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FOUNDRY POTENTIALITY OF SAND SAMPLES FROM PENETANGUISHENE, ONTARIO

by

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PHYSICAL METALLURGY DIVISION

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SUMMARY OF RESULTS

A sample of sand from Penetanguishene, Ontario, was tested to determine its foundry suitability.

The sample, as received, contained a high fraction of mineral impurities, which made it unsuitable for use in synthetic iron foundry systems. A sample from which the iron minerals had been removed by magnetic separation was improved, but was still inferior to imported lake sands.

A test casting indicated that the screened sand from Penetanguishene is suitable for use as an iron and non-ferrous core sand.

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INTRODUCTION

On March 23, 1960, Mr. D. Geoffry Minnes delivered a sample of sand for test to determine its suitability for foundry use. The sample was from a Penetanguishene, Ontario property of Canadian Weatherby Company, Toronto, Ontario.

MINERALOGICAL ANALYSIS

A sample of the Penetanguishene sand, and two samples of lake sands from the U.S.A., were sent to the Mineral Sciences Division, Mines Branch, for a mineralogical analysis. By a heavy liquid separation, and by a grain count of the light fraction etched in cold hydrofluoric acid, the following analysis was obtained:

	1	2	3
Quartz	58.7%	89.4%	95.1%
Feldspar	31.8	9.7	4.1
Ferromagnesium Silicates	9.1	0.8	0.5
Others (chiefly magnetite and hematite)	0.4	0.1	0.3

1 - Penetanguishene, Ontario

2 - Juniata, U.S.A.

3 - Muskegon, Michigan, U.S.A. - (Sample A)

ACID LEACH

The sands were leached in hot dilute hydrochloric acid. The residue was decanted. This would remove calcite and clay.

	Loss Per Cent
Penetanguishene	3.5
Juniata	0.5
Muskegon-Sample A	0.65
Muskegon-Sample B	1.4

MICROSCOPIC EXAMINATION

The sand had a round to subangular grain shape, which is suitable for foundry use. (Figures 1 and 2.) The Muskegon sand in Figure 2 represents the sample supplied by Mr. Minnes, which was used in the foundry tests described below.

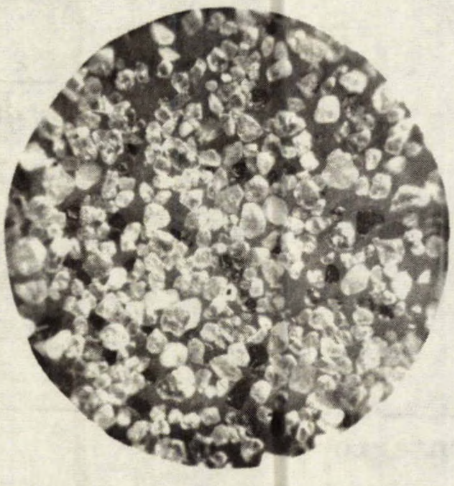

Figure 1 - Penetanguishene Sand.
X20

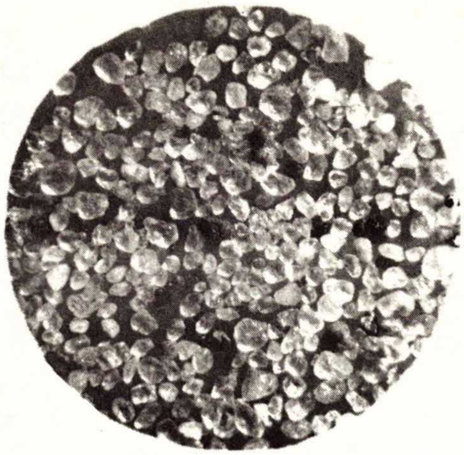

Figure 2 - Muskegon-Sample B
X20

SINTERING POINT

The samples had AFS sintering points as follows:

Penetanguishene - screened -	2175-2200°F
Penetanguishene - screened and magnetically separated -	2350°F
Port Crescent -	2395°F
Muskegon - Sample A -	2405°F
Muskegon - Sample B -	2395°F
Juniata -	2375°F
McConnellsville -	2390°F
Ottawa -	over 3000°F
Calgary -	2410°F

SCREEN DISTRIBUTION

The screen distribution of some of the sands described in this report is as follows:

U.S.A. Screen No.	Percent Retained 1	2	3	4	5
20	-	-	-	0.1	-
30	-	0.8	1.1	0.2	-
40	-	6.7	4.9	1.6	1.3
50	23.5	30.5	21.6	16.6	14.4
70	40.94	33.6	35.4	54.2	40.1
100	29.0	21.7	30.2	26.6	32.6
140	6.0	5.2	6.1	0.5	8.7
200	0.4	1.3	0.6	0.1	2.1
270	0.1	Trace	Trace	Trace	0.5
Pan	-	Trace	Trace	Trace	0.2
AFS Hardness No.	57	54	56	54	62

1. Penetanguishene - Sample of March 23, 1960
2. Penetanguishene - Sample of April 7, 1960
3. Penetanguishene - Magnetically separated
4. Muskegon - Sample B
5. Ottawa "45".

Moulding and Core-Making Properties

Moulding sand test mixture:

2000 g sand
195 g western bentonite
Moisture to temper
Mulled 1 min dry, 5 min wet in laboratory muller.

Core sand test mixture:

2500 g sand
25 g gelatinized corn flour
25 g AFS reference linseed oil
Moisture to temper to 3.5%
Mixed 1 min dry, 1 min with water, 4 min with oil in laboratory paddle mixer
Baked $1\frac{1}{2}$ hr at 400°F.

Moulding Sand

	Penetanguishene	Ottawa, Illinois
Moisture, per cent	3.5	3.1
Wt of AFS specimen, g	157	159
Permeability	229	179
Green compressive strength, psi	7.5	7.45
Deformation, per cent	2.39	2.40
Green tensile strength, psi	0.99	1.03
Dry compressive strength, psi	90	118

Core Sand

Jolts to break overhang specimen

High jolts	2	2
Low jolts	6	5-6
Baked tensile strength, psi	280	343

CASTING TESTS

Test No. 1 - Steel Founders' Society of America
Scab Test Blocks

Mixture: 53 pounds sand
2.5 pounds western bentonite
8 ounces gelatinized corn flour
Moisture to temper (Note - moisture was high to equal moisture of pit run sample)
Mulled 1 min dry and 5 min wet in foundry muller.

Test No. 2 - SFSA Scab Test Blocks

Mixture: 50 pounds sand
3 pounds 5 oz western bentonite
3 pounds sea coal
Moisture to temper
Mulled 1 min dry, 5 min wet in foundry muller.

SAND PROPERTIES

	1	2	3	4	5	6	7	8
Moisture, per cent	5.0	4.8	5.5	5.2	3.5	3.6	3.6	3.6
Green compressive strength, psi	8.0	6.9	6.5	6.4	8.8	9.2	9.9	9.4
Green deformation, per cent	4.1	4.3	4.6	4.5	2.75	2.93	2.13	2.38
Green tensile strength, psi	0.88	0.79	0.64	0.67	1.06	0.91	1.07	1.02
Dry compressive strength, psi	158	137	218	139	141	120	140	149

1. Penetanguishene - pit run - Mixture No. 1
2. Penetanguishene - screened- " "
3. Calgary sand " "
4. Ottawa "45" " "
5. Muskegon - Sample B " No. 2
6. Penetanguishene - magnetically separated " "
7. " - screened " "
8. Ottawa "45" " "

The moulds were rammed, as near as possible, to a mould hardness of 80. They were poured in grey iron at a temperature of 1400°C (2552°F). The castings are shown in Figures 3 and 4.

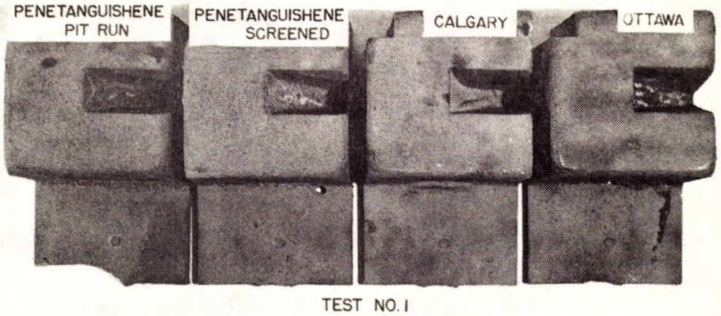

Figure 3 - Scab blocks, Mixture No. 1

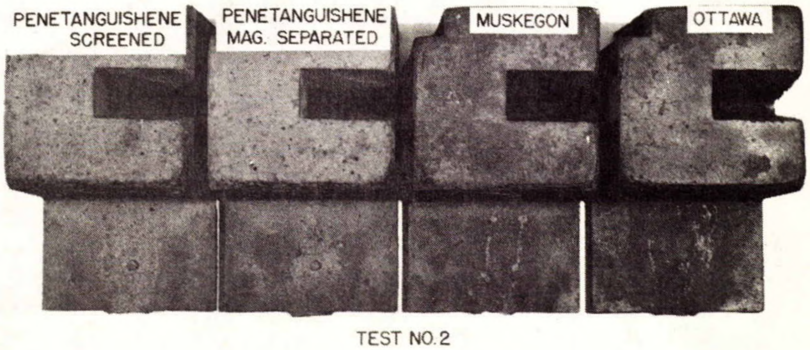

Figure 4 - Scab blocks, Mixture No. 2

In the scab blocks shown in Figures 3 and 4 the surface produced by the Penetanguishene sand is inferior to that produced by the other three sands. Magnetically separating the iron minerals (Test No. 2) produced an improvement, but the result is still inferior to those obtained with imported lake (Muskegon) and silica (Ottawa) sands. This sample was prepared by removing about 20% of the material in a dry magnetic separator.

Core Test

Mixture:

2000 g sand
20 g gelatinized corn flour
20 g AFS reference linseed oil
Moixture to produce 3.5%
Mixed 1 min dry, 1 min wet, 4 min with oil in laboratory paddle mixer.
Baked $1\frac{1}{2}$ hr at 400°F.

These cores were used in a 5-in. diameter, 5-in. high metal penetration casting. (Foundry Sand Handbook, AFS, Chicago, p.121). The mould was poured in grey iron at 1400°C (2552°F). The casting was cut, and the core surfaces are shown in Figure 5.

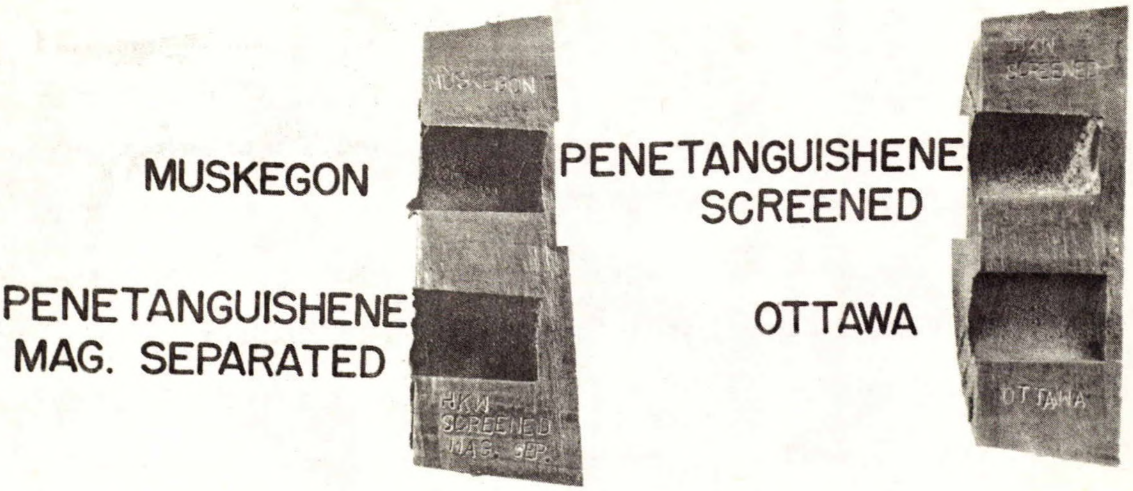

Figure 5 - Cored surface Produced by
Four Sands.

Figure 5 shows that the cored surface produced by the four sands is about equal. However, the Penetanguishene unseparated sand has a tendency to burn on and be penetrated. The magnetically separated material was better in this respect, and appeared to be about as good as the Muskegon sand. With both the Penetanguishene and Muskegon sands the weight of the metal had bulged the upper surface of the core, but this is not the case with the Ottawa sand. Apparently the sands with lower sintering points had softened somewhat, allowing the core to sag. A slight depression in the Ottawa core was caused by the impression of the identification number.

DISCUSSION

The tests with moulding sands (Figures 3 and 4) show that the Penetanguishene sand fuses at too low a temperature to be suitable for use in iron foundry synthetic sand systems. Magnetic separation of the iron minerals does not improve the sand enough to make it as good as the lake sands now in use in iron foundry synthetic sands.

When used as a core sand (Figure 5) the Penetanguishene sand is almost as good as the imported sands. There was an increased tendency to be subject to metal penetration and burn-on, but the casting is designed to test this feature. In small and medium-sized castings this tendency should not be noticeable.

Magnetically separating the iron minerals lessened the tendency for the Penetanguishene sand to penetrate and burn on. However, the improvement was probably not great enough to justify this step.

In Canada comparatively few iron foundries have synthetic sand systems, but those which do have them are large. They use the same sand in moulds and cores. Foundries using natural sands use a sharp (clay-free) sand in their cores. The Penetanguishene sand would be suitable for this purpose.

CONCLUSIONS

1. The Penetanguishene sand is not refractory enough to substitute for imported lake sands now used for iron foundry synthetic sand systems.
2. The sand appears to be suitable for use as an iron and non-ferrous foundry core sand.
3. Magnetic separation of the iron minerals does not improve the sand enough to justify the step.

AEM/KW