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The Laboratory Concentration of Bell Iron Ore

by

T.W. Hardy and H.H. Bleakney

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The Laboratory Concentration of Bell Iron Ore.

-- T. W. Hardy and H. H. Bleakney --

Object of Investigation -

To determine the degree to which Bell Iron Ore may be beneficiated, with particular reference to its adaptability to the manufacture of sponge iron.

General Considerations -

It has become clear that, to be suitable for the manufacture of sponge iron for subsequent conversion into steel, an ore must be of such a mineralogical nature that the iron mineral may be separated from the gangue minerals by grinding to a reasonable size and separated from it by concentration; in other words the ore must respond to a high degree to beneficiation methods either before or after the low temperature reduction process, and its value as a raw material for the manufacture of sponge iron depends to a large extent upon the degree to which it responds to concentration.

Bell ore is not a Canadian ore, but is mined in the Mesaba Range of the Lake Superior District. It is, however, one of the ores used by the Algoma Steel Corporation, and for

this reason, and for the reason that it was the ore chosen for the demonstration of the Musso Process for the semi-direct production of steel from Iron Ore in our laboratory, it seemed desirable to determine under more or less ideal laboratory conditions just how completely the iron mineral might be separated from the gangue, thus making it possible for us to pre-determine the grade of sponge iron we might hope to approximate in practice.

Experimental Method -

For this work, it was most convenient to use the method we have described in detail in our report on "The Laboratory Concentration of Wabana Iron Ore." This method, in brief, involves first the conversion of the hematite into an artificial magnetite by a reducing roast, followed by crushing this magnetite to various degrees of fineness and the wet magnetic concentration of these different sized samples in the Davis Magnetic tube.

For these tests, a representative sample of the Bell Ore, crushed to pass a 20 mesh Tyler screen, was roasted to the magnetic state in an electrically heated rotating retort, the retort being held at a temperature of 1000° F (538° C), while a circulation of city gas through the retort was maintained during the heating and cooling of the ore. No attempt was made to study the details of the reducing roast; our sole object being to obtain the ore in the form of magnetite so that we might by means of magnetic separation study the effect of fineness of grinding on the concentration of the ore.

The artificial magnetite was then carefully sampled to provide a head sample, and then small quantities were ground to pass 20, 80, 100, 150 and 200 mesh Tyler screens. Each of

these five samples was then concentrated in the Davis Magnetic tube. In each case the magnetic concentrate and the non-magnetic tailing were weighed and assayed

Results Obtained -

	Size of Ore Fed to Magnetic Tube (Mesh)				
	-20	-80	-100	-150	-200
Tube Feed -					
Iron percent.	57.90	57.90	57.90	57.90	57.90
Insoluble "	14.30	14.30	14.30	14.30	14.30
Phosphorus "	0.10	0.10	0.10	0.10	0.10
Tube Concentrate -					
Weight percent.	88.0	87.6	86.9	86.4	86.2
Iron "	64.04	64.86	65.25	65.69	65.98
Insoluble "	6.50	5.70	5.20	4.80	4.40
Phosphorus "	0.079	0.076	0.076	0.075	0.075
Tube Tailing -					
Iron percent.	11.82	8.53	8.50	9.05	7.81
Insoluble "	71.50	74.94	75.50	74.30	77.00
Phosphorus "	0.25	.25	0.26	0.26	0.25
Ratio of Concentration -	1.14:1	1.14:1	1.15:1	1.16:1	1.16:1
Insoluble Rejected %	60.0	65.1	68.4	71.0	73.5
Phosphorus Rejected%	30.5	33.4	34.0	35.2	35.4
Calculated Iron Content of Sponge Iron Theoretically producible from this Concentrate. /	85.2%	86.7	87.4	88.2	88.7%

/ Iron assumed to be completely metallized.

Conclusions -

The results tabulated show that this ore responds to concentration to a considerable degree; 60 percent of the insoluble being rejected in the -20 mesh material and 77% in the -200 mesh.

The degree of beneficiation obtained with the minus 20 mesh material makes it theoretically possible to produce a sponge iron containing 85 percent iron while the corresponding figure for the minus 200 mesh material is 88.7%. Since reduction in practice would not be 100%, as assumed for these calculated values, and since the results of magnetic concentration in commercial practice would probably not be as good as those obtained in these laboratory experiments, it is probable that in commercial practice, Bell Ore would not produce a concentrated sponge iron containing more than 80 to 85% iron.