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MINES BRANCH INVESTIGATION REPORT IR 62-71

# BENEFICIATION OF SILICA ROCK FROM CANAL FLATS, B. C. (PROJECT MP-IM-6208)

by

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MINERAL PROCESSING DIVISION

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## SUMMARY OF RESULTS

Dry, "rock" milling performed on a sample of sandstone, produced a high silica, low-iron quartz sand in a size range that could be screened to produce glass-grade silica, and sized fractions from minus 28 mesh to a fine powder.

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## INTRODUCTION

A 3,000 lb sample, considered representative of the deposit of sandstone at Canal Flats, B.C. was sent to the Mines Branch by P.N.S. Industrial Minerals Ltd., of Calgary, Alta. This material was used to ascertain whether marketable silica products could be made.

## DESCRIPTION OF SAMPLE

The sample consisted of lumps of white sandstone 2 in. to 10 in. in size. Some were friable. An occasional "mud" seam was found in narrow cracks in certain rock specimens. The natural size of the grains composing this sandstone was -28 mesh.

## TEST WORK

The sample as received appeared to be amenable to "rock" milling. In this method, larger size pieces of the feed are used to do the grinding instead of balls or pebbles. A test series of this type was tried.

The series was of the "locked" kind, i.e., each individual test was a batch grind, the charge to succeeding batches being composed of oversize from the previous run made up with fresh feed to a standard weight. This type of test gives results which are in general similar to a continuous milling operation.

The series was done in a Patterson mill lined with silica brick to prevent iron contamination. The feed and discharge ends of this mill were closed off to convert it into a batch machine.

Since the material to be ground and the material which would do the grinding were the same, except for particle size, it was necessary to prepare a stock of grinding lumps as well as a stock of feed. For feed, a representative portion of the sample was crushed to -3/4 in. For grinding lumps, about 300 lb of sample, -8 in. + 1 in., were selected and placed in the mill. The mill was then rotated for 60 min to remove edges and corners from the lumps and develop a graded charge. This was done in order to prevent, as much as possible, chips from the grinding lumps entering the feed part of the charge to the mill during the tests. In practice wearing-in of the grinding lumps would not be necessary.

As it was expected the "rock" type of milling would have a strong tendency to liberate the sand grains at their natural grain size (-28 mesh), this was selected as the desirable product size. The feed was, therefore, all screened on 28 mesh, and only -3/4 in. +28 mesh was used in the tests. The -28 mesh obtained from the feed was kept separate from the -28 mesh developed in the test runs.

For the first test in the series, 200 lb of grinding lumps and 100 lb of -3/4 in. +8 m feed were charged to the mill, which was then rotated for 15 min. The load was dumped, screened on 1 in. to recover the grinding lumps and on 28 mesh to recover the product. For the next test, the weight of grinding lumps was made up to 200 lb from the prepared stock, and new feed was added to the remaining +28 mesh from the prior test to make the charge up to 100 lb. Five complete cycles were performed in this way. Material from the fifth cycle was considered to be reasonably indicative of a product which would be obtained by continuous grinding.

## RESULTS

The -1 in. material derived from preparing, or "wearing-in", the grinding lumps was discarded.

The feed preparation produced 82.5% -3/4 in. +28 mesh and 17.5% -28 mesh. The -28 mesh thus derived was examined under the microscope and chemically analysed. The product from the 5th cycle of the grinding tests was similarly examined and analysed. Very little difference was found in the two materials, except that the -28 mesh derived from feed preparation was coarser in size distribution than that from the grinding tests. Table 1 gives a comparison of the particle size distribution.

TABLE 1

Comparison of Particle Size Percent Distribution

| Fraction | From Feed | From Test No. | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| - 28 + 35 m | 8.0 | 0.2 | 3.0 | 2.7 | 3.2 | 2.5 |
| - 35 + 48 m | 26.9 | 17.8 | 14.1 | 12.9 | 13.6 | 13.7 |
| - 48 + 65 m | 31.4 | 31.9 | 32.2 | 32.4 | 34.1 | 33.6 |
| - 65 +100 m | 18.9 | 24.9 | 25.4 | 25.8 | 25.9 | 26.2 |
| -100 +150 m | 6.3 | 8.8 | 8.3 | 8.3 | 7.6 | 7.7 |
| -150 +200 m | 3.4 | 4.2 | 4.6 | 4.8 | 4.3 | 4.4 |
| -200 m | 5.1 | 12.2 | 12.4 | 13.1 | 11.3 | 11.9 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Analyses of the -28 mesh material from the feed and from Test No. 5 are compared in Table 2.

TABLE 2

Comparison of Analysis on -28 mesh products

| Determination | Feed Preparation | Test No. 5 |
|---|---|---|
| $SiO_2$ | 99.18 | 99.20 |
| $Fe_2O_3$ | 0.02 | 0.02 |
| $Al_2O_3$ | 0.24 | 0.28 |
| CaO | 0.09 | 0.05 |
| MgO | 0.01 | 0.09 |
| LOI | 0.15 | 0.18 |
| | 99.69 | 99.82 |

A high yield of -28 mesh product was obtained in each test with low wear on the grinding lumps, as shown in Table 3.

TABLE 3

Product Yield and Lump Loss

| Test No. | -28 M Product (lb) | Grinding lump loss (lb) |
|---|---|---|
| 1 | 79.5 | 2.5 |
| 2 | 78.5 | 1.5 |
| 3 | 77.0 | 3.5 |
| 4 | 82.5 | 3.5 |
| 5 | 81.5 | 2.0 |

## DISCUSSION

"Rock" milling offers a way to keep contamination to a minimum for a product in which the iron content is critical. In addition, the price of grinding media is greatly reduced or eliminated.

Sufficient work was done to establish that this method of comminution produces a product in the size range that can be sold "as is", or on a screened basis, to glass manufacturers. Products such as silica flour would require further size reduction of another type. This is normal procedure.

Examination of the end product from the tests showed all free grains.

Since the -28 mesh from feed preparation is essentially the same as that from the grinding except that it is coarser, it could either be sold separately as a coarser product, or the two products could be mixed.

## CONCLUSIONS

(1) "Rock" grinding will produce a "free" grain sand.

(2) Analyses of the products indicate that glass-grade silica sand could be made.

FHH/Jg