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DEPARTMENT OF ENERGY, MINES AND RESOURCES

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MINES BRANCH INVESTIGATION REPORT IR 67-33

JIGGING INVESTIGATION OF UPGRADED ORE FROM CREST EXPLORATION LIMITED, YUKON TERRITORY

by

G. W. RILEY

MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

Jigging the portion of ore upgraded by conductance sorting and the untreated fines produced concentrate of grade and recovery comparable to those obtained by jigging the whole ore. Jig concentrate produced from the high-grade and fines of Lot 127A assayed 61.2% sol Fe and 0.22% total P with a recovery of 57.6% of the iron in the original feed. Jigging the high grade and fines from Lot 127B produced a concentrate with a grade of 60.2% sol Fe and 0.16% total P with an overall recovery of 55.2% of the iron in the original feed.

Treating the middling fractions indicated that a concentrate assaying over 61% sol Fe could be produced which, with the concentrate from the high-grade and fines, could increase the overall recovery by about 6 per cent.

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INTRODUCTION

A testing programme using the SL-RN reduction process is being made on iron ore from the Snake River, Yukon Territory deposit of Crest Exploration Limited. The ore must first be upgraded and a previous investigation* made at the Mines Branch on similar ore has shown that the Wemco-Remer jig could upgrade the ore to about 62% Fe with 60% overall recovery. The company is now proposing to first remove barren waste by conductance sorting and use the upgraded product as feed for the subsequent jig circuit.

Conductance sorting was carried out by Ore Sorters (Canada) Limited on two lots of ore, designated Lot 127A and Lot 127B. Lot 127A is from the upper zone of the deposit and contains a higher phosphorous content than Lot 127B.

Purpose of the Investigation

To produce, from upgraded ore obtained by conductance sorting of crude ore, a jig concentrate comparable to that produced from previous pilot plant jig tests on raw ore.

Shipment

Over 5700 lb of ore was received on June 1, 1966 from P.M. Wreford, Manager, Ore Sorters (Canada) Limited, Peterborough, Ontario. The shipment consisted of fourteen samples of the products from conductance sorting as described in Table 1.

TABLE 1

Description of Samples

Products of Sorting	Lot 127A		Lot 127B	
	Sample No.	Weight lb	Sample No.	Weight lb
+2 in.				
High-grade	154/66	1370	161/66	1040
Middling	155/66	287	162/66	340
Waste	156/66	214	163/66	213
-2 in. + 3/4 in.				
High-grade	151/66	665	158/66	489 1/2
Middling	152/66	308 1/2	159/66	199 1/2
Waste	153/66	117	160/66	47 1/2
-3/4 in.				
Untreated Fines	150/66	243 1/2	157/66	192
Total		3205		2521 1/2

*Mines Branch Investigation Report IR 63-103.

Sampling and Analysis

All the samples received were crushed to minus 4 mesh. A Hazemag impact crusher in closed circuit with a vibrating screen was used in order to obtain products with a minimum of fines.

A sample of each of the crushed fractions was riffled out for a screen test and chemical and gravimetric analysis. The results are given in Tables 2, 3, 4 and 5.

TABLE 2

Screen Test of Minus 4 Mesh Products

Mesh Tyler	-3/4 in. Fines	-2 in. Fraction			+2 in. Fraction		
		High-Grade	Middling	Waste	High-Grade	Middling	Waste
Lot 127A							
+ 6	12.5	6.2	11.0	13.3	4.9	15.9	16.7
- 6+ 8	20.4	19.3	23.3	19.8	17.1	19.8	21.8
- 8+ 10	16.1	21.1	21.5	15.5	21.4	18.8	15.8
- 10+ 14	11.3	14.3	13.4	11.2	15.7	12.8	10.9
- 14+ 20	8.9	10.8	8.7	9.4	11.2	9.2	8.6
- 20+ 28	6.9	8.0	6.0	6.4	9.0	5.8	6.0
- 28+ 35	5.2	5.4	3.6	4.9	5.1	3.7	4.5
- 35+ 48	4.3	4.1	2.8	3.7	3.8	3.1	4.3
- 48+ 65	3.2	3.0	2.1	3.1	2.8	2.2	2.7
- 65+100	2.7	2.6	2.0	3.1	2.8	2.1	2.4
-100+150	2.0	1.5	1.4	2.2	1.2	1.4	1.6
-150+200	1.4	0.9	1.0	1.6	1.0	1.1	1.2
-200	5.1	2.8	3.2	5.8	4.0	4.1	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Lot 127B							
6	8.4	1.1	12.6	7.6	5.0	9.6	13.1
- 6+ 8	19.6	21.9	24.6	18.3	17.8	20.4	17.3
- 8+ 10	18.5	19.9	20.0	20.2	19.5	20.3	17.1
- 10+ 14	12.2	13.4	11.6	13.2	15.2	13.0	11.3
- 14+ 20	9.4	10.2	8.3	9.9	11.3	9.0	9.6
- 20+ 28	6.9	7.7	5.6	7.5	8.8	6.6	7.1
- 28+ 35	5.4	5.4	4.0	4.6	6.2	4.9	5.4
- 35+ 48	3.6	3.6	2.6	4.1	3.9	3.2	3.7
- 48+ 65	3.0	3.0	2.1	3.1	3.0	2.7	3.4
- 65+100	2.9	2.9	2.0	2.9	2.6	2.6	3.2
-100+150	2.2	3.0	1.4	2.0	1.6	1.7	2.2
-150+200	1.7	1.5	1.1	1.5	1.1	1.2	1.6
-200	6.2	6.4	4.1	5.1	4.0	4.8	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 3

Chemical Analysis of Products from Conductance Sorting

Product	Weight %	Analysis %			Distribution %
		Sol Fe	SiO_2	Tot P	Sol Fe
Lot 127A					
+2 in.					
High-grade	42.7	45.1	24.2	0.41	47.2
Middling	9.0	34.1	36.9	0.35	7.5
Waste	6.7	16.1	51.3	0.35	2.6
-2 in. +3/4 in.					
High-grade	20.7	48.3	20.7	0.51	24.5
Middling	9.6	36.8	33.6	0.43	8.6
Waste	3.7	19.4	49.9	0.51	1.8
-3/4 in.					
Fines	7.6	41.7	28.3	0.57	7.8
Total High-grade & fines	71.0	45.6	23.6	0.46	79.5
Total Middling	18.6	35.5	35.3	0.39	16.1
Total Waste	10.4	17.3	50.8	0.41	4.4
Feed	100.0	40.8	28.6	0.44	100.0
Lot 127B					
+2 in.					
High-grade	41.3	43.1	25.6	0.34	43.0
Middling	13.5	35.1	38.2	0.25	11.5
Waste	8.4	22.0	44.8	0.19	4.4
-2 in. +3/4 in.					
High-grade	19.4	51.1	17.9	0.27	23.9
Middling	7.9	38.7	30.3	0.23	7.4
Waste	1.9	20.2	48.4	0.20	0.9
-3/4 in.					
Fines	7.6	48.3	21.8	0.35	8.9
Total High-grade & fines	68.3	45.9	22.9	0.32	75.8
Total Middling	21.4	36.4	35.3	0.24	18.9
Total Waste	10.3	21.6	45.5	0.19	5.3
Feed	100.0	41.4	27.9	0.27	100.0

TABLE 4

Gravimetric Analysis of Products from Conductance Sorting Lot 127A

Product	Weight % Fraction			Weight % Raw Ore		
	+14 mesh	-14 mesh	Total	+14 mesh	-14 mesh	Total
High-grade & fines						
Float at sp gr 2.80	3.3	2.4	5.7	2.4	1.7	4.1
Float at sp gr 2.96	3.7	1.8	5.5	2.6	1.3	3.9
Float at sp gr 3.33	6.0	6.1	12.1	4.3	4.3	8.6
Float at sp gr 3.70	6.5	4.5	11.0	4.6	3.2	7.8
Sink at sp gr 3.70	38.2	27.5	65.7	27.1	19.5	46.6
Total	57.7	42.3	100.0	41.0	30.0	71.0
Middling						
Float at sp gr 2.80	6.1	3.0	9.1	1.1	0.6	1.7
Float at sp gr 2.96	7.9	7.5	15.4	1.5	1.4	2.9
Float at sp gr 3.33	12.2	9.3	21.5	2.3	1.7	4.0
Float at sp gr 3.70	5.9	4.6	10.5	1.1	0.8	1.9
Sink at sp gr 3.70	28.1	15.4	43.5	5.2	2.9	8.1
Total	60.2	39.8	100.0	11.2	7.4	18.6
Waste						
Float at sp gr 2.80	21.1	8.6	29.7	2.2	0.9	3.1
Float at sp gr 2.96	15.9	10.6	26.5	1.7	1.1	2.8
Float at sp gr 3.33	12.9	11.3	24.2	1.3	1.2	2.5
Float at sp gr 3.70	7.2	2.2	9.4	0.8	0.2	1.0
Sink at sp gr 3.70	7.1	3.1	10.2	0.7	0.3	1.0
Total	64.2	35.8	100.0	6.7	3.7	10.4
Feed						
Float at sp gr 2.80				5.7	3.2	8.9
Float at sp gr 2.96				5.8	3.8	9.6
Float at sp gr 3.33				7.9	7.2	15.1
Float at sp gr 3.70				6.5	4.2	10.7
Sink at sp gr 3.70				33.0	22.7	55.7
Total				58.9	41.1	100.0

TABLE 5

Gravimetric Analysis of Products from Conductance Sorting Lot 127B

Product	Weight % Fraction			Weight % Raw Ore		
	+14 mesh	-14 mesh	Total	+14 mesh	-14 mesh	Total
High-grade & fines						
Float at sp gr 2.80	3.6	3.1	6.7	2.5	2.1	4.6
Float at sp gr 2.96	4.1	2.0	6.1	2.8	1.4	4.2
Float at sp gr 3.33	7.4	4.5	11.9	5.0	3.1	8.1
Float at sp gr 3.70	7.1	2.2	9.3	4.8	1.5	6.3
Sink at sp gr 3.70	40.5	25.5	66.0	27.7	17.4	45.1
Total	62.7	37.3	100.0	42.8	25.5	68.3
Middling						
Float at sp gr 2.80	4.7	2.8	7.5	1.0	0.6	1.6
Float at sp gr 2.96	6.5	4.9	11.4	1.4	1.0	2.4
Float at sp gr 3.33	9.4	11.5	20.9	2.0	2.5	4.5
Float at sp gr 3.70	8.6	3.8	12.4	1.8	0.8	2.6
Sink at sp gr 3.70	26.5	21.3	47.8	5.7	4.6	10.3
Total	55.7	44.3	100.0	11.9	9.5	21.4
Waste						
Float at sp gr 2.80	11.9	4.3	16.2	1.2	0.4	1.6
Float at sp gr 2.96	10.6	7.7	18.3	1.1	0.8	1.9
Float at sp gr 3.33	28.3	16.3	44.6	2.9	1.7	4.6
Float at sp gr 3.70	5.4	2.6	8.0	0.6	0.3	0.9
Sink at sp gr 3.70	8.4	4.5	12.9	0.9	0.4	1.3
Total	64.6	35.4	100.0	6.7	3.6	10.3
Feed						
Float at sp gr 2.80				4.7	3.1	7.8
Float at sp gr 2.96				5.3	3.2	8.5
Float at sp gr 3.33				9.9	7.3	17.2
Float at sp gr 3.70				7.2	2.6	9.8
Sink at sp gr 3.70				34.3	22.4	56.7
Total				61.4	38.6	100.0

Chemical analysis for sol Fe was made on the products from the gravimetric analysis of the high-grade and fines fractions of Lots 127A and 127B. Results are given in Table 6.

TABLE 6

Gravimetric and Chemical Analysis of High-Grade & Fines

Product	+14 Mesh			-14 Mesh			Feed		
	Wt % Orig	% Sol Fe	Distn% Fe	Wt % Orig	% Sol Fe	Distn % Fe	Wt %	Sol Fe	Distn %
Lot 127A									
Float @ 2.80	3.3	8.9	0.6	2.4	1.9	0.1	5.7	6.0	0.7
Float @ 2.96	3.7	14.4	1.2	1.8	7.6	0.3	5.5	12.2	1.5
Float @ 3.33	6.0	19.9	2.6	6.1	14.6	1.9	12.1	17.2	4.5
Float @ 3.70	6.5	33.3	4.7	4.5	32.0	3.2	11.0	32.7	7.9
Sink @ 3.70	38.2	59.0	49.3	27.5	60.0	36.1	65.7	59.4	85.4
Total	57.7	46.3	58.4	42.3	45.0	41.6	100.0	45.7	100.0
Lot 127B									
Float @ 2.80	3.6	10.8	0.8	3.1	5.6	0.4	6.7	8.4	1.2
Float @ 2.96	4.1	12.6	1.1	2.0	9.1	0.4	6.1	11.5	1.5
Float @ 3.33	7.4	21.0	3.4	4.5	17.1	1.7	11.9	19.5	5.1
Float @ 3.70	7.1	37.4	5.8	2.2	32.2	1.5	9.3	36.1	7.3
Sink @ 3.70	40.5	60.0	52.7	25.5	58.2	32.2	66.0	59.3	84.9
Total	62.7	46.9	63.8	37.3	44.7	36.2	100.0	46.1	100.0

Outline of Investigation

The investigation began with a detailed analysis of the products from conductance sorting. These products consisted of high-grade, middling and minus 3/4 in. fines fractions. Results of chemical and gravimetic analysis are shown in Tables 3, 4 and 5.

The high-grade fractions and the minus 3/4 in. fines from each lot were combined and each composite was treated separately in the pilot plant jig.

The middling fractions from both lots were combined and treated in the same jig to recover additional concentrate and increase the overall recovery.

From the results of the sorting operation and previous jig tests it was calculated that it would be necessary to operate the jig to recover about 60% of the weight fed. This would give results comparable to the previous pilot plant tests when sorting did not precede jigging.

The jig was operated as for the previous pilot plant jig tests at a speed of 155 rpm with a stroke of 3/8 in. and 1/2 in. diameter hutch-discharge spigots. However, in order to produce a concentrate of over 60% sol Fe grade with maximum recovery from the hutches some changes were made to the other operating conditions. The method used to operate the jig during these tests produced a low-grade gate product which was rejected with the tailing from the jig-overflow weir. This eliminated the need to return the gate product to the circuit after grinding as was done in the previous pilot plant jig tests.

Because of the limited amount of ore available it was not possible to operate the jig for runs of longer than one hour. After each test the bed was left undisturbed and the jig products were dried, sampled and recombined for the next test.

Tests on the High-Grade and minus 3/4 in. Fines Fractions.

Lot 127A

The crushed high-grade and minus 3/4 in. fines fractions were combined and fed to the jig. The sample amounted to 71.0% by weight and contained 79.5% of the sol Fe in the original ore. See Table 3.

The results of a screen test of the feed to the jig are shown in Table 7.

TABLE 7

Screen Test of Jig Feed - Lot 127A

Mesh Tyler	Weight %
+ 6	6.1
- 6+ 8	16.6
- 8+ 10	18.2
- 10+ 14	14.4
- 14+ 20	10.8
- 20+ 28	8.3
- 28+ 35	6.3
- 35+ 48	4.4
- 48+ 65	3.1
- 65+100	2.8
-100+150	2.0
-150+200	1.7
-200	5.3
Total	100.0

Jigging Tests

Test 1

Jig operating conditions are shown in Table 8 and the results of the test in Table 9.

TABLE 8

Jig Operating Conditions Test 1

Primary eccentric	3/8 in. stroke at 155 rpm			
Secondary eccentric	1/16 in. stroke at 470 rpm			
Discharge spigots	1/2 in. diameter			
Slope of jig	1 in. per foot			
Feed rate	2400 lb per hr			
	Ragging-Steel Balls		Water	
	Size in.	Depth in.	%	gpm*
No. 1 Hutch	3/8	2	26.5	14.8
No. 2 Hutch	3/8	2	10.6	5.9
No. 3 Hutch	1/2	1 1/2	12.0	6.7
No. 4 Hutch	1/2	1 1/2	31.9	17.8
Top water			19.0	10.6
Total water			100.0	55.8

*U.S. Gallons

TABLE 9

Results of Jigging Test 1

Product	Weight % Test	Analysis % Sol Fe	Distribution % Fe Test	Distribution % Fe Original
No. 1 Hutch	0.9			
No. 2 Hutch	0.9	61.6	50.4	40.1
No. 3 Hutch	14.4 (35.3)			
No. 4 Hutch	19.1			
Gate	11.7	41.4	11.2	8.9
Tailing	53.0	31.3	38.4	30.5
Feed (calcd)	100.0	43.2	100.0	79.5

Results of a gravimetric analysis made on the tailing is shown in Table 10.

TABLE 10

Gravimetric Analysis of Tailing Test 1

Product	Weight % +14 mesh	Weight % -14 mesh	Weight % Total
Float at sp gr 2.80	5.6	5.5	11.1
Float at sp gr 2.96	7.7	4.4	12.1
Float at sp gr 3.33	11.6	12.6	24.2
Float at sp gr 3.70	5.5	11.2	16.7
Sink at sp gr 3.70	3.4	32.5	35.9
Total	33.8	66.2	100.0

Test 2

The ragging in No. 2 Hutch was changed from 3/8 in. to 1/2 in. steel balls to allow for more product discharge from the No. 2 Hutch. The feed rate was cut back to 1920 lb per hour to reduce the amount of the tailing and its content of fine, high-grade iron shown by the gravimetric analysis of Test 1 in Table 10. All other operating conditions remained the same as in Test 1. Results of the test are shown in Table 11.

TABLE 11

Results of Jigging Test 2

Product	Weight %	Analysis %	Distribution % Fe	
	Test	Sol Fe	Test	Original
No. 1 Hutch	1.3	64.7	1.8	1.4
No. 2 Hutch	21.0	62.7	28.8	22.9
No. 3 Hutch	22.9	55.7	27.8	22.1
No. 4 Hutch	19.7	49.0	21.1	16.8
Gate	17.8	26.0	10.1	8.0
Tailing	17.3	27.4	10.4	8.3
Feed (calcd)	100.0	45.8	100.0	79.5
Comb hutch conc	64.9	56.2	79.5	63.2

Test 3

Fine high-grade iron was still being lost to the tailing-overflow weir and the grade of concentrate from No. 3 and No. 4 hutches was too low. It was decided to decrease the slope of the jig to 4/5 in. per foot and the feed rate to 1500 lb per hour. The water admitted to the hutches was also adjusted to give maximum suction in the first hutch and increased upward flow in the last hutch. Final jig operating conditions are shown in Table 12 and the results of the test in Table 13.

TABLE 12

Jig Operating Conditions Test 3

Primary eccentric	3/8 in. stroke at 155 rpm			
Secondary eccentric	1/16 in. stroke at 470 rpm			
Discharge spigots	1/2 in. diameter			
Slope of jig	4/5 in. per foot			
Feed rate	1500 lb/hr			
	Ragging-Steel Balls		Water	
	Size in.	Depth in.	%	gpm
No. 1 Hutch	3/8	2	0.0	0.0
No. 2 Hutch	1/2	2	13.7	7.4
No. 3 Hutch	1/2	1 1/2	24.1	13.0
No. 4 Hutch	1/2	1 1/2	30.9	16.7
Top water			31.3	16.9
Total water			100.0	54.0

TABLE 13

Results of Jigging Test 3

Product	Weight %	Analysis %		Distribution % Fe	
	Test	Sol Fe	Tot P	Test	Original
No. 1 Hutch	2.4	63.1	0.16	3.2	2.5
No. 2 Hutch	15.3	64.8	0.19	20.8	16.6
No. 3 Hutch	35.1	59.6	0.23	43.8	34.8
No. 4 Hutch	3.7	60.2	0.24	4.7	3.7
Gate	29.5	33.5	0.55	20.7	16.5
Tailing	14.0	23.4	0.59	6.8	5.4
Feed (calcd)	100.0	47.7	0.38	100.0	79.5
Comb hutch conc	56.5	61.2	0.22	72.5	57.6

Results of a screen test and gravimetric analysis on the products from Test 3 are shown in Tables 14 and 15 respectively.

TABLE 14

Results of Screen Tests Test 3

Mesh Tyler	No. 1 Hutch	No. 2 Hutch	No. 3 Hutch	No. 4 Hutch	Gate	Tailing
+ 6	1.4	5.6	4.5	3.1	5.0	1.8
6+ 8	5.2	24.1	14.7	6.8	13.6	5.6
- 8+ 10	9.8	29.4	26.6	9.1	19.8	10.0
- 10+ 14	5.4	13.2	18.9	9.1	14.3	11.2
- 14+ 20	3.4	7.0	15.4	13.0	13.7	12.7
- 20+ 28	2.4	3.3	8.2	14.8	10.5	11.4
- 28+ 35	4.6	2.7	4.6	16.3	8.3	11.4
- 35+ 48	8.0	2.5	2.3	11.7	5.3	9.0
- 48+ 65	13.0	2.9	1.6	8.2	3.8	8.9
- 65+100	14.1	3.1	1.2	4.4	2.5	7.0
-100+150	13.8	2.9	0.9	2.1	1.8	5.3
-150+200	8.0	1.6	0.5	0.7	0.7	2.5
-200	10.9	1.7	0.6	0.7	0.7	3.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 15

Gravimetric Analysis of Jig Products Test 3

Product	Weight % Jig Feed				Weight % Original			
	Fl 3.33	Fl 3.70	Sink 3.70	Total	Fl 3.33	Fl 3.70	Sink 3.70	Total
1, 2, 3 & 4 Hutches								
+14 mesh	0.2	3.5	30.5	34.2	0.1	2.5	21.7	24.3
-14 mesh	0.3	0.5	21.5	22.3	0.2	0.3	15.3	15.8
Total	0.5	4.0	52.0	56.5	0.3	2.8	37.0	40.1
Gate								
+14 mesh	9.7	2.9	2.9	15.5	6.9	2.0	2.1	11.0
-14 mesh	4.6	1.8	7.6	14.0	3.3	1.3	5.4	10.0
Total	14.3	4.7	10.5	29.5	10.2	3.3	7.5	21.0
Tailing								
+14 mesh	3.4	0.4	0.2	4.0	2.4	0.3	0.1	2.8
-14 mesh	5.9	1.0	3.1	10.0	4.2	0.7	2.2	7.1
Total	9.3	1.4	3.3	14.0	6.6	1.0	2.3	9.9
Feed (calcd)								
+14 mesh	13.3	6.8	33.6	53.7	9.4	4.8	23.9	38.1
-14 mesh	10.8	3.3	32.2	46.3	7.7	2.3	22.9	32.9
Total	24.1	10.1	65.8	100.0	17.1	7.1	46.8	71.0

Lot 127B

The crushed high-grade and minus 3/4 in. fines fractions were combined and fed to the jig. The sample amounted to 68.3% by weight and contained 75.8% of the sol Fe in the original ore. See Table 3. The results of a screen test of the feed to the jig are shown in Table 16.

TABLE 16

Screen Test of Jig Feed - Lot 127B

Mesh Tyler	Weight %
+ 6	5.0
- 6+ 8	19.5
- 8+ 10	23.2
- 10+ 14	15.0
- 14+ 20	11.7
- 20+ 28	8.0
- 28+ 35	5.8
- 35+ 48	3.8
- 48+ 65	3.1
- 65+100	2.3
-100+150	1.4
-150+200	0.8
-200	0.4
Total	100.0

Jigging Tests

Test 4

The combined fractions were fed to the jig using the same operating conditions and feed rate of 1500 lb per hour as for Test 3. Results of the test are shown in Table 17.

TABLE 17

Results of Jigging Test 4

Product	Weight %	Analysis %	Distribution % Fe	
	Test	Sol Fe	Test	Original
No. 1 Hutch	2.7	62.7	3.7	2.8
No. 2 Hutch	11.3	64.6	16.1	12.2
No. 3 Hutch	27.2	59.8	35.8	27.1
No. 4 Hutch	7.4	59.7	9.7	7.4
Gate	20.6	37.1	16.8	12.7
Tailing	30.8	26.3	17.9	13.6
Feed (calcd)	100.0	45.2	100.0	75.8
Comb hutch conc	48.6	61.1	65.3	49.5

Test 5

The large amount of tailing and its content of fine, high-grade iron suggested that the rate of feed was too high in Test 4. The rate of feed in Test 5 was, therefore, reduced to 1140 lb per hour. Other operating conditions remained the same. The results of the test are shown in Table 18.

TABLE 18

Results of Jigging Test 5

Product	Weight %	Analysis %		Distribution % Fe	
	Test	Sol Fe	Tot P	Test	Original
No. 1 Hutch	6.0	63.6	0.13	8.1	6.1
No. 2 Hutch	25.0	63.0	0.13	33.3	25.2
No. 3 Hutch	25.9	57.6	0.19	31.5	23.9
No. 4 Hutch	7.3	51.0	0.23	7.8	5.9
Gate	16.0	32.2	0.47	10.9	8.3
Tailing	19.8	20.0	0.53	8.4	6.4
Feed (calcd)	100.0	47.3	0.29	100.0	75.8
Comb 1, 2, 3 hutches	56.9	60.6	0.16	72.9	55.2
Comb 1, 2, 3, 4 hutches	64.2	59.5	0.17	80.7	61.1

Results of screen tests and gravimetric analysis on the products from Test 5 are shown in Tables 19 and 20 respectively.

TABLE 19

Screen Test of Jig Products Test 5

Mesh Tyler	No. 1 Hutch	No. 2 Hutch	No. 3 Hutch	No. 4 Hutch	Gate	Tailing
+ 6	2.3	6.9	4.7	8.8	6.1	1.4
- 6+ 8	9.4	23.6	10.7	11.5	13.7	4.6
- 8+ 10	12.1	30.6	21.2	18.0	21.0	12.0
- 10+ 14	7.8	15.6	18.4	14.0	14.2	12.4
- 14+ 20	5.5	8.9	17.4	14.3	13.3	13.8
- 20+ 28	3.9	4.5	11.4	12.6	10.5	12.3
- 28+ 35	5.5	3.3	7.5	10.0	8.7	11.5
- 35+ 48	7.1	2.1	3.6	5.5	5.2	9.1
- 48+ 65	10.1	1.5	2.0	2.7	3.4	8.1
- 65+100	10.6	0.9	1.0	1.1	1.8	5.9
-100+150	10.0	0.8	0.5	0.4	1.1	4.5
-150+200	9.9	0.3	0.1	0.1	0.3	1.7
-200	5.8	1.0	1.5	1.0	0.7	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 20

Gravimetric Analysis of Jig Products Test 5

Product	Weight % Jig Feed				Weight % Original			
	Fl 3.33	Fl 3.70	Sink 3.70	Total	Fl 3.33	Fl 3.70	Sink 3.70	Total
1, 2 & 3 Hutches								
+14 mesh	0.1	2.2	34.6	36.9	0.1	1.5	23.6	25.2
-14 mesh	0.4	0.4	19.2	20.0	0.2	0.3	13.2	13.7
Total	0.5	2.6	53.8	56.9	0.3	1.8	36.8	38.9
4 Hutch								
+14 mesh	0.3	1.0	2.5	3.8	0.2	0.7	1.7	2.6
-14 mesh	0.2	0.5	2.8	3.5	0.2	0.3	1.9	2.4
	0.5	1.5	5.3	7.3	0.4	1.0	3.6	5.0
Gate								
+14 mesh	5.8	1.7	1.3	8.8	4.0	1.1	0.9	6.0
-14 mesh	2.2	0.7	4.3	7.2	1.5	0.5	2.9	4.9
Total	8.0	2.4	5.6	16.0	5.5	1.6	3.8	10.9
Tailing								
+14 mesh	5.4	0.4	0.2	6.0	3.7	0.3	0.1	4.1
-14 mesh	9.1	1.5	3.2	13.8	6.2	1.0	2.2	9.4
Total	14.5	1.9	3.4	19.8	9.9	1.3	2.3	13.5
Feed (calcd)								
+14 mesh	11.6	5.3	38.6	55.5	8.0	3.6	26.3	37.9
-14 mesh	11.9	3.1	29.5	44.5	8.1	2.1	20.2	30.4
Total	23.5	8.4	68.1	100.0	16.1	5.7	46.5	68.3

Tests on the Middling Fractions

Lots 127A and 127B

Test 6

Because of the small amount of the samples the "middling" of each lot (Table 3) was combined for testing in the Wemco-Remer jig. The sample amounted to an average of 20% by weight and contained an average of 17.5% of the sol Fe in the original ore.

The jig was first cleaned of any of the bed material from treating the high-grade ore and then the combined middlings were fed for twenty minutes and a new bed formed. To establish a simulated continuous operation the products from the hutches, gate and overflow weir were then recombined and fed back to the jig circuit. The jig operated under the same conditions and feed rate of 1140 lb per hour as for Test 5. Results of the screen test on the feed are shown in Table 21 and results of the test in Table 22.

TABLE 21

Screen Test of Jig Feed - Middlings

Mesh Tyler	Weight %
+ 6	11.2
- 6+ 8	22.0
- 8+ 10	20.4
- 10+ 14	11.6
- 14+ 20	9.3
- 20+ 28	6.0
- 28+ 35	4.6
- 35+ 48	3.1
- 48+ 65	2.7
- 65+100	2.1
-100+150	1.7
-150+200	0.9
-200	4.4
Total	100.0

TABLE 22

Results of Jigging Test 6

Product	Weight %	Analysis %		Distribution % Fe	
	Test	Sol Fe	Tot P	Test	Original
No. 1 Hutch	4.9	61.9	0.16	8.4	1.5
No. 2 Hutch	16.1	61.8	0.17	27.9	4.9
No. 3 Hutch	19.2	51.6	0.25	27.8	4.9
No. 4 Hutch	11.3	36.4	0.36	11.5	2.0
Gate	15.1	19.1	0.40	8.1	1.4
Tailing	33.4	17.4	0.37	16.3	2.8
Feed (calcd)	100.0	35.7	0.31	100.0	17.5
Comb 1, 2 hutches	21.0	61.8	0.17	36.3	6.4
Comb 1, 2, 3 hutches	40.2	56.9	0.21	64.1	11.3

SUMMARY AND DISCUSSION OF RESULTS

Jigging of the high-grade conductance-sorting products and the untreated fines of Lot 127A gave a recovery of 57.6% of the sol Fe at 61.2% grade when treating 71.0% of the original ore. Similarly with Lot 127B, 55.2% sol Fe was recovered at a grade of 60.6% sol Fe when treating 68.3% of the original ore. See Tables 3, 13 and 18.

By jigging the combined conductance-sorting middling fractions of the two lots of ore amounting to about 20% of the original ore, an additional recovery of 6.4% sol Fe was obtained at a grade of 61.8% sol Fe. The economic justification for jigging this additional amount of ore to obtain an additional recovery of 6.4% would have to be determined. See Tables 3 and 22.

Representation of the gravimetric analyses of the jig feed and its distribution into the jig products are shown by block distribution diagrams. See appendices A and B and Tables 15 and 20.

From gravimetric analyses of the feed to the jig it was calculated that about 85% of the iron in the feed occurred in particles of specific gravity above 3.7 and assayed about 59% sol Fe. See Table 6.

From gravimetric analysis of the jig products of Lot 127A it was calculated that 90.8% of the high grade material in the plus 14 mesh fraction and 66.8% in the minus 14 mesh fraction of the jig feed was recovered by the jig. Similarly with Lot 127B, 89.6% of the high-grade material in the plus 14 mesh fraction and 65.4% in the minus 14 mesh fraction of the jig feed was recovered. See Tables 15 and 20.

From the gravimetric studies it can be seen that about 20% of the high-grade material was lost and that most of this material was in the minus 14 mesh fraction. The average grade of this material is below 60% sol Fe hence some would have to be sacrificed to increase the grade of the recovered portion. Further gravimetric analyses at higher specific gravities could indicate the maximum theoretical grade and recovery that could be obtained from this ore.

Methods for the recovery of additional fine material should be investigated. Sizing before jigging might be beneficial or additional methods of treatment might be used. There is a possibility that jigging of the ore without any pretreatment might result in a jig bed with a slightly lower density which would allow the fine material to penetrate more easily and thus increase recovery.

Although the lots of ore appeared to be similar from the results of screen tests, chemical and gravimetric analyses, there was a difference since it was necessary to reduce the feed rate for the low-phosphorus ore in order to obtain the same recovery.

CONCLUSIONS

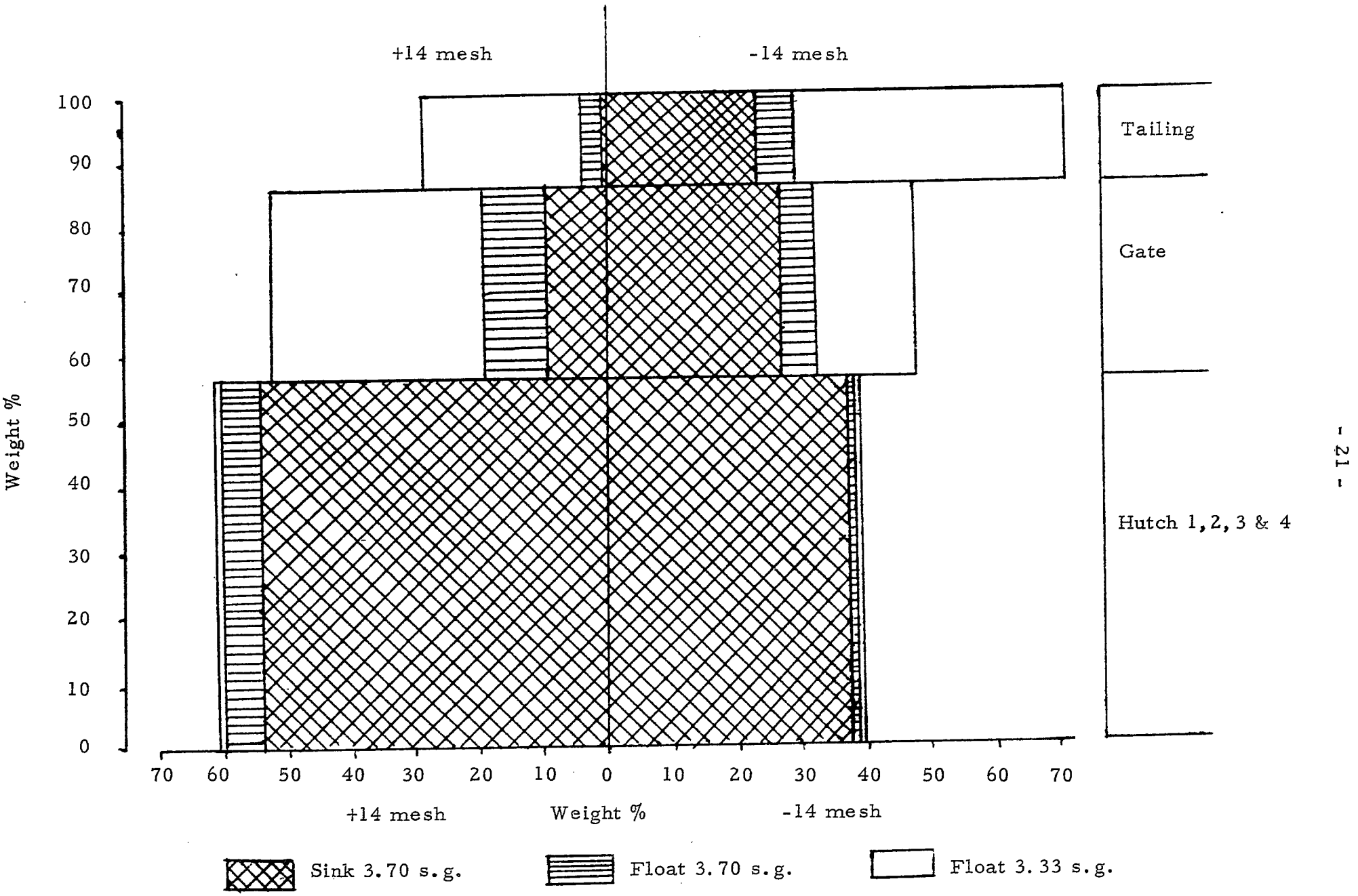
The results of the investigation showed that, by rejecting the waste fraction from conductance sorting of raw ore and treating the high-grade, fines and middling fractions in a Wemco-Remer pilot plant jig, concentrates averaging about 61% sol Fe with an overall recovery of about 63% sol Fe can be obtained. This compared favourably with jigging the raw ore which produced concentrates assaying 61.9% sol Fe with an overall recovery of 60.7%. The concentrate from the middling fraction was included as it increased recovery without lowering the grade of the combined concentrates. The greater part of the iron losses were in the minus 14 mesh fraction in both the gate and tailing products.

Recovery of iron, grade of concentrate and degree of rejection of phosphorus was about the same for each lot of ore.

GWR:cw

APPENDIX A

Block Distribution Diagram Lot 127A



APPENDIX B

Block Distribution Diagram Lot 127B