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To W.W. Muir

From Stan Chmelyk

Date March 21/80

Subject METALLURGICAL TESTING OF OXIDE STOCKPILE ORE*P.J. Brown*Procedure

In October 1979, the mill received 500 tons of oxidized ore representative of the upper third of the oxide stockpile. Belt cuts of this ore were taken in order to obtain a representative sample for lab testing. Standard rougher flotation tests were performed to determine the effects of a finer grind and lower lead rougher pH. Additional tests were performed as well in order to optimize reagent usage. A portion of the sample was screened through a ¼" screen to remove the highly oxidized fines and rougher and cleaner flotation tests performed on the over-size material.

Observations and Conclusions

High concentrations of soluble copper in the tailing was a problem with oxide stockpile ore. In order to maintain soluble copper within the 0.20 ppm environmental limits it was necessary to reduce the cyanide addition rate to 0.045 kg/tonne. At the decreased cyanide addition rates excessive lead oxidation occurred during grinding, particularly during the finer grinds. This resulted in increased collector consumption in the lead circuit, a drop in lead recovery and a subsequent increase in the amount of lead reporting to the zinc concentrate. Because of increased oxidation the demand for cyanide is greater at the finer grinds. This demand decreases the cyanide available to leach copper resulting in lower soluble copper readings in the finer grinds.

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Refer to graphs 1 and 2, fine grind rougher flotation tests with oxide stockpile material display much the same results as fine grind test with normal ore. Both zinc grade and recovery improved about 2 units as a result of the finer grind. Lead grade dropped 1-2 units while recoveries improved 1-2 units. These test were all done with normal cyanide addition rates with soluble copper concentrations far exceeding the environmental limits.

Cyanide usage was reduced in the cleaner tests to lower the soluble copper concentrations. Without sufficient cyanide available to prevent oxidation in the finer grinds additional xanthate had to be used in the lead circuit. Lead recovery dropped about 3 units, see graphs 5 and 6, and lead reporting to the zinc concentrate increased about 1 unit.

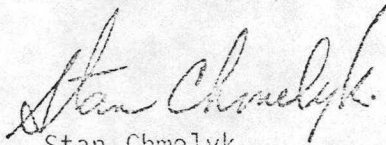
In order to ascertain the effects of reduced soda ash addition, a series of rougher flotation tests were conducted at a lead rougher pH of 9.5 and compared to tests at the normal lead rougher pH of 10.0. Refer to graphs 3 and 4. Lead recovery improved as much as 4 units at the lower pH, lead grade improved 2-3 units as well. Zinc metallurgy was not as dramatically affected. Tests with the normal lead rougher pH 10.0 had a somewhat faster zinc float as well as improved zinc grades in the early stages of the float. Soda ash and lime consumption decreased 3 kg/tonne and 0.5 kg/tonne respectively with the lower pH.

Tests with the screened sample were more sensitive to decreased cyanide additions. Soluble copper was a very large problem and cyanide reduction resulted in a marked deterioration in lead metallurgy (see graph 7). Fine grinding without sufficient cyanide again resulted in lower lead recoveries and high lead content in the zincs (see graph 5). The screened sample, at the coarse grind where sufficient cyanide was available, had much improved lead grades and recoveries, 4-5 units, compared to the un-screened sample.

.../3

The characteristic "slow" zinc float of oxidized ore was more noticeable in the screened sample (refer to graph 8). The coarse, dark marmatitic zinc type characteristic of the oxide stockpile ore was more prevalent in the screened sample. Fine grinding again did show some improvement in zinc metallurgy (see graph 6).

Screening reduced soda consumption by 3.0 kg/tonne in the coarse grind and 5.0 kg/tonne in the fine grind. Although 45.6% of the total sample was discarded as fines, the amount of lead and zinc oxide was only reduced by about a third.



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SUMMARY OF RESULTS  
ROUGHER AND CLEANER TESTS

Rougher Tests

Group 1 - Variable - Fineness of grind.

Test #	No. of Tests	p80 (microns)	Pb RGHR pH	NaCN (g/t)	Rougher Lead (%)		Conc's Zinc (%)		Zinc Scav. Tail Cu <sup>++</sup> (ppm)
					G	R	G	R	
1,3,5,7	4	110	9.5-10.0	75	31.1	81.2	40.0	78.0	Range 5-7
2,4,6,8	4	49	9.5-10.0	75	30.2	82.6	41.7	79.5	Range 5-7
17,19	2	110 <sup>+</sup>	10.0	30	35.5	80.3	41.0	75.3	0.31
18,20	2	49 <sup>+</sup>	10.0	30	30.4	81.9	40.8	75.1	0.10

+ Rod mill feed + $\frac{1}{4}$  inch.

Group 2 - Variable - Lead rougher pH

Test #	No. of Tests	p80 (microns)	Pb RGHR pH	NaCN (g/t)	Rougher Lead (%)		Conc's Zinc (%)		Zinc Scav. Tail Cu <sup>++</sup> (ppm)
					G	R	G	R	
1, 5	2	110	10.0	75	29.7	79.3	38.8	78.2	Range 5-7
3, 7	2	110	9.5	75	32.6	83.0	41.3	77.8	Range 5-7
2, 6	2	49	10.0	75	29.2	80.1	40.8	80.0	Range 5-7
4, 8	2	49	9.5	75	31.1	84.7	42.6	78.8	Range 5-7

Cleaner Tests

Test #	No. of Tests	p80 (microns)	Pb RGHR pH	NaCN (g/t) Total	Lead Conc. Grade	Zinc Conc. Grade	Zinc Scav. Tail Cu <sup>++</sup> (ppm)
					Rec. 70%	Rec. 80%	
1	1	110	10.0	45	63	49.5	0.40
2	1	49	10.0	45	58	43.0	0.24
3	1	110	10.0 <sup>+</sup>	45	71	44.0	0.22
4	1	49	10.0 <sup>+</sup>	45	58	46.5	0.12

+ Rod mill feed + $\frac{1}{4}$  inch.

Data:

	<u>Pb</u>	<u>Zn</u>	<u>Fe</u>	<u>Cu</u>	<u>Mn</u>	<u>Ag</u>	<u>PbO</u>	<u>ZnO</u>
Oxide STP Heads	3.20	5.32	27.2	0.17	0.11	1.33	0.74	0.32
Oxide STP - $\frac{1}{2}$ in.	3.30	4.87	28.6	0.11	0.09	1.21	0.75	0.35
Oxide STP + $\frac{1}{2}$ in.	3.10	5.33	25.7	0.17	0.12	1.28	0.53	0.23

Flot Feed p80 - 110 microns

Four Test Average

Pb Rougher Feed pH 10.0

# 1,3,5 and 7

<u>Na<sub>2</sub>CO<sub>3</sub></u>	<u>Na<sub>2</sub>SO<sub>3</sub></u>	<u>NaCN</u>	<u>xanthate</u>		<u>CuSO<sub>4</sub></u>	<u>CuO</u>
			<u>Lead</u>	<u>Zinc</u>		
6.7	2.5	0.075	0.055	0.055	0.38	2.9

All reagent figures are given in kg/tonne

<u>Product</u>	<u>WT</u>	<u>Grade</u>		<u>Distribution</u>	
		<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>
Heads	7991.9	3.13	5.23	100.00	100.00
Pb Ro. Conc.	652.8	31.11	9.73	81.24	15.19
Zn Ro. Conc.	816.0	1.35	39.96	4.40	77.95
Tails	6253.1	0.55	0.44	14.35	6.86

Flot Feed p80 - 49 microns

Four Test Average

Pb Rougher Feed pH 10.0

# 2,4,6 and 8

<u>Na<sub>2</sub>CO<sub>3</sub></u>	<u>Na<sub>2</sub>SO<sub>3</sub></u>	<u>NaCN</u>	<u>xanthate</u>		<u>CuSO<sub>4</sub></u>	<u>CuO</u>
			<u>Lead</u>	<u>Zinc</u>		
7.3	2.5	0.075	0.055	0.055	0.38	2.7

<u>Product</u>	<u>WT</u>	<u>Grade</u>		<u>Distribution</u>	
		<u>Pb</u>	<u>Zn</u>	<u>Pb</u>	<u>Zn</u>
Heads	7935.6	3.08	5.28	100.00	100.00
Pb Ro. Conc.	668.4	30.21	9.87	82.64	15.74
Zn Ro. Conc.	799.1	1.26	41.67	4.12	79.48
Tails	6468.1	0.50	0.31	13.23	4.79

Flot Feed p80 - 110 microns  
 Pb Rougher Feed pH 10.0

Two Test Average  
 # 1 and 5

$\text{Na}_2\text{CO}_3$	$\text{Na}_2\text{SO}_3$	NaCN	xanthate		$\text{CuSO}_4$	CuO
			Lead	Zinc		
8.5	2.5	0.075	0.055	0.055	0.38	3.2

Product	WT	Grades		Distribution	
		Pb	Zn	Pb	Zn
Feed	4003.7	3.07	5.31	100.00	100.00
Pb Ro. Conc.	328.6	29.65	9.93	79.26	15.36
Zn Ro. Conc.	429.0	1.40	38.75	4.89	78.23
Tails	3246.1	0.60	0.42	15.84	6.42

Flot Feed p80 - 110 microns  
 Pb Rougher Feed pH 9.5

Two Test Average  
 # 3 and 7

$\text{Na}_2\text{CO}_3$	$\text{Na}_2\text{SO}_3$	NaCN	xanthate		$\text{CuSO}_4$	CuO
			Lead	Zinc		
5.0	2.5	0.075	0.055	0.055	0.38	2.7

Product	WT	Grades		Distribution	
		Pb	Zn	Pb	Zn
Feed	3988.2	3.19	5.15	100.00	100.00
Pb Ro. Conc.	324.2	32.59	9.53	82.97	15.04
Zn Ro. Conc.	387.0	1.29	41.31	3.91	77.79
Tails	3277.0	0.51	0.45	13.12	7.17

Flot Feed p80 - 49 microns  
 Pb Rougher Feed pH 10.0

Two Test Average  
 # 2 and 6

Na <sub>2</sub> CO <sub>3</sub>	Na <sub>2</sub> SO <sub>3</sub>	NaCN	xanthate Lead	Zinc	CuSO <sub>4</sub>	CuO
8.9	2.5	0.075	0.055	0.055	0.38	2.9

Product	WT	Assays		Distribution	
		Pb	Zn	Pb	Zn
Feed	3944.2	2.94	5.32	100.00	100.00
Pb Ro. Conc.	317.8	29.19	9.95	80.03	15.07
Zn Ro. Conc.	411.4	1.39	40.83	4.93	80.03
Tails	3215.0	0.54	0.32	14.99	4.90

Flot Feed p80 - 49 microns  
 Pb Rougher Feed pH 9.5

Two Test Average  
 # 4 and 8

Na <sub>2</sub> CO <sub>3</sub>	Na <sub>2</sub> SO <sub>3</sub>	NaCN	xanthate Lead	Zinc	CuSO <sub>4</sub>	CuO
5.7	2.5	0.075	0.055	0.055	0.38	2.6

Product	WT	Assays		Distribution	
		Pb	Zn	Pb	Zn
Heads	3991.4	3.23	5.25	100.00	100.00
Pb Ro. Conc.	350.6	31.14	9.79	84.74	16.39
Zn Ro. Conc.	387.7	1.13	42.56	3.39	78.80
Tails	3253.1	0.31	0.47	4.82	11.80

Flot Feed p80 - 110 microns

Pb Rougher Feed pH 10.0

Two Test Average

+½ in. screened sample  
# 17 and 19

$\text{Na}_2\text{CO}_3$	$\text{Na}_2\text{SO}_3$	NaCN	xanthate		$\text{CuSO}_4$
			Lead	Zinc	
7.20	2.5	0.03	0.055	0.055	0.38

Product	WT	Assays		Distribution	
		Pb	Zn	Pb	Zn
Heads	4009.1	3.63	5.80	100.00	100.00
Pb Ro. Conc.	329.7	35.46	11.50	80.27	16.30
Zn Ro. Conc.	427.3	2.31	41.00	6.78	75.31
Tails	3252.1	0.58	0.60	12.95	8.39

Flot Feed p80 - 49 microns

Pb Rougher Feed pH 10.0

Two Test Average

+½ in. screened sample  
# 18 and 20

$\text{Na}_2\text{CO}_3$	$\text{Na}_2\text{SO}_3$	NaCN	xanthate		$\text{CuSO}_4$
			Lead	Zinc	
7.7	2.5	0.03	0.080	0.055	0.38

Product	WT	Assays		Distribution	
		Pb	Zn	Pb	Zn
Heads	4025.8	3.52	5.81	100.00	100.00
Pb Ro. Conc.	381.3	30.40	11.63	81.87	18.95
Zn Ro. Conc.	431.3	2.60	40.76	7.92	75.14
Tails	3213.2	0.45	0.43	10.21	5.91

Cleaner Test

Test #1

Flot Feed p80 - 110 microns

Pb Rougher Feed pH 10.0

	Na <sub>2</sub> CO <sub>3</sub>	Na <sub>2</sub> SO <sub>3</sub>	NaCN	xanthate Lead	Zinc	CuSO <sub>4</sub>
Rougher	10.0	2.5	0.03	0.055	0.055	0.38
Cleaner	2.0	-	0.015	0.065	0.175	0.15
Total	12.0	2.5	0.045	0.120	0.230	0.53

Product	WT	Assays			Distribution		
		Pb	Zn	Ag	Pb	Zn	Ag
Feed	1999.7	3.27	4.98	1.19	100.00	100.00	100.00
Pb 1st CLNR Conc.	95.2	51.59	7.17	14.74	75.16	6.85	58.89
Pb 2nd CLNR Conc.	77.1	60.90	4.91	16.82	71.83	3.80	54.41
Pb Conc.	64.9	66.50	3.41	17.90	66.03	2.22	48.73
Zn Ro. Conc.	185.0	1.99	44.86	2.05	5.64	83.31	15.87
Zn 1st CLNR Conc.	156.9	1.86	50.18	2.13	4.46	79.02	14.00
Zn 2nd CLNR Conc.	147.2	1.77	51.49	2.14	3.99	76.08	13.20
Zn 3rd CLNR Conc.	137.1	1.68	52.22	2.15	3.53	71.86	12.36
Zn Conc.	119.6	1.62	53.60	2.21	2.96	64.35	11.09
Tails	1719.5	0.73	0.57	0.35	19.20	9.84	25.24

Cleaner Test

Test #2

Flot Feed p80 - 49 microns

Pb Rougher pH 10.0

	Na <sub>2</sub> CO <sub>3</sub>	Na <sub>2</sub> SO <sub>3</sub>	NaCN	xanthate		CuSO <sub>4</sub>
				Lead	Zinc	
Rougher	11.5	2.5	0.03	0.105	0.055	0.38
Cleaner	2.85	-	0.015	0.055	0.110	0.15
Total	14.35	2.5	0.045	0.160	0.165	0.53

Product	WT	Assays			Distribution		
		Pb	Zn	Ag	Pb	Zn	Ag
Heads	1999.7	3.30	5.29	1.23	100.00	100.00	100.00
Pb 1st CLNR Conc.	95.2	50.98	6.36	14.48	72.54	5.66	55.40
Pb 2nd CLNR Conc.	77.1	61.18	4.37	14.93	67.87	3.03	44.54
Pb Conc.	64.9	66.10	3.35	15.93	63.03	2.00	40.84
Zn Ro. Conc.	185.0	2.81	37.93	2.31	10.02	84.56	22.17
Zn 1st CLNR Conc.	156.9	2.50	50.78	1.76	5.78	73.33	10.92
Zn 2nd CLNR Conc.	147.2	2.41	53.99	1.74	4.88	68.37	9.49
Zn 3rd CLNR Conc.	137.1	2.32	54.95	1.70	4.19	61.89	8.26
Zn Conc.	119.6	2.16	55.50	1.63	3.38	54.32	6.87
Tails	1719.5	0.69	0.62	0.33	17.44	9.79	22.43

Cleaner Test

Test #3 4 1/2 in. screened sample

Flot Feed p80 - 110 microns

Pb Rougher Feed pH 10.0

	Na <sub>2</sub> CO <sub>3</sub>	Na <sub>2</sub> SO <sub>3</sub>	NaCN	xanthate		CuSO <sub>4</sub>
				Lead	Zinc	
Rougher	6.9	2.5	0.03	0.065	0.055	0.38
Cleaner	1.8	-	0.015	0.07	0.160	0.25
Total	8.7	2.5	0.045	0.135	0.215	0.63

Product	WT	Assays			Distribution		
		Pb	Zn	Ag	Pb	Zn	Ag
Feed	2010.4	3.58	5.54	1.17	100.00	100.00	100.00
Pb 1st CLNR Conc.	105.3	54.43	7.33	13.36	79.56	6.93	60.00
Pb 2nd CLNR Conc.	75.0	69.12	4.28	16.34	71.95	2.88	52.27
Pb Conc.	63.7	74.20	3.02	17.65	65.60	1.73	47.95
Zn Ro. Conc.	201.0	2.07	44.04	1.44	5.77	79.46	12.39
Zn 1st CLNR Conc.	136.5	1.98	49.87	1.47	3.76	61.10	8.59
Zn 2nd CLNR Conc.	111.1	1.80	51.83	1.41	2.78	51.69	6.70
Zn 3rd CLNR Conc.	83.9	1.63	52.87	1.34	1.90	39.82	4.79
Zn Conc.	57.6	1.59	53.50	1.31	1.27	27.66	3.22
Tails	1704.1	0.89	0.62	0.38	14.66	13.61	27.64

Cleaner Test

Test #4 +1/4 in. screened sample

Flot Feed p80 - 49 microns

Pb Rougher Feed pH 10.0

	Na <sub>2</sub> CO <sub>3</sub>	Na <sub>2</sub> SO <sub>3</sub>	NaCN	xanthate		CuSO <sub>4</sub>
				Lead	Zinc	
Rougher	7.5	2.5	0.03	0.08	0.055	0.38
Cleaner	1.7	-	0.015	0.08	0.17	0.25
Total	9.2	2.5	0.045	0.16	0.225	0.63

Product	WT	Assays			Distribution		
		Pb	Zn	Ag	Pb	Zn	Ag
Feed	2016.3	3.28	5.44	1.14	100.00	100.00	100.00
Pb 1st CLNR Conc.	88.9	54.08	6.08	14.72	72.75	4.92	57.01
Pb 2nd CLNR Conc.	68.9	63.23	3.55	17.08	65.91	2.23	51.28
Pb Conc.	60.1	66.50	2.66	17.89	60.46	1.46	46.84
Zn Ro. Conc.	290.1	3.67	32.93	1.54	16.11	87.02	19.45
Zn 1st CLNR Conc.	194.2	4.41	45.63	1.47	12.94	80.74	12.43
Zn 2nd CLNR Conc.	170.5	4.44	48.84	1.41	11.46	75.86	10.47
Zn 3rd CLNR Conc.	148.6	4.26	50.07	1.43	9.57	67.78	9.28
Zn Conc.	128.6	4.10	50.90	1.47	7.98	59.63	8.24
Tails	1637.3	0.45	0.54	0.33	11.15	8.05	23.54

Oxide Stockpile  
Rougher Flotation Test  
Grade Vs Recovery  
4 Test Average

LEAD

Flot Feed p80 110 $\mu$

Flot Feed p80 49 $\mu$

% Grade

46 0780

10 X 10 TO THE FEET 7 X 10 INCHES  
KUFEL & ESSER CO. MADE IN USA

20 30 40 50 60 70 80

% Recovery

90

80

70

60

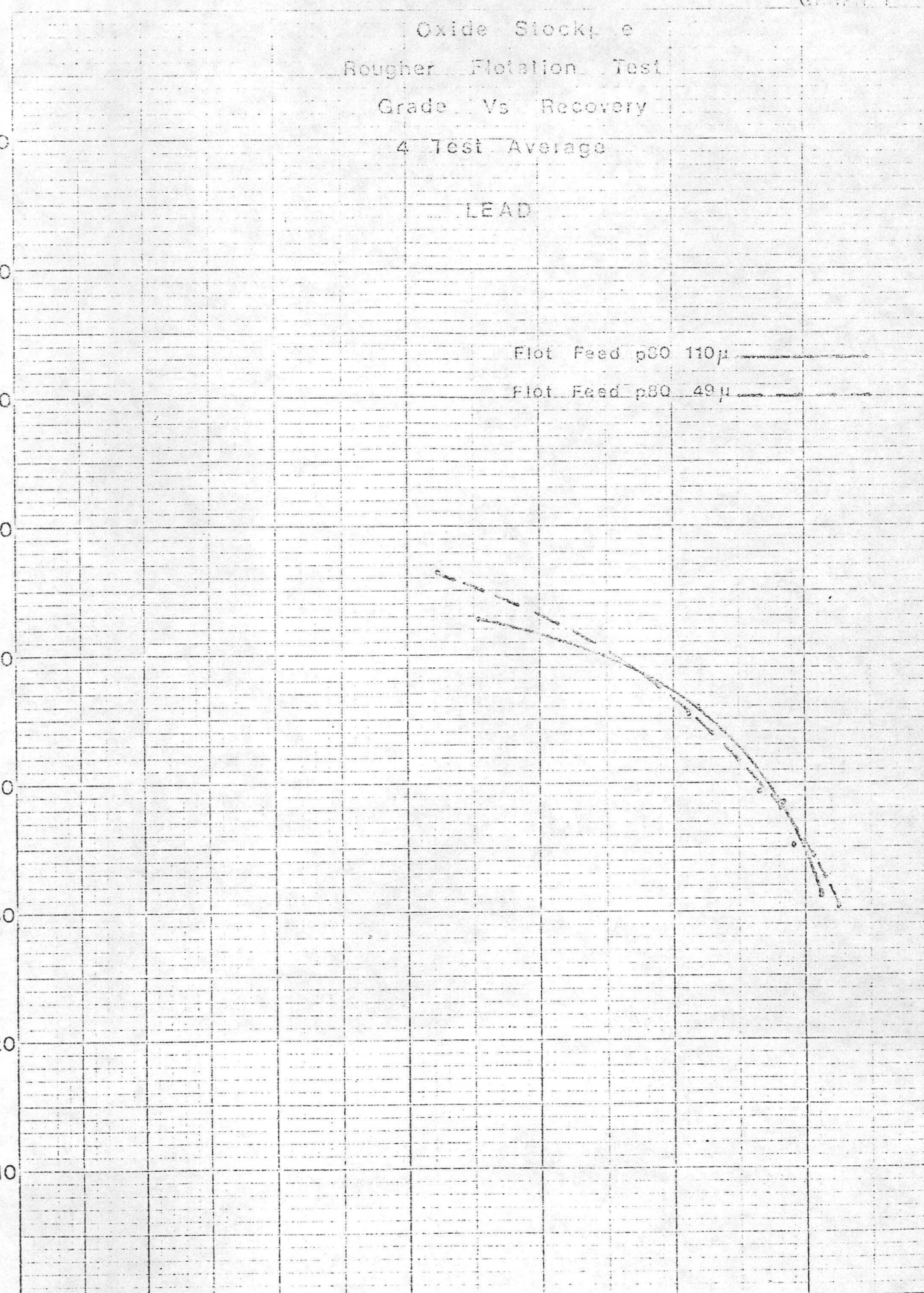
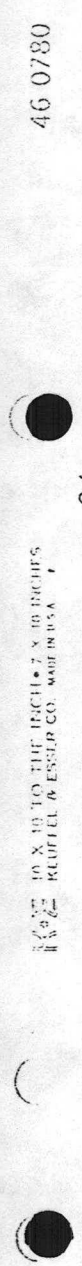
50

40

30

20

10



% Recovery	% Grade (p80 110 $\mu$ )	% Grade (p80 49 $\mu$ )
52	57	53
60	53	51
70	47	47
80	35	35
82	32	31

Oxide Stockpile  
Rougher Flotation Test  
Grade Vs Recovery  
4 Test Average

ZINC

Flot. Feed p80 110 $\mu$

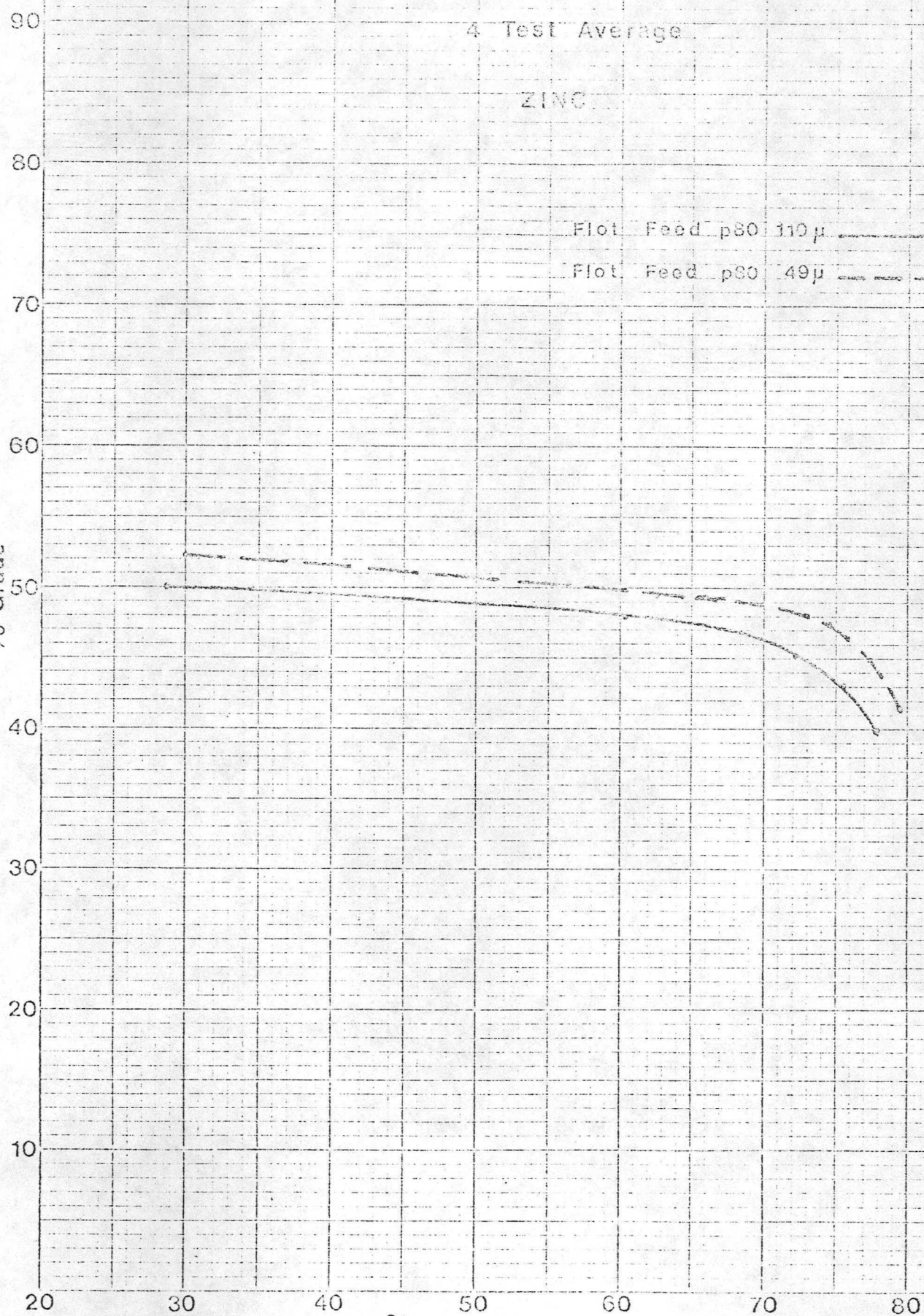
Flot. Feed p80 49 $\mu$

46 0780

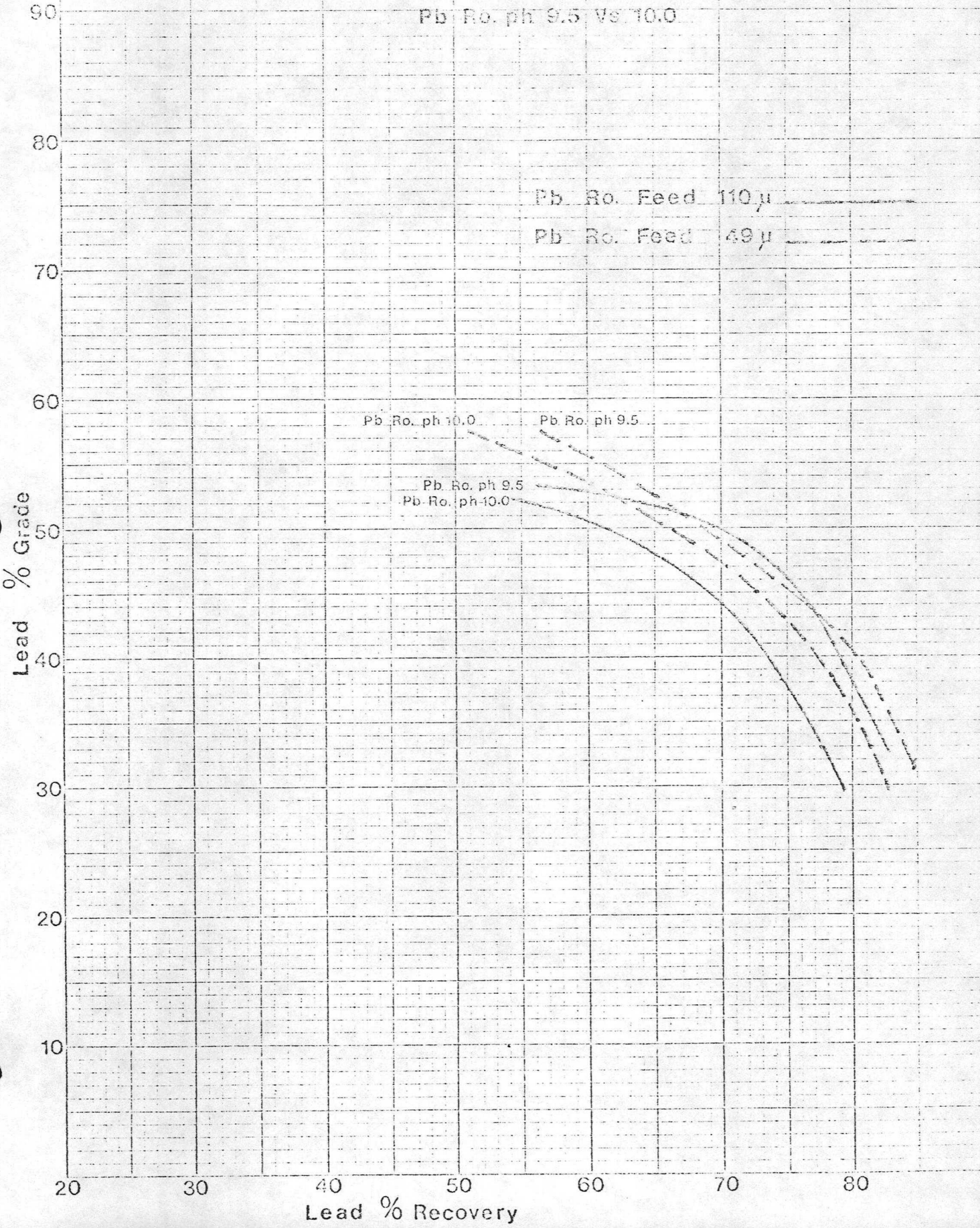
10 X 10 TO THE INCH  
KLEFFEL & ENSER CO. MADE IN U.S.A.

% Grade

% Recovery



Oxide Stockpile  
Lead Rougher Flotation Test  
Grade Vs Recovery  
Pb Ro. ph 9.5 Vs 10.0



46 0730

10 X 10 TO BLUE INCHES 1 X 10 INCHES  
KODAK SAFETY FILM  
KODAK SAFETY FILM

Oxide Stockpile  
Zinc Rougher Flotation Test  
Grade Vs Recovery  
Pb Ro. ph 9.5 Vs 10.0

46 0780

IN X 10 TO THE RIGHT OF THE CURVE IS TO BE USED  
KLEFFL W. LESSER CO. MADE IN U.S.A.

% Grade

Zinc

Pb Ro. Feed 110 μ

Pb Ro. Feed 49 μ

Pb Ro. ph 10.0

Pb Ro. ph 10.0

Pb Ro. ph 9.5

Pb Ro. ph 9.5

90

80

70

60

50

40

30

20

10

20

30

40

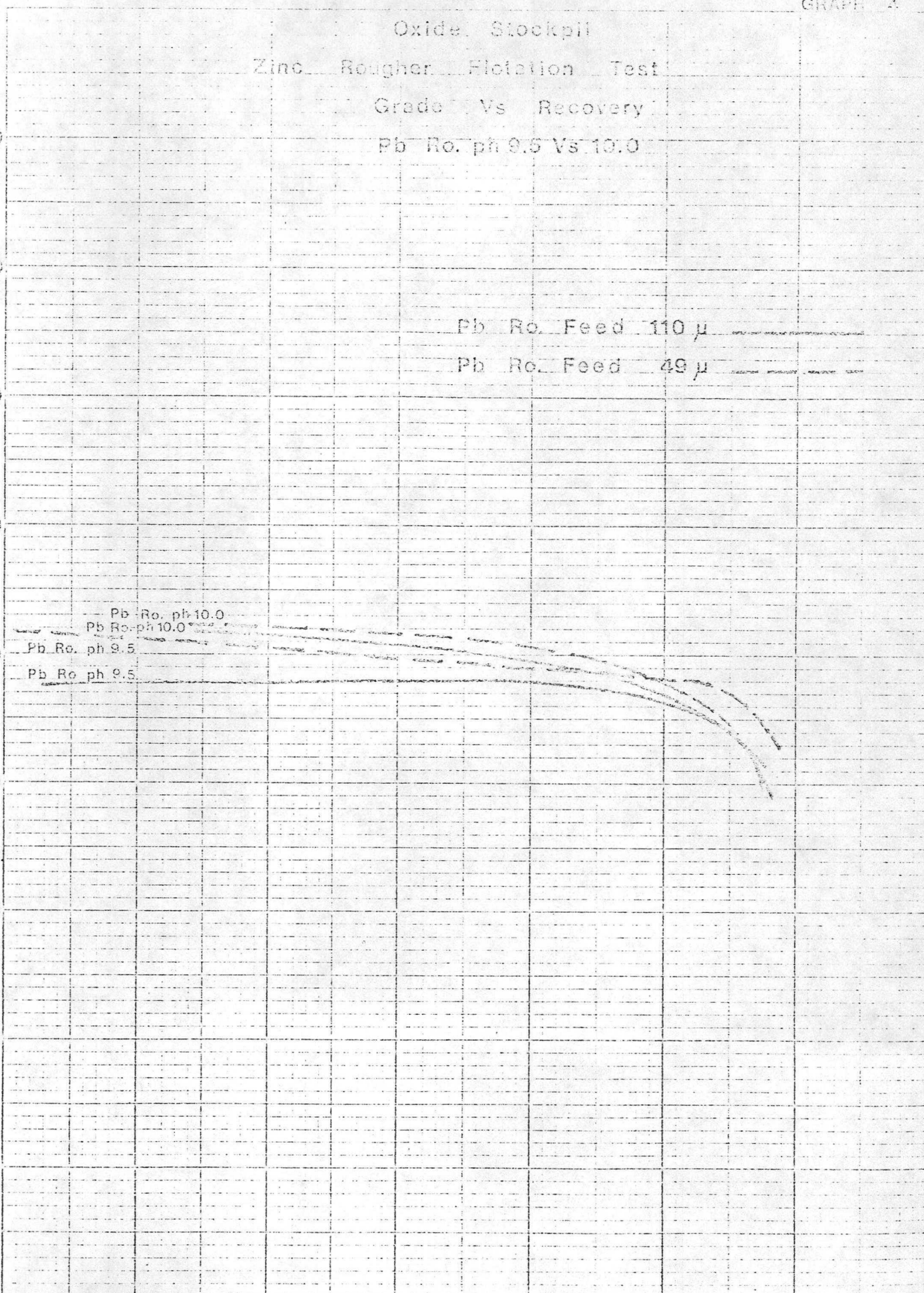
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60

70

80

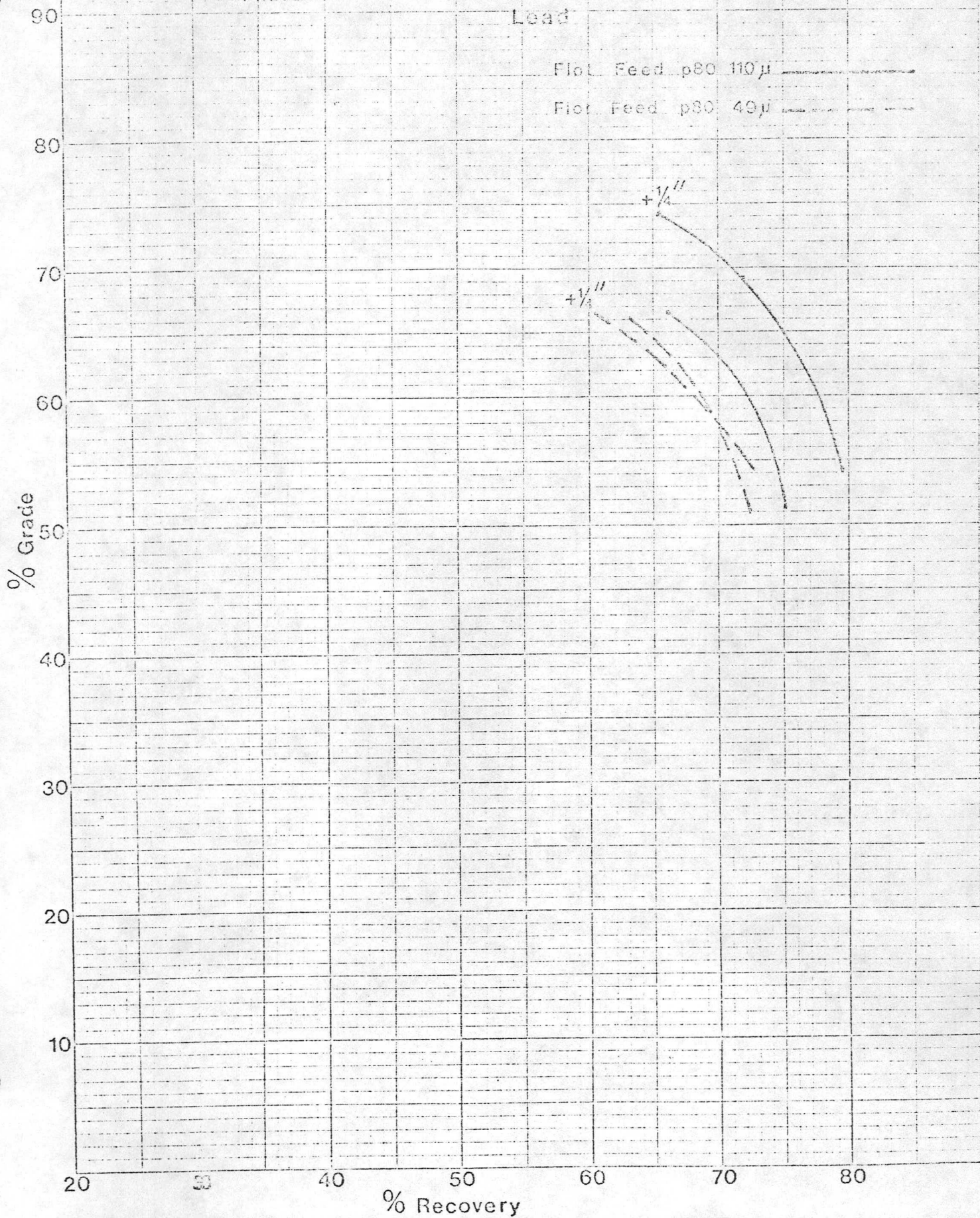
Zinc % Recovery



# Cleaner Flotation Test Grade Vs Recovery Lead

Flot. Feed p80 110 $\mu$

Flot. Feed p80 40 $\mu$



45 0780

10 X 10 TO THE INCH • 7 X 10 INCHES  
KUPFFEL & ESSER CO. MADE IN U.S.A.

### Cleaner Flotation Test Grade Vs Recovery

Zinc

Flot Feed p80 110 μ

Flot Feed p80 49 μ

% Grade

46 0780

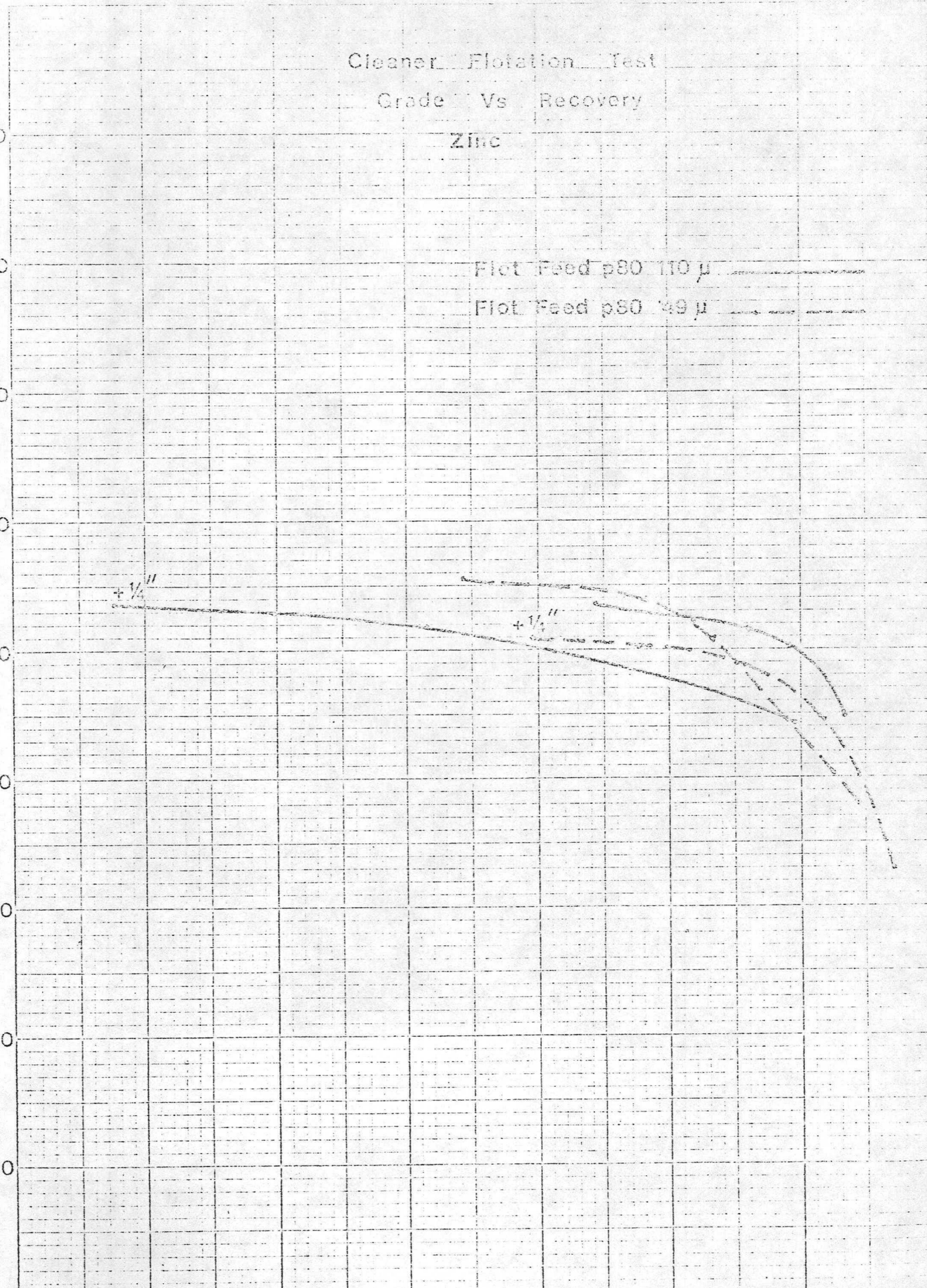
1 1/2" X 10" TO THE INCH • 7 X 10 PITCHES  
W. W. KEUFEL & SONS CO. MADE IN U.S.A.

20 30 40 50 60 70 80

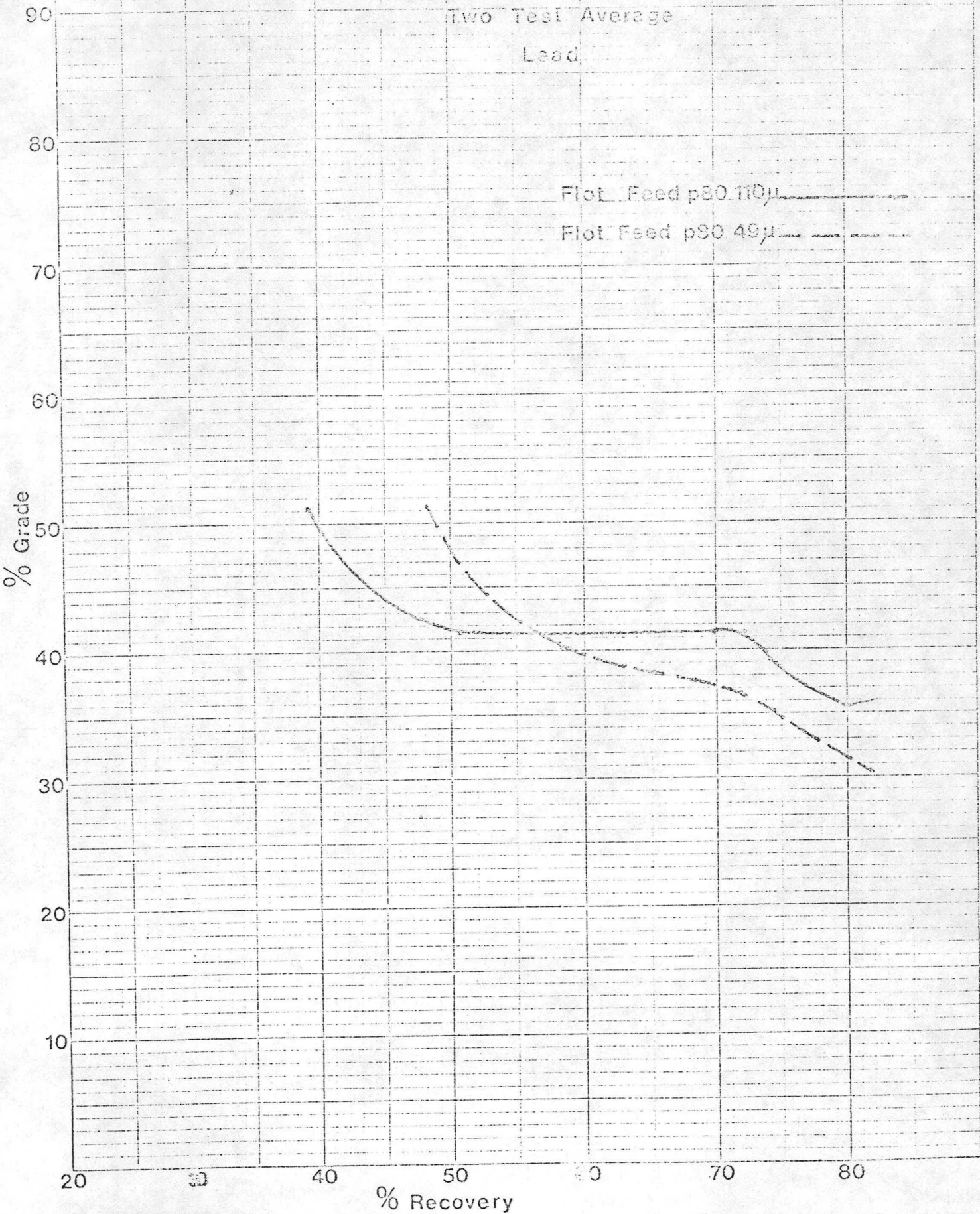
% Recovery

+ 1/4"

+ 1/4"



+ 1/4" Oxide Stockp  
Rougher Flotation Test  
Grade Vs Recovery  
Two Test Average  
Lead



46 0780

NOTE: 10 X 10 TO THE INCHES  
KUFFEL & ESSER CO. MADE IN U.S.A.

3/4" Oxide Stock  
Rougher Flotation Test  
Grade Vs Recovery

Two Test Average  
Zinc

Flot. Feed p80 110 μ

Flot. Feed p80 49 μ

46 0780

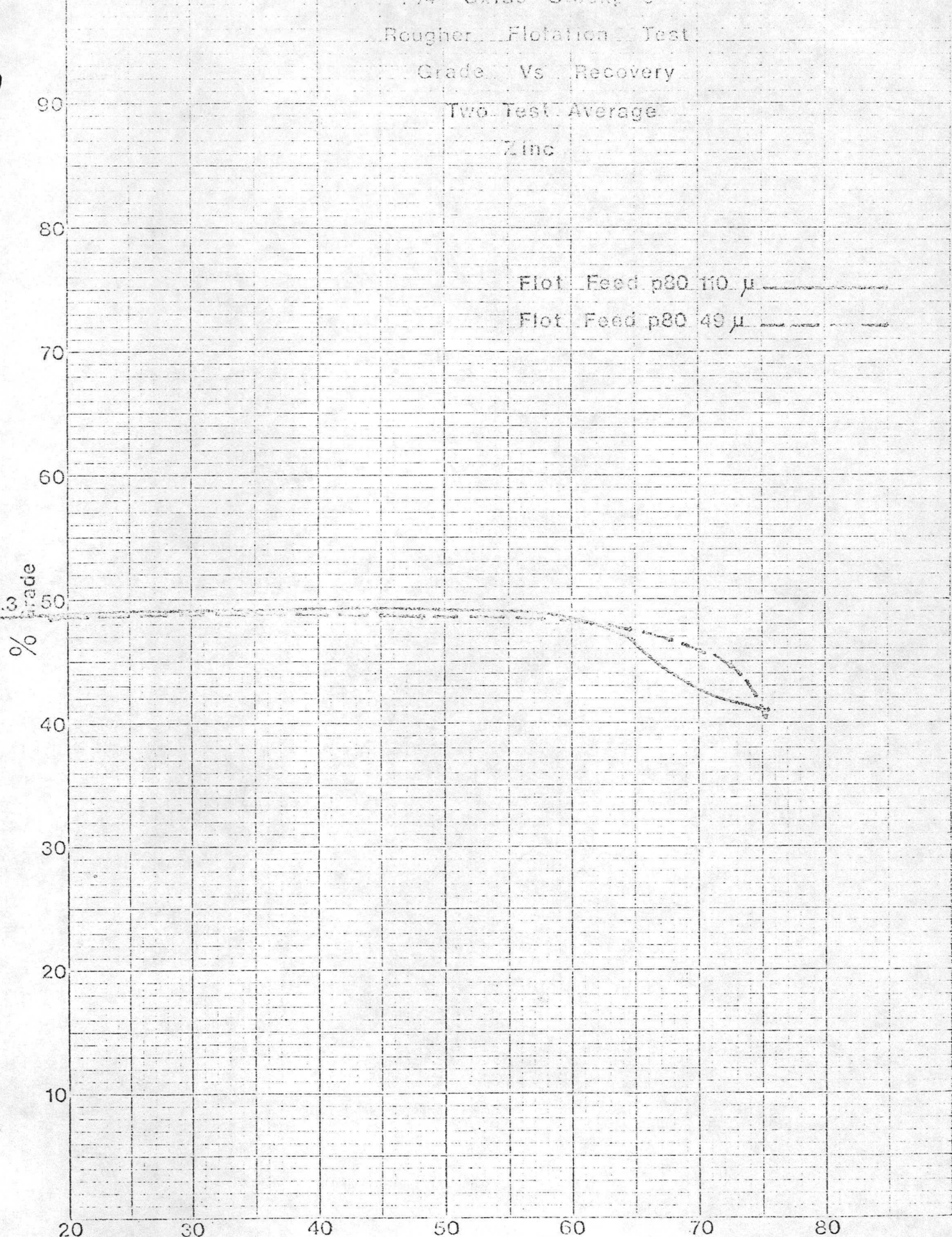
10 X 10 TO THE INCH • 7 X 10 INCHES  
KLEFFEL & ESSER CO. MADE IN U.S.A.

% Grade

90  
80  
70  
60  
50  
40  
30  
20  
10

20 30 40 50 60 70 80

% Recovery



273-A

CC: MEGL  
LPT  
MAD 19/3/81  
116 FRI-4To G. WIGHTCC: T. Biggs, J. Oik, R.A. McCallumFrom R.C. SMITHJ.K. CarringtonDate March 16, 1981.Subject 1982 METALLURGICAL FORECAST.

I have been advised by P. Taggart that some concern was expressed over the reduced production forecast for the oxidized ore stockpile during the subject period.

The following should be noted:

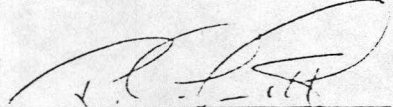
1. The Metallurgical Forecast presented for oxidized ore in the study "The Development of the Vangorda Plateau Ore Deposits" was based on information obtained from laboratory work. The current forecast is based on information gained from a 5 day plant test held in 1979 and consequently not available for the feasibility study.

A second plant test, postponed following the Third Quarter Review, has been rescheduled for May 1981, and the 1982 Plan Metallurgy will be revised if necessary when the results of this plant test are available.

2. Current grinding practice at plan throughput gives a P80 of 120 microns. During the previous five day plant test, Mill throughput was reduced to obtain a fine grind and in this case, P80 = 76 Microns - the grind expected following the completion of the grinding circuit modification is P80 = 40 microns. Metallurgical test data for oxidized ore indicates that while a fine grind does not improve lead grade or recovery, it does improve zinc grade or recovery.

On the basis of the above, and until further data is available, it would be rash to forecast better metallurgy than that shown in the most recent 1982 Metallurgical Forecast.

RCS/d

  
R.C. Smith,  
Mill Superintendent.