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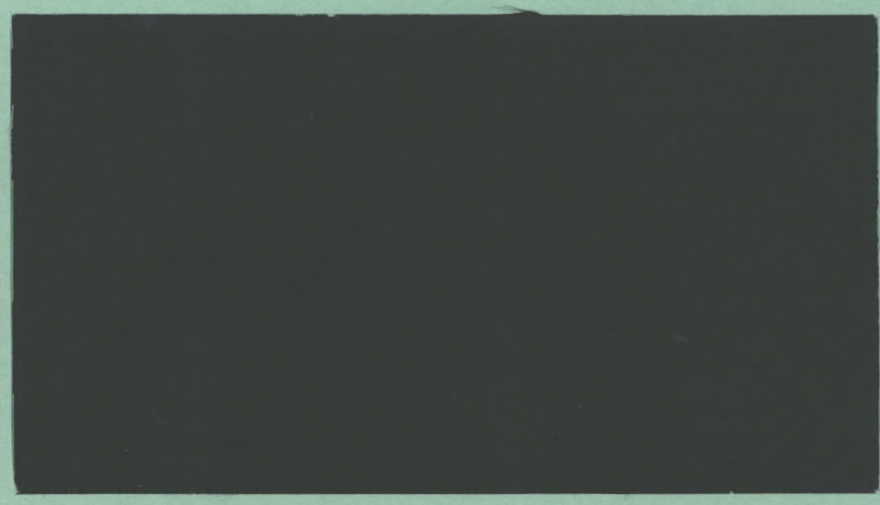
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Mines Branch Investigation Report IR 71-25

MINERALOGICAL EVALUATION OF IRON
CONCENTRATES FROM THE IRON ORE
COMPANY OF CANADA, SCHEFFERVILLE,
QUEBEC

by

E. H. Nickel

Mineral Sciences Division

NOTE: This report relates essentially to the samples as received, the report and any correspondence connected therewith shall not be used in full or in part as publicity or advertising matter.

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Mines Branch Investigation Report IR 71-25

MINERALOGICAL EVALUATION OF IRON CONCENTRATES FROM
THE IRON ORE COMPANY OF CANADA,
SCHEFFERVILLE, QUEBEC

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E. H. Nickel*

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SUMMARY OF RESULTS

No significant differences could be found between the occurrences of silica in the "satisfactory" and "unsatisfactory" concentrates. The silica content can be attributed almost entirely to quartz which can be separated from the iron oxides by heavy-liquid procedures. The quartz grains generally contain adhering particles of the fine iron oxides, and it is suggested that these may have an effect on the flotation behaviour of the quartz.

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INTRODUCTION

On February 4, 1971, Mr. H. Neal, consulting engineer for the Iron Ore Company of Canada left five samples of iron ore concentrate with the writer and requested that they be examined to determine if reasons for differences in their SiO_2 contents could be ascertained. Mr. Neal stated that some samples of ore respond well to concentration by flotation, that others do not, and that iron concentrates have unacceptably high silica contents. He hoped that a mineralogical evaluation might shed some light on this problem and might possibly lead to a rapid field method for distinguishing ore with favourable flotation characteristics from that with unfavourable ones.

Subsequently, at the author's request, screen analyses of the concentrates and the corresponding head samples were provided, and samples of the tailings were also supplied.

SAMPLES

The concentrates received, together with analyses for iron and silica provided by Mr. Neal, are listed in Table 1.

TABLE 1
Samples and Approximate Analyses

Sample No	Fe (%)	SiO_2 (%)
KL-603-548-1	65.5	5.4
KL-603-580-2	54.7	15.2
KL-603-590-1	63.5	6.4
KL-603-595-2	58.0	14.5
KL-603-771	58.6	14.2

Mr. Neal reported that samples KL-603-548-1 and KL-603-590-1 represented acceptable concentrates but that the other three were unacceptable because of their high silica contents.

The screen analysis of the head samples indicate that the iron content generally decreases, and the silica content increases with decreasing particle size. The screen analyses of the concentrates indicate a reversal of this relationship, i. e., with increasing comminution the iron content tends to become higher and the silica lower.

RESULTS OF INVESTIGATION

Special effort was directed toward establishing the identity of the silica-bearing minerals because this might prove to be the key to the beneficiation problems. This work which included X-ray diffraction analysis, microscopic examination of oil-immersion mounts, and heavy-liquid separations indicated that practically all of the silica is in the form of quartz. A minor amount of feldspar is present in several of the samples but not in sufficient amounts to account for the large differences in beneficiation results.

Microscopic examination of the samples showed, as expected, that the three "unacceptable" concentrates contain considerably more quartz than the two "acceptable" ones. However, no obvious differences could be discerned between the quartz particles in the different samples that might account for their apparent differences in flotation behaviour.

Heavy-liquid separations were performed on all five samples using methylene iodide with a specific gravity of 3.3 in an effort to determine whether the differences in behaviour might be attributed to differences in the degree of liberation. The results, shown in Table 2, cannot be considered as strictly quantitative because the samples were deslimed prior to the separations. However, desliming would not be expected to obscure the comparatively gross effects required to explain the differences between the samples.

TABLE 2
Results of Heavy-Liquid Separations

<u>Sample No.</u>	<u>% Float at 3.3</u>
KL-603-548-1	1.8
KL-603-580-2	12.0
KL-603-590-1	1.4
KL-603-595-2	9.7
KL-603-771	5.3

The results shown in Table 2 give an approximation of the amount of free (i. e., liberated) quartz in each of the samples, because quartz combined with an appreciable proportion of iron oxides would tend to sink during the course of the heavy-liquid separations and would not report in the float fractions.

Efforts were then directed toward an examination of the quartz particles recovered from the concentrates to determine if they had special characteristics that had prevented their original separation from the iron oxides. To assist in this evaluation, samples of the tailing were available to allow a direct comparison to be made between the quartz that had been effectively separated from the iron oxides during beneficiation (i. e., the tailings sample) and the quartz that had been retained in the concentrates (i. e., the float fraction of the heavy-liquid separations made of the concentrates). Unfortunately, no significant differences could be discerned: the quartz grains in both sets of samples contain abundant opaque inclusions, and, generally, adhering particles of iron oxides to cause a brown, rusty appearance. No appreciable differences in the grain size of the quartz could be detected between the two sets of "quartz concentrates".

Finally, the relative proportions of hematite and goethite in the concentrates were assessed by comparing peak heights on X-ray diffractometer tracings made from the concentrates; this was done in an effort to determine whether a correlation could be made between hematite:goethite ratio and flotation behaviour. There are substantial differences in the hematite:goethite ratios, but no unequivocal correlation could be made with flotation behaviour. The sample with the highest hematite:goethite ratio (KL-603-548-1) has satisfactory flotation characteristics; however sample KL-603-590-1 which also has good flotation characteristics ranks third in hematite:goethite ratio.

RECOMMENDATIONS

No mineralogical factors could be discovered that might serve to explain why the quartz in some samples of the ore can be removed more effectively than in other samples. However some possibilities can be eliminated: the different behaviours of the samples apparently cannot be explained by the presence of different kinds of silica-containing minerals, by differences in size distribution, or by substantial differences in the degree of liberation of the quartz and iron oxides.

One is left, therefore, to consider more subtle effects. The writer recommends that, if not already done, special tests be made to determine whether concentration tests on samples of the same kind of ore are reproducible; this would eliminate the possibility of the results being due to relatively minor changes in operating procedure at the beneficiation plant. After this possibility has been eliminated, attention might be directed toward the fine particles of iron oxides adhering to the surfaces of the quartz grains; it is quite possible that these may affect the flotation behaviour of the quartz and, if this is the case, investigation of methods for their control should be undertaken.