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DEPARTMENT OF MINES AND RESOURCES
BUREAU OF MINES
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Ottawa, February 15, 1947.

R E P O R T
of the
ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2181.

Investigation of Soybean Flour for Use as a
Foundry Sand Binder.

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Introduction:

During a recent visit to the Physical Metallurgy Research Laboratories, Mr. E. F. McGee, sales manager of the flour division of Victory Mills Limited, 285 Fleet Street East, Toronto, Ontario, requested an investigation to determine the properties of extracted soybean flour as a foundry sand binder. This request was confirmed by a letter dated February 4, 1947. A sample of the soybean flour, which is marketed under the trade name of "Indosoy," was received on February 7, 1947.

Method of Testing:

Equipment and procedure recommended by the American Foundrymen's Association (Foundry Sand Testing Handbook, 1944 Edition, A.F.A.) were used in making the tests. Test mixtures were made using A.F.A. #50-70 test sand.

Results of tests on a corn flour foundry binder (Casco) are included in this report for comparative purposes.

Test Mixtures:

The properties of two types of mixtures were tested. In the first type soybean flour was used as the sole binder. In the other type of mixture, the flour was used in conjunction with an oil binder.

The first mixtures used were as follows:

- (1) 6,000 grams A.F.A. test sand.
75 " soybean flour.
1.2 per cent water.
- (2) 6,000 grams A.F.A. test sand.
75 " Casco.
1.2 per cent water.

The green compressive strengths before baking were:

- Mixture No. 1 - 0.7 p.s.i.
Mixture No. 2 - 0.85 p.s.i.

The mixtures had the following baked tensile strengths (p.s.i.):

<u>Baking Time</u>	<u>Mixture No. 1 Baked at 375° F.</u>	<u>Mixture No. 1 Baked at 450° F.</u>	<u>Mixture No. 2 Baked at 450° F.</u>
20 min.	-	48	85.5
40 min.	40.5	43	60.5
1 hr. 20 min.	30.0	50	50.0
2 hr.	29.5	10	57.0
2 hr. 40 min.	31.5	Nil.	49.0
3 hr. 20 min.	7.5	Nil.	45.0
4 hr.	7.0	Nil.	31.0

(Test Mixtures, cont'd) -

The second mixtures, which contained core oil, were as follows:

(3) 2,000 grams A.F.A. test sand.
20 grams soybean flour.
20 grams core oil.
2.2 per cent water.

(4) 2,000 grams A.F.A. test sand.
20 grams Casco.
20 grams core oil.
2.2 per cent water.

The tensile strengths of these mixtures were tested after baking test specimens for 2 hours at 400° F.

The results were:

	Tensile Strength, <u>P.S.I.</u>
Mixture No. 1 -	120.5
Mixture No. 2 -	217.5

Discussion:

Corn flour is used in moulding sand and core mixtures to serve two purposes:

1. To impart "green bond" to the sand. "Green bond" is the strength possessed by a sand mixture before it is dried or baked. A certain amount of green strength is required in all sand mixtures to enable the mould or core to retain its shape until it is baked.

2. "Dry bond" or baked strength is the strength possessed by the sand after it is dried or baked. The mould or core must possess dry bond to permit it to be handled, and to resist washing by the metal. Sometimes cereal flour is used alone as a core binder, in which case the dry bond imparted by it is an important factor. More often, however, a drying oil is used to produce baked strength, and cereal is used in the mixture because it supplies green bond yet does not interfere

(Discussion, cont'd) -

with the bonding action of the core oil.

Cereals are used in moulding sand mixtures to improve the green and dry strength of the sand. When used in moulding sands they are always used in conjunction with a clay binder, which supplies most of the strength. A small amount of cereal added to the sand mixture facilitates the making of the moulds, and also prevents the sand from becoming crumbly at projecting edges as the mould dries out.

A comparison of the results obtained by using soybean flour with those of the corn flour mixtures indicates that the two materials are approximately equal in ability to supply green bond, although the cereal flour is somewhat superior in this respect. Cereal supplies a much higher dry bond than does the soybean flour, however. Even more serious, however, is the degree to which the soybean flour destroys the effectiveness of the oil bond. The low dry and baked strength of the mixtures containing soybean flour would discourage its use as a foundry sand binder.

Conclusions:

The sample of extracted soybean flour ("Indosoy") is inferior to corn flour as a foundry sand binder because of the following reasons:

- (1) It supplies a slightly lower green bond.
- (2) The dry bond is inferior.
- (3) It impairs the effectiveness of oil binders.

Suggestions:

1. Although "Indosoy" is inferior to cereal flour as a sand binder, it is the best substitute that has been tested by these Laboratories. When cereals are not available for Foundry use, Indosoy, if it is available, would be a usable

(Suggestions, cont'd) -

substitute.

2. It is possible that some treatment, such as an alkalization of the proteins, could be given to improve the properties. This, of course, would add somewhat to the cost. If sufficient material is available to justify further investigation a study along these lines might be carried out by an organic research laboratory.

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