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O T T A W A April 13, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2029.

A Comparison of the Properties of Two Moulding Sands.

(Copy No. 5.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

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Origin of Request and Object of Investigation:

On March 2, 1946, a verbal request was received from Mr. Don Caplan, chemist, the Hull Iron and Steel Foundries Limited, Hull, Quebec, for a comparison of the properties of two moulding sands, to determine which was better suited for steel foundry use. Approximately 50 pounds of each sand was supplied.

Description of Material:

The two samples were described as follows:

(1) #50 Sand = Car CN-501520.

(2) #60 Sand = Car BAR-65363.

These samples will be identified in this report as No. 1 and No. 2 respectively.

Microscopic Examination:

Samples of the sand were examined under the microscope. Photomicrographs of the two sands are shown in Figures 1 and 2.

Screen Test:

A screen test was made of the two samples. A sample of Sand No. 1 was also screened selectively to give approximately the same screen analysis as found in Sample No. 2. The screen analyses of the three samples are given in Table I. (The screen analysis supplied by the shippers of Sample No. 1 is also given, for comparison.)

TABLE I. - Screen Analyses

U.S. Screen No.	CAR NO. CN-501520 Shipper's Analysis	CAR NO. CN-501520 P.M.R.L. Analysis	CAR NO. CN-501520 Selectively Screened	CAR NO. BAR-65563
	- P e r C e n t -			
20	-	0.1	0.0	0.0
30	0.6	0.3	0.4	0.4
40	24.6	17.7	3.8	3.2
50	41.0	34.0	16.5	17.0
70	18.7	22.7	39.2	40.9
100	10.7	16.2	32.5	33.0
140	3.9	6.2	6.4	4 6
200	0.4	1.5	0.8	0.4
270	-	0.3	0.2	0.05
Pan	0.1	0.3	0.2	0.05
A.F.A. Clay	-	0.3	0.0	0.0
A.F.A. Fineness No.	45.5	51.5	58.7	56.8

Mechanical Tests:

Mechanical tests made on the sand included core oil requirements, permeability of the moulding sand, weight of A.F.A. test specimens of core and moulding sand, and hot strength determinations. The mixtures used were as follows:

(1) Mixture to Test Core Oil Requirements:

2,000 grams sand.
20 grams cereal.
20 grams "5X" core oil.

2.7 per cent moisture.

Baked at 400° F. for 2 hours.

(Mechanical Tests, cont'd) -

(2) Mixture to Test Hot Strength:

2,000 grams sand.
20 grams cereal.
20 grams "No-Vein".
20 grams "5X" core oil.

2.7 per cent moisture.

Baked at 400° F. for 2 hours.

(3) Moulding Sand Mixture:

2,000 grams sand.
80 grams western bentonite.

2.3 per cent moisture.

Mulled 2 minutes dry and 4 minutes wet in 18-in. laboratory mixer.

The results of those tests are shown in Table II.

TABLE II. - Mechanical Properties.

	CN-501520		BAR-65367
	As Rec'd	After Screening	
Core Sand			
Permeability -	185	138	138
Wt. of A.F.A. specimen, grams -	170	164	161
Tensile strength, p.s.i. -	191	169	205
Hot Strength of mixture No. 2, p.s.i. -	85		70
Moulding Sand			
Green bond, p.s.i. -	4.0		4.0
Permeability -	275		205
Flowability -	82.5		83.5
Wt. of A.F.A. specimen, grams -	162		150

(Continued on next page)

(Mechanical Tests, cont'd) -

Mulling Time -

The sands were mixed with western bentonite and mulled in a laboratory mixer for various lengths of time. The mulling curves obtained are shown in Figure 3.

Discussion:

Comparison of the two sands shows the following:

(1) Sand No. 1 (CAR No. CN-501520) requires slightly more core oil than Sand No. 2. If both sands have the same screen distribution this difference is greater and Sand No. 2 has only about 80 per cent of the tensile strength of Sand No. 1 with the same amount of core oil.

(2) Sand No. 1 rams more densely than Sand No. 2, although the permeability is greater. The greater density of the rammed sand should increase its resistance to metal penetration. Most of this difference in ramming ability is due to the different grain distribution, as the two sands showed almost the same ramming properties when screened to the same grain size.

To obtain a fine finish with good permeability, a sand with a narrow grain distribution is often specified. Some authorities believe that the use of sands of this type will promote metal penetration by increasing the volume of voids in the sand. (See "A Study of 'Burnt-on' or Adhering Sand," by J. B. Caine, in Trans. A.F.A. Vol. 51, No. 3, March 1944; discussion, p. 699.) If sands with narrow grain distributions do cause metal penetration, surface finish will be sacrificed instead of improved by their use.

(3) The two sands had almost the same mulling curve (see Figure 3). The mulling curve for Sand No. 2 is slightly steeper than that for Sand No. 1, which has more of

(Mechanical Tests, cont'd) -

a tendency to pile up ahead of the muller blades and does not turn over as rapidly. Sand No. 1 is evidently somewhat less flowable in the tempered state than No. 2; this might also cause difficulty in sand mixed for the core blowers.

(4) The hot strengths of the sands are similar (2500° F., 12-minute soak). Specimens of both sand resisted spalling under the shock test, and either one is refractory enough for steel sand work. Both sands showed a tendency to crack slightly under this test when coated with a mould wash. The use of 2 per cent No-Vein did not improve this condition noticeably, but when 1½ per cent wood flour (Akro) was used no further cracking was noted.

Conclusion:

1. Sand No. 1 (from Car No. CN-501520) requires about 10 per cent more core oil than Sand No. 2.

2. Sand No. 1 has a wider grain distribution, which might give it better resistance to metal penetration than Sand No. 2.

3. Sand No. 1 shows a slightly greater tendency to pile up ahead of the muller blades. This indicates a lack of flowability in the tempered state which might cause trouble in core blowing.

4. Both are sufficiently refractory for steel foundry use. They have similar properties at elevated temperatures.

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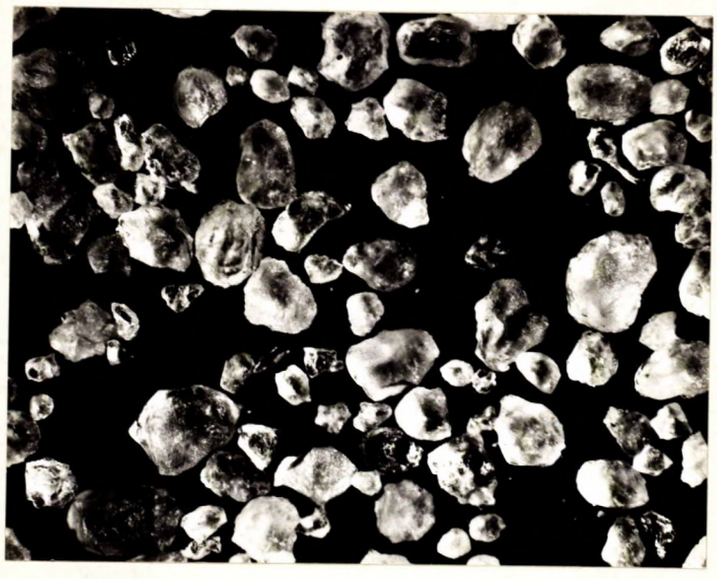
(Figures 1 to 3 follow,
on Pages 6 and 7.)

Figure 1.



X20.

SAND FROM CAR NO. CN-501520.

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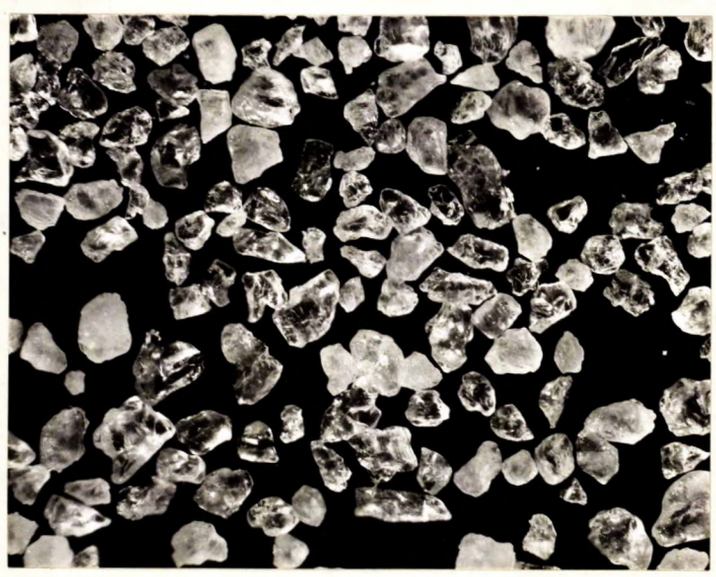
Figure 2.



X20.

SAND FROM CAR NO. BAR-65363.

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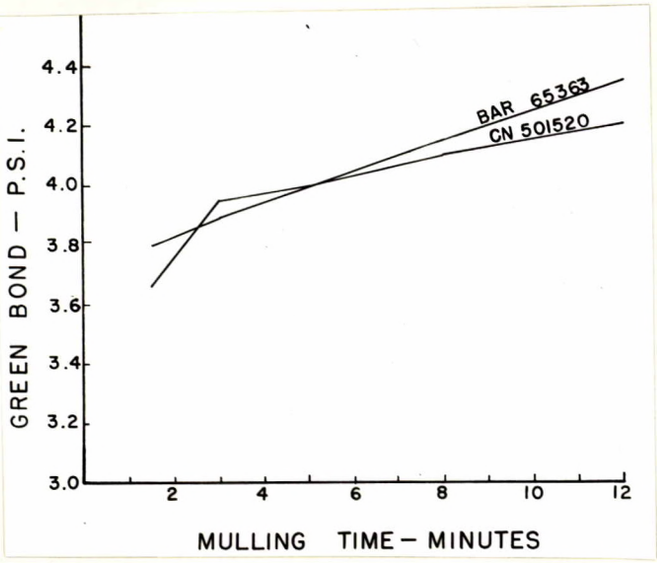
Figure 3.



MULLING CURVES FOR THE TWO SANDS.

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