Inv. # 385

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Ottawa, Oct. 27, 1930.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES

Report No. 385

Sintering and Sponge Iron Tests on Pyrite Residues

T.W. Hardy.

Shipment: A shipment of 500 pounds of pyrite residues was received from the Sulphide Research Corporation, c/o Canada Power and Paper Corporation, St. Maurice Division, Cap de la Madelaine, P.Q.

Nature of Sample and Object of Tests: This material is the residue or by-product resulting from the Freeman Process for the utilization of Pyrites in Pulp and Acid manufacture. This process is fully described by Mr. Horace Freeman in a paper entitled "The Utilization of Pyrites in Pulp and Acid Manufacture" which was read at the Annual Meeting of the Canadian Institute of Mining and Metallurgy in March 1930. Briefly, the Freeman Process is designed to displace the use of imported elemental sulphur by native pyrite concentrates in the manufacture of pulp and acid and it involves the combustion of the sulphur content of these

finely divided concentrates, under controlled conditions, to sulphur dioxide, with the accompanying formation of oxide of iron as a by-product. It is the commercial utilization of this iron oxide residue that is the problem involved in the tests herein recorded.

Screen Analysis: As received the shipment consisted largely of very finely divided material, with a few clinkers as large as 1½" in diameter. Screening through a 10 mesh screen, gave the following results.

Through 10 mesh	467 pounds	or 93.4%
Ore 10 mesh	33 pounds	or 6.6%

These 33 pounds of oversize material were then crushed to pass a 10 mesh screen and then thoroughly mixed with the bulk of the shipment. A screen analysis of the shipment as a whole at this stage gave the following results,-

On 20 Mesh		1.35%
-20	+28	0.75
28	35	0.75
35	48	0.95
48	65	2.85
65	100	5.70
100	150	15.55
150	200	26.30
-200		45.80

Chemical Analysis of Shipment: The shipment was carefully sampled and a head sample obtained which on chemical analyses gave the following results,-

Iron (Fe)	63.00%
Sulphur(S)	0.65
Insoluble	6.92

Sintering Tests: With the object of agglomerating and lowering the sulphur content of this finely divided, high-sulphur material and thus making it suitable for blast furnace use, a number of sintering tests were made.

These tests were carried out in a down draft sintering pan of the laboratory type, the size of the pan grate being 12 x 18 inches.

The results of a number of typical sintering tests,

in which the proportions of fuel, moisture and other ingredients of the charge were varied, are shown in the accompanying table.

In each test, the general procedure adopted was as follows. The various ingredients making up the charge to be sintered were thoroughly mixed and distributed evenly over the grate through a quarter inch screen. The depth of the bed carried from 3 to 4½ inches from charge to charge. To facilitate ignition, a layer of charcoal was spread over the surface of the bed and the whole ignited by means of a movable gas burner, air being drawn down through the charge by a suction pump throughout the entire operation. The suction in the line connecting the pan with the pump was usually about 12 inches of water at the start of a run, and gradually diminished as the charge sintered and became porous. When the sintering action appeared completed, the charge was dumped and the fines separated from the sinter by means of a ten mesh screen. The analyses shown in the table are those of the sinter, the fines being discarded. These discarded fines always contained a large proportion of small particles of sinter.

The results of these tests indicate that a product suitable for blast furnace use can readily be obtained by sintering these pyrite residues. The sinter obtained while satisfactory is rather weak and brittle, due probably to the finely divided nature of the residues and their comparative freedom from gangue, and it seems probable that a stronger sinter could be obtained by mixing the residues with fine iron ore. The sulphur content of the residue can be reduced to 0.15% by sintering, making it acceptable to the blast furnace.

Sinter Tests

Mix No.	Charge - Pounds: Pyrite Residues	Coke Breeze	Soft Coal	Water	Returned Fine Sinter	Thickness of Bed	Time Mins.	Wt. Sinter Lbs.	Wt. Fines Lbs.	Analyses Sinter: Fe %	S %	Character of Sinter
P 8	40.0	2.4	2.4	4.5	Nil.	4.5"	40.0	20.0	19.0	64.86	0.25	Well Fused, Weak, Brittle.
P 9	34.0	2.0	2.0	4.4	6.0	4.5"	37.0	23.0	16.0	64.02	0.50	Well Fused, Stronger than P 8
P 10+	34.0	2.0	2.0	4.4	6.0	4.5"	40.0	22.0	16.0	60.65	0.14	Well Fused, Similar to P 9
P 11	30.0	2.1	0.9	3.9	6.0	3.5"	35.0	21.5	11.0	64.02	0.18	Well Fused, Stronger than P 10
P 12	30.0	2.1	0.9	4.9	6.0	3.5"	30.0	22.5	10.0	64.02	0.11	Well Fused, Fairly Strong
P 13	30.0	0.9	0.6	5.6	6.0	3.0"	30.0	26.5	6.0	63.82	0.14	Well Fused, Fairly Strong

+ Charge also contained 1.2 pounds sand and 1.2 pounds lime.

44.8

(23)

50. | 11.5
+0.0
150

62.0
50.5
11.5

Sponge Iron Tests: The high iron content of the sintered material and its rather fragile nature suggested that it might be more desirable for the manufacture of sponge iron than for use in the blast furnace. It was, therefore, decided to reduce the sintered residues to sponge iron in an electrically heated, batch type, rotary retort, using city gas as the reducing agent; and to determine the suitability of this sponge iron for the production of steel in electric oropen hearth furnaces.

The results of a test in which some of this sinter was metallized are summarized herein. Reduction was effected by passing a stream of city gas through the retort during the heating operation.

These tests, which should be confirmed on a larger scale, indicate that by sintering and metallizing these residues, using a process such as the Wiberg or the Norsk Staal for converting the sinter into sponge iron, a product is obtained suitable for conversion into steel in electric or open hearth furnaces. The iron content of the concentrated sponge iron should preferably be higher, and further tests are desirable to determine whether or not the above results can be improved upon.

Conclusions: These tests indicate that by sintering, this material may be made chemically and mechanically suitable for blast furnace use.

They also indicate that it may readily be converted into a comparatively low sulphur sponge iron suitable for direct conversion into steel. Further experimentation on the conversion of these residues into sponge iron is desirable.

Sponge Iron Tests.

City Gas Used as Reducing Agent.

Results of Metallization Test.

Materials - Lbs.	Analyses - %			Contents - Lbs.		
	Wt.	%	Total Iron	Met. Iron	Sulphur	Total Iron	Met. Iron	Sulphur
Sintered Pyrite Residue	41.5	83.9	66.96	Nil.	0.11	27.79	Nil.	0.046
Lime	8.0	16.1	-	-	-	-	-	-
Sponge Iron (Crude)	41.8	84.4	67.18	62.85	0.12	28.08	26.27	0.050

Metallization - 93.5%

Results of Magnetic Concentration Tests

Materials - Lbs.	Analyses - %			Contents - Lbs.		
	Wt.	%	Total Iron	Met. Iron	Sulphur	Total Iron	Met. Iron	Sulphur
Sponge Iron (Crude	38.6	100.0	67.18	62.85	0.12	25.98	24.26	.046
Magnetic Concentrate	32.2	84.4	80.24	76.20	0.06	25.84	24.54	.019
Tailing	6.4	15.6	5.93	0.75	0.50	0.38	.05	.032