File

DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

Ottawa, June 4, 1946.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2059.

Investigation of Sands from
Melanson's Foundry, Montreal, Quebec.

========

(Copy No. 6.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

O T T A W A June 4, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2059.

Investigation of Sands from
Melanson's Foundry, Montreal, Quebec.

===========

Introduction:

On May 20, 1946, Mr. R. A. Frigon, Montreal Regional Representative, Research and Development Branch, Department of Reconstruction and Supply, delivered for examination two samples of foundry sand from Melanson's Foundry, 2430 Ville-Marie, Montreal, Quebec.

In the covering correspondence, Mr. Frigon explained that this foundry was experiencing "drops" in the use of these sands; that is, the sand would drop out of the mould into the mould cavity before the metal was poured. The aid of the sand research laboratory of the P.M.R.L. was requested to determine the best means of remedying this difficulty.

Description and Identification of Samples:

About a pint of each of the samples was submitted for investigation. They were identified as:

No. 1 Sample - No. 1½ Albany heap sand with 2 per cent clay addition.

No. 4 Sample - No. 0 Albany heap sand, used as received.

The sands were being used in making moulds for medium weight grey iron castings (up to 2½ inches in thickness).

Method of Testing:

Screen Test -

A screen test, using the procedure recommended by the American Foundrymen's Association (Foundry Sand Testing Handbook, 1944 Edition, A.F.A.), was made on the two sands. The results are tabulated below in Table I and shown in graphical form in Figure 1.

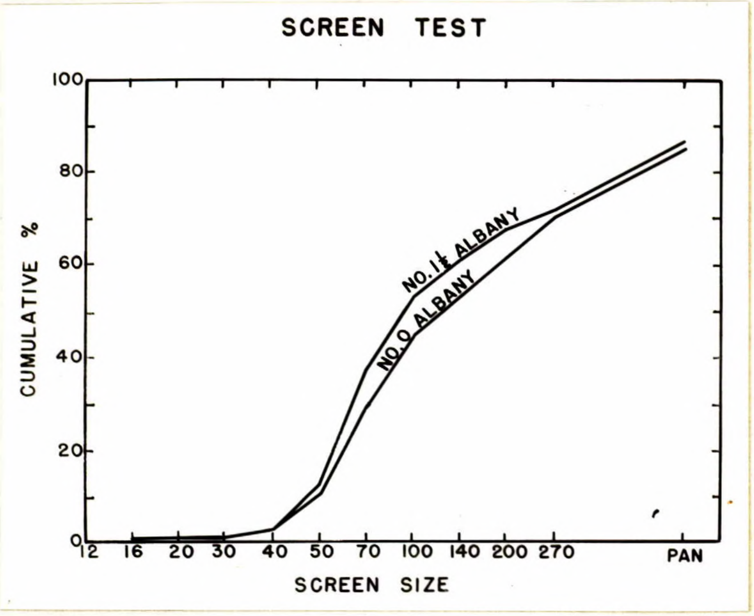
TABLE I. - Screen Test Results

U.S. Screen No.		PER CENT RETAINED Sample No. 1.	Sample No. 2.
16	-	0.2	0.4
20	-	0.2	0.3
30	-	0.7	0.8
40	-	1.8	1.7
50	-	9.2	7.3
70	-	25.8	19.2
100	-	15.7	14.9
140	-	7.4	9.1
200	-	6.8	8.2
270	-	4.1	6.2
Pan	-	14.5	17.5
A.F.A. Clay	-	13.4	13.7
A.F.A. Fineness No.	-	112	126

(Continued on next page)

(Screen Test, cont'd) -

Figure 1.



SCREEN TEST OF TWO SANDS.

-

Physical Tests -

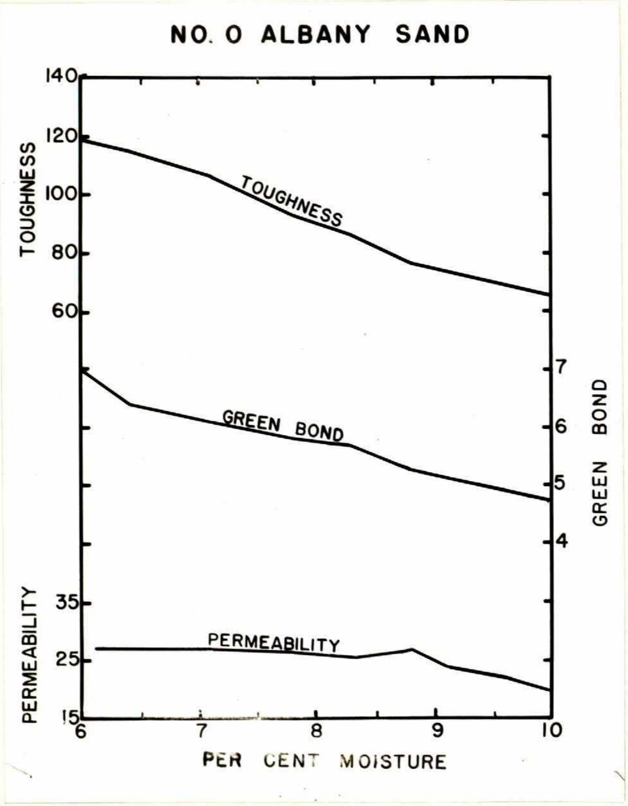
The physical properties of the sands were tested at various moisture contents, to determine their working characteristics. The properties specifically so tested were: permeability, green compression, and toughness (green compression multiplied by deformation of the A.F.A. specimen in thousandths of an inch per inch).

Dry compression should have been included in these tests, but unfortunately the amount of the samples submitted was too small to permit any additional tests. The results of the tests made are shown graphically in Figures 2 and 3.

(Figures 2 and 3 follow,)
(on Page 4.)

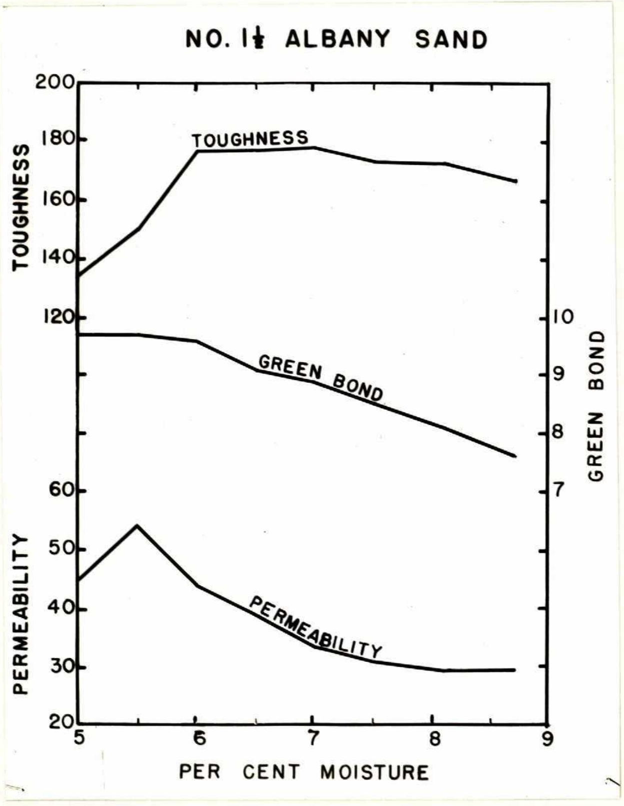
(Physical Tests, cont'd) -

Figure 2.



MOULDING PROPERTIES OF NO. 0 ALBANY SAND.

Figure 3.



MOULDING PROPERTIES OF NO. 1½ ALBANY SAND.

Discussion:

These two sands are typical of natural bonded moulding sands being used in grey iron foundries in this country. With proper sand control they are being used to produce satisfactory moulds. The green bond and toughness of the No. 0 Albany sand (Sample No. 4) are, however, slightly low for the best results. With this exception, the physical properties are in the best range for the type of moulds being made.

The fact that "drops" are being encountered in using these sands suggests the following possibilities:

(1) As Sample No. 4 has a somewhat lower strength than is usually found to be most satisfactory, some additional clay or new sand would improve its moulding properties and help to prevent drops.

If clay is used in rebonding, some type which is easy to mix with sand should be used if no muller is available to condition the sand. Western bentonite (Volclay, Federal Green Bond, etc.) is undesirable as a rebonding clay if a sand muller is not available, as it is difficult to mix with the sand. Southern bentonite (Dixie Bond, Panther Creek, etc.) and Minco Bond are satisfactory rebonding clays, as they are easy to mix with the sand. Southern bentonite is about three times as effective as Minco Bond in raising the green bond of the sand, but if these clays are compared on the basis of 3:1, Minco Bond imparts a higher dry strength. About 0.5-1 percent Southern bentonite, or 2 percent Minco Bond, should give the No. 0 Albany sufficient green bond to prevent drops. The amount of rebonding clay being used with the No. 1½ Albany appears to be satisfactory.

(Discussion, cont'd) -

(2) The sand may not be correctly tempered before it is used. Each moulding sand has an optimum moisture within which the moisture content must be held if best results are to be obtained. If the moisture content is too high or too low, the toughness of the sand may be lessened, and drops will result. If the moisture content is too high, the permeability is decreased and a greater volume of steam is generated. The increased mould gas pressure results in blows and pinholes in the castings. Moisture contents which are too low cause the sand to be less permeable and to have a lower dry strength. The low permeability results in pinholes and blows, and the low dry strength causes the sand to wash under the stream of metal.

A study of the chart of the physical properties of the No. 1½ Albany sand (Figure 2) shows that with a moisture content of 5.5 percent this sand has a maximum permeability, but the toughness is at a maximum with 6 percent moisture. Unfortunately, the dry strength curve for this sand is not available, but with all moulding sands the dry strength decreases with decreasing moisture content, and if the sand is tempered too dry it is likely to wash into the mould with the metal. The moisture content for this sand should be held fairly closely between 6 percent and 7 percent for best results. With this moisture content the permeability is not at a maximum, but is still high enough so that little trouble from blows and pinholes should be caused by the sand, even without any venting.

(Discussion, cont'd) -

The toughness of the No. 0 Albany sand (Figure 3) increases with decreasing moisture content, down to 6 percent moisture, and this sand should cause less trouble from drops if worked on the dry side. However, this sand appears to be very friable, or "crumbly," if worked much below 8 percent moisture. This is an indication that this sand would cut and wash if worked much below 8 percent moisture. The best working conditions for this sand are between 8 percent and 9 percent moisture. Above 9 percent moisture the permeability is too low, and the sand has not enough venting power to take off the excess steam formed. This results in the formation of pinholes and blows. Below 8 percent moisture, loose sand will be washed into the mould. If the toughness of this sand is too low in the 8 to 9 percent range, it should be raised by adding clay or rebonding sand as described above.

In conditioning the sand, one or more of the following items of equipment should be used:

(a) Sand muller or mixer.

(b) Mechanical aerator.

(c) Mechanical riddle.

(d) Hand riddle.

For a small foundry using natural sand, the intensive mixing given by a sand muller is not necessary, and the use of a mechanical aerator is probably the best method of tempering the sand. This mixes the moisture and clay additions with the sand much more efficiently than can be done with shovels, and leaves the sand in a fluffy condition which is best for moulding. A mechanical riddle is also a good conditioner of

(Discussion, cont'd) -

sand, but is not so rapid as the aerator. Even if an aerator is used, however, all the sand next to the pattern should be riddled by the moulder through a riddle with about $\frac{1}{4}$-inch openings. In addition to preparing this sand in its most fluffy condition, this practice discourages the tendency to temper the sand too wet, which is almost universal when the sand is tempered by "feel." Wet sand is more difficult to put through a small screen than is properly tempered sand.

In addition to sand conditioning equipment, it would be desirable to install some control testing equipment. The most important variable in sand conditioning, and the one most difficult to control, is the moisture content. Hence the most important piece of equipment for a sand-testing laboratory is a moisture tester. Probably the most suitable moisture testing equipment for control work is a carbide bomb, with which the moisture content of a sand can be determined in about a minute. This principle is patented by a British firm and is marketed under the trade name of "Speedy Moisture Teller." This is a most desirable piece of equipment for controlling the conditioning of sand, as results are available, and corrective measures may be taken, while the sand is being conditioned.

The standard A.F.A. testing equipment, including a sand rammer, permeability meter and strength machine, would also be useful in controlling the conditioning of the sand. With this equipment, changes in sand properties such as permeability, strength, and moisture required to temper could be detected, and corrective action

(Discussion, cont'd) -

taken if this were necessary.

. .

(3) Patterns and moulding boxes may not be designed to produce the minimum strain on the sand. Sometimes a simple modification of design, such as a change in the parting line, the addition of a simple core, or the turning over of a pattern, will result in easier moulding and greater production.

. .

(4) Even with good sand and patterns, the moulder must possess a certain degree of skill to obtain best results. Knowledge of such factors as the degree of ramming required, or the right amount of artificial support (such as nails, or "gaggers") to give the sand, comes only with experience. A mould which is rammed too hard requires artificial venting, and may be more likely to drop than one rammed more lightly, because the sand has less resistance to deformation. An experienced moulder learns to compensate for varying conditions of the sand by varying the degree of ramming he gives the moulds.

Adequate supports should be used in the moulding boxes, and gaggers are sometimes required in difficult portions. The indescriminate use of gaggers should not, however, be regarded as a substitute for good moulding technique.

. .

(5) Sections being cast may be too large in area for the type of sand in use. It is difficult to make very large moulds with this type of sand, even if supports in the boxes, and gaggers in the sand, are used. If

(Discussion, cont'd) -

much work is cast in large moulding boxes, a coarser sand, which is less likely to drop, should be used.

. .

CONCLUSIONS:

1. The No. 0. Albany sand could be improved with a small addition of clay or rebonding sand, but is otherwise similar to sand being used in grey iron foundries, reportedly with satisfactory results.

2. The No. 1½ Albany sand's properties are in the range which are generally considered to give the most satisfactory results.

3. The fact that "drops" are being encountered suggests the following possibilities:

(a) The strength of the No. 0 Albany sand may be too low.

(b) The sands may not be correctly tempered before they are used.

(c) Patterns and moulding boxes may not be correctly designed to produce the minimum strain on the sand.

(d) Sufficient supports in the boxes, and nails for the sand, may not be in use.

(e) Sections being cast may be too large in area for this type of sand.

SUGGESTIONS:

(1) Add rebonding clay or sand to the No. 0 Albany sand.

(2) Condition all sand with an aerator or mechanical riddle.

(3) Screen all sand next to the pattern through a riddle having about ¼-inch openings. This will ensure that

(Suggestions, cont'd) -

the sand is fluffy, and will help to overcome the tendency to temper the sand too wet.

(4) Obtain sand testing equipment, such as moisture tester, sand rammer, permeability meter and strength machine, to control the conditioning of the sand.

(5) Check patterns and moulding boxes to determine whether or not modification of design would impose less strain on the sand.

(6) Use reinforcements in the boxes, and nails in the sand, if necessary.

(7) If the above measures fail to check the "drops," it may be necessary to resort to a coarser sand.

ooooooooooo
ooooooo
o

AEM:EF.