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DEPARTMENT OF MINES AND RESOURCES

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CANADA

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Ottawa, June 20, 1945.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2065

Substitutes for Cereal Flour
in Foundry Work.

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(Copy No. 4.)

Bureau of Mines
Division of Metallic
Minerals
-
Physical Metallurgy
Research Laboratories

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
Mines and Geology Branch

OTTAWA June 20, 1946.

REPORT

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Introduction:

On May 8, 1946, a request was received from Mr. W. R. Weir, Metallurgist, Dominion Foundries and Steel, Limited, Hamilton, Ontario, to develop sand mixtures to replace the ones in present use containing cereal flour. Food products are now unavailable to foundries, and substitutes must be used. The request was accompanied by the formulae used in making two of their sand mixtures. It was thought by Mr. Weir that if substitutes could be developed for these two mixtures that they could be used satisfactorily in all their other mixtures. The two formulae and the properties obtained from the sand, follow:

OIL CORE FACING.

Bolsters - Side Frames - General Work.

Mix and Physical Properties

1000 # Washed Silica Sand A.F.A. #60,
50 # Silica Flour A.F.A. 185,
8 Dippers (18 lbs.) Cereal Bond,
5 qts. Linseed Core Oil.

(OIL CORE FACING CONT'D)

Physicals

Moisture %	4%	
Green Permeability	100	
Green Compression	3.15	p.s.i.
Dry Permeability	165	
Hi Dry Compression	300	p.s.i. capacity
Tensile Core Strength	137.5	p.s.i.

ARM CORE.

Collapsible Mix for Body Cores.

1800 # Black System Sand,
700 # Washed and Dried Sand A.F.A. #60,
3 Dippers Cereal Binder (3.5#),
9 Dippers Sawdust,
7 qts. Glutrin.

Physicals

Moisture %	3.4%	
Green Permeability	110	
Green Compression	4.1	p.s.i.
Dry Compression	95	p.s.i.
Dry Permeability	155	
Dry Tensile Strength	19.0	p.s.i.

Method of Procedure:

A test mixture was made to the formulae for Oil Core Facing (Bolsters-side frames-general work), using a washed New Jersey moulding sand with an A.F.A. fineness number of 50. The properties obtained with the New Jersey sand were somewhat different from those given for the sand in use at Dominion Foundries and Steel, but the mixture is useful as a basis for comparison with substitute mixtures.

The mixtures used in this report were made and tested using standard A.F.A. equipment and procedures.

Mixtures Tested:

Of the many mixtures tested, two had properties which approximated those obtained with the cereal flour mixture. The cereal flour mixture used, and the two substitute mixtures were as follows:

1. Cereal Flour Mixture:-

2000 gms. #50 New Jersey Sand,
100 gms. Silica Flour,
35 gms. Casco,
22 gms. Core Oil.

2. Wood Flour - Sulphite Liquor Mixture:-

2000 gms. #50 New Jersey Sand,
100 gms. Silica Flour,
40 gms. Sulphite Liquor Residue (GOULAC),
40 gms. Wood Flour (AKRO),
22 gms. Core Oil.

3. Southern Bentonite - Resin Mixture:-

2000 gms. #50 New Jersey Sand,
100 gms. Silica Flour,
40 gms. Southern Bentonite,
40 gms. Resin (TRULINE).

Properties of Mixture:

The three mixtures had the following properties:

	#1	#2	#3
Green Permeability........ -	102	99	99
Green Bond, p.s.i......... -	2.2	1.0	1.9
Deformation -ins/in....... -	0.065	0.015	0.055
Flowability............... -	85	81.5	84.0
Baked Permeability........ -	122	---	126
Weight of A.F.A. Specimen, gms........... -	168	168	168
Baked Tensile, p.s.i...... -	180.0	31.0	35.0
Baked Compression, p.s.i. -	850	535	200
Core Gas - cc's per gm... -	15.2	24.6	8.6

Hot strength tests were made in a high temperature sand dilatometer under an atmosphere of nitrogen. Charts showing the hot strength properties of the mixtures at 1000°F and 2000°F are shown in Figures 1 and 2.

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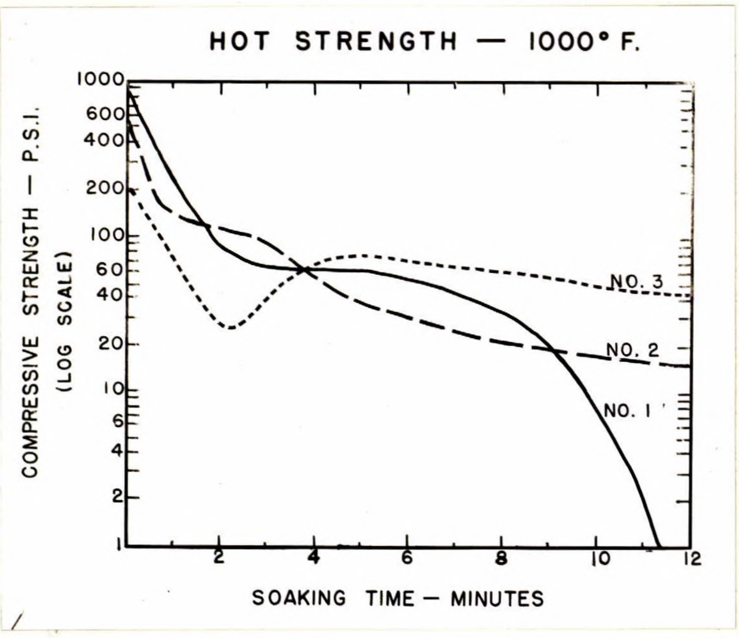

Figure 1.

Hot Strength-1000° F

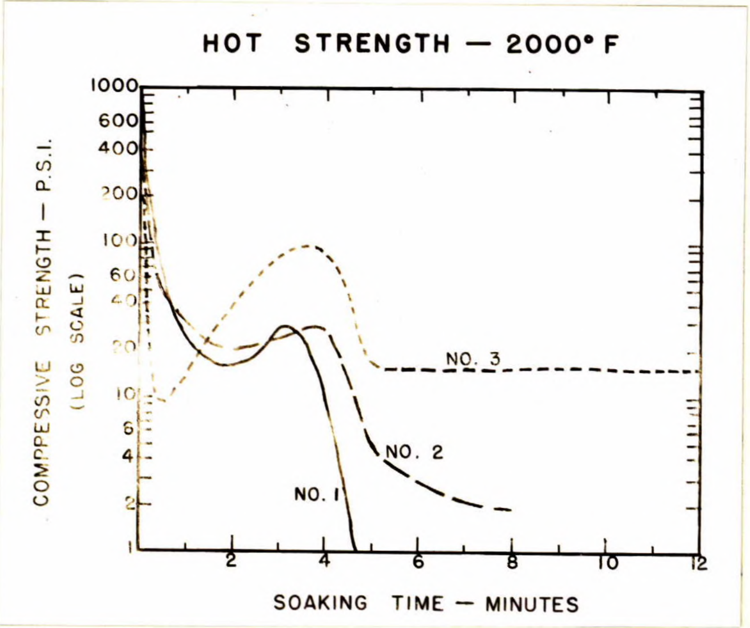

Figure 2.

Hot Strength-2000° F

Discussion:

None of the materials tested are equal to cereal flour as a sand binder. However, it should be possible to use the alternative materials suggested in this report until better substitutes or cereal flour are available to the foundry industry. The substitutes suggested are:

1. Sulphite liquor and wood flour.

These two materials together provide a sand with somewhat the same moulding characteristics as a cereal-bonded sand. The collapsibility is about the same as for Mixture No. 1 (See Figures 1 and 2).

The disadvantages of this substitution are:

(a) The green strength and deformation are somewhat lower than that obtained with cereal flour.

(b) Trouble may be experienced from this sand sticking in core blowers and boxes. Possibility this mixture could be improved by the addition of kerosene or fuel oil.

(c) The tensile strength of this mixture is lower than that of the cereal-bonded mixture, possibly requiring the use of more core oil.

(d) Trouble might be experienced from the high gas content. The rate of gas evolution, however, is about the same as for the cereal-bonded sand.

(e) The materials used have some ash content. However, as the amounts used are so small, the effect of the ash content or the sand properties would be negligible.

2. Southern bentonite and resin.

Southern bentonite mixtures are easy to work with, and have a good collapsibility. The use of core oil in these mixtures is uneconomical however, as it is absorbed by the clay. If much bentonite is used, therefore, resin should be used instead of core oil to obtain baked strength. The disadvantage of Southern bentonite - resin mixtures over the cereal - core oil mixtures are:

(a) Low tensile strength.

(b) Somewhat lower flowability, possibly resulting in core-blowing troubles. If this trouble develops it should be possible to overcome it with the use of fuel oil or kerosene.

(c) Different collapsing characteristics (Figures 1 and 2). The initial collapsing rate of resin-bonded sands is faster than for oil-bonded sands, but a secondary hot strength is developed when the resin forms a coke. This difference in behaviour may be either beneficial or detrimental, depending upon the type of casting being poured.

(d) Less core gas is generated than with the oil-cereal flour mixture. If it is found that the volume of gas generated is too small, resulting in metal penetration, additional gas-producing materials, such as wood flour or more resin, may be used.

3. Southern bentonite and glutrin.

In the black sand mixture for Arm Cores, the purpose of the cereal flour is to increase the green and dry strength of the core sand without increasing the hot strength. In this case Southern bentonite can be substituted for cereal flour, as it has a good green strength and a low hot strength. Additional glutrin may be added to maintain the dry strength. This Southern bentonite mixture should prove as satisfactory as the cereal-bonded mixture.

Conclusions:

(1) None of the materials investigated as sand binders had all of the desirable properties possessed by cereal flour.

(2) The substitutes recommended are:

(a) Sulphite liquor, wood flour and core oil instead of cereal flour and core oil.

(b) Southern bentonite and resin instead of cereal flour and core oil.

(c) Southern bentonite and additional sulphite liquor instead of cereal flour in black sand mixtures.

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