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AN INVESTIGATION OF SAND FROM THE MISSINAIBI RIVER AREA OF NORTHERN ONTARIO

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The results of this investigation indicate that the Missinaibi River sand deposits, as represented by the samples received, are of interest as potential sources of high-purity sand for use in glass manufacture. Seven of the 14 samples examined contained in excess of 20 per cent plus 20 mesh. This fraction would be too coarse for use in glass but quite satisfactory for use in the manufacture of silicon carbide and for other uses that require a coarser sand.

The chief mineral impurity in this sand was clay, which coated the individual grains of quartz. This was largely removed by vigorous attrition scrubbing followed by water washing. Other impurities were iron-oxide staining, muscovite mica, and white grains of kaolinite. However, these latter impurities were not present in excessive quantities except in two or three samples. Although methods of reducing these were not investigated in detail, acid leaching could be employed to remove the iron and wet or dry tabling to remove the mica. Kaolinite, where excessive, could be separated from the quartz by froth flotation or by electrostatic separation.

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INTRODUCTION

At the request of Franc R. Joubin & Associates Limited, Mining Geologists, Toronto, an investigation of sand and clay samples from Burstall Township, northern Ontario, was initiated in November, 1962.

Ten samples of clay and 14 samples of sand, each weighing from 2 to 20 lb, were received in the Ceramic Section. The clay samples, and the clay removed from the sand samples by washing, were retained by that Section for examination, while the washed sands, separated into plus 150 and minus 150 mesh fractions, were transferred to the Non-Metallic Minerals Section for evaluation as glass sand. These latter samples were identified as GMA-1, -3, -4, -6A, -6B, -8, -9, -10, -11, -18, -19B, -20, -21A and -21B.

This report covers the work performed on the sand fractions. That conducted on the clay is covered in Mines Branch Report IR 63-85 by J.G. Brady, R.M. Buchanan, K.E. Bell, and H. Mercier.

EXAMINATION OF SAMPLES

The plus 150 mesh sand, which represented from 80 to 95 per cent of the total weight of the washed sand samples, was largely composed of sub-rounded to angular grains of clear quartz. Seven of the samples were relatively coarse, containing in excess of 20 per cent plus 20 mesh material; the remaining samples were considerably finer. Some iron-stained quartz grains were observed, but iron-staining on the whole was not excessive except in one sample, GMA-11, in which 50 per cent of the grains were heavily stained. Finely-divided muscovite mica was noted in a few samples; however, this mica was not present in large amounts except in sample GMA-10. Apart from the iron-staining and mica noted above, the chief impurity observed was small particles of a white, opaque mineral. Some of these white particles were identified as quartz, others as kaolinite.

The minus 150 mesh sand, which represented from 1 to 5 per cent of the original weight of the samples, was impure. No test work was undertaken on this fraction but samples of GMA-4, -10, -11, -20, and -21B were submitted to the Ore Mineralogy Section for identification of the mineral constituents. Quartz was the major constituent in GMA-4, -20 and -21B. Minor amounts of kaolin were also identified. Kaolin was the principal constituent in GMA-10 and -11 with some quartz and mica. Rutile was a minor constituent in all five samples.

PROCEDURE

Sieve analyses were conducted on all samples. Representative head samples were then separately scrubbed in a 200-g attrition scrubber for a 5-min period and the scrubbed products were water-washed and dried. Product recovery was in excess of 95 per cent.

A sample of GMA-10 was submitted to the Industrial Minerals Milling Section for investigation of the removal of mica by tabling. The small sample size did not permit both wet and dry tabling tests, efforts therefore were confined to panning and air tabling. The plus 35 mesh material was separated by screening and the mica removed from this fraction by panning. The minus 35 mesh sand was treated on a small air table. Tabling resulted in two products, a "heavy" quartz fraction, which represented the bulk of the sample, and a "light" fraction, which largely consisted of mica and finely divided silica. The "light" fraction represented less than 10 per cent of the weight of feed.

RESULTS

The sample weights and percentage recoveries of clay and of plus 150 mesh and minus 150 mesh sand, as reported by the Ceramic Section, are shown in Table 1. Sieve analyses for the plus 150 mesh sand are included.

Table 2 contains chemical analyses of some of the plus 150 mesh sand products. Most of these were analysed by J.T. Donald & Co. Ltd. of Montreal.

TABLE I

Sample Weight and Percentage Recovery of Clay and Sand,
and
Sieve Analysis of plus 150 Mesh Sand

	Sample Identification													
	GMA-1	GMA-3	GMA-4	GMA-6A	GMA-6B	GMA-8	GMA-9	GMA-10	GMA-11	GMA-18	GMA-19B	GMA-20	GMA-21A	GMA-21B
Sample Weight, lb	10.0	20.0	2.3	14.0	3.3	7.3	17.0	4.0	8.0	5.5	16.5	12.3	20.0	9.8
% +150 Sand	95.3	91.0	80.7	89.4	86.6	94.8	93.9	90.6	92.9	93.9	88.5	81.9	94.7	91.9
% -150 Sand	1.3	2.2	2.9	3.0	3.9	1.7	1.8	2.5	1.9	1.9	4.2	5.1	1.2	1.6
% Clay	3.4	6.8	16.4	7.6	9.5	3.5	4.3	6.9	5.2	4.2	7.3	13.0	4.1	6.5
Mesh Size	Sieve Analyses, +150 mesh Sand - Weight Per Cent													
+14	10.6	15.0	24.5	6.0	5.7	6.7	7.1	0.2	4.8	16.2	8.9	55.4	3.5	22.7
-14 +20	16.7	11.9	28.9	8.4	6.6	11.8	12.5	0.9	7.7	14.9	11.9	12.6	12.0	34.0
-20 +28	21.4	14.0	23.5	12.5	12.6	17.9	15.0	2.0	9.9	16.6	14.5	6.5	21.8	26.4
-28 +35	26.0	15.9	13.3	16.8	24.6	22.4	18.5	6.4	15.7	17.3	19.4	4.4	29.2	10.4
-35 +48	16.0	18.4	5.6	21.0	27.3	22.4	23.4	19.0	24.7	17.0	20.1	5.4	23.6	3.1
-48 +65	5.8	13.2	2.2	21.8	16.0	13.4	15.6	30.9	22.0	11.7	17.1	6.8	7.8	1.7
-65 +100	2.3	8.0	1.1	10.4	5.4	4.1	6.2	31.1	12.1	4.6	5.3	5.7	1.7	1.1
-100	1.2	3.6	.9	3.1	1.8	1.3	1.7	9.5	3.1	1.7	2.8	3.2	0.4	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 2

Chemical Analyses - Weight Per Cent

Sample Identification	Washed Product (1)		Scrubbed Product (2)		
	Fe_2O_3	Al_2O_3	SiO_2	Fe_2O_3	Al_2O_3
GMA-1	0.014	0.367	99.74	0.009	0.10
GMA-3			99.36	0.056	0.37
GMA-4			99.71	0.018	0.13
GMA-6A			99.60	0.031	0.20
GMA-6B			99.67	0.031	0.15
GMA-8			99.62	0.022	0.18
GMA-9			99.45	0.024	0.22
GMA-10			98.92	0.045	0.74
GMA-11	0.061	0.909	99.37	0.050	0.37
GMA-18			99.63	0.013	0.16
GMA-19B			99.73	0.011	0.10
GMA-20	0.024	0.686	99.67	0.018	0.15
GMA-21A			99.67	0.009	0.14
GMA-21B			99.74	0.009	0.12
GMA-10, Head (3)				0.057	0.74
GMA-10, -20+35 heavy (3)				0.030	0.62
GMA-10, -35+150 heavy (3)				0.050	0.73

(1) Mines Branch, Internal Report MS-AC-63-342 by J.C. Hole.
(2) Analyses by J.T. Donald & Co. Ltd. except where noted otherwise.
(3) Mines Branch, Internal Report MS-AC-63-575 by J.C. Hole.

DISCUSSION

Glass companies have rigid specifications for the grain size and chemical purity of the sand used in glass manufacture. While these specifications vary from company to company, glass sand typically should satisfy the following specifications -

Grain Size: -20 +150 mesh

Chemical Requirements:

SiO_2	-	99% +
Fe_2O_3	-	less than 0.04%
Al_2O_3	-	generally less than 0.20% but may be higher if uniform
Others	-	low

All fourteen samples contain substantial quantities of coarse material. Samples GMA-4, -20 and -21B, in particular, contain in excess of 50 per cent plus 20 mesh. Although the coarser sizes could be reduced to 20 mesh by simple crushing, they preferably should be utilized where coarse sand is required, for example, in silicon carbide manufacture or as poultry grit.

The silica content of all but one scrubbed sample, GMA-10, exceeded 99 per cent and the iron content is most samples was less than 0.04 per cent Fe_2O_3. The heavily iron-stained sample, GMA-11, after scrubbing, contained 0.05 per cent Fe_2O_3. This could be reduced by acid leaching at elevated temperatures but, because this would be costly, heavily iron-stained areas preferably should be avoided during mining operations.

The alumina content, although partially reduced by scrubbing, in most samples exceeded 0.20 per cent and in GMA-11 was 0.74 per cent. Some glass companies would accept a sand with alumina in excess of 0.20 per cent provided that it did not vary from shipment to shipment. The alumina content of the scrubbed product undoubtedly is due to the white, opaque grains of kaolinite. Because the kaolinite is not uniformly distributed throughout the deposit alternate methods of reducing this impurity, such as froth flotation or electrostatic separation, should be considered.

The small amount of mica in several samples probably would present no problem although if excessive, as in sample GMA-10, it should be removed. The air table tests resulted in a substantial reduction in the mica in this sample, with a recovery of sand in excess of 90 per cent. Wet tabling could also be employed for this purpose. The removal of mica did not result in any marked reduction of the alumina.

CONCLUSIONS

Much of the sand in the area under consideration, on the basis of the samples received, is of potential interest as a future source of high-purity sand. Beneficiation would largely be confined to vigorous attrition scrubbing followed by thorough water washing. Areas of heavy iron stain, excessive mica, or high kaolin content should be avoided but, if desired, probably could be mined and upgraded to a large degree by utilizing additional processing techniques such as acid leaching, wet or dry tabling, froth flotation, and electrostatic separation.

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