J. D. Johnston

O T T A W A  May 26th, 1942.

# R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1234.

## Sink-and-Float Tests on Samples of Quartz Ore from Powell Rouyn Mine at Noranda, Quebec.

(Copy No. 28)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Shipment:

Two samples of ore, weighing 425 pounds, were received on February 16th, 1942. The samples were submitted by D. S. Johnston, Powell Rouyn Gold Mines Limited, Noranda, Quebec.

Location of Property:

This property is situated in Rouyn township, Temiscamingue county, northwestern Quebec, about one mile from the town of Noranda.

Character of the Samples:

While no microscopic examination was made of the present shipment, it is the same type of siliceous ore that has been submitted on previous occasions and described in reports issued in 1937, 1939, and 1940.

Sampling and Assaying:

While no assay sample was taken from the shipment, head sample assays calculated from the products of tests are as follows:

| | | $SiO_2$, per cent | Gold, oz./ton |
|---|---|---|---|
| $-\frac{1}{8}$ inch rock | = | 73.74 | 0.128 |
| $+\frac{1}{8}$ inch rock | = | 71.30 | 0.118 |

Experimental Tests:

A series of small-scale sink-and-float tests was conducted on each of the samples submitted to determine their suitability or otherwise for concentration of the highly siliceous minerals by the sink-and-float process.

The working principle of this process is to separate according to their respective densities the lighter portions of the ore from the heavier portions in a bath of substantially stable galena-water suspension. The suspension serves the purpose of a solution of high specific gravity and is adjusted to such density as will allow the heavier portion of the ore to sink while the lighter portion floats and is skimmed off. The density of the separating medium is adjusted by simply altering the proportions of the galena

(Experimental Tests, cont'd) -

and the water.

Material finer than 8 mesh cannot be treated by this process under any circumstances and for any given ore the lower size limit may be coarser yet. The upper size limit is usually decided by the character of the ore and depends on the size at which the minerals to be separated are broken free from each other. The upper size limit is often somewhere in the neighbourhood of one inch.

The $-\frac{1}{2}$ inch sample submitted was screened on 8 mesh and the oversize treated without further crushing. The $+\frac{1}{2}$ inch sample submitted was crushed to minus one inch and the -8 mesh material screened out. Sink-and-float tests were conducted on the -1"+8 mesh fraction.

The tests will be described in detail as follows:

Test No. 1. - Size-Density Analysis of $-\frac{1}{2}$ Inch Rock.

Material finer than 8 mesh was screened from this sample, weighed, and assayed for gold and silica. The material coarser than 8 mesh was treated as follows:

A density separation was made at a medium density of 2.625. The float was taken out as a finished product and the sink was retreated at 2.65, giving an intermediate float and a second sink product. The second sink product was again retreated at 2.675, giving a second intermediate product and a final sink product.

Each of the density fractions was then screened on 3-, 4- and 6-mesh screens and the different sizes were weighed and assayed.

The results of this test are laid down in the following table:

## SIZE-DENSITY ANALYSIS.

(S.F. Test No. 31 - Powell Rouyn)

-½ Inch Rock

| Size Fractions | -6+8 Mesh | | -4+6 Mesh | | -3+4 Mesh | | -½"+3 Mesh | |
|---|---|---|---|---|---|---|---|---|
| | - W e i g h t p r o p o r t i o n s - | | | | | | | |
| DENSITY FRACTIONS | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed |
| Float @ 2.675 | 73.41 | 4.64 | 66.21 | 5.57 | 48.85 | 6.65 | 20.98 | 15.03 |
| Float @ 2.65; sink @ 2.625 | 20.12 | 1.27 | 20.86 | 1.76 | 24.11 | 3.28 | 18.09 | 12.96 |
| Float @ 2.675; sink @ 2.65 | 4.54 | 0.29 | 7.40 | 0.62 | 13.11 | 1.78 | 20.35 | 14.59 |
| Sink @ 2.675 | 1.93 | 0.12 | 5.53 | 0.47 | 13.93 | 1.89 | 40.58 | 29.08 |
| TOTAL - | 100.00 | 6.32 | 100.00 | 8.42 | 100.00 | 13.60 | 100.00 | 71.66 |
| | Assays, per cent | | Assays, per cent | | Assays, per cent | | Assays, per cent | |
| | $SiO_2$ | Au | $SiO_2$ | Au | $SiO_2$ | Au | $SiO_2$ | Au |
| Float @ 2.625 | 80.78 | 0.08 | 80.10 | 0.07 | 82.66 | 0.06 | 86.22 | 0.06 |
| Float @ 2.65; sink @ 2.625 | 68.28 | 0.09 | 73.94 | 0.09 | 84.76 | 0.10 | 77.04 | 0.06 |
| Float @ 2.675; sink @ 2.65 | 60.12 | 0.18 | 64.48 | 0.14 | 69.88 | 0.14 | 79.36 | 0.10 |
| Sink @ 2.675 | 39.92 | 1.98 | 43.98 | 0.46 | 49.30 | 0.22 | 58.42 | 0.19 |

-½ Inch Rock

(Test No. 1, cont'd) -

It will be noted that in almost every case the grade of product, with respect to silica, goes up as the particle size increases. The opposite is true with respect to the gold. This would indicate that the grade of the silica product could be raised by screening the feed to sink-and-float on 4 or 6 mesh but recovery would be lower.

The figures in the size-density analysis have been reduced to a density analysis by combining together all the fractions obtained at each separating density. The minus 8 mesh fines are also incorporated in this table in the proper proportion.

| Product | Weight, per cent | Assays | | Distribution, per cent | |
|---|---|---|---|---|---|
| | | $SiO_2$, per cent | Gold, oz./ton | $SiO_2$ | Gold |
| Float @ 2.625 | 25.47 | 83.62 | 0.065 | 29.17 | 12.69 |
| Float @ 2.65; sink @ 2.625 | 15.40 | 77.50 | 0.072 | 16.34 | 8.49 |
| Float @ 2.675; sink @ 2.65 | 13.81 | 77.54 | 0.107 | 14.66 | 11.37 |
| Sink @ 2.675 | 25.22 | 57.58 | 0.203 | 19.89 | 39.43 |
| -8 mesh fines | 20.10 | 72.10 | 0.18 | 19.94 | 28.02 |
| Ore | 100.00 | 73.03 | 0.130 | 100.00 | 100.00 |

This test indicates that with a separating density of 2.675 a product assaying 80.21 per cent $SiO_2$ and representing 54.78 per cent of the weight of ore treated would be floated off leaving sink plus fines to be treated in the cyanide plant. The two products together would assay 0.193 ounce per ton in gold.

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(Experimental Tests, cont'd) -

Test No. 2. - Confirmatory Test on -½ Inch Rock.

This separation was made in bulk on a sample of rock in the size range -½ inch +8 mesh. The separating densities were 2.675 and 2.70. This test was conducted to confirm the first test and, in addition, to find out whether or not any further recovery could be effected by using a higher separating density.

Summary of Results, Test No. 2.

| Product | Weight, per cent | Assays $SiO_2$, per cent | Assays Gold, oz./ton | Distribution, per cent $SiO_2$ | Distribution, per cent Gold |
|---|---|---|---|---|---|
| Float @ 2.675 | 51.78 | 83.62 | 0.06 | 58.10 | 26.67 |
| Float @ 2.70; sink @ 2.675 | 11.64 | 71.88 | 0.14 | 11.23 | 13.99 |
| Sink @ 2.70 | 16.48 | 50.76 | 0.20 | 11.22 | 28.29 |
| -8 mesh fines | 20.10 | 72.10 | 0.18 | 19.45 | 31.05 |
| Ore | 100.00 | 74.52 | 0.117 | 100.00 | 100.00 |

Separating at a density of 2.70, the average grade of the float would be 81.47 per cent $SiO_2$ and 0.075 ounce gold per ton and the feed to the cyanide plant would assay 0.189 ounce gold per ton. If the separation is made at a density of 2.675 the feed to the cyanide plant would assay 0.177 ounce gold per ton.

Test No. 3. - Size-Density Analysis on -½ Inch Rock.

This sample of rock was crushed finer than one inch and everything finer than 8 mesh screened out. A size-density analysis was then made as follows: The rock was sized on a series of screens at 1/8" intervals starting with 7/8 inch and going down to ½ inch. On each of these sized fractions a series of density separations was made similar to the procedure in Test No. 1. Separations were made at the following medium densities: 2.65, 2.675, and 2.70. The results of this test are laid down in the following table:

## SIZE-DENSITY ANALYSIS.

(S.F. Test No. 32 - Powell Rouyn)

$+\frac{1}{2}$ Inch Rock

| Size Fractions | $-\frac{1}{2}+8$ Mesh | | $-5/8"+\frac{1}{2}"$ | | $-\frac{3}{4}"+5/8"$ | | $-7/8"+\frac{3}{4}"$ | | $-1"+7/8"$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | - W e i g h t P r o p o r t i o n s - | | | | | | | | | |
| DENSITY FRACTIONS | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed | % Size fraction | % S.F. feed |
| Float @ 2.65 | 47.46 | 12.79 | 22.00 | 3.74 | 12.00 | 2.02 | 16.55 | 4.17 | 10.63 | 1.49 |
| Float @ 2.675; sink @ 2.65 | 18.92 | 5.10 | 20.13 | 3.42 | 23.35 | 3.94 | 9.43 | 2.37 | 14.41 | 2.02 |
| Float @ 2.70; sink @ 2.675 | 12.50 | 3.37 | 27.64 | 4.70 | 18.49 | 3.12 | 33.64 | 8.46 | 34.92 | 4.90 |
| Sink @ 2.70 | 21.12 | 5.69 | 30.23 | 5.14 | 46.16 | 7.79 | 40.38 | 10.16 | 40.04 | 5.61 |
| TOTAL - | 100.00 | 26.95 | 100.00 | 17.00 | 100.00 | 16.87 | 100.00 | 25.16 | 100.00 | 14.02 |
| | Assays, per cent | | Assays, per cent | | Assays, per cent | | Assays, per cent | | Assays, per cent | |
| | $SiO_2$ | Au | $SiO_2$ | Au | $SiO_2$ | Au | $SiO_2$ | Au | $SiO_2$ | Au |
| Float @ 2.65 | 82.80 | 0.07 | 90.58 | 0.07 | 91.34 | 0.05 | 91.58 | 0.05 | 85.24 | 0.08 |
| Float @ 2.675; sink @ 2.65 | 76.40 | 0.10 | 83.02 | 0.06 | 83.92 | 0.08 | 86.60 | 0.09 | 88.20 | 0.25 |
| Float @ 2.70; sink @ 2.675 | 69.40 | 0.14 | 73.60 | 0.11 | 74.30 | 0.15 | 76.70 | 0.13 | 75.00 | 0.08 |
| Sink @ 2.70 | 48.50 | 0.18 | 54.30 | 0.20 | 55.00 | 0.14 | 58.60 | 0.11 | 54.60 | 0.14 |

$+\frac{1}{2}$ Inch Rock

(Test No. 3, cont'd) -

Here again it will be noticed that as the particle size increases the grade of the products rise in silica and drop in gold as a general rule. There seems to be some evidence of a departure from this rule in the coarsest fraction, which might indicate that -7/8 inch is the economical upper size limit. The indications are indefinite, however, and a confirmatory test conducted on a sample of ore crushed -7/8 inch failed to show any improvement in grade with respect to silica. It may therefore be that the upper size limit has not yet been reached.

Following is a density analysis calculated from the figures in the size-density analysis:

| Product | Weight, per cent | Assays | | Distribution, per cent | |
|---|---|---|---|---|---|
| | | $SiO_2$, per cent | Gold, oz./ton | $SiO_2$ | Gold |
| Float @ 2.65 | 22.15 | 86.38 | 0.065 | 26.69 | 11.86 |
| Float @ 2.675; sink @ 2.65 | 15.43 | 82.35 | 0.104 | 17.72 | 13.09 |
| Float @ 2.70; sink @ 2.675 | 22.45 | 74.46 | 0.12 | 23.31 | 22.04 |
| Sink @ 2.70 | 31.47 | 54.82 | 0.147 | 24.06 | 37.73 |
| -8 mesh fines | 8.50 | 69.34 | 0.22 | 8.22 | 15.28 |
| Ore | 100.00 | 71.70 | 0.122 | 100.00 | 100.00 |

If a separation be made at a density of 2.675 the float would assay 84.73 per cent silica and 0.081 ounce per ton gold. The feed to the cyanide plant would assay 0.147 ounce per ton gold. If a separation were made at a density of 2.70 the float would assay 80.89 per cent silica and 0.096 ounce per ton gold. The feed to the cyanide plant would then assay 0.162 ounce per ton gold.

(Experimental Tests, cont'd) -

Test No. 4. - Confirmatory Test on +½ Inch Rock.

In this test the separations were made in bulk at densities of 2.675 and 2.70. The object of the test was to confirm the results indicated by the size-density analysis. The products were assayed for silica and gold. For this test the size range of the ore was -1"+8 mesh.

Summary of Results, Test No. 4.

| Product | Weight, per cent | Assays $SiO_2$, per cent | Assays Gold, oz./ton | Distribution, per cent $SiO_2$ | Distribution, per cent Gold |
|---|---|---|---|---|---|
| Float @ 2.675 | 32.71 | 85.55 | 0.07 | 39.87 | 18.72 |
| Float @ 2.70; sink @ 2.675 | 25.94 | 72.50 | 0.07 | 26.79 | 14.84 |
| Sink @ 2.70 | 32.35 | 53.04 | 0.19 | 24.45 | 50.25 |
| -8 mesh fines | 9.00 | 69.34 | 0.22 | 8.89 | 16.19 |
| Ore | 100.00 | 70.19 | 0.122 | 100.00 | 100.00 |

If the separation be made at a density of 2.70 the float would assay 79.78 per cent silica and 0.070 ounce per ton gold and the feed to the cyanide plant would assay 0.197 ounce per ton gold. If the separation be made at 2.675 the feed to the cyanide plant would assay 0.148 ounce per ton gold.

Test No. 5. - Further Confirmatory Test on +½ Inch Rock.

In this test the ore was crushed -7/8 inch and the separation made on the size range -7/8"+8 mesh. Separations were made at densities of 2.675 and 2.70. This test was conducted to see if the silica assay of the float would be any higher because of the finer crushing, the size-density analysis having indicated this possibility.

(Continued on next page)

(Test No. 5, cont'd) -

Summary of Results Test No. 5.

| Product | Weight, per cent | Assays $SiO_2$, per cent | Assays Gold, oz./ton | Distribution, per cent $SiO_2$ | Distribution, per cent Gold |
|---|---|---|---|---|---|
| Float @ 2.675 | 42.40 | 83.64 | 0.06 | 49.24 | 22.86 |
| Float @ 2.70; sink @ 2.675 | 14.03 | 74.58 | 0.12 | 14.53 | 15.13 |
| Sink @ 2.70 | 33.57 | 57.08 | 0.14 | 26.60 | 42.24 |
| -8 mesh fines | 10.00 | 69.34 | 0.22 | 9.63 | 19.77 |
| Ore | 100.00 | 72.02 | 0.111 | 100.00 | 100.00 |

Separating the ore at a density of 2.675 would give a product for cyanidation assaying 0.149 ounce per ton in gold. Separating the ore at a density of 2.70 would give a float product assaying 81.39 per cent silica and 0.075 ounce per ton in gold, leaving a product for cyanidation assaying 0.158 ounce per ton gold.

A comparison of the results of Tests Nos. 4 and 5 reveals only slight differences and these may be attributed to peculiarities of the samples rather than to the difference in crushing.

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CONCLUSIONS:

The results of these tests indicate that the grade of product to be used as smelter flux can be improved by this process and at the same time the feed to the cyanide plant will also be improved.

The ore can be treated successfully in the size range -1"+8 mesh and it is possible that this upper size limit might be increased. At the same time, however, the grade of

(Conclusions, cont'd) -

the float product with respect to silica could be improved by moving the lower size limit up to 4 or 6 mesh. This, of course, would reduce the tonnage available for sale to a smelter.

The size-density analyses indicate that the coarse sizes produce the highest grade floats and it would therefore be wise to treat the ore at the coarsest size possible.

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