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LABORATORY EVALUATION OF BEARPAW FORMATION BENTONITE AS A BINDER FOR IRON ORE PELLETIZING

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Metals Reduction and Energy Centre

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SUMMARY

Preliminary laboratory evaluation of Bearpaw Formation bentonite indicates that this bentonite (when used in commercial quantities) may be a suitable substitute for Wyoming bentonite in iron ore pelletizing, but commercial plant trials would be required before conclusions could be finalized.

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BACKGROUND

In June, 1970 a sample of Bearpaw Formation bentonite was received from Mr. J.G. Brady of the Industrial Minerals Sub-Division of the Mines Branch. It was requested that it be evaluated for its suitability in iron ore pelletizing. The sample of bentonite had been shipped to the Industrial Minerals Sub-Division by Mr. C.A.L. Hogg, Consulting Geologist, Regina, Sask. It was obtained from the Bearpaw Formation, located about forty miles south of Regina. The Pyrometallurgy Section of the Metals Reduction and Energy Centre agreed to make a preliminary evaluation of this sample of bentonite.

EXPERIMENTAL WORK

Raw Material

The Bearpaw bentonite, as received, had a surface area of 23.6 m^2/g (see letter of J.G. Brady, June 17, 1970) and was ground to 25% minus 325 mesh (dry screening). This bentonite was later reground to 51% minus 325 mesh (dry screening) or 98.8% minus 325 mesh (wet screening). The commercial Wyoming bentonite, used for comparative tests, was 61% minus 325 mesh (dry screening) or 98.5% minus 500 mesh (wet screening). Commercial bentonites have surface area values up to 749 m^2/g (see Mines Branch Monograph 873 - by J.C. Ross).

The iron ore used for these tests was a commercial magnetite concentrate, 71% passing 325 mesh, containing 5% moisture, and assaying 69% total iron and 1.3% silica.

Procedure

The evaluation of the Bearpaw bentonite as a binder in iron ore pelletizing was to be achieved by comparing its effect with the effect of Wyoming bentonite on the following ball and pellet properties:

1. Green-ball drop number
2. Green-ball compression strength
3. Dry-ball compression strength
4. Fired-ball compression strength.

The drop number of the green-balls was determined by dropping 10 balls individually from a height of 18 inches onto a steel plate and then determining the average number of drops required to break the ball. The compression strength of green-balls was determined by testing 10 balls, individually, on an Allis-Chalmer's Pelletester machine. The average strength for the 10 balls was determined and then recalculated on the basis of ½-inch balls, using the hypothesis that the strength varies directly as the square of the ball diameter. The dry and fired compression strengths were both determined on a

Dietert sand-core testing machine. In each case the average strength for 10 balls or pellets was reported on the basis of ½-inch diameter.

The following general procedure was used to produce balls and pellets for testing.

1. Iron ore concentrate was mixed with the desired quantity of binder in a Hobart mixer for ½ hour.
2. Seed pellets (3 ½ to 4-mesh size) were made from this mixture in a balling tire. The balling tire consists of an 8 x 20-inch aeroplane tire, affixed to a variable-speed drive, which was rotated at 51 rpm for these tests.
3. In each test the mixture was fed for 4 ½ minutes (by hand) onto 100 g of seed pellets, contained in the balling tire. Sufficient moisture was sprayed into the tire to form balls of the desired final moisture and ball size. The formed balls were allowed to roll for one minute, then removed from the tire and screened to retain the 1/2 to 3/8-inch size.
4. Samples of the freshly formed balls were taken for (a) moisture determination (b) green drop strength (c) green compression strength (d) fired compression strength.
5. Fired compression strengths were determined on balls that had been dried overnight and then fired at 1300°C for 1 hour in a laboratory muffle furnace.

RESULTS AND DISCUSSION

The results of these experiments are outlined in Table 1. Each test reported in this table represents the average of three tests done under similar conditions. It should be noted in this table that the bentonite additions appear to be more effective in the dry-ball and fired-ball stages than in the green-ball stage. That is, without the bentonite addition, the dry-balls are always weaker and the fired-balls (pellets) are usually weaker, whereas the green-ball compression strength does not appear to be significantly increased by bentonite additions of less than 2% (40 lb per ton of concentrate).

The Bearpaw bentonite, when used in commercial quantities (1/2 to 3/4 per cent) and ground to 51% minus 325 - mesh size (dry screening), gives dry-ball and fired-ball compression strengths which compare favourably to those obtained with the use of the Wyoming bentonite binder (compare tests 2, 4 and 5, 7). The coarser Bearpaw bentonite gives weaker dry-ball compression strengths, but appears to give fired-ball compression strengths that are equivalent to or slightly better than those obtained with the Wyoming bentonite binder.

TABLE 1

Comparative Pelletizing Tests With Wyoming and Bearpaw Bentonites

Test No.	Bentonite Binder		Green-ball			Dry-ball Compression Strength (lb)		Fired-ball Compression Strength (lb)
	Material	*Amount Used (lb/ton) of Conc)	Moisture Content (%)	Drop No.	Compression Strength (lb)	Oven	Air	
1	None	-	8.1	4.5	1.3	0.5	0.5	411
2	Wyoming	10	8.9	6.4	1.4	5.5	5.4	473
3	Bearpaw (coarse)**	10	8.2	4.1	1.4	4.9	4.9	339
4	Bearpaw (fine)***	10	8.6	4.6	1.1	5.6	5.6	597
5	Wyoming	15	8.8	6.8	1.9	7.4	7.0	501
6	Bearpaw (coarse)**	15	8.6	5.4	1.2	6.4	6.3	732
7	Bearpaw (fine)***	15	8.7	6.3	1.1	7.5	7.5	691
8	Wyoming	20	10.0	15.5	1.5	11.8	9.9	838
9	Bearpaw (coarse)**	20	8.7	5.8	1.2	7.7	7.0	940
10	Bearpaw (fine)***	20	8.9	6.6	1.5	8.2	4.7	533
11	Bearpaw (coarse)**	40	9.8	10.2	1.8	21.1	20.1	816
12	Bearpaw (fine)***	40	9.2	22.5	3.4	19.1	9.5	998

*lb of binder per 2000 lb of Concentrate (5% moisture)

**Bearpaw bentonite, as received

***Bearpaw bentonite, ground to finer size

These experiments indicate that this particular sample of Bearpaw Formation bentonite will give results equivalent to those obtained with commercial Wyoming bentonite, when used as a binder in iron ore pelletizing. There are even indications that, if the sample of Bearpaw bentonite were ground to a finer size, the binding properties might be superior to those of Wyoming bentonite. However, these results are only preliminary laboratory evaluations with a particular iron ore concentrate and commercial plant trials would be required before conclusions could be finalized.

CONCLUSION

These experiments indicate that Bearpaw Formation bentonite may be a suitable substitute for Wyoming bentonite in iron ore pelletizing.