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TEST OF ALBERTA LIGNITE AS SEA COAL SUBSTITUTE

by

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PHYSICAL METALLURGY DIVISION

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SUMMARY OF RESULTS

A sample of Alberta lignite was tested to determine its suitability for use as a substitute for sea coal. It was found to give better protection against expansion defects such as scabbing and rat tails, but gave inferior peel, and would cause more trouble from casting shrinkage. Sand reconditioned with lignite did not require bentonite additions to maintain the bond, indicating that the lignite has some bonding properties.

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INTRODUCTION

In a letter dated January 2, 1964, Mr. David Pritchard, Magcobar Mining Company Ltd., 510 - Fifth Street S. W., Calgary, Alberta, requested tests of a sample of Alberta lignite to determine if it would be suitable for use as a substitute for foundry sea coal.

METHOD OF TESTING

Scabbing Tendency

The Alberta lignite, and a sample of Ohio sea coal were added to sand (Ottawa AFS 62) mixtures bonded with western bentonite. The test batches of sand were each used for ten heats. They were mulled one minute dry and six minutes wet before each use. The initial batch of sand was mulled with western bentonite in a weight ratio of 5 parts to 100 parts of sand. Subsequent bentonite additions were made to produce and maintain a green compressive strength of about 9 psi.

The sea coal and lignite samples were added to the new sand on a weight basis of 6 parts to 100 parts of sand. Subsequent additions were made to maintain the same gas evolution at 1095°C (2005°F) as the new sand had.

A test casting developed by the Steel Founders' Society of America was used to evaluate the effectiveness of the additives in preventing the casting defect known as "scabbing". Four castings from each heat were poured. Extra sand was used on the first heat, to ensure that after ten heats there would still be enough sand to make the required four moulds. This extra sand was mixed in after each heat to keep the sand uniform.

The moulds were prepared to produce, as closely as possible, a mould hardness of 80. They were rammed with a combination of hand ramming and jolt squeezing.

The castings were poured at 1400°C (2550°F) in grey iron with an approximate composition of

Carbon	3.50 %
Silicon	2.45 %
Manganese	0.80 %.

Mould Wall Movement

A troublesome problem, which occurs in pouring hypoeutectic iron, is mould wall movement, whereby the sand will move to enlarge the mould cavity. This causes the castings to contain shrink holes, because there is not enough metal left to fill the mould. Sea coal is helpful in preventing mould wall movement. A bar 2 in. in diameter by 7 in. long was used to test this property. The bar was fed by a riser to supply the metal required by the enlargement of the mould cavity. The mould was rammed to a hardness of 88-90.

The castings were poured at 1400°C (2550°F) in grey iron with the following analysis:

Carbon	3.20 %
Silicon	1.74 %
Manganese	0.52%

The relative mould wall movement was estimated by weighing the castings.

TEST RESULTS

Screen Distribution

U. S. Screen No.	Per Cent Retained	
	Alberta Lignite	Ohio Sea Coal
16	0.1	4.2
20	0.3	4.3
30	0.9	11.9
40	4.6	12.2
50	9.4	12.6
70	12.1	12.2
100	13.3	10.7
140	11.3	6.9
200	11.6	5.4
270	8.7	4.2
Pan	27.5	15.5

The Ohio sea coal was the finest grade that could be obtained from the supplier but, as shown above, it was about twice as coarse as the Alberta lignite. Fine grind is usually considered an advantage with sea coal.

Sand Properties

The moulding properties of the sands, together with the amounts of bentonite and coal used, are shown in Tables 1 and 2. The most surprising feature of these results is that the reconditioned sand using Alberta lignite did not require bentonite additions. It appears that the lignite has an active bond.

Scabbing Tendency

Representative scab block castings from the two test series are shown in Figures 1 to 4 inclusive. It will be seen that the lignite is somewhat more effective than the sea coal in preventing scabs.

Mould Wall Movement

Two bars were cast in each test batch of sand. The weights in grams were as follows:

No Addition	3005, 2988
Sea Coal	2863, 2853
Lignite	2962, 2977

These results indicate that sea coal is much more effective than Alberta lignite in preventing mould wall movement.

Casting Peel

One purpose of making sea coal additions is to promote casting peel. This sample was very helpful in this respect; small castings in sand conditioned with sea coal would not require blasting or tumbling. However, there was sand adherence when the lignite was used, and the castings would have to be cleaned.

Moulding and Shakeout

There was no significant difference in the moulding properties or in the shakeout.

DISCUSSION

A comparison of sea coal and the lignite sample is as follows:

1. The sand conditioned with lignite appeared to be less susceptible to expansion defects such as scabs and rat tails.
2. Lignite is less helpful in preventing mould wall movement (expansion of the mould cavity) than sea coal.
3. Sand peel with sea coal is much better. This would sometimes enable castings to be finished without blasting or tumbling. Lignite is not helpful in promoting peel..
4. Surface finish is about the same.
5. The lignite seemed to have some bonding properties. The sand reconditioned with lignite did not require bentonite additions to maintain the green strength.
6. The moulding and shakeout properties were about the same.

CONCLUSION

The sample of Alberta lignite can be used as a substitute for sea coal. It has certain advantages and disadvantages, as described above.

AEM/KW

TABLE 1

Properties of Sand Conditioned with Sea Coal

Heat No.	Moisture, Per Cent	Permeability	Green Compressive Strength, psi	Green Deformation, Per Cent	Green Shear Strength, psi	Dry Compressive Strength, psi	Addition, Pounds (900 pound batch) Bentonite	Sea Coal
1	2.8	119	6.6	2.61	1.8	91	45	54
2	3.2	105	7.3	2.66	2.0	131	5	2.5
3	3.2	111	9.1	2.69	2.0	106	5	-
4	3.3	105	9.0	2.74	2.2	110	-	3.75
5	3.5	105	9.1	2.79	2.5	110	5	3.75
6	3.5	115	9.1	2.57	2.5	101	-	3.75
7	3.5	117	10.3	2.71	2.4	89	5	3.75
8	3.6	102	8.8	2.82	2.5	81	-	5
9	3.3	114	10.0	2.77	2.8	70	5	5
10	3.6	102	9.9	2.75	2.4	80	2.5	5
						Total	72.5	86.5

TABLE 2

Properties of Sand Conditioned with Alberta Lignite

Heat No.	Moisture, Per Cent	Permeability	Green Compressive Strength, psi	Green Deformation, Per Cent	Green Shear Strength, psi	Dry Compressive Strength, psi	Additions, pounds (900 pound batch)	
							Bentonite	Lignite
1	3.6	126	11.8	2.44	2.8	32	45	54
2	4.0	138	12.1	2.49	3.4	41	5	2.5
3	4.2	138	11.9	2.41	2.9	53	-	2.5
4	4.2	138	10.3	2.69	2.8	70	-	2.5
5	4.3	138	10.6	2.80	2.8	61	-	2.5
6	4.3	138	10.8	2.58	2.8	56	-	5
7	4.4	154	12.0	2.56	3.0	50	-	2.5
8	4.5	138	9.5	2.65	2.6	60	-	2.5
9	4.0	163	10.1	2.39	2.6	38	-	2.5
10	4.1	163	9.4	2.75	2.4	48	-	2.5
						Total	50	79

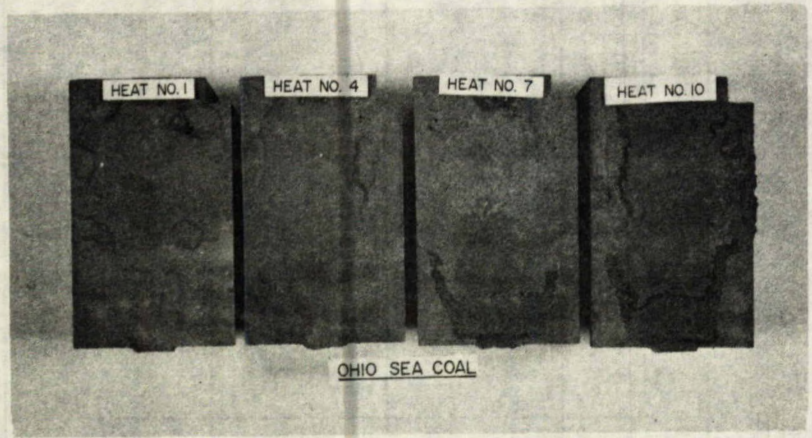

Figure 1 - Ohio Sea Coal - Cope

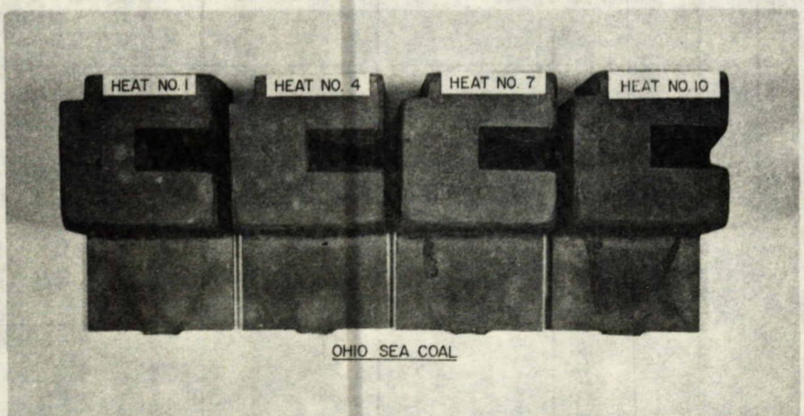

Figure 2 - Ohio Sea Coal - Drag

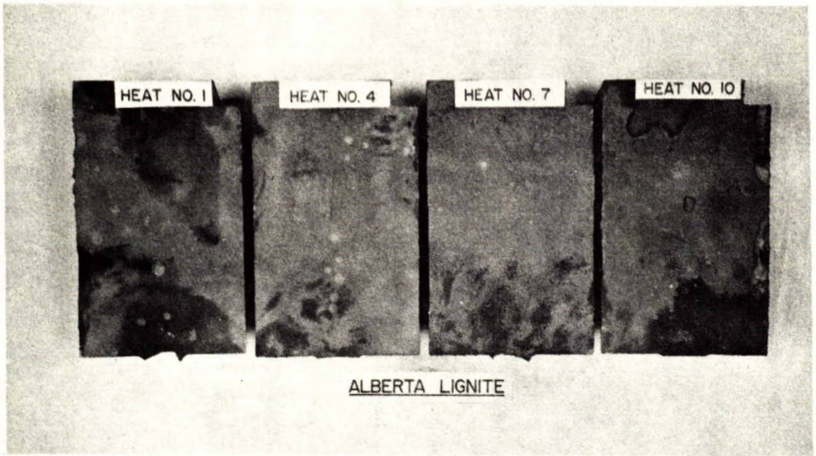

Figure 3 - Alberta Lignite - Cope

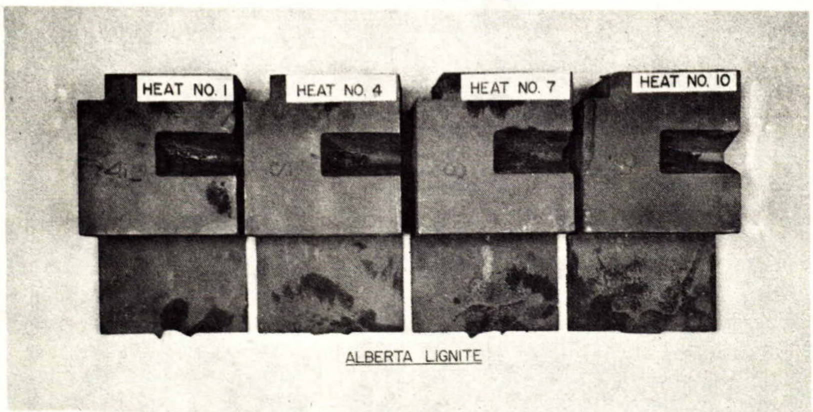

Figure 4 - Alberta Lignite - Drag