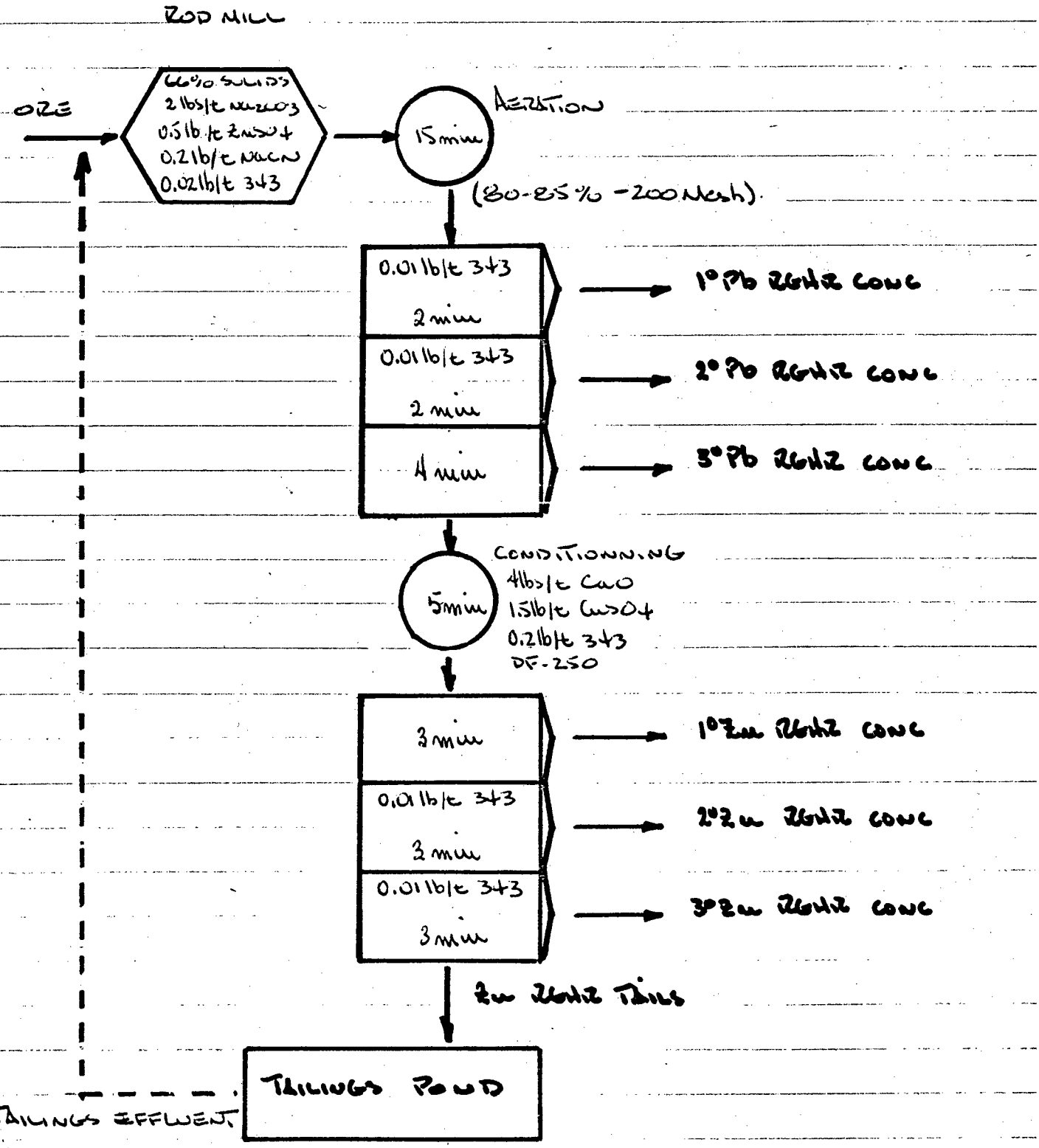


TABLE-1

MEASUREMENTS

TEST NO.	DATE	TEMPERATURE (°C)		PH		$S_2O_3^=$ (PPM)	
		1	2	1	2	1	2
1	20/9/77	73	84	7.4	9.2	—	9.0
2	21/9/77	70	83	7.7	9.5	1.1	14.6
3	22/9/77	71	83	7.6	9.6	1.1	14.6
4	23/9/77	73	83	7.7	10.0	3.4	22.4
5	26/9/77	75	83	7.8	10.0	—	16.8
6	27/9/77	73	83	7.8	10.3	1.1	PAS MESURÉ
7	28/9/77	73	83	7.9	10.1	2.2	7.8
8	29/9/77	74	88	7.9	10.0	—	11.2
9	30/9/77	74	87	8.0	10.2	—	10.1
10	3/10/77	76	87	7.7	10.1	—	11.2
11	4/10/77	76	87	7.9	10.3	—	9.0
12	5/10/77	76	84	8.2	10.2	—	7.8
13	7/10/77	74	81	8.0	9.9	—	10.1
14	14/10/77	69	85	7.7	9.4	—	11.2
15	17/10/77	74	87	8.0	9.0	—	16.8
16	21/10/77	74	88	7.9	9.7	—	16.8
17	28/10/77	75	87	8.1	10.2	—	13.4
18	1/11/77	75	88	8.0	10.3	—	11.2
19	4/11/77	78	90	8.1	10.4	—	15.7
20	11/11/77	78	90	8.0	10.4	—	9.0
21	21/11/77	74	89	8.0	10.2	19.0	24.6
22	2/12/77	75	90	7.9	10.1	—	16.8
23	6/12/77	77	88	8.1	10.4	—	11.2
24	7/12/77	77	89	8.2	10.3	—	9.0
25	12/12/77	68	80	8.1	10.0	—	12.3
26	16/12/77	75	85	8.0	10.9	—	9.0
27	4/1/78	68	82	7.9	9.7	—	7.8

1- BEFORE THE TEST, IN THE POND
2- AT THE END OF THE TEST, IN THE CELL

Results for 1^{o}Pb Rougher concentrate, 1^{o}Zn rougher concentrate and Zn rougher tails are illustrated in figures 2 to 7. For each, analyses and recoveries for Ag, Pb and Zn are plotted against test number. Detailed results are found in table 2 and 3 at the end of this report.

Conclusion

The 1^{o} Pb rougher concentrate behaves normally through the 27 tests and doesn't show any particular trend. Lower recoveries and higher grades for lead appear in the first tests because this concentrate was not pulled enough.

Figure-5 reveals wide variations in zinc recoveries at the beginning for the 1^{o} Zn rougher concentrate whereas zinc analyses are more stable. Because not pulled enough in some of the first tests, bad zinc recoveries and high grades were obtained in the concentrate. After a certain number of tests, flotation was observed to become more frothy. Somehow, here again no adverse effect on zinc flotation can be noticed.

...7

The many wide variations in silver recoveries and grades in the zinc rougher tails should be mentioned. The behaviours of lead and zinc are about the same in the tails.

To sum up, the use of tailings effluent had no significant effects on lead and zinc flotation for Grum ore through all the tests performed in laboratory.

FIGURE -2

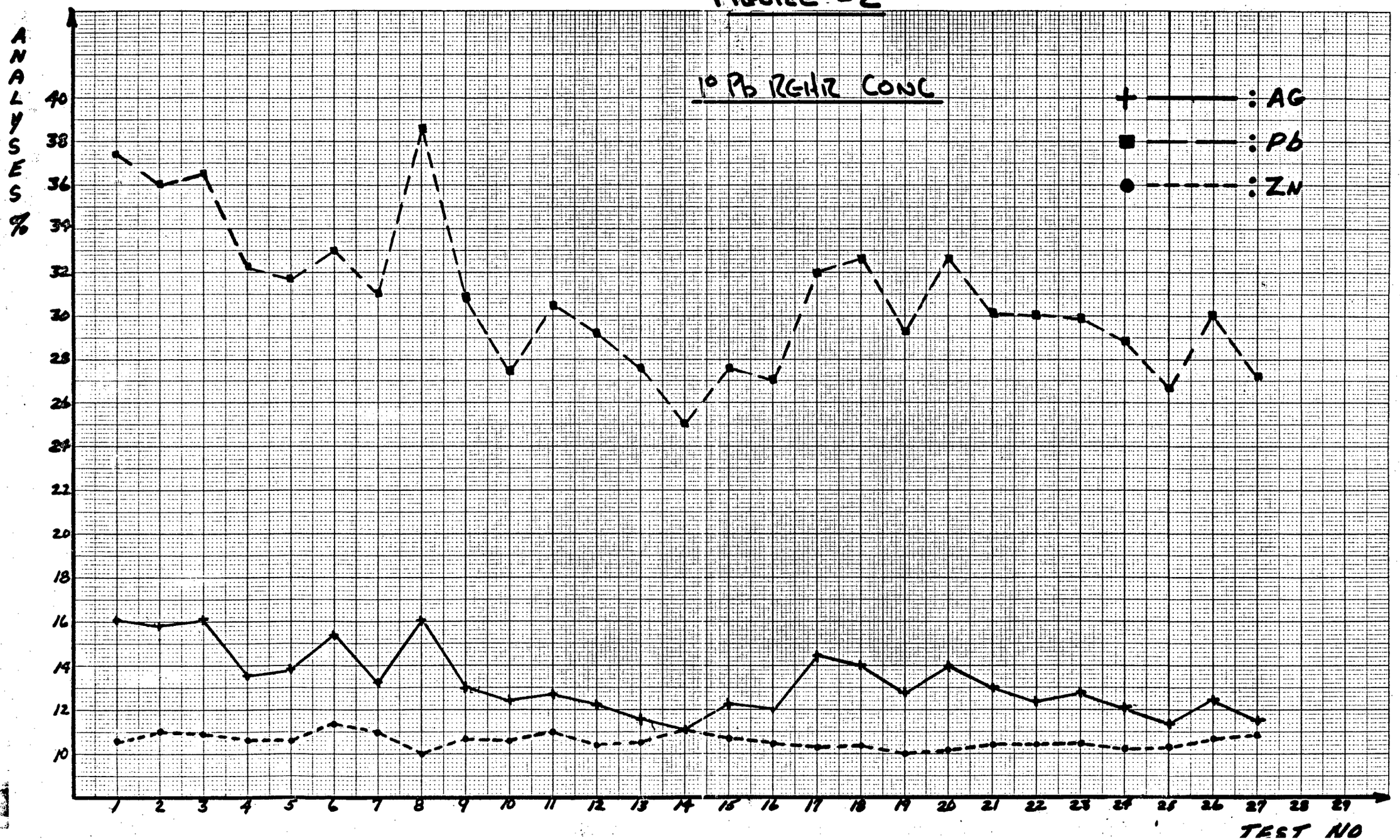


FIGURE - 3

1° Pb RGHR CONC

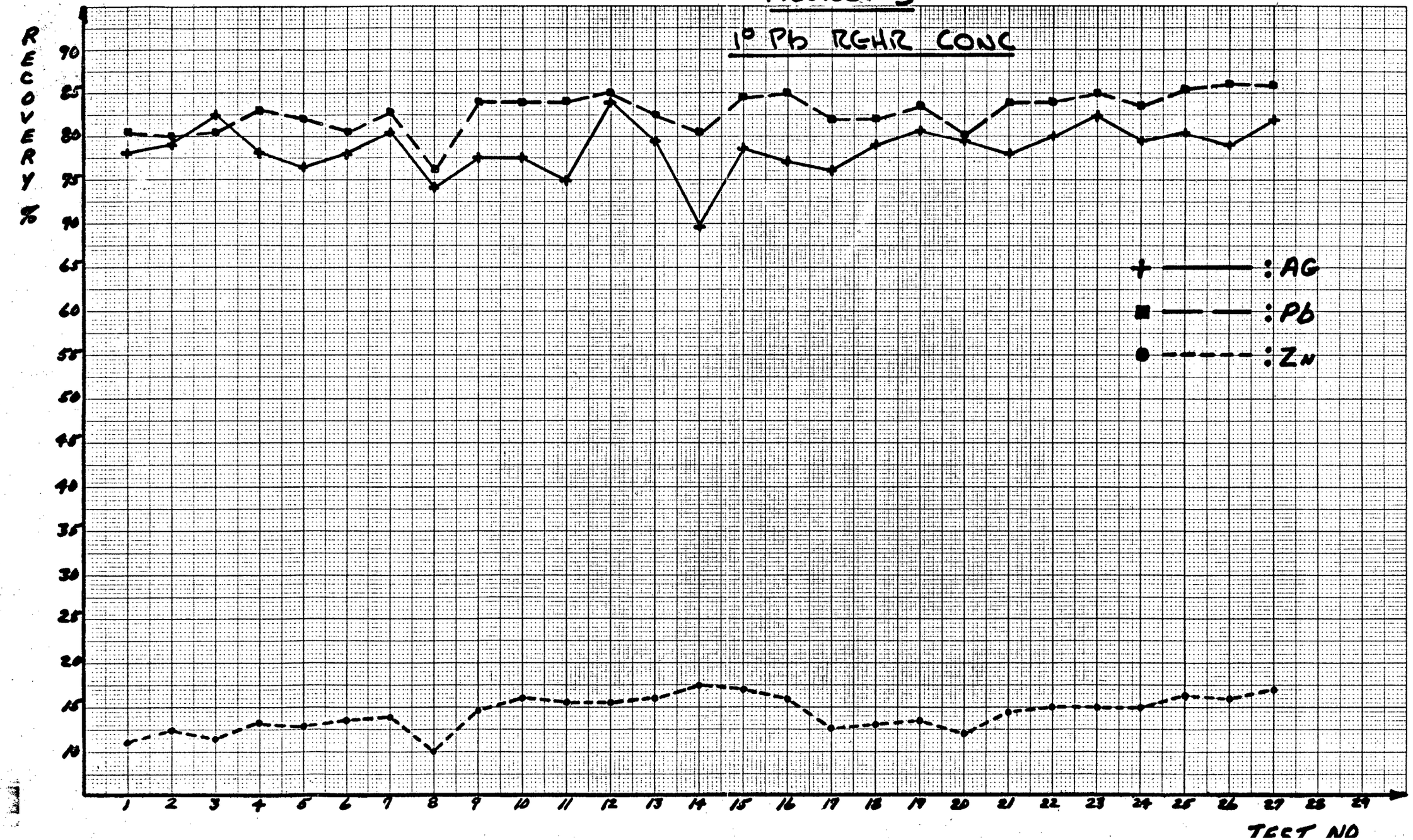


FIGURE - 4

10 Zn RGHR CONC

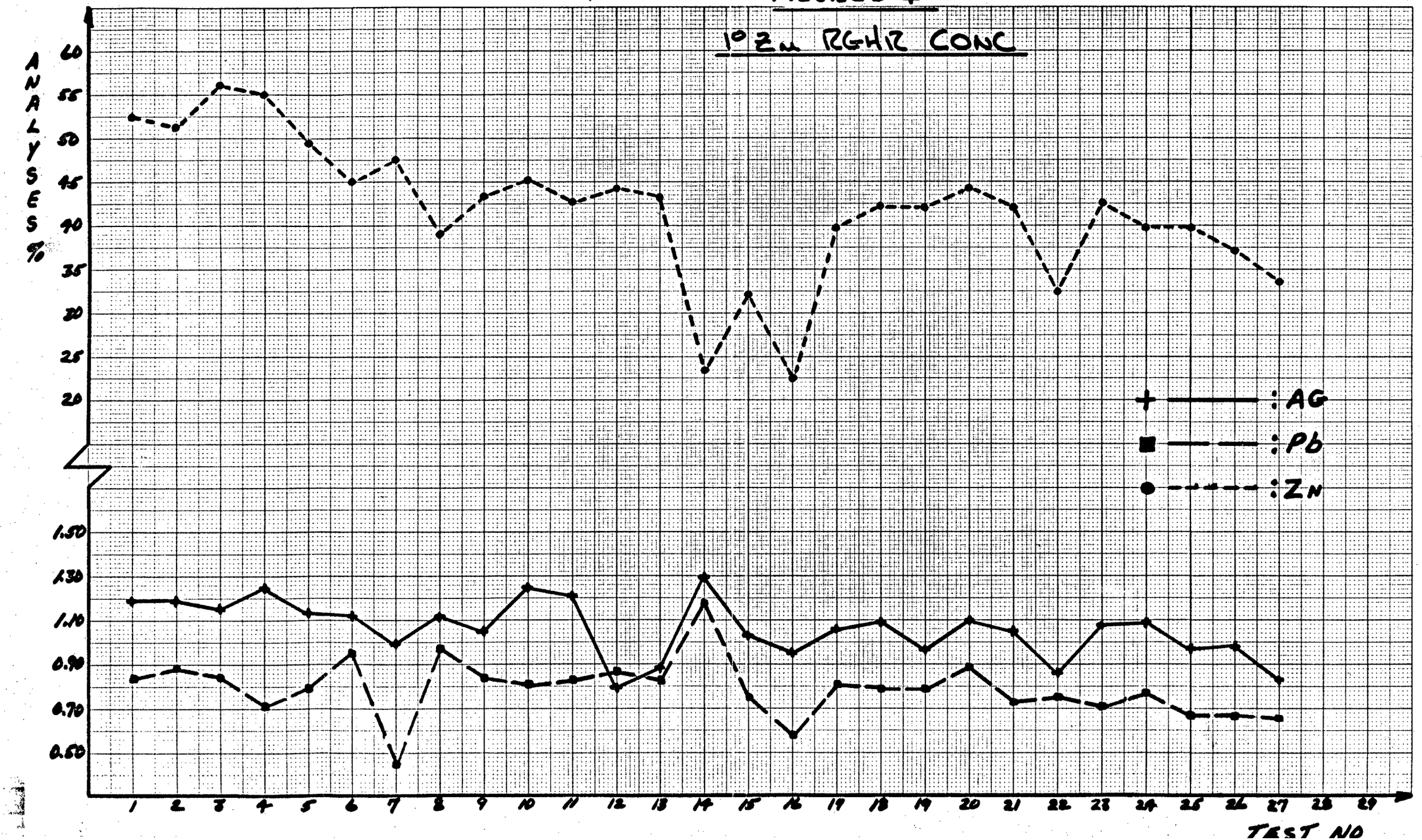


FIGURE 5

1° ZN 12GHR CONC

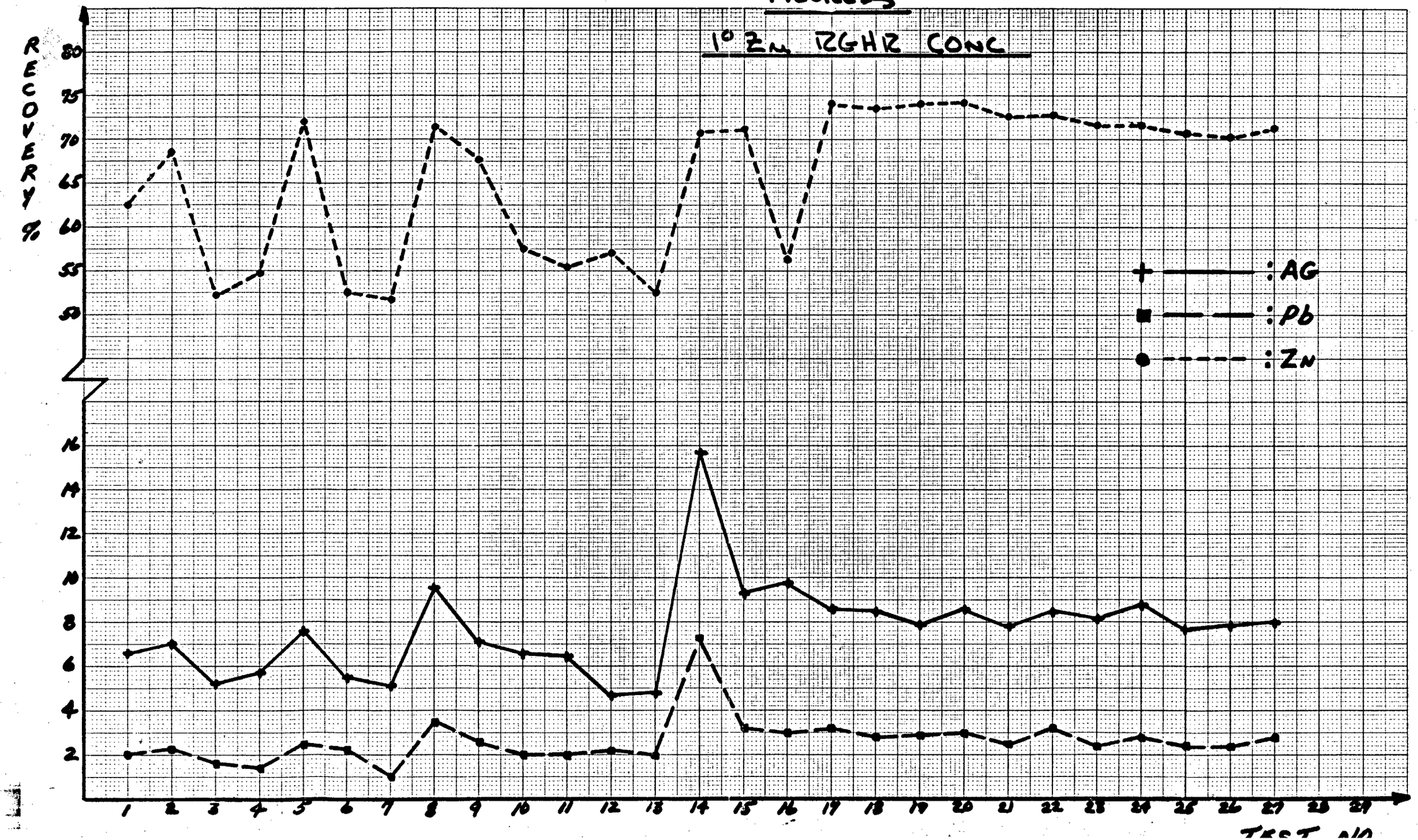


FIGURE - 6

ZN. RGHR TAILS

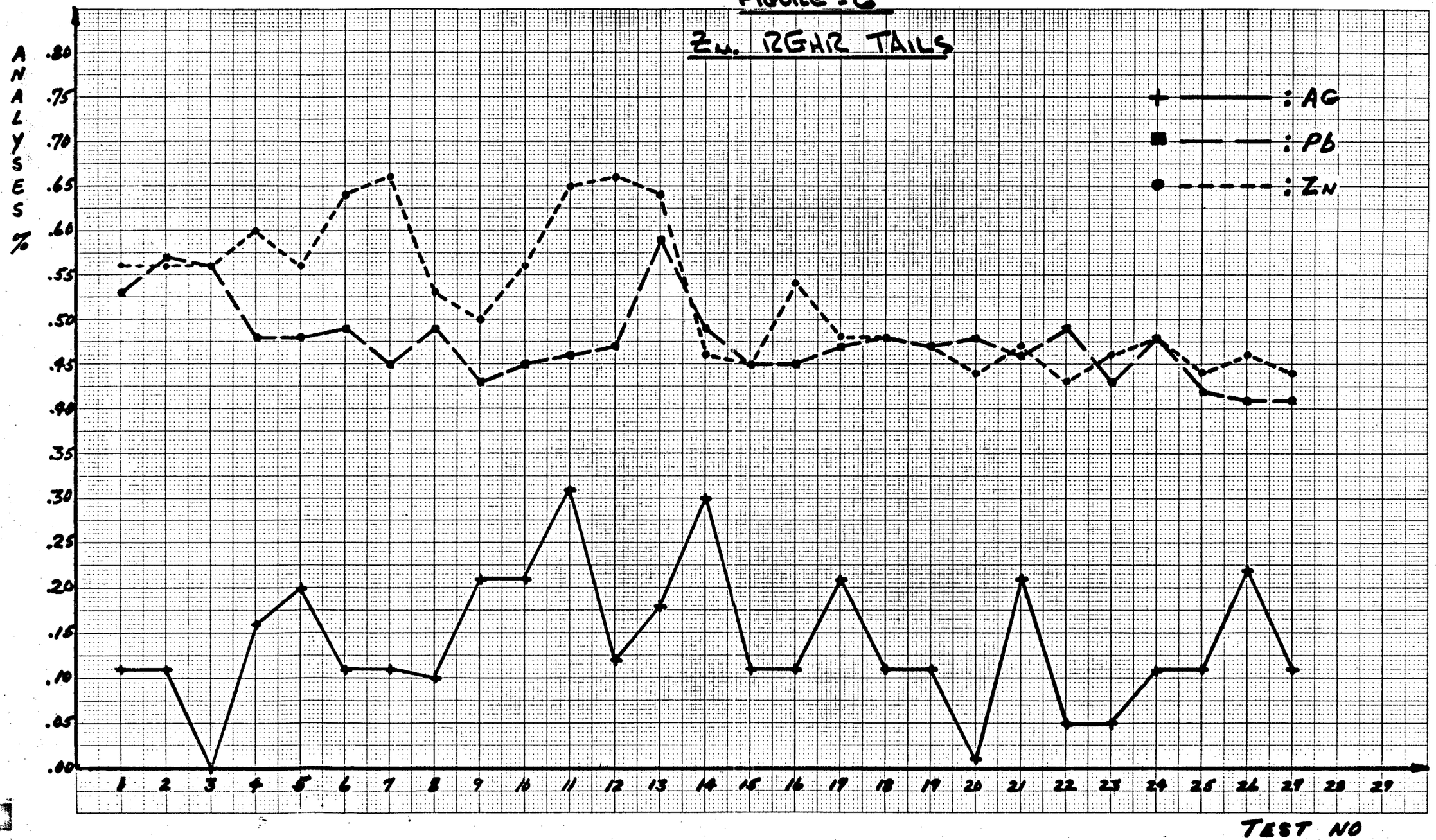


FIGURE - 7

ZN RGHR TAILS

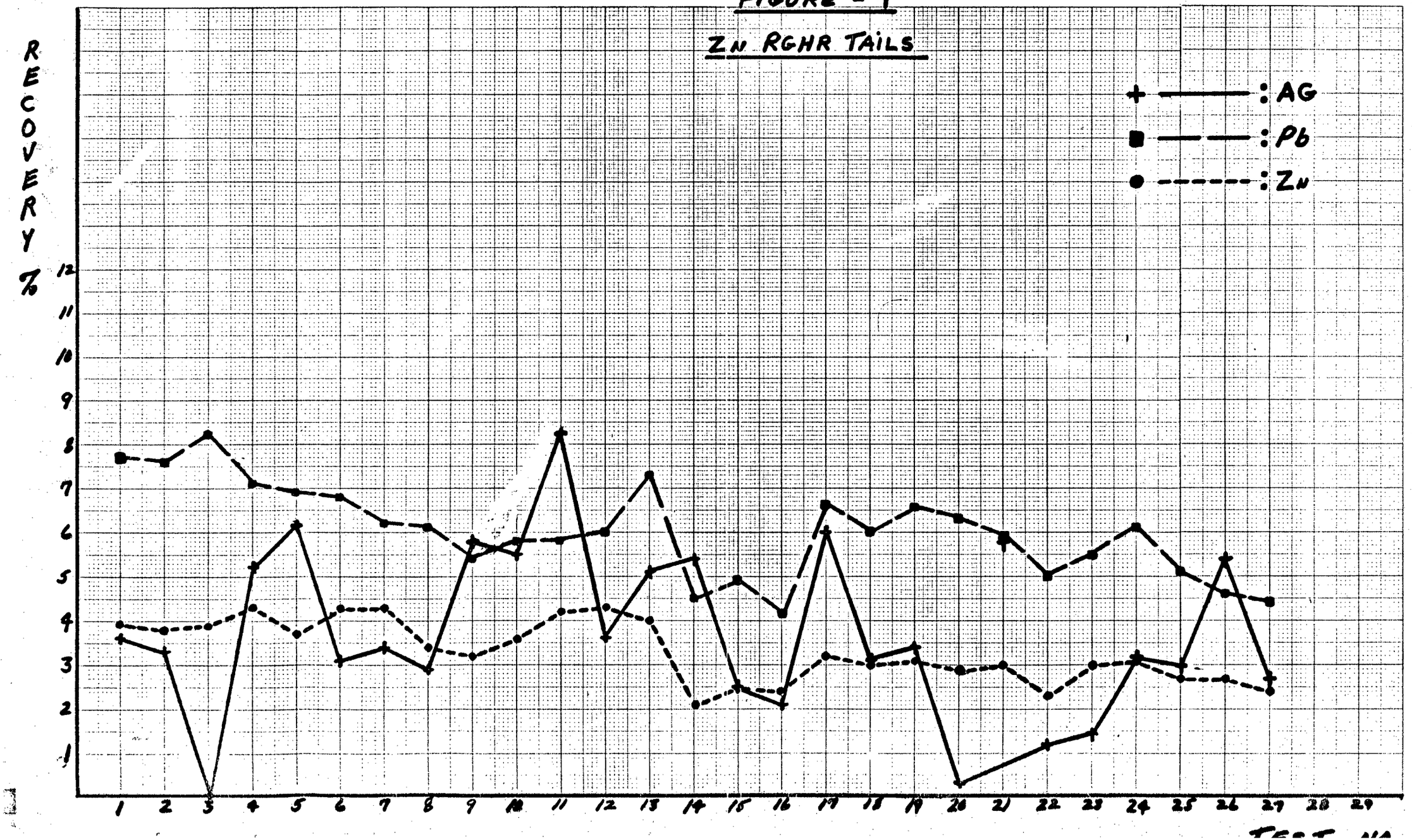


TABLE-2

Test No.	FEED				LEAD CIRCUIT																		
					10% PBHR CONC							20% PBHR CONC							30% PBHR CONC						
	WGHT	ANALYSES			WGHT	ANALYSES (OZ/t/%)			% DISTRIBUTION			WGHT	ANALYSES (OZ/t/%)			% DISTRIBUTION			WGHT	ANALYSES (OZ/t/%)			% DISTRIBUTION		
	Gr	Ag	Pb	Zn	Gr	Ag	Pb	Zn	Ag	Pb	Zn	Gr	Ag	Pb	Zn	Ag	Pb	Zn	Gr	Ag	Pb	Zn	Ag	Pb	Zn
1	1,000	1.98	4.46	9.21	96.1	16.10	37.41	10.55	78.30	80.65	11.01	34.6	3.02	6.67	12.80	5.29	5.18	4.82	24.3	2.16	4.00	11.68	2.66	2.18	3.08
2	"	2.06	4.61	9.09	102.7	15.80	35.94	10.98	78.83	80.10	12.40	31.3	3.70	7.71	12.54	5.63	5.24	4.32	27.3	1.95	3.59	11.49	2.58	2.13	3.45
3	"	1.94	4.49	9.47	99.2	16.08	36.53	10.91	82.42	80.62	11.43	42.3	2.81	5.75	12.44	6.14	5.42	5.56	31.4	1.78	3.12	11.17	2.89	2.18	3.70
4	"	1.98	4.40	9.08	113.8	13.57	32.21	10.65	78.03	83.39	13.34	40.7	2.44	4.67	11.59	5.02	4.33	5.19	28.4	1.73	2.89	10.69	2.48	1.88	3.34
5	"	2.02	4.33	9.30	112.6	13.80	31.70	10.61	76.86	82.39	12.84	37.0	2.68	5.29	11.99	4.91	4.52	4.77	27.5	1.85	3.13	11.00	2.52	1.99	3.25
6	"	2.16	4.49	9.12	109.9	15.36	33.00	11.36	78.04	80.74	13.69	43.6	3.33	5.73	13.08	6.71	5.56	6.25	35.5	1.79	2.98	10.52	2.94	2.36	4.09
7	"	1.94	4.41	9.26	117.9	13.27	31.01	10.92	80.44	82.83	13.90	45.8	2.19	5.48	11.44	5.16	5.69	5.66	42.1	1.31	3.35	10.72	2.82	3.19	4.87
8	"	2.00	4.67	9.06	92.3	16.06	38.61	9.99	74.28	76.24	10.18	39.7	3.45	4.04	13.02	6.87	7.68	5.70	48.4	2.03	4.76	11.86	4.93	4.93	6.33
9	"	2.08	4.58	9.08	124.8	12.96	30.83	10.69	77.64	84.10	14.68	49.3	2.09	4.08	11.04	4.94	4.40	6.00	36.4	1.46	2.36	10.54	2.55	1.88	4.22
10	"	2.17	4.45	9.00	136.2	12.41	27.43	10.59	77.71	84.03	16.03	47.0	2.10	3.98	10.81	4.54	4.22	5.64	35.2	1.47	2.36	10.06	2.38	1.87	3.93
11	"	2.20	4.67	9.05	129.0	12.71	30.52	10.97	74.46	84.27	15.63	47.6	2.24	4.22	11.16	4.84	4.30	5.87	40.1	1.53	2.31	9.98	2.79	1.98	4.42
12	"	1.96	4.63	9.03	134.9	12.19	29.18	10.42	83.89	85.04	15.57	51.2	1.69	3.43	10.42	4.41	3.79	5.91	30.2	1.02	2.16	10.06	1.57	1.41	3.37
13	"	2.02	4.64	9.11	138.8	11.54	27.59	10.53	79.41	82.46	16.04	55.1	1.68	3.71	10.72	4.59	4.40	6.48	40.9	1.41	2.49	10.10	2.86	2.19	4.53
14	"	2.24	4.37	8.93	140.8	11.09	24.97	11.08	69.69	80.52	17.47	38.6	2.50	3.89	11.60	4.31	3.44	5.02	24.5	1.79	3.12	11.20	1.96	1.75	3.07
15	"	2.06	4.32	8.42	132.7	12.26	27.62	10.72	78.80	84.81	16.90	34.4	2.27	4.32	10.76	3.78	3.44	4.40	27.3	1.65	2.75	10.34	2.18	1.74	3.35
16	"	2.20	4.46	9.10	141.2	11.99	26.95	10.44	76.93	85.24	16.20	41.2	2.21	3.89	10.47	4.14	3.59	4.74	28.5	1.79	2.74	10.25	2.32	1.75	3.21
17	"	2.10	4.31	8.94	110.5	14.51	31.99	10.30	76.23	81.97	12.73	40.4	2.65	5.41	11.23	5.09	5.07	5.07	24.5	2.12	3.42	10.42	2.47	1.94	2.86
18	"	2.06	4.59	9.26	115.5	14.05	32.65	10.37	78.90	82.25	12.93	39.1	2.83	6.03	11.65	5.38	5.14	4.92	26.1	2.07	3.66	10.93	2.63	2.08	3.08
19	"	1.92	4.26	8.95	121.5	12.77	29.32	10.04	80.75	83.58	13.64	35.2	2.45	4.72	10.96	4.49	3.90	4.31	21.6	1.71	2.96	10.23	1.92	1.50	2.47
20	"	1.94	4.47	9.03	109.6	14.05	32.73	10.16	79.40	80.30	12.34	43.7	3.31	6.58	10.69	7.46	6.44	5.18	22.7	2.11	3.97	10.54	2.47	2.02	2.65
21	"	2.11	4.52	9.08	126.3	13.04	30.08	10.38	77.93	84.12	14.44	35.9	2.61	5.05	10.49	4.43	4.01	4.15	27.3	1.77	3.22	10.41	2.29	1.95	3.13
22	"	1.97	4.56	8.68	127.5	12.34	30.04	10.39	80.03	83.99	15.26	34.6	2.57	5.03	10.70	4.52	3.82	4.27	30.4	1.82	3.11	10.44	2.81	2.07	3.66
23	"	2.01	4.56	8.98	129.9	12.77	29.89	10.46	82.68	85.24	15.13	40.7	2.04	4.31	10.42	4.11	3.82	4.69	26.3	1.82	3.02	10.05	2.39	1.74	2.94
24	"	1.98	4.49	8.87	130.1	12.09	28.84	10.21	79.40	83.60	14.97	38.7	2.29	4.90	10.42	4.47	4.22	4.55	28.6	1.63	2.91	9.69	2.35	1.85	3.12
25	"	2.03	4.48	9.04	143.7	11.35	26.67	10.29	80.39	85.57	16.34	39.2	2.27	4.29	10.58	4.39	3.76	4.58	33.3	1.41	2.45	9.71	2.32	1.82	3.56
26	"	2.17	4.80	9.16	137.7	12.44	30.09	10.73	79.02	86.34	16.14	42.2	2.18	4.21	11.21	4.24	3.70	5.17	26.6	1.53	3.03	10.32	1.88	1.68	3.00
27	"	2.01	4.54	9.11	133.4	11.49	27.22	10.89	81.82	86.00	17.15	41.4	1.87	4.02	10.13	3.84	3.67	4.61	31.1	1.36	2.69	9.97	2.10	1.64	3.41

TABLE-3

Zn CIRCUIT

TEST NO.	1° Zn RGHR CONC							2° Zn RGHR CONC							3° Zn RGHR CONC							Zn RGHR TAILS						
	WGHT	ANALYSIS (oz/t / %)			% DISTRIBUTION			WGHT	ANALYSIS (oz/t / %)			% DISTRIBUTION			WGHT	ANALYSIS (oz/t / %)			% DISTRIBUTION			WGHT	ANALYSIS (oz/t / %)			% DISTRIBUTION		
	Gr	Ag	Pb	Zn	Ag	Pb	Zn	Gr	Ag	Pb	Zn	Ag	Pb	Zn	Gr	Ag	Pb	Zn	Ag	Pb	Zn	Gr	Ag	Pb	Zn	Ag	Pb	Zn
1	109.0	1.19	0.84	52.84	6.56	2.05	62.54	46.7	0.97	1.20	23.64	2.29	1.26	11.99	39.6	0.64	1.08	6.08	1.28	0.96	2.61	649.7	0.11	0.53	0.56	3.62	7.72	3.95
2	121.3	1.19	0.88	51.40	7.01	2.32	68.56	54.3	0.64	1.33	10.54	1.69	1.57	6.29	45.8	0.43	1.02	2.35	0.96	1.00	1.18	617.3	0.11	0.57	0.56	3.30	7.64	3.80
3	87.9	1.15	0.84	56.39	5.23	1.64	52.35	49.7	0.89	1.05	39.09	2.28	1.16	20.51	32.1	0.63	1.11	7.55	1.04	0.79	2.56	657.4	0.00	0.56	0.56	0.00	8.19	3.89
4	90.5	1.25	0.71	54.92	5.72	1.46	54.73	46.9	1.09	1.09	32.91	2.58	1.16	16.99	27.9	0.64	1.04	6.81	0.90	0.66	2.09	651.8	0.16	0.48	0.60	5.27	7.12	4.32
5	135.3	1.13	0.79	49.56	7.56	2.47	72.07	44.7	0.61	1.20	5.82	1.35	1.23	2.80	21.6	0.61	1.09	2.29	0.65	0.54	0.53	621.3	0.20	0.48	0.56	6.15	6.88	3.74
6	106.4	1.12	0.95	44.99	5.51	2.25	52.48	56.2	1.00	1.15	25.92	2.60	1.44	15.97	35.4	0.66	1.22	8.26	1.08	0.96	3.22	613.0	0.11	0.49	0.64	3.12	6.69	4.30
7	100.5	0.99	0.45	47.68	5.12	1.03	51.73	55.4	0.87	0.55	28.08	2.48	0.69	16.79	32.2	0.33	0.54	7.88	0.55	0.39	2.74	606.1	0.11	0.45	0.66	3.43	6.18	4.31
8	170.3	1.12	0.97	38.09	9.56	3.53	71.56	36.9	0.41	1.09	4.46	0.76	0.86	1.82	34.5	0.41	0.95	2.71	0.70	0.70	1.03	577.9	0.10	0.49	0.53	2.90	6.06	3.38
9	141.5	1.05	0.84	43.41	7.13	2.60	67.67	46.4	0.62	1.08	6.95	1.38	1.10	3.55	28.2	0.42	0.89	2.32	0.58	0.54	0.72	573.4	0.21	0.43	0.50	5.78	5.38	3.16
10	114.3	1.25	0.81	45.36	6.57	2.08	57.61	56.4	0.84	0.97	18.64	2.18	1.23	11.68	37.8	0.62	0.91	3.67	1.08	0.77	1.54	573.1	0.21	0.45	0.56	5.54	5.80	3.57
11	117.4	1.21	0.83	42.73	6.45	2.08	55.42	49.4	1.02	0.94	24.20	2.06	0.89	11.87	35.6	0.71	0.92	6.54	1.15	0.70	2.58	585.9	0.31	0.46	0.65	8.25	5.78	4.21
12	116.2	0.79	0.87	44.30	4.68	2.18	57.02	46.1	0.56	0.98	22.63	1.32	0.98	11.56	28.7	0.34	0.93	7.04	0.50	0.58	2.24	592.7	0.12	0.47	0.66	3.63	6.02	4.33
13	110.7	0.88	0.83	43.31	4.82	1.98	52.62	52.2	0.88	0.96	24.98	2.28	1.08	14.32	30.5	0.62	0.94	5.94	0.94	0.62	1.99	571.8	0.18	0.59	0.64	5.10	7.27	4.02
14	270.2	1.30	1.18	23.40	15.68	7.30	70.82	96.8	0.49	0.78	1.09	2.12	1.73	1.18	28.5	0.69	1.17	1.18	0.88	0.76	0.38	400.6	0.30	0.49	0.46	5.36	4.50	2.06
15	186.1	1.03	0.78	32.27	9.29	3.23	71.32	46.3	0.61	0.83	1.72	1.37	0.89	0.95	102.2	0.42	0.42	0.46	2.08	0.99	0.56	471.0	0.11	0.45	0.45	2.50	4.90	2.52
16	227.2	0.95	0.58	22.57	9.80	2.95	56.36	119.9	0.74	0.65	12.63	4.03	1.74	16.64	30.6	0.52	0.84	1.21	0.72	0.58	0.41	411.4	0.11	0.45	0.54	2.06	4.15	2.44
17	170.8	1.06	0.81	38.83	8.60	3.21	74.18	32.7	0.63	1.07	3.89	0.98	0.81	1.42	17.2	0.74	1.06	2.58	0.60	0.42	0.50	603.9	0.21	0.47	0.48	6.03	6.58	3.24
18	161.4	1.09	0.79	42.26	8.55	2.78	73.66	62.1	0.33	0.94	2.38	1.00	1.27	1.60	22.3	0.44	0.96	3.46	0.48	0.47	0.83	573.5	0.11	0.48	0.48	3.07	6.00	2.97
19	157.7	0.96	0.79	42.02	7.88	2.92	74.07	54.3	0.43	0.93	3.39	1.21	1.18	2.06	15.5	0.43	1.00	1.93	0.35	0.36	0.33	594.2	0.11	0.47	0.47	3.40	6.55	3.12
20	151.5	1.10	0.89	44.22	8.60	3.02	74.22	59.6	0.40	0.99	3.46	1.23	1.32	2.28	26.2	0.40	1.04	1.61	0.54	0.61	0.47	586.7	0.01	0.48	0.44	0.30	6.30	2.86
21	156.5	1.05	0.73	42.12	7.77	2.53	72.62	50.7	0.52	0.92	3.80	1.25	1.03	2.12	22.7	0.52	0.89	2.13	0.56	0.45	0.53	580.6	0.21	0.46	0.47	5.77	5.91	3.01
22	194.4	0.86	0.76	32.51	8.51	3.24	72.82	94.7	0.43	0.67	1.29	2.07	1.39	1.41	53.6	0.32	0.42	0.45	0.87	0.49	0.28	464.8	0.05	0.49	0.43	1.17	5.00	2.30
23	151.3	1.08	0.71	42.57	8.15	2.36	71.73	44.6	0.43	0.91	3.82	0.96	0.89	1.90	25.4	0.21	0.83	2.22	0.26	0.46	0.63	582.1	0.05	0.43	0.46	1.45	5.49	2.98
24	154.9	1.09	0.77	39.75	8.80	2.74	71.63	51.2	0.54	0.93	3.72	1.39	1.06	2.15	18.5	0.44	0.96	2.32	0.41	0.40	0.48	573.0	0.11	0.48	0.48	3.18	6.13	3.10
25	161.3	0.97	0.67	39.72	7.71	2.41	70.86	36.9	0.76	0.89	3.42	1.38	0.73	1.40	39.4	0.44	0.67	1.32	0.85	0.59	0.58	546.2	0.11	0.42	0.44	2.96	5.12	2.66
26	173.5	0.98	0.67	37.11	7.84	2.42	70.31	59.5	0.44	0.74	3.39	1.21	0.92	2.20	24.1	0.33	0.71	1.88	0.37	0.36	0.49	536.4	0.22	0.41	0.46	5.44	4.58	2.69
27	194.1	0.83	0.66	33.42	8.00	2.82	71.23	37.5	0.31	0.77	2.05	0.58	0.64	0.84	64.3	0.31	0.44	0.57	0.99	0.62	0.40	488.2	0.11	0.41	0.44	2.67	4.41	2.36

Both types of waste crushed well, producing a fair percentage of fines in one pass (15-20% passing 100 mesh).

The waste samples have a grinding work index of about 15 KWH/T. While this is high in comparison to Grum ores, it is quite low when compared to the hardness of non-sulphidic, siliceous wastes encountered elsewhere. The dark waste crushed into slaty, thin fragments.

Both samples contained high silica, 48-57%.

When exposed to water for days or weeks the wastes did not absorb any. There was no indication of increasing stickiness caused by the presence of clay components or the like. The rocks appeared quite stable during the time span (weeks) of observation.

When added to the ore, flotation would not suffer more than one would expect from 10 to 50% dilution. The contents of CaO and MgO increased slightly in the rougher concentrates but only in proportions which could be explained by much reduced base metal content of the flotation feed.

If the two samples of waste are representative of the non-sulphidic waste rock at Grum, one could not expect unusual difficulties from this dilution.

K Kun.

MATTAGAMI LAKE MINES LIMITED
CONCENTRATOR LABORATORY

Use of tailings effluent in GRUM Pb-Zn Flotation

Michel Garon
January 19, 1973

Summary

Twenty seven laboratory batch tests were conducted from the 20 September 1977 to the 4 January 1978 with Grum ore (composite no.2) substituting tailings effluent from a laboratory tailings pond for FRESH raw water, in order to know the particular effects it could have on lead and zinc flotation.

According to the results obtained it did not influence the flotation performances. A more frothy zinc flotation was observed after several tests but it did not do any damage. Results are summarized below for the seven last tests and for the three main flotation products.

	Analyses (% or oz/t)			% Distribution		
	Ag	Pb	Zn	Ag	Pb	Zn
1° Pb rougher conc	12.22	28.98	10.48	80.2	85.0	15.6
1° Zn rougher conc	0.98	0.71	38.18	8.0	2.6	71.6
Zn rougher tails	0.12	0.44	0.45	3.2	5.2	2.7
Head	2.04	4.56	8.99	100	100	100

...2

Laboratory work and results

From the 20 September 1977 to the 4 January 1978, flotation tests were performed with Grum ore (composite no. 2), substituting tailings effluent from a small laboratory tailings pond for raw water.

A certain amount of fresh flotation tailings were poured into the experimental pond and then, the following procedure was applied for each test:

1. Before the test, measure the temperature, the pH and the $S_2O_3^=$ concentration of the water in the tailings pond.

2. Float the lead and the zinc according to figure-1, using tailings effluent whenever water is required (to wash the rods of the grinding mill, to raise the pulp level in the cell, etc...).

3. At the end of the test, measure the temperature, the pH and the $S_2O_3^=$ concentration of the water in the cell.

The flowsheet used is shown in figure-1. One thousand gr. of ore were ground to about 80-85% -200 mesh with the reagents indicated and then, aerated for 15 minutes before flotation. Three lead rougher

...3

concentrates were floated and analysed for Ag, Pb and Zn. Following a conditionning of 5 minutes, Zn was also floated in three concentrates and assayed for the same elements. A small cup with a long handle was used to sample the zinc rougher tails at the end of the tests, directly in the cell while being agitated, and they were assayed. The tails (solids + water) were put into the pond as well as the filtrate of each zinc and lead concentrate.

Table-1 demonstrates the temperatures, pH's and $S_2O_3^=$ concentrations of the water before and after each test. After each test those measurements were made in the cell.

...4

FIGURE-1

LABORATORY FLOWSHEET

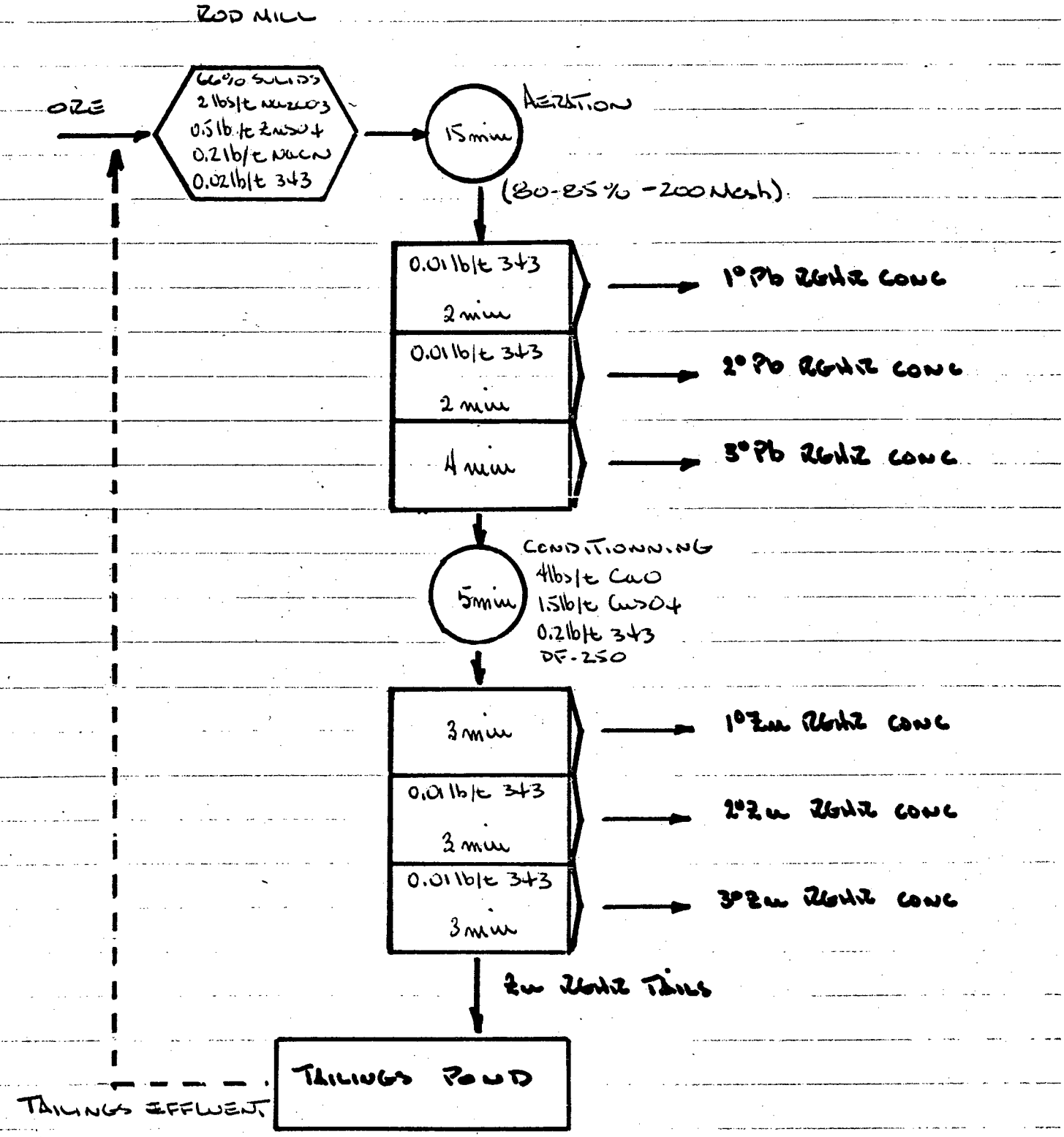


TABLE-1

MEASUREMENTS

TEST NO.	DATE	TEMPERATURE (°C)		PH		$S_2O_3^=$ (PPM)	
		1	2	1	2	1	2
1	20/9/77	73	84	7.4	9.2	—	9.0
2	21/9/77	70	83	7.7	9.5	1.1	14.6
3	22/9/77	71	83	7.6	9.6	1.1	14.6
4	23/9/77	73	83	7.7	10.0	3.4	22.4
5	26/9/77	75	83	7.8	10.0	—	16.8
6	27/9/77	73	83	7.8	10.3	1.1	PAS MESURÉ
7	28/9/77	73	83	7.9	10.1	2.2	7.8
8	29/9/77	74	88	7.9	10.0	—	11.2
9	30/9/77	74	87	8.0	10.2	—	10.1
10	3/10/77	76	87	7.7	10.1	—	11.2
11	4/10/77	76	87	7.9	10.3	—	9.0
12	5/10/77	76	84	8.2	10.2	—	7.8
13	7/10/77	74	81	8.0	9.9	—	10.1
14	14/10/77	69	85	7.7	9.4	—	11.2
15	17/10/77	74	87	8.0	9.0	—	16.8
16	21/10/77	74	88	7.9	9.7	—	16.8
17	28/10/77	75	87	8.1	10.2	—	13.4
18	1/11/77	75	88	8.0	10.3	—	11.2
19	4/11/77	78	90	8.1	10.4	—	15.7
20	11/11/77	78	90	8.0	10.4	—	9.0
21	21/11/77	74	89	8.0	10.2	19.0	24.6
22	2/12/77	75	90	7.9	10.1	—	16.8
23	6/12/77	77	88	8.1	10.4	—	11.2
24	7/12/77	77	89	8.2	10.3	—	9.0
25	12/12/77	68	80	8.1	10.0	—	12.3
26	16/12/77	75	85	8.0	10.9	—	9.0
27	4/1/78	68	82	7.9	9.7	—	7.8

1- BEFORE THE TEST, IN THE POND
2- AT THE END OF THE TEST, IN THE CELL

Results for 1°Pb Rougher concentrate, 1°Zn rougher concentrate and Zn rougher tails are illustrated in figures 2 to 7. For each, analyses and recoveries for Ag, Pb and Zn are plotted against test number. Detailed results are found in table 2 and 3 at the end of this report.

Conclusion

The 1° Pb rougher concentrate behaves normally through the 27 tests and doesn't show any particular trend. Lower recoveries and higher grades for lead appear in the first tests because this concentrate was not pulled enough.

Figure-5 reveals wide variations in zinc recoveries at the beginning for the 1° Zn rougher concentrate whereas zinc analyses are more stable. Because not pulled enough in some of the first tests, bad zinc recoveries and high grades were obtained in the concentrate. After a certain number of tests, flotation was observed to become more frothy. Somehow, here again no adverse effect on zinc flotation can be noticed.

...7

The many wide variations in silver recoveries and grades in the zinc rougher tails should be mentioned. The behaviours of lead and zinc are about the same in the tails.

To sum up, the use of tailings effluent had no significant effects on lead and zinc flotation for Grum ore through all the tests performed in laboratory.

MATTAGAMI LAKE MINES LIMITED

Concentrator Laboratory

WASTE ADDITION TO GRUM ORE

Michel Garon
February 9, 1978

Summary

Laboratory testwork was undertaken with some Grum waste blended with ore (pilot plant sample) in different proportions (10 to 50%) to evaluate its influence on flottation performances. The waste presents two colours: white and grey. The work index is high for both (15.9 - 14.1) and they contain an important amount of silica (47 - 57%). Tests were carried out with the white one. In rougher flottation tests no adverse effects resulted from the waste addition. Recoveries and grades were good although grades would have been better by pulling less hard for high waste contents. The table on the following page shows some results for the 1° and 2° rougher concentrates put together for lead and zinc.

Few CaO, MgO and SiO_2 reported in lead and zinc rougher concentrates. Despite the high work index, the fineness of grind was not changed for all waste to ore ratios.

% Waste	Pb Rghr Conc						Zn Rghr Conc					
	Analyses (%)			% Distribution			Analyses (%)			% Distribution		
	Ag	Pb	Zn	Ag	Pb	Zn	Ag	Pb	Zn	Ag	Pb	Zn
30	11.54	27.18	11.05	75.6	72.9	18.4	1.49	2.62	32.70	12.3	8.9	68.7
50	11.25	26.13	11.40	72.0	69.8	18.3	1.55	2.45	26.88	15.8	10.4	68.5

Introduction

On January 17, 1978, waste samples of the Grum deposit were received at the concentrator laboratory. Two different colours were observed and therefore the material was divided in two types. One type displays a whitish colour (white waste) while the other is dark grey (black waste). Table-1 demonstrates different characteristics for each of these materials. From these data we notice an important silica content and a high work index for both of these rocks. These two types did not absorb water after being put into water for 2 weeks and no change could be seen, either in hardness or texture (both crushed).

Tests were run with varying amounts of waste blended to Grum ore (pilot plant sample) , to evaluate the effects it could have on Pb and Zn flotation. White waste was used for all the tests.

TABLE -1

Head analyses	WHITE WASTE	BLACK WASTE
Au oz/t	< .002	< .002
Ag oz/t	< .05	< .05
Cu %	.014	.015
Zn	.06	.06
Pb	.02	.02
Fe	4.2	4.2
S	3.8	7.5
Ni	.012	.012
Co	.002	.002
Cd	< .001	< .001
CaO	9.8	.83
MgO	2.78	1.66
SiO_2	47.7	57.1
As	< .01	< .01
Insol	63.6	80.9
FeS_2	3.2 ?	1.6 ?
Hg PPM	.280	.232
Specific Gravity	2.64	2.61
Natural pH	8.3	8.2
ppm $S_2O_3^=$ (10 and 20 min grind at 67% solids)	29.1-28.0	9.0-10.1
Work Index	15.87 Kwh/ton	14.12 Kwh/ton

-Laboratory work and results-

The different proportions of waste blended to the ore were 0, 10, 20, 30 and 50%. From 0 to 50%, the head grade decreased from 2.51 oz/t Ag, 6.34 % Pb, 10.32% Zn, to 1.14 oz/t Ag, 3.00 % Pb, 5.00 % Zn for the first series of tests and from 2.62 oz/t Ag, 6.01 % Pb, 9.98 % Zn to 1.32 oz/t Ag, 2.87 % Pb, 4.77 % Zn, for the second series, the same tests having been repeated. The flowsheet used is shown in figure 1. The ore was ground in a rod mill at 66% solids with the reagents indicated and then three successive lead rougher concentrates were floated adding certain amounts of 343. Lead flotation was followed by conditionning, the pH being raised with lime, and by three zinc rougher flotations using 343. Reagents addition was decreased according to the percentage of waste mixed with the ore.

Figures 2 and 3 present the Ag, Pb, Zn analyses and recoveries for the $1^o + 2^o$ Pb Rougher concentrates and $1^o + 2^o$ Zn Rougher concentrates, and table 2 averages the CaO, MgO, SiO_2 analyses and distributions of the two series of tests, for the same products. Tables 3 and 4 show the detailed results.

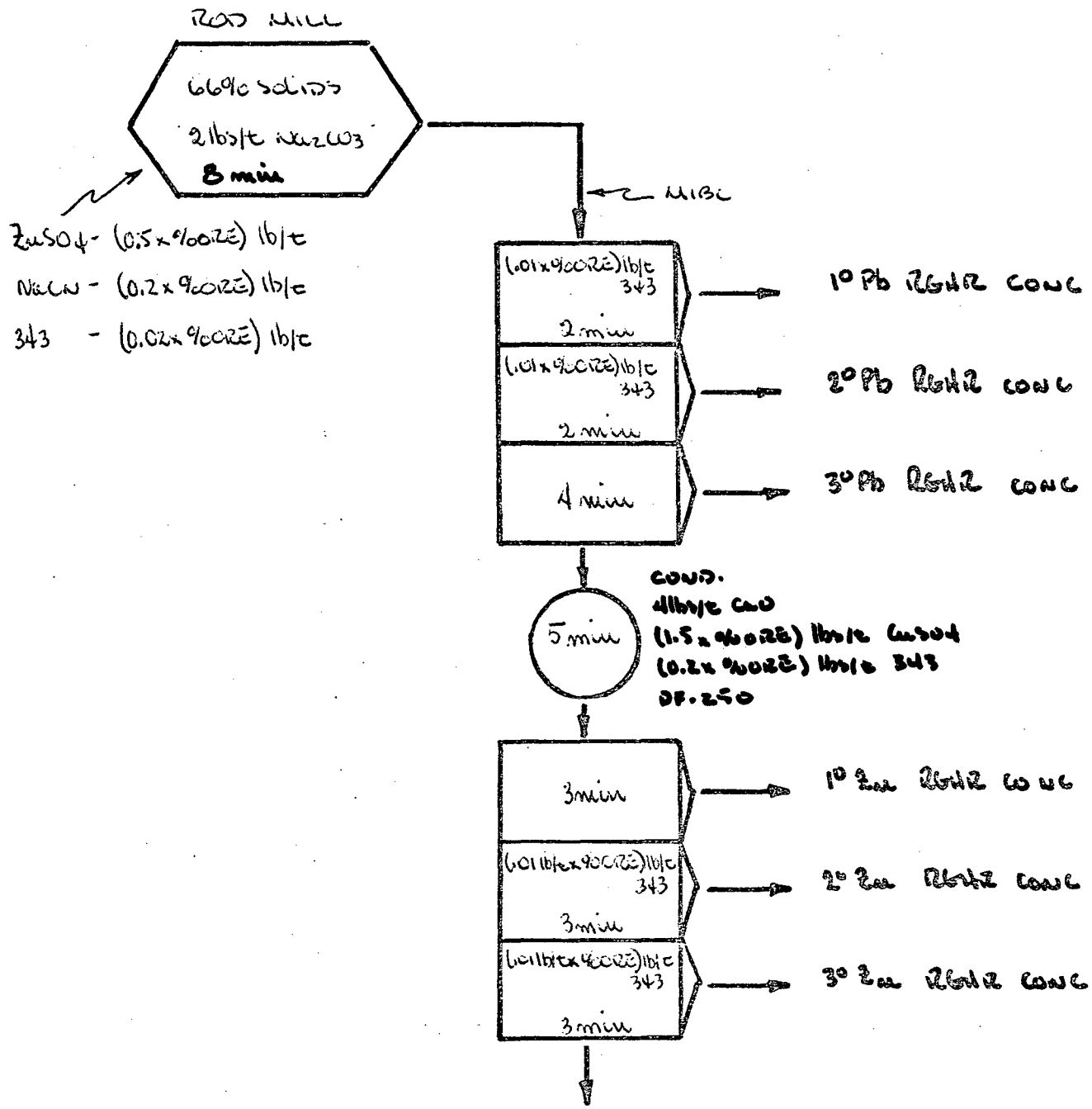
TABLE-2

AVERAGE RESULTS FOR THE TWO SERIES OF TESTS

% Waste	1° + 2° Pb Rghr Conc Analyses (%)			% Distribution			1°+ 2° Zn Rghr Conc Analyses (%)			% Distribution		
	CaO	MgO	SiO_2	CaO	MgO	SiO_2	CaO	MgO	SiO_2	CaO	MgO	SiO_2
0	0.27	0.13	5.6	4.0	5.7	3.4	0.52	0.14	8.8	9.9	8.5	7.0
10	0.34	0.15	5.6	2.2	3.0	2.6	0.62	0.17	8.1	4.7	4.0	4.5
20	0.45	0.20	6.1	1.7	2.1	2.4	0.67	0.21	8.7	4.0	3.4	5.3
30	0.54	0.30	6.2	1.8	2.6	2.3	0.90	0.30	10.7	3.8	3.4	4.8
50	0.77	0.31	6.2	1.1	1.4	1.4	1.36	0.40	13.7	3.0	2.7	4.8

FIGURE-1

LABORATORY FLOWSHEET

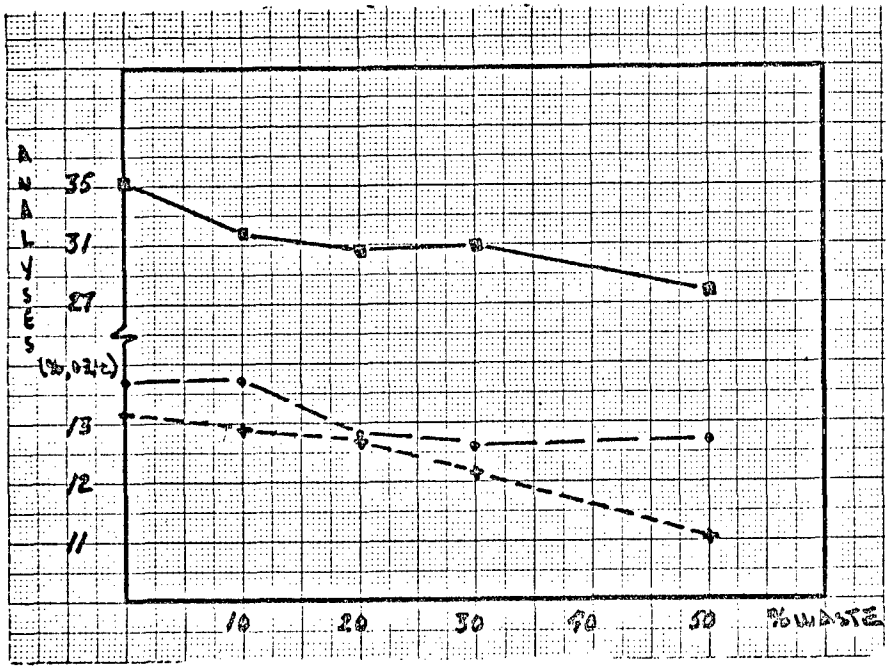


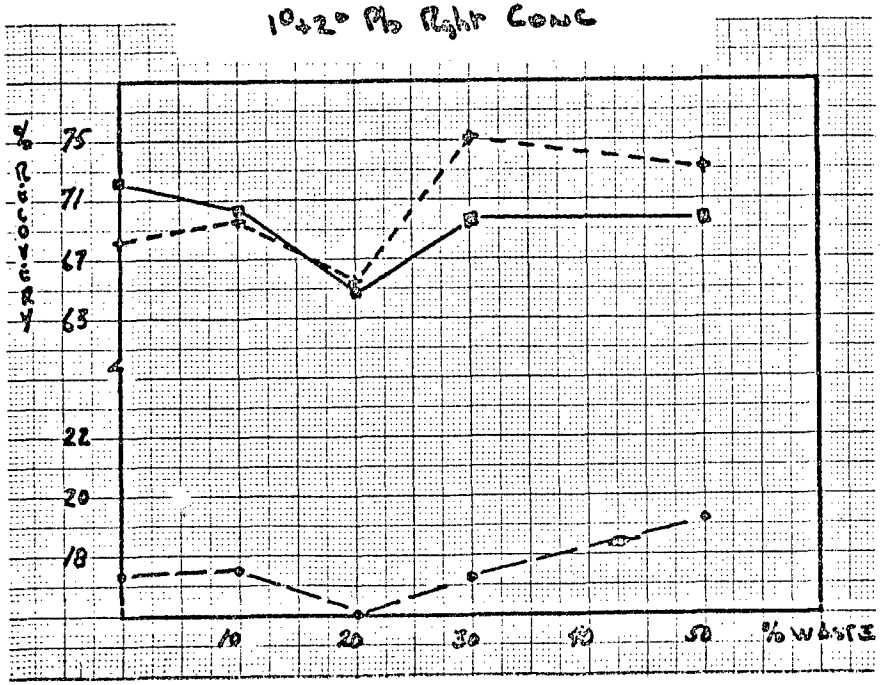
	% -200	% -325 MESH
0% WASTE	95.1	72.5
10	94.5	71.6
20	95.6	72.0
30	94.5	73.1
60	93.4	73.0

FIGURE-2

10 SERIES OF TESTS

Ag+---- Pb□___ Zn○___





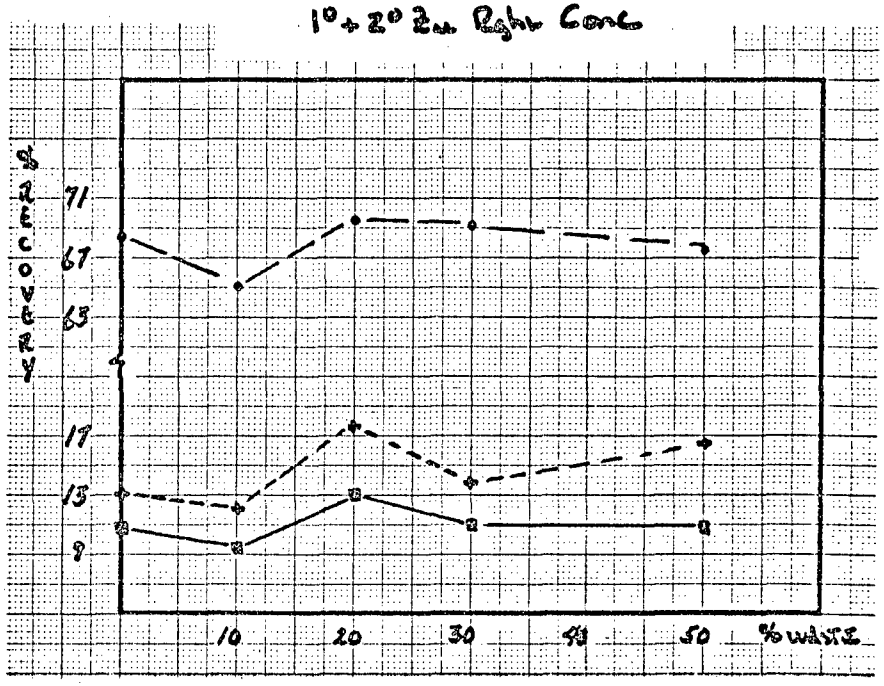
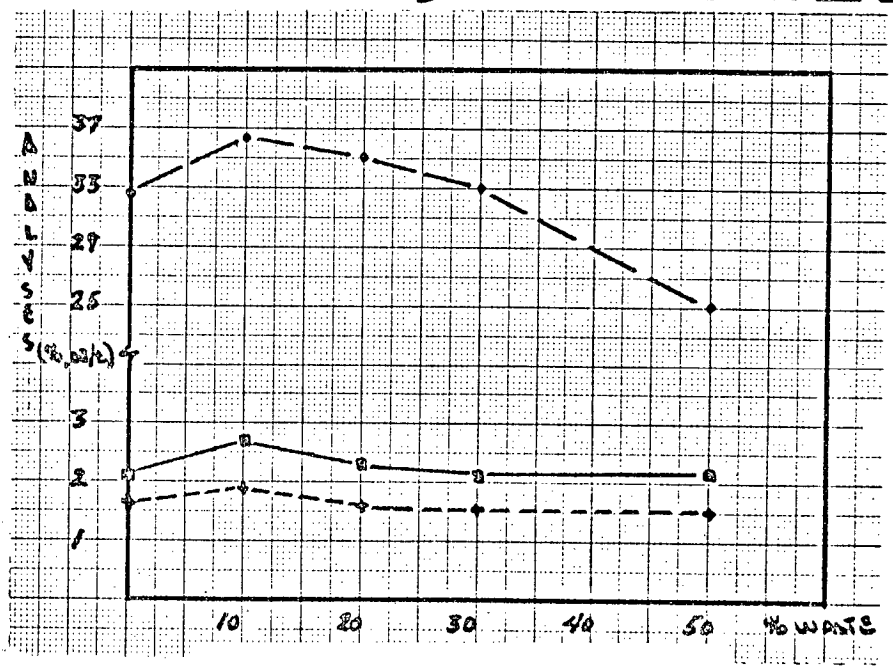


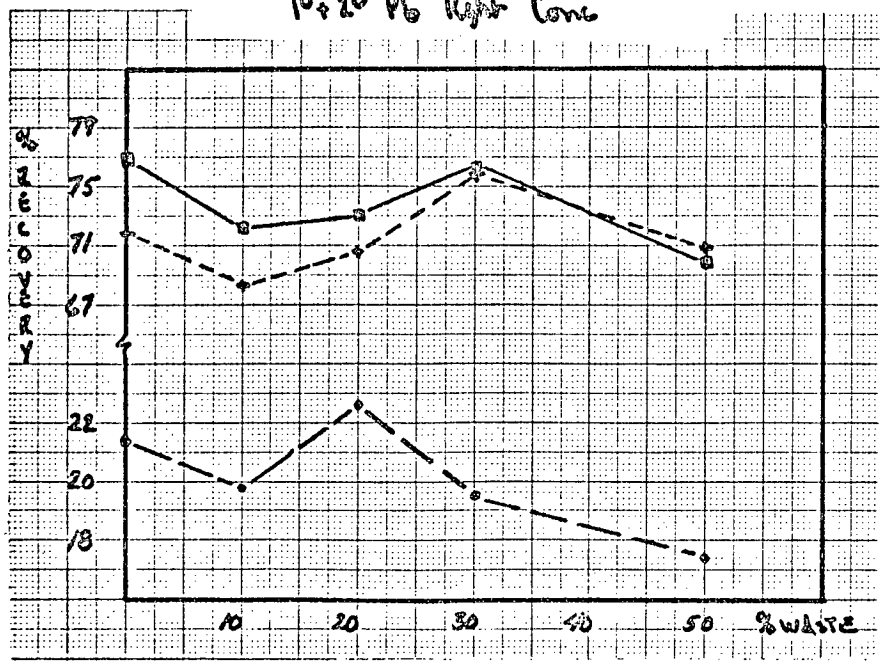
FIGURE-3

2° SERIES OF TESTS

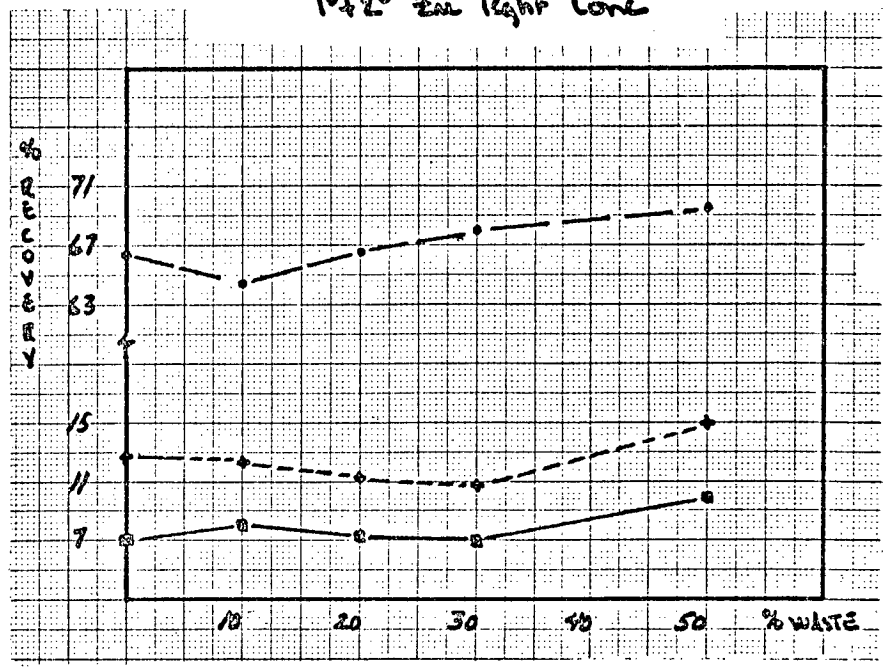
Ag+ ---- Pb■ ___ Zn●



10+2° Pb Rghr Conc



10+2° Zn Rghr Conc



Conclusion

Experimental results suggest that no adverse effects result from the addition of waste (white waste) to the ore for the ratios studied. Good recoveries for both lead and zinc were obtained. In general, the grades were decreasing slightly for lead and a little bit more for zinc as the waste content was increased, mainly because concentrates were not pulled slowly enough, flotation time having not been reduced. However, the waste did not float very much and therefore presented no major problems. Although the work index of this material is high, it did not alter the fineness of grind.

TABLE-3

Pb CIRCUIT

TEST NO.	% WASTE	FEED WGHT Gr.	FEED Ag	FEED Pb	FEED Zn	FEED CaO	FEED MgO	FEED SiO2	1° Pb ROUGHER CONC. WGHT Gr.	1° Pb ROUGHER CONC. Ag	1° Pb ROUGHER CONC. Pb	1° Pb ROUGHER CONC. Zn	1° Pb ROUGHER CONC. CaO	1° Pb ROUGHER CONC. MgO	1° Pb ROUGHER CONC. SiO2	% DISTRIBUTION Ag	% DISTRIBUTION Pb	% DISTRIBUTION Zn	% DISTRIBUTION CaO	% DISTRIBUTION MgO	% DISTRIBUTION SiO2
		ANALYSES (oz/t, %)							ANALYSES (oz/t, %)												
1	0	995.1	2.51	6.34	10.32	1.11	0.35	29.50	84.8	16.65	42.24	12.58	0.22	0.12	4.4	56.5	56.7	10.4	1.7	2.9	1.5
2	10	1001.2	2.15	5.25	9.09	2.07	0.68	27.16	76.5	16.44	37.63	13.07	0.34	0.17	5.5	58.5	57.7	11.0	1.3	1.9	1.5
3	20	997.2	1.99	4.86	8.26	2.98	1.08	28.58	66.7	16.01	37.49	11.78	0.53	0.24	5.3	53.7	51.6	9.5	1.2	1.5	1.2
4	30	996.6	1.59	4.38	7.18	3.79	1.20	31.73	61.6	16.05	39.63	11.79	0.55	0.27	5.6	62.4	55.9	10.1	0.9	1.4	1.1
5	50	1000.2	1.14	3.60	5.80	5.46	1.63	35.72	43.1	14.73	34.29	12.25	0.69	0.27	4.7	62.2	58.1	11.8	0.6	0.8	0.6
6	0	998.2	2.62	6.01	9.98	0.98	0.31	25.13	126.3	13.19	32.16	12.39	0.25	0.12	5.4	63.7	67.7	15.7	3.2	4.9	2.7
7	10	992.8	2.39	5.34	8.88	1.95	0.61	28.10	103.4	13.63	31.74	12.11	0.27	0.12	5.0	61.1	63.8	14.6	1.5	2.1	1.9
8	20	987.7	2.07	4.68	7.81	2.85	1.01	29.41	87.5	14.71	33.83	12.14	0.29	0.14	4.8	62.8	63.9	13.8	0.9	1.2	1.5
9	30	986.1	1.88	4.02	6.37	3.12	1.37	31.31	91.4	13.42	29.03	9.38	0.39	0.18	4.9	67.0	66.9	13.6	1.2	1.2	1.4
10	50	989.7	1.32	2.87	4.77	6.62	2.10	36.48	56.2	14.17	30.00	9.95	0.53	0.26	5.1	61.0	59.4	11.9	0.5	0.7	0.8

TEST NO.	% WASTE	2° Pb ROUGHER CONC. WGHT Gr.	2° Pb ROUGHER CONC. Ag	2° Pb ROUGHER CONC. Pb	2° Pb ROUGHER CONC. Zn	2° Pb ROUGHER CONC. CaO	2° Pb ROUGHER CONC. MgO	2° Pb ROUGHER CONC. SiO2	% DISTRIBUTION Ag	% DISTRIBUTION Pb	% DISTRIBUTION Zn	% DISTRIBUTION CaO	% DISTRIBUTION MgO	% DISTRIBUTION SiO2	3° Pb ROUGHER CONC. WGHT Gr.	3° Pb ROUGHER CONC. Ag	3° Pb ROUGHER CONC. Pb	3° Pb ROUGHER CONC. Zn	3° Pb ROUGHER CONC. CaO	3° Pb ROUGHER CONC. MgO	3° Pb ROUGHER CONC. SiO2	% DISTRIBUTION Ag	% DISTRIBUTION Pb	% DISTRIBUTION Zn	% DISTRIBUTION CaO	% DISTRIBUTION MgO	% DISTRIBUTION SiO2
		ANALYSES (oz/t, %)													ANALYSES (oz/t, %)												
1	0	44.9	6.51	21.91	15.76	0.32	0.12	6.3	11.7	15.6	6.9	1.3	1.5	1.2	40.7	4.16	13.34	14.17	0.45	0.22	10.7	6.8	6.7	5.6	1.7	2.6	1.8
2	10	39.5	6.09	16.49	14.85	0.41	0.18	6.1	11.2	12.4	6.5	0.8	1.0	0.9	50.6	3.95	9.91	14.47	0.55	0.22	8.4	9.3	9.5	8.0	1.4	1.6	1.6
3	20	36.1	6.51	17.84	14.77	0.59	0.23	7.1	11.8	13.3	6.5	0.7	0.8	0.9	42.1	4.38	11.21	15.23	0.85	0.35	11.3	9.3	9.7	7.8	1.2	1.4	1.7
4	30	36.6	5.55	16.39	14.02	0.72	0.58	7.6	12.8	13.7	7.2	0.7	1.8	0.9	37.2	3.30	9.18	12.85	1.07	0.38	11.5	7.7	7.8	6.7	1.0	1.2	1.3
5	50	27.3	4.59	12.72	13.49	1.12	0.42	8.7	11.0	11.6	7.4	0.6	0.7	0.7	22.2	2.68	7.13	12.39	1.68	0.56	15.0	5.6	5.3	5.5	0.7	0.8	0.9
6	0	42.4	5.08	12.95	13.38	0.39	0.18	8.2	8.2	9.2	5.7	1.7	2.1	1.4	40.3	3.24	7.77	12.96	0.48	0.18	10.6	5.0	5.2	5.0	2.0	2.3	1.7
7	10	34.5	4.97	12.78	13.20	0.49	0.17	7.1	7.2	8.3	5.2	0.9	1.0	0.9	37.6	3.67	9.27	12.92	0.69	0.22	9.5	5.8	6.6	5.5	1.2	1.4	1.3
8	20	31.5	5.08	13.36	13.35	0.52	0.18	10.4	7.8	9.1	5.4	0.6	0.6	1.1	33.5	3.67	8.52	12.57	0.83	0.26	7.3	6.0	6.1	5.4	1.0	0.9	0.8
9	30	37.6	4.43	9.71	9.88	0.67	0.28	9.1	9.0	9.2	6.0	0.8	0.8	1.1	25.4	3.09	6.26	9.48	0.85	0.38	11.6	4.2	4.0	3.9	0.7	0.7	1.0
10	50	24.6	5.20	12.00	10.48	1.06	0.39	8.8	9.8	10.4	5.5	0.4	0.5	0.6	26.0	3.31	7.50	10.20	1.60	0.61	11.8	6.6	6.9	5.6	0.7	0.8	0.9

TABLE - 4

2nd CIRCUIT

TEST NO.	% WASTE	1° 2nd ROUGHER CONC.													2° 2nd ROUGHER CONC.											
		WEIGHT	ANALYSES (oz/t, %)						% DISTRIBUTION						WEIGHT	ANALYSES (oz/t, %)						% DISTRIBUTION					
		Gr.	Ag	Pb	Zn	CaO	MgO	SiO_2	Ag	Pb	Zn	CaO	MgO	SiO_2	Gr.	Ag	Pb	Zn	CaO	MgO	SiO_2	Ag	Pb	Zn	CaO	MgO	SiO_2
1	0	152.3	1.91	3.67	42.65	0.37	0.12	5.7	11.6	8.9	63.2	5.1	5.2	3.5	36.9	0.94	3.46	14.15	0.78	0.24	14.3	1.4	2.0	5.2	2.6	2.5	2.2
2	10	102.6	1.71	3.24	46.06	0.55	0.17	6.4	8.2	6.3	52.0	2.7	2.6	2.4	46.3	1.91	3.63	25.76	0.74	0.22	16.4	4.1	3.2	13.1	1.6	1.5	1.8
3	20	158.9	1.91	3.39	34.76	0.51	0.17	7.2	15.2	11.1	67.0	2.8	2.5	4.0	41.2	1.17	2.23	5.39	0.69	0.28	12.1	2.4	1.9	2.7	1.3	1.1	1.8
4	30	126.6	1.49	3.17	37.96	0.74	0.25	8.1	11.9	9.2	67.1	2.5	2.7	3.2	26.2	1.17	2.92	5.69	1.71	0.51	18.8	1.9	1.8	2.1	1.2	1.1	1.6
5	50	98.2	1.71	2.92	33.59	1.15	0.39	10.7	14.7	9.6	66.0	2.1	2.4	2.9	19.5	1.07	1.97	3.89	1.90	0.21	21.0	1.8	1.3	1.5	0.7	0.2	1.2
6	0	172.7	1.62	1.99	36.46	0.52	0.13	9.2	10.7	5.7	63.2	9.2	7.2	6.3	30.4	1.73	2.72	10.38	0.94	0.22	15.6	2.0	1.4	3.2	2.9	2.1	1.9
7	10	118.2	1.94	2.64	42.21	0.50	0.13	6.9	9.7	5.9	56.6	3.1	2.5	2.9	37.6	1.94	2.69	18.41	0.99	0.22	14.1	2.9	2.0	7.8	1.9	1.4	1.9
8	20	119.1	1.55	2.13	40.72	0.63	0.19	7.7	9.0	5.5	62.7	2.6	2.3	3.2	27.7	1.73	2.91	10.83	1.22	0.34	14.9	2.4	1.7	3.9	1.2	0.9	1.4
9	30	108.1	1.55	2.03	38.00	0.77	0.27	9.3	9.0	5.5	65.4	2.7	2.2	3.2	21.4	1.55	2.52	7.75	1.51	0.49	22.6	1.8	1.4	2.6	1.1	0.8	1.6
10	50	110.1	1.55	2.17	29.07	1.26	0.38	12.8	13.1	8.4	67.8	2.3	2.0	4.0	20.7	1.22	2.05	3.88	2.48	0.69	26.2	1.9	1.5	1.7	0.9	0.7	1.5

TEST NO.	% WASTE	3° 2nd ROUGHER CONC.													2nd ROUGHER TAILS											
		WEIGHT	ANALYSES (oz/t, %)						% DISTRIBUTION						WEIGHT	ANALYSES (oz/t, %)						% DISTRIBUTION					
		Gr.	Ag	Pb	Zn	CaO	MgO	SiO_2	Ag	Pb	Zn	CaO	MgO	SiO_2	Gr.	Ag	Pb	Zn	CaO	MgO	SiO_2	Ag	Pb	Zn	CaO	MgO	SiO_2
1	0	24.5	1.49	3.47	6.59	0.88	0.26	15.8	1.5	1.3	1.6	1.9	1.8	1.6	611.0	0.43	0.91	1.20	1.55	0.98	35.2	10.5	8.8	7.1	85.7	83.5	88.2
2	10	28.7	1.49	3.19	8.18	1.02	0.28	16.2	2.0	1.8	2.6	1.4	1.2	1.7	459.0	0.22	0.73	0.95	2.86	0.94	37.3	6.7	9.1	6.8	90.8	90.2	90.1
3	20	30.2	0.63	1.39	1.75	0.87	0.27	8.8	1.0	0.9	0.6	0.9	0.7	0.9	322.0	0.21	0.90	0.78	4.31	1.59	41.0	6.6	11.5	5.9	91.9	92.0	89.5
4	30	27.4	0.63	1.46	1.98	1.48	0.45	13.8	1.1	0.9	0.8	1.1	1.0	1.2	181.0	0.05	0.69	0.63	5.13	1.59	42.1	2.2	10.7	6.0	92.6	90.8	90.7
5	50	22.9	0.63	1.29	1.77	2.25	0.64	19.2	1.3	1.0	0.9	0.9	0.9	1.2	762.0	0.05	0.52	0.46	6.77	2.01	43.4	3.4	13.2	7.0	94.4	94.2	92.5
6	0	32.1	0.86	1.54	3.17	0.62	0.15	9.1	1.1	0.8	1.0	2.0	1.5	1.2	559.0	0.44	1.08	1.11	1.40	0.45	38.4	9.3	10.0	6.2	79.0	79.9	84.8
7	10	21.5	1.62	2.70	8.42	1.27	0.35	18.2	1.5	1.1	2.1	1.4	1.2	1.4	537.0	0.44	1.02	1.13	2.73	0.86	39.3	11.8	12.3	8.2	90.0	90.4	89.7
8	20	18.4	1.33	2.33	4.80	1.32	0.38	16.5	1.2	0.9	1.1	0.9	0.7	1.0	478.0	0.38	0.88	0.88	3.69	1.39	39.4	10.8	12.8	7.7	92.8	93.4	91.0
9	30	11.2	1.32	2.68	4.45	2.03	0.71	24.9	0.8	0.8	0.8	0.7	0.6	0.9	491.0	0.22	0.70	0.71	4.14	1.83	40.6	8.2	12.2	7.8	92.8	93.7	90.8
10	50	15.1	1.22	1.82	2.96	3.05	0.85	28.1	1.4	1.0	0.9	0.8	0.6	1.2	737.0	0.11	0.48	0.42	7.63	2.47	43.6	6.2	12.4	6.6	94.4	94.7	91.0