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Discussion - Continued

2. Primary Grinding Size Distribution

The size distributions of the different grinds used in the laboratory testwork on the various composites is shown in Table No. 14 for Composite 1A, Table No. 15 for Composite 1B, Table No. 16 for Composite No. 2, Table No. 17 for Composite No. 3 and Table No. 18 for Composite No. 4.

In general, most of the ore types had a ball mill Bond Work Index of below 10 (metric) at 74 µm size and the ore is considered a soft ore.

From the size distribution data and the grindability test data, it can be concluded that with the present grinding capacity of the plant, the Vangorda ore may give a grind of K₉₀ 52 µm. This is the minimum requirement for achieving high lead and zinc rougher recoveries.

TABLE NO. 14 : Grinding Size Distribution on Composite 1A

30 minute Grind			40 minute Grind			50 minute Grind			60 minute Grind			70 minute Grind		
Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum
+150M	1.3	1.5	98.5	-	-	-	-	-	-	-	-	-	-	-
200M	4.8	8.4	93.8	+200M	3.3	3.3	96.7	+200M	1.8	1.8	98.1	270	2.7	3.5
270M	12.0	19.4	81.8	270	7.2	10.5	89.9	270	4.1	6.0	92.0	400	9.4	19.0
27.8µm	28.0	48.4	59.6	27.8µm	28.0	34.2	62.8	27.8µm	28.0	34.8	65.2	28.1µm	11.4	24.4
21.8	11.2	57.6	42.4	21.8	12.6	48.9	51.1	21.8	12.8	47.8	52.4	21.8	11.4	35.8
15.1	11.3	68.9	31.1	15.1	13.8	62.4	37.8	15.1	13.7	61.3	38.7	18.2	18.9	51.7
10.4	8.0	77.8	23.6	10.4	9.9	72.5	27.8	10.4	10.3	71.8	28.4	10.4	12.8	64.5
8.0	4.8	82.0	18.0	8.0	4.7	78.9	23.1	8.0	5.8	77.4	22.8	8.1	7.4	71.9
-8.0	18.0	100.0	-	-8.0	23.1	100.0	-	-8.0	22.8	100.0	-	-8.1	28.1	100.0
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-

TABLE NO. 15 : Grinding Size Distribution on Composite 1B

30 minute Grind			40 minute Grind			50 minute Grind					
Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum			
+200M	8.3	8.3	93.7	+200M	3.4	3.4	96.6	+200M	1.5	1.5	98.5
270	10.1	18.4	83.6	270	7.5	10.9	89.1	270	5.8	7.3	92.7
400	17.1	33.5	66.5	400	12.7	23.8	76.4	400	11.3	18.6	81.4
+27.0µm	12.9	46.4	53.6	+27.0µm	15.1	38.7	61.3	+26.9µm	14.3	32.9	67.1
20.9	10.7	57.1	42.9	20.9	12.0	50.7	49.3	20.9	12.1	45.0	55.0
14.6	12.1	69.2	30.8	14.6	19.7	64.4	35.6	14.6	14.7	59.7	40.3
10.0	8.8	78.0	22.0	10.0	10.1	74.5	25.5	10.0	11.0	70.7	29.3
7.8	4.5	82.5	17.5	7.8	5.3	79.8	20.2	7.7	8.1	78.8	23.2
-7.8	17.5	100.0	-	-7.8	20.2	100.0	-	-7.7	23.2	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

Discussion - Continued

TABLE NO. 16 : Grinding Size Distribution on Composite No. 2

30 minute Grind				40 minute Grind				50 minute Grind			
Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum
+150M	1.0	1.0	99.0	+150M	0.5	0.5	99.5	-	-	-	-
200	4.0	5.0	96.0	200	1.8	2.3	97.7	+200M	1.5	1.5	98.5
270	10.2	15.2	84.8	270	5.9	6.2	91.6	270	3.5	5.0	95.0
27.2µm	27.3	42.5	57.2	27.1µm	28.1	34.3	65.7	27.1µm	24.3	29.3	70.7
21.1	12.0	54.5	45.5	21.1	13.0	47.3	52.7	21.1	19.2	42.5	57.5
14.7	12.6	67.1	32.9	14.7	14.3	61.6	38.4	14.7	15.3	57.8	42.2
10.1	9.2	76.3	23.7	10.1	10.7	72.3	27.7	10.1	11.7	69.5	30.5
7.8	4.8	81.1	18.9	7.8	5.5	77.8	22.2	7.8	6.1	75.6	24.4
-7.8	18.9	100.0	-	-7.8	22.2	100.0	-	-7.8	24.4	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 17 : Grinding Size Distribution on Composite 3

30 minute Grind				40 minute Grind				50 minute Grind				60 minute Grind				70 minute Grind			
Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum
+200M	3.7	3.7	96.3	-	-	-	-	+270M	4.3	4.3	95.7	+270M	2.4	2.4	97.6	+270M	0.7	0.7	99.3
270	7.8	11.5	88.5	+270M	8.7	8.7	93.3	400	8.9	13.1	88.9	400	6.3	5.7	91.3	400	9.0	6.7	91.3
27.7µm	28.8	40.4	69.6	27.8µm	24.7	31.4	68.6	27.8µm	11.9	24.7	75.3	27.8µm	10.9	18.0	80.4	27.8µm	20.1	29.5	71.2
21.6	12.3	52.7	47.3	21.8	13.3	44.7	55.3	21.6	12.3	37.0	63.0	21.6	12.3	31.9	88.1	21.6	16.3	48.1	84.9
15.8	13.8	66.5	33.5	15.1	15.7	60.4	39.6	15.1	16.9	53.9	46.1	15.1	17.7	49.2	60.4	16.1	17.9	66.9	57.1
10.3	9.5	76.1	23.9	10.4	11.3	71.7	28.3	10.4	12.6	68.7	39.3	10.4	14.0	63.8	36.4	10.4	11.5	74.4	25.8
8.0	4.9	81.0	19.0	8.0	4.1	77.8	22.2	8.0	7.0	73.7	28.3	8.0	7.8	71.5	26.5	8.0	5.7	80.1	19.1
-8.0	10.0	100.0	-	-8.0	22.2	100.0	-	-8.0	28.3	100.0	-	-8.0	28.8	100.0	-	-8.0	18.8	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 18 : Grinding Size Distribution on Composite No. 4

30 minute Grind				40 minute Grind				50 minute Grind			
Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum	Particle Size	% Retained Ind	Cum	% Pass Cum
+150M	1.5	1.5	98.5	-	-	-	-	-	-	-	-
200	7.6	9.1	90.9	+200M	4.4	4.4	95.6	+200M	2.4	2.4	97.6
270	12.6	21.9	78.1	270	10.7	15.1	84.9	270	6.4	8.8	91.2
400	15.3	37.2	62.8	400	17.7	32.8	67.2	400	16.3	25.1	74.9
34.8µm	4.0	41.2	58.8	34.8µm	3.9	36.7	63.3	34.8µm	4.4	29.5	70.5
27.0	8.4	49.6	50.4	28.8	3.3	45.0	55.0	27.0	9.3	38.8	61.2
18.8	13.9	63.4	36.6	18.7	15.3	60.3	39.7	18.8	18.9	55.7	44.3
12.9	11.1	74.5	25.5	12.9	11.9	72.2	27.8	12.9	13.4	69.1	30.9
10.0	5.9	80.4	19.6	9.9	6.0	78.2	21.8	10.0	6.8	75.9	24.1
-10.0	19.8	100.0	-	-9.9	21.8	100.0	-	-10.0	24.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

Discussion - Continued

3. Lead Regrind Size Distribution

A detailed evaluation of the lead regrinding requirements was conducted on Composite 3 ore. On the other composites, the optimum regrind developed on Composite 3 ore was used. The lead regrinding size distribution is shown in Tables 19 (Composite 1A), Table 20 (Composite 1B), Table 21 (Composite 2), Table 22 (Composite 3) and Table 23 (Composite 4).

TABLE NO. 19 : Pb Regrind Size Distribution on Composite 1A

Particle Size	No Regrind % Retained		% Pass Cum	Particle Size	20 minute Regrind % Retained		% Pass Cum
	Ind.	Cum			Ind.	Cum	
+270 mesh	2.3	2.3	97.7	-	-	-	-
27.8 µm	15.1	17.4	82.6	+29.0 µm	0.1	0.1	99.9
21.6	10.6	28.0	72.0	22.5	0.9	1.0	99.0
15.1	15.7	43.7	56.3	15.7	9.2	10.2	89.8
10.3	12.8	56.5	43.5	10.8	8.0	28.2	71.8
8.0	6.9	63.4	36.6	6.3	13.1	41.3	58.7
-8.0	36.6	100.0	-	-8.3	58.7	100.0	-
Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 20 : Pb Regrind Size Distribution on Composite 1B

Particle Size	No Regrind % Retained		% Pass Cum
	Ind.	Cum	
+270 mesh	1.2	1.2	98.8
26.8 µm	22.6	23.8	76.2
20.8	13.6	37.4	62.6
14.5	17.0	54.4	45.6
9.0	11.2	65.6	34.4
7.7	4.8	70.4	29.6
-7.7	29.6	100.0	-
Total	100.0	-	-

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Discussion - Continued

TABLE NO. 21 : Pb Re grind Size Distribution on Composite 2

Particle Size	No Re grind		% Pass Cum	Particle Size	30 minute Re grind		% Pass Cum
	% Retained Ind.	% Retained Cum			% Retained Ind.	% Retained Cum	
+270 mesh	3.1	3.1	96.9	-	-	-	-
26.8 μ m	16.6	19.7	80.3	33.9 μ m	0.5	0.5	99.5
20.8	9.1	28.8	71.2	26.3	1.4	1.9	98.1
14.5	15.4	44.2	55.8	18.4	10.2	12.1	87.9
9.0	11.4	55.6	44.4	12.6	19.1	31.2	68.8
7.7	5.4	61.0	39.0	9.8	12.6	43.8	56.2
-7.7	39.0	100.0	-	-9.8	56.2	100.0	-
Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 22 : Pb Re grind Size Distribution on Composite 3

Particle Size	No Re grind			Particle Size	5 minute Grind			Particle Size	10 minute Grind		
	% Retained Ind.	% Retained Cum	% Pass Cum		% Retained Ind.	% Retained Cum	% Pass Cum		% Retained Ind.	% Retained Cum	% Pass Cum
+24.6 μ m	28.2	28.2	71.8	24.6 μ m	15.4	15.4	84.6	24.6 μ m	6.7	6.7	93.3
19.0	14.5	42.7	57.3	19.0	13.9	29.3	70.7	19.0	10.3	17.0	83.0
13.3	16.2	58.9	41.1	13.3	18.7	48.0	52.0	13.3	9.7	26.7	73.3
9.1	11.6	70.5	29.5	9.1	14.9	62.9	37.1	9.1	2.1	28.8	71.2
7.1	9.9	76.4	23.6	7.1	8.0	70.9	29.1	7.1	6.1	34.9	65.1
-7.1	23.6	100.0	-	-7.1	29.1	100.0	-	-7.1	65.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

Particle Size	20 minute Re grind		% Pass Cum
	% Retained Ind.	% Retained Cum	
+24.8 μ m	5.5	5.5	94.5
19.0	8.3	13.8	86.2
13.3	17.6	31.4	68.6
9.1	18.0	49.4	50.6
7.1	10.2	59.6	40.4
-7.1	40.4	100.0	-
Total	100.0	-	-

Discussion - Continued

TABLE NO. 23 : Pb Re grind Size Distribution on Composite 4

Particle Size	No Re grind		% Pass Cum	Particle Size	20 minute Re grind		% Pass Cum
	% Retained Ind.	Cum			% Retained Ind.	Cum	
+270 mesh	3.9	3.9	96.1	-	-	-	-
34.6 μ m	11.2	15.1	84.9	35.1 μ m	-	-	100.0
26.8	8.1	23.2	76.8	27.2	0.6	0.6	99.4
18.7	14.3	37.5	62.5	19.0	7.1	7.7	92.3
12.9	13.1	50.6	49.4	13.1	16.4	24.1	75.9
9.9	7.7	58.3	41.7	10.1	12.8	36.9	63.1
-8.8	41.7	100.0	-	-10.1	63.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-

The best metallurgical results were obtained using a re grind of 20 minutes. In order to obtain a similar size distribution in the plant, 4 inch cyclones are required. These cyclones would operate at a lower pulp density (i.e. 25 % solids). Under these conditions, a similar re grind fineness to that obtained in the laboratory may be achieved with the present re grinding capacities.

4. Flotation Testwork**4.1. Flotation Testwork on Composite 1A**

Composite 1A consisted of oxidized ore and contained secondary copper minerals. A total of eight tests were performed on this composite, five of which were roughing tests and three cleaning tests. In general, problems were experienced with this composite in obtaining selectivity between lead and zinc minerals and with production of a high grade lead concentrate.

4.1.1. Lead and Zinc Rougher Tests

A series of five tests were conducted in which the primary grinding time varied from 30 minutes to 70 minutes per 2000 grams. The results of several tests are shown in Table No. 24.

The results obtained in these tests indicated the following:

1. Finer primary grinding improved lead and zinc rougher recovery slightly.
2. An average of 65 % of the total zinc reported in the lead rougher concentrate. Even with high cyanide additions, zinc rejection was not possible.