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DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

Ottawa, November 23, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2141.

Foundry Potentialities of a Sample of Sand from Windsor, Ontario.

(Copy No. 6.)

Bureau of Mines
Division of Metallic Minerals

Physical Metallurgy
Research Laboratories

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Introduction:

On November 14, 1946, a sample of sand was received from the National Research Council, Ottawa, to be tested for its suitability for foundry work. The sand sample had been submitted to the National Research Council by Foster & Robarts, real estate and insurance agents, Bartlett Building, 76 London St. W., Windsor, Ontario. An accompanying letter from Foster & Robarts requested that the sand be tested to determine whether it would be suitable for moulding sand, or for the manufacture of lime brick.

The sand sample was fairly free of organic matter, but contained a considerable amount of clay.

Use in Sand-Lime Brick:

Dr. A. T. Prince, engineer of the Ceramic Section of this Division, examined the sand to determine if it would be suitable for making sand-lime brick and reported that it was too fine for this purpose.

Method of Testing as Moulding Sand:

Methods and equipment recommended by the American Foundrymen's Association (Foundry Sand Testing Handbook, 1944 edition, A.F.A.) were used in testing the sand to determine its suitability for use as a moulding sand.

Microscopic Examination:

The sand was examined under the microscope. A photomicrograph appears in Figure 1.

Figure 1.

X30.

SAND FROM WINDSOR, ONTARIO, DISTRICT.

Grains round to subangular, rough.

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Screen Test:

The sand was found to have the following screen analysis:

TABLE I.

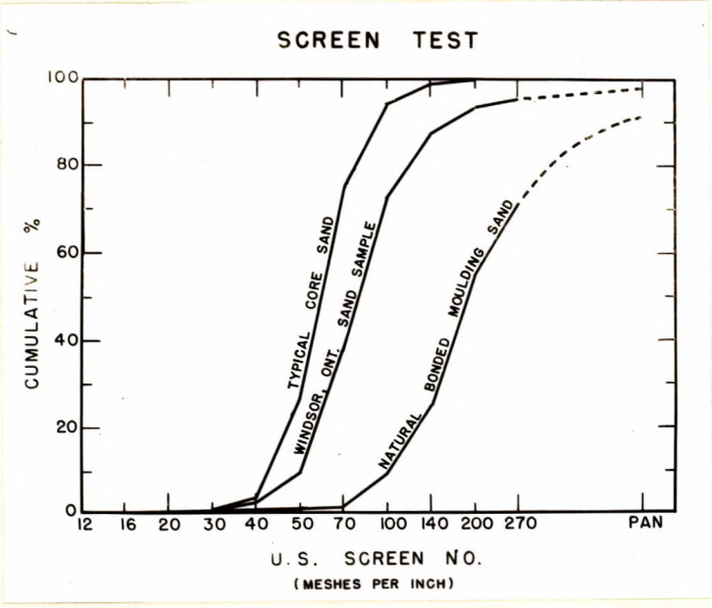
U.S. Screen No.		Per Cent Retained
20	-	0.1
30	-	0.5
40	-	1.6
50	-	7.4
70	-	28.1
100	-	34.7
140	-	15.2
200	-	5.9
270	-	1.7
Pan	-	1.8
"A.F.A. Clay"	-	3.0
A.F.A. Fineness No.	-	76.6

The screen distribution of this sand is shown, in the form of a per cent cumulative curve, in Figure 2. Curves for two representative types of sand used in foundry work also appear in Figure 2, for purposes of comparison. In making a per cent cumulative curve, the per cent retained on each screen is added to the sum of the percentages retained on all the coarser screens, and this sum is plotted as the cumulative per cent on that screen. Thus, if the figure plotted on the No. 70 screen is 37.7 per cent for the Windsor sand, it means that 37.7 per cent by weight of this sand is coarser than 70 mesh.

(Figure 2 follows, on Page 4.)

(Screen Test, cont'd) -

Figure 2.



PER CENT CUMULATIVE CURVE FOR THREE SAND SAMPLES.

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Test Sand Mixtures:

The sand was used in making up test core mixtures, similar to those used in foundry practice. One mixture was made up using the sand as received, and one with the sand after removing the fines by washing. The following test mixtures were used:

2,000 grams sand.
20 grams corn flour.
20 grams core oil.

3.5 per cent moisture.

Baked at 400° F. for 2 hours.

Included in the following test results are those from a mixture made with a commercial core sand:

(Table II follows,
on Page 5.)

(Test Sand Mixtures, cont'd) -

TABLE II.

	Windsor Sand, As Received	Windsor Sand, Washed	Commercial Core Sand
Permeability -	75	88	138
Green Compression, p.s.i. -	1.7	0.2	0.6
Baked Tensile Strength, p.s.i. -	48	89	225
Sintering point -	2100° F.	2300° F.	2500° F.

DISCUSSION:

Most of the sand used in Canadian foundries is imported from the United States. As much of the cost of moulding sand is charged to the freight, foundries which can find a suitable local supply are very fortunate.

Three general types of moulding sands are used by the foundry industry:

(1) Natural bonded moulding sand is used by most of the medium- and small-sized iron and non-ferrous foundries. This type of sand is fairly fine (averaging between 100 and 170 mesh), and contains from 8 to 15 per cent clay material. This sand can be mixed with water manually or by mechanical mixers, and is used in making moulds to be poured in iron or non-ferrous metals.

(2) Synthetic moulding sand is used by most steel foundries, which require a refractory sand with a high permeability. Many large iron foundries which possess good sand conditioning and control equipment also use synthetic moulding sand. This consists of a clean, refractory silica sand to which a clay binder is added in mechanical mixers.

(3) Sand cores are used by foundries to form

(Discussion, cont'd) -

internal cavities in castings, or to make it possible to draw some portion of the pattern from the sand when the shape does not naturally permit this. Drying oils, which develop their strength on baking, are usually used as the binder in sand cores. A sand which will form a base for synthetic sand will usually prove to be a satisfactory core sand. Core sands for iron and non-ferrous foundries do not need to be so refractory as those which are to be used in steel founding.

A study of Figure 2 will show that the Windsor sand sample more closely resembles a core sand in screen size than it does a natural bonded moulding sand. The grain size of the sand grains is larger than is normal for natural sands, and there is not enough clay material to bind them together. The sand differs from the average core sand, however, in that the clay content is higher, and the sand grains are somewhat finer. The Windsor sand may be made to more closely resemble the normal core sand in grain size and distribution by washing out the fines with water.

Sands vary quite widely in the amount of core oil they require to give them a suitable bond for foundry work. The amount of core oil required to produce a given tensile strength is a function of grain size, grain shape, the surface condition of the grains, screen distribution, and the amount of fines contained in the sand. As core oil is an expensive item, and excess amounts will produce defective castings, the core oil requirement of a sand is an important measure of merit. By referring to Table II, it will be seen that the Windsor sand, even when it is washed, develops an abnormally low tensile strength with the baked test mixture.

(Continued on next page)

(Discussion, cont'd) -

This indicates that this sand requires an excessive amount of core oil to make cores with sufficient baked strength for foundry use. This high consumption of core oil is attributed to the rough condition of the grain surfaces (Figure 1). These rough grains will absorb more oil than will smooth ones, and will also provide a lower surface contact area between grains.

The low refractoriness of both the washed and the unwashed sand would make it unsuitable as a base for a synthetic moulding sand.

CONCLUSIONS:

The sand is unsuitable for foundry work because:

(a) It is too coarse, and does not contain sufficient clay, to be used as a natural moulding sand.

(b) It is not refractory enough to be used as a base for synthetic moulding sand.

(c) The core oil requirements are too high to make it suitable for use as a core sand.

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