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HARRIS MINING COMPANY'S COARSE MICA FLOTATION PILOT PLANT

by
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ABSTRACT

Approximately fifty-eight tons of minus nine mesh, partially deslimed, rod milled ore was processed in twenty-nine flotation pilot plant tests. In an ideal test, 95% of the mica was recovered with an 89% mica grade. This is considerable improvement over present plant practice in which coarse mica is recovered in a separation process based on shape factors and using Humphrey spirals.

*This report made public April 17, 1980. Courtesy of Harris Mining Company.

78-20

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HARRIS MINING COMPANY'S
COARSE MICA FLOTATION PILOT PLANT

RML Project No. 89 - October, 1978
Lab Nos. 4483, 4485, 4487, 4490, 4496, 4511, 4517
Book Nos. 405, 409

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INTRODUCTION

In March, 1978, a project, RML-86, entitled "Harris Mining Company's Plant Feed Preparation Study" was completed. Data developed in this project showed the possibility of increasing coarse mica grade and recovery by flotation when compared with plant Humphrey spiral separation process. A project, RML-89, entitled "Harris Mining Company's Coarse Mica Flotation Pilot Plant" was undertaken to verify previous test results in a pilot plant.

Sampling of spirals during operation, and analysis of plant feed and tailings showed an 18-40% mica recovery. Plant products analyzed approximately 70% mica and 30% sand. The ideal flotation pilot plant resulted in a 95% mica recovery and 89% mica grade. The average of the twenty-nine pilot plant tests was 69.3% mica recovery and 68.3% mica grade. The average of the 6 best tests was 86.6% mica recovery and 82.3% mica grade.

SAMPLES

Pilot plant feed samples of approximately eight tons each were obtained by Harris Mining Company personnel from on-stream production of -9 mesh trommel-screened, partially deslimed ore. Seven samples, over a period of weeks, were trucked to the Laboratory as needed. The mica content varied from 6.1 to 15.5% mica with an average of 9.3% mica. Some booky (not delaminated) mica was noted in all of the samples. The samples contained approximately 18% moisture. The grain size, excluding coarse +1/4 inch rock contaminant resulting from hole in trommel screen, loading, or other sources, ranged from 9 mesh to 150 mesh in addition to approximately 12% -150 mesh clay slimes. Chemical analyses were obtained on one of the feed samples and are shown in Appendix B (Page 48).

PROCEDURE

Pilot Plant Description

The pilot plant flowsheet is presented in Figure 1. The ore was loaded into 55-gallon drums, weighed, and then fed into the feed-belt

hopper. The ore was fed at approximately 600 pounds (dry basis) per hour and regulated through the feed hopper by an adjustable gate. The belt conveyor discharged onto a stationary screen, consisting of 1/4" square holes, for the removal of tramp oversize material. The undersize material was washed through the screen with water sprays. The quantity of oversize material was insignificant and was discarded as waste. The undersize material was pumped to a three-inch Dorrco cyclone for desliming at 150 mesh (Tyler). The cyclone overflow slimes flowed to a common sampling point, along with subsequent slimes from other equipment, and discharged to waste. The underflow was dewatered in an 8-foot X 12-inch screw classifier and fed at controlled percent solids density to a 3-pot Wemco scrubber. The screw overflow went to slime disposal. The scrubbed material was diluted with water and pumped to a 3-inch Dorrco cyclone to remove slime, which was sent to the common slime disposal. The cyclone underflow was diluted with water and pumped to a 3-inch Dorrco cyclone for additional removal of slime, which was sent to the common slime disposal. The cyclone underflow was dewatered in an 8-foot X 9-inch screw classifier and fed at controlled percent solids density to a 2-pot 1.74 cubic foot conditioner. The screw overflow went to slime disposal. All cyclone overflows and dewatering-screw overflows were combined and sampled. In the conditioner, sulfuric acid and fuel oil were added with sufficient water to establish a desired pulp density. In most tests, amine and frother were added in the conditioner discharge hose to allow for a short period of contact before the material entered the flotation cells. The conditioner discharge was fed to a 4-cell, at 2.75 cubic foot, Denver No. 8 rougher flotation machine. Water was added to the rougher cells for density control. The tailings from the rougher cells, which included (most tests) the cleaner tailings, were sampled and pumped to 4-foot diameter by 4-foot high, open-bottom cyclindrical containers for drainage and disposal. The rougher concentrates flowed by gravity to the first cleaner stage, and sulfuric acid was added to the cell for pH control. The cleaner tailings were recirculated into the rougher cells through the rougher standpipe suction and subjected to possible additional recovery in the rougher cells. The cleaner concentrates flowed by gravity to a second cleaning stage. The second cleaner tailings recirculated through the first cleaner cell and rougher cell for possible additional recovery. The concentrates were sampled as they flowed by gravity to drum dewatering and storage.

Sampling & Control

A head feed sample was taken every half hour for moisture determination so that the exact dry weight of ore processed each day could be calculated. The same sample was also used as a head feed sample for mica analysis. Timed samples of various process streams were taken for operational control and to provide data for determining material balances. The samples were dried each day, weighed, and a portion split out for mica analysis. Samples of pulps from various streams were obtained during operation to determine percent solids, density and pH. Water quantities to all equipment were monitored and controlled continuously.

Analyses

Mica Determination - The mica content was determined with the aid of a Frantz Isodynamic magnetic separator (mica is removed on the magnetic side). The samples were screened (most tests) on 65 mesh and, the plus and minus fractions assayed separately for better accuracy and additional data.

Screen Analyses - Samples were screened on a Ro-Tap for 30 minutes using appropriate screens and reported as Tyler Mesh.

Reagent Make-Up and Feeding

Sodium Hydroxide - Tycar Chemical Company's sodium hydroxide was used for slime dispersion and fed at 2 1/2% strength to the scrubber with a Brosites feeder.

Sulfuric Acid - Tycar Chemical Company's 66° Baume acid, made up to 10% strength by weight, was fed to the conditioner and cleaner cell with a Brosites feeder.

Fuel Oil - No. 2 fuel oil was fed to the conditioner with a Denver Equipment Company cup and disk feeder.

Amine - Armour Armac-T was used for most tests and AZ 2642-1 used in some tests. Several amines were tested in batch tests, see Appendix B. The amine was made up to 2 1/2% strength and fed to the rougher flotation cells with a Brosites feeder.

Frother - American Cyanamid Company's F-65 was used in most tests, and Hunticol H-26 used in some tests. The frother was made up to 2 1/2% strength and fed with a Brosites feeder.

Water Regulation

Flowrators were used to regulate the water distribution throughout the pilot plant, and a totalizing meter used to record the total water consumption. Total water used was 9,672 gallons per ton of ore.

Air Regulation

Flowrators were used to regulate air to the flotation cells when operating with auxiliary air in the later tests. Self-induced air was not regulated with flowrators.

Batch Tests

Batch tests were conducted on the pilot plant feed samples so that data could be correlated with that of the pilot plant. Samples from various pilot plant streams were subjected to flotation in a batch cell to pinpoint the effects of pilot plant scrubbing, conditioning, retention times, or float cell operation. Process variables and reagent types were explored by batch flotation.

Scale-Up to Commercial Plant

Based on pilot plant equipment size and data, a scale-up to a 20 tons-per-hour-feed commercial plant is submitted as a guide.

Water Requirements -

No. 1 Pump (20 TPH Solids @ 25% Solids)
GPM Pulp-269
GPM Water-240
No. 2 Pump (18 TPH Solids @ 25% Solids)
GPM Pulp-242
GPM Water-216
No. 3 Pump (18 TPH Solids @ 25% Solids)
GPM Pulp-242
GPM Water-216

Scrubber (18 TPH @ 65% Solids)
GPM Water-39
Conditioner (18 TPH @ 55% Solids)
GPM Water-59
Rougher Cells (18 TPH @ 12% Solids)
GPM Water-528
Cleaner Cells (2 TPH @ 7% Solids)
GPM Water-106

Equipment Size (Based on tons of feed to each step)
Scrubber (6.39 cu ft/ton of ore*)
Total cu ft - 115
Conditioner (5.22 cu ft/ton of ore*)
Total cu ft - 94
Rougher Cells (30.56 cu ft/ton of ore* used in pilot plant; however, only half of the rougher cells floated the majority of the mica.) Scale-up based on 15.28 cu ft/ton of ore* and allow one extra cell for control.
Total cu ft - 275 + one extra cell
Cleaner Cells (15.28 cu ft/ton of ore*)
Total cu ft - 275
Air Blower (8 CFM per 2.75 cu ft cell)
Total CFM - 2401

RESULTS

Data pertaining to each pilot plant test are shown in Appendix A. Batch testing data are shown in Appendix B. Screen analyses and mica distribution by sizes, for batch and pilot plant tests, are shown in Appendix C. The standard flowsheet is shown in Figure 1, and a graph depicting the mica recovery and grade at various mesh sizes, as obtained in Pilot Plant 21, is shown in Figure 2.

Pilot Plant Test No. 1

Rougher flotation cells were operated as open-trough with Sub-A standpipes. Cleaner tailings were circulated through rougher cells.

*Ore refers to pilot plant feed.

Conditioner contained baffles. Scrubber discharged from top outlet. No sulfuric acid was added to cleaner cells. The objective of this test was to adjust equipment, obtain data relating to process variables and make attempt at sampling. Seventy-four percent of the mica was recovered with a 71.1% mica grade. Batch tests on this ore gave a 90.7% mica recovery with a 90.8% mica grade.

Batch flotation test using pilot plant retention times for scrubbing and conditioning resulted in a 96.5% mica recovery with an 89.2% mica grade. Batch flotation tests based on amine reagent types showed a 98.8% mica recovery and 90.3% mica grade for Armac-T; 87.4% mica recovery and 96.9% mica grade for AZ-2642; and 64.1% mica recovery and 98.4% mica grade for AZ-180.

Pilot Plant Test No. 2

Sulfuric acid was added to the first cleaner cell and the scrubber discharge lowered to the center outlet. Fifty-six percent of the mica was recovered with a 77.5% mica grade.

Pilot Plant Test No. 3

Vortex finders in cyclones were changed from 3/8" diameter to 3/4" diameter. Rougher flotation cells were converted to Sub-A (cell to cell). Seventy-nine percent of the mica was recovered with a 75.0% mica grade. Batch flotation test on pilot plant feed material to conditioner was conducted using pilot plant reagents, percent solids, and retention times. Eighty-eight percent of the mica was recovered with a 69.1% mica grade.

Pilot Plant Test No. 4

Changed ores. Auxiliary air was provided to cells. Vortex finders in cyclones were increased to 1" diameter. Seventy-four percent of the mica was recovered with a 72.9% mica grade. A standard batch flotation test with 65% solids scrub resulted in 95.0% mica recovery with an 81.9% mica grade. A batch flotation test deslimed on 150 mesh instead of 200 mesh gave a 95.8% mica recovery with a 79.0% mica grade. A batch flotation test with a higher (70.0%) solids scrub resulted in a 99.5% mica recovery with a 74.4% mica grade.

Pilot Plant Test No. 5

Installed additional cyclone desliming step following scrubbing and removed baffles from conditioner in an effort to remove more slimes from the pulp. Sixty-six percent of the mica was recovered with a 76.0% mica grade. Batch flotation of pilot plant rougher cell feed at 1800 rpm impeller speed resulted in a 94.0% mica recovery with a 49.9% mica grade. The same test but with 1200 rpm impeller speed resulted in a 99.2% mica recovery with a 42.5% mica grade. Batch flotation test of pilot plant tailings resulted in 52.2% mica recovery with a 34.5% mica grade. Batch flotation of pilot plant rougher cell feed including a cleaner stage resulted in a 96.9% mica recovery with a 53.7% mica grade.

Pilot Plant Test No. 6

Reduced flotation cells rpm from 740 to 490. Removed large stopper from divider between No. 1 and No. 2 cleaner cells. Used 1/4"-diameter-opening sand relief stoppers in all cells. Air compressor quit operating before 11:00 a. m., opened air intake to atmospheric in all cells, but air found to be insufficient due to low impeller rpm. Sixty-three percent of the mica was recovered with a 72.4% mica grade. A standard batch flotation test resulted in an 88.5% mica recovery and 66.9% mica grade. Batch flotation with 8 minutes conditioning time in cell gave a 1.81% mica tailing. The same test but with frother added after conditioning in cell gave a 1.6% mica tailing. Batch flotation test whereby froth was removed for one minute, then agitate for three minutes, then removed remaining froth resulted in a 0.9% mica tailing. A standard batch flotation test, except floated at 25% solids, resulted in a 1.4% mica tailing. Batch flotation test of deslimed ore with 8 minute conditioning time in cell and 1800 rpm impeller speed resulted in a 1.7% mica tailing. Batch flotation test with 8 minute conditioning time in cell and AZ amine resulted in a 3.0% mica tailing. Batch flotation test with 8 minute conditioning time in cell and pine oil frother instead of F-65 resulted in 1.4% mica tailing. A good batch flotation tailing was established at 1.5% mica.

Pilot Plant Test No. 7

Changed ore. Fed rougher cells via divider gate into standpipe suction instead of on surface of water. Changed to 3/8"-diameter-opening sand relief stoppers. Sixty percent of the mica was recovered with a 62.4% mica grade.

Pilot Plant Test No. 8

Ran rougher flotation cells only, no circulating middlings, no cleaner cells. Installed second froth-remover blades on all cells. Fed conditioned material near front of rougher cell on surface of pulp. Replaced diffuser in No. 4 cell (three teeth were missing). Eighty-nine percent of the mica was recovered with a 46.2% mica grade in a rougher float with no cleaners. By screening the concentrate on 65 mesh, 76.9% of the mica was recovered with a 77.7% mica grade.

Pilot Plant Test No. 9

Cleaner tailings were caught in a drum, not circulated. Installed froth control water at back of cleaner cells to assist in removing froth. Fifty-one percent of the mica was recovered with a 73.9% mica grade.

Pilot Plant Test No. 10

Circulated cleaner tailings to No. 2 pump and back through 2 cyclones, spiral classifier and conditioner. Eighty-eight percent of the mica was recovered with a 65.4% mica grade. By screening the concentrate on 65 mesh, 82.6% of the mica was recovered with an 83.7% mica grade.

Pilot Plant Test No. 11

Eliminated No. 2 cleaner cell and circulated No. 1 cleaner cell tailings through rougher cells. Eighty-one percent of the mica was recovered with a 61.9% mica grade. By screening on 65 mesh, 71.6% of the mica was recovered with an 86.9% mica grade. Standard batch flotation test with desliming on 150 mesh resulted in 98.4% mica recovery and 81.3% mica grade. The same test except desliming on 200 mesh resulted in 91.4% mica recovery and 57.4% mica grade. Batch flotation of reagentized pilot plant flotation feed resulted in an 89.0% mica recovery and 58.2% mica grade.

Pilot Plant Test No. 12

Changed ore. Amine added to all cells. One cleaner stage. Scrubber discharge changed from middle outlet to bottom outlet. Fifty-three percent of the mica was recovered with a 74.2% mica grade. Standard batch test with high (70%) solids scrub resulted in 95.3% mica recovery with 95.5% mica grade. The same test but with 60% solids scrub resulted in 96.5% mica recovery and 92.8% mica grade.

Pilot Plant Test No. 13

Converted rougher cells to open trough. Circulated cleaner tailings to No. 2 pump. One cleaner stage only. Sixty-two percent of the mica was recovered with a 67.2% mica grade.

Pilot Plant Test No. 14

Converted rougher cells to Sub-A (cell to cell). Plugged leaks in level control gates. Ran cleaner cell on self-generated air, other cells on auxiliary air. Changed No. 1 cleaner cell standpipe so it would not pull through No. 2 cleaner cell. Increased sand relief holes in rougher cells to 1/2" diameter openings. Cleaner tailings caught in drum and not circulated. Cleaner cell ran flooded. Seventy-seven percent of the mica was recovered with a 59.2% mica grade.

Pilot Plant Test No. 15

Installed second cleaner, both cleaner tailings caught in drum. Rougher cells operated on auxiliary air, cleaner cells on self-generated air. Froth-control gates leaks sealed. Amine added to No. 1 and No. 2 rougher cells and No. 1 cleaner cell. Thirty-four percent of the mica was recovered with a 69.3% mica grade.

Pilot Plant No. 16

Used two cleaner stages and cleaner tailings caught in drum. Speeded up cells from 490 to 700 rpm. Amine in cleaner changed from surface addition to partition addition. Cleaner cells converted to auxiliary air. Slimes were generated and showed up in mica concentrate drum. Thirty-two percent of mica was recovered with a 69.6% mica grade.

Pilot Plant No. 17

Changed ore. Reduced all cells to 490 rpm. Auxiliary air provided to No. 1 and No. 2 rougher cells, self generated to No. 3 and No. 4 rougher cells. One cleaner stage only. Cleaner tailings caught in drum. Baffles installed in corners of all cells to reduce turbulence. Sand relief holes increased to 3/4" diameter openings. Forty-three percent of the mica was recovered with a 67.0% mica grade. Standard batch test with a high (70%) solids scrub resulted in an 89.8% mica recovery with an 80.1% mica grade. The same test but with a low (60%) solids scrub resulted in a 96.6% mica recovery with an 83.1% mica grade. The same test, but with ferric sulfate added to float, resulted in a 97.3% mica recovery with a 94.4% mica grade. Batch test with pilot plant retention times and percent solids resulted in a 97.1% mica recovery with a 96.8% mica grade.

Pilot Plant No. 18

Cleaner tailings caught in drum. Auxiliary air used in rougher and cleaner cells. Reduced amount of pipe fittings from air header to increase available air. Raised conditioner outlet to middle outlet. Each cleaner cell measured at 6 CFM and each rougher cell at 8 CFM of air. Sixty-four percent of the mica was recovered with a 66.2% mica grade.

Pilot Plant No. 19

Reduced reagent rates to near batch test level. Same physical set-up as pilot plant No. 18. Eighty-six percent of the mica was recovered with a 77.4% mica grade. By screening on 65 mesh, 70.5% of the mica was recovered with a 95.5% mica grade.

Pilot Plant No. 20

All cells on auxiliary air and increased air volume. Conditioner discharge material fed to back of No. 1 rougher cell. Used batch flotation reagent rates. Ninety-two percent of the mica was recovered with a 71.8% mica grade. By screening on 65 mesh, 85.5% of the mica was recovered with a 96.1% mica grade.

Pilot Plant Test No. 21

Installed large stopper with 1/2" diameter hole in intake of No. 1 cleaner cell from No. 2 cleaner cell to assist in controlling froth level. Ninety-five percent of the mica was recovered with an 88.9% mica grade. These results are comparable to batch flotation tests.

Pilot Plant Test No. 22

Rougher cells converted to open trough, otherwise same as pilot plant No. 21. Changed standpipes in rougher cells No. 2, 3, 4 to D-R. Ninety-six percent of the mica was recovered with an 82.5% mica grade. By screening on 65 mesh, 78.7% of the mica was recovered with a 97.4% mica grade.

Pilot Plant Test No. 23

Same as pilot plant test No. 22 except changed amines to AZ-180. Seventy-seven percent of the mica was recovered with a 76.6% mica grade. Tailings increased from 0.5 to 3.5% mica compared with test No. 22 in which Armac-T was used.

Pilot Plant Test No. 24

Changed conditioner hose to discharge into partition between 1st cleaner cell and rougher cell instead of on surface of rougher pulp. Changed to amine AZ-2642 and H-26 frother. Eighty-two percent of the mica was recovered with a 76.5% mica grade. By screening on 80 mesh, 74.6% of the mica was recovered with a 93.9% mica grade. Batch flotation test amine-rate series resulted in a 97.9% mica recovery with a 91.8% mica grade for a 0.7 lb/ton-of-ore reagent rate; 98.1% mica recovery with an 87.2% mica grade for a 0.9 lb/ton-of-ore reagent rate, and 98.7% mica recovery with a 76.8% mica grade for a 1.1 lb/ton-of-ore reagent rate. Standard batch flotation test but with AZ-2642 amine and pine oil frother resulted in a 96.4% mica recovery with a 90.4% mica grade. Standard batch flotation test but with AZ-2642 amine and H-26 frother resulted in a 98.8% mica recovery with an 89.5% mica grade.

Pilot Plant Test No. 25

Changed ore. Used Amine AZ-2642. Eliminated No. 3 and 4 rougher cells. Air turned off on No. 3 and 4 rougher cells to lower froth and pulp level. Coarse mica dropped out in tailings due to short-circuiting. Batch flotation and screening of pilot plant tailings showed coarse mica in tailings. Scrubber solids were too low, slime noted in mica concentrate. Sixty-eight percent of the mica was recovered with a 36.3% mica grade. Batch flotation test using AZ-2642 amine and pine oil frother, in the float, and sodium silicate in the scrubber in place of sodium hydroxide, resulted in 47.3% of the mica recovered with a 96.5% mica grade. Batch flotation test using AZ-2642 amine and H-26 frother in the float, and sodium hydroxide in the scrubber in place of sodium silicate, resulted in 94.4% mica recovery with an 87.6% mica grade.

Pilot Plant Test No. 26

Changed back to four rougher cells, otherwise same as pilot plant No. 25. Changed conditioner discharge hose into surface of No. 1 rougher cell. All cells ran flooded, and recovery appeared to improve. Sixty-nine percent of the mica was recovered with a 53.3% mica grade. Batch flotation of feed to pilot plant rougher cell resulted in 91.7% mica recovery with a 64.5% mica grade.

Pilot Plant Test No. 27

Reduced amine rate, otherwise same as pilot plant test No. 26. Conditioner discharged into partition between cleaner and rougher cells. Used AZ-2642 amine. Eighty-four percent of the mica was recovered with a 55.9% mica grade. By screening on 80 mesh, 72.2% of the mica was recovered with an 84.3% mica grade.

Pilot Plant Test No. 28

Painted inside of cells. Rougher cells operated as Sub-A (cell to cell). Used three rougher cells and two cleaner cells. Used AZ-2642 amine. Thirty-seven percent of the mica was recovered with a 71.8% mica grade. By screening on 80 mesh, 31.1% of the mica was recovered with a 91.5% mica grade.

Pilot Plant Test No. 29

Same procedure and conditions as pilot plant test No. 28 except changed to Armac-T amine during the run. This test can be compared with pilot plant test No. 28 for effect of different amines. Seventy-two percent of the mica was recovered with a 64.3% mica grade. By screening on 80 mesh, 63.1% of the mica was recovered with an 87.4% mica grade.

DISCUSSION

The average for 29 pilot plant tests was 69.3% mica recovery with a 68.3% mica grade. The average for standard batch flotation tests was 94.6% mica recovery with an 86.6% mica grade. For 29 pilot plant tests, the average mica concentrate after screening contained 59.4% of the mica with an 89.1% mica grade. For standard batch flotation tests, the average mica concentrate after screening recovered 63.3% of the mica and contained 93.5% mica. A comparison of data indicates that the pilot plant grade is lowered by fine-size silica contamination, and recovery is lowered by short circuiting or failure to float booky (insufficiently delaminated) mica. Reduced rougher-tailings losses are noted in tests in which the cleaner tailings were not recirculated through the rougher cells. A good comparison of grades and recoveries between pilot plant and batch testing was obtained during some of the later tests.

Slimes were found to have adverse effect on efficient separation, and good scrubbing and desliming were required.

While satisfactory (70% grade and 70% recovery) results were obtained in most of the first seventeen runs, the pilot plant did not produce as good as batch testing. Considerable improvement was accomplished after that, and comparable results were obtained. The improvement in grade and recovery can be credited primarily to increased and controlled aeration in the flotation cells.

Armac-T amine reagent was found to be more effective than AZ-2642; however, AZ-2642 amine may work just as well in a commercial plant where the distance of travel through the flotation cells would be longer. It appears that AZ-2642 amine is a little slower than Armac-T in floating mica.

Open-trough flotation cells with D-R standpipes worked equally as well as Sub-A cell-to-cell installation.

CONCLUSIONS

1. Flotation can be used in place of Humphrey spirals to recover coarse (-9 mesh) mica.
2. Flotation mica recoveries in the pilot plant averaged 69.3% with several tests exceeding 90%. The company's Humphrey - spirals-plant mica recoveries varied from 18% to 40%.
3. Flotation mica grade in the pilot plant averaged 68.3% which is approximately the same as the company's Humphrey-spirals-plant product.
4. Exact control of reagents and feed rate, as well as use of sufficient scrubbing, desliming, and air volume to cells are necessary for efficient flotation operation.

TABLE A

HARRIS MINING COMPANY

PILOT PLANT SUMMARY

P.P. No.	Lab No.	Mica Conc. Grade	Mica Conc. Rec. %	Screened Conc. Grade	Screened Conc. Rec. %	Remarks
2	4483	77.5	56.2	99.3	48.1	Armac-T 1.57 (lb/ton) Open trough.
3	4483	75.0	79.0	91.8	67.7	Armac-T 1.39 Sub-A.
4	4485	72.9	73.5	92.5	54.5	Armac-T 1.03 Aux. air.
5	4485	76.0	65.6	80.5	56.4	Armac-T 1.58
6	4485	72.4	62.5	93.5	53.0	Armac-T 1.45 Reduced cell rpm.
7	4487	62.4	59.8	84.8	53.9	Armac-T 1.54
8	4487	46.2	89.4	77.7	76.9	Armac-T 1.09 Ro. flot. only.
9	4487	73.9	51.0	87.5	46.5	Armac-T 1.43 Cleaner tails caught in drum.
10	4487	65.4	87.6	83.7	82.6	Armac-T 1.62 Cir. cl. tails thru cond.
11	4487	61.9	81.4	86.9	71.6	Armac-T 1.35 1 cleaner cell.
12	4490	74.2	53.3	94.8	46.0	Armac-T 1.20 Amine fed to all cells.
13	4490	67.2	62.4	91.5	54.2	Armac-T 1.49 ro. cell, 0.43 cl. cell Open trough. Cir. cl. tails.
14	4490	59.2	77.3	87.7	65.9	Armac-T 1.42 Sub-A. Aux. air & self air.
15	4490	69.3	34.1	93.8	28.4	Armac-T 1.52, 0.32 Aux. air & self air. Cl. tails in drum.
16	4490	69.6	32.3	95.9	26.9	Armac-T 1.74, 0.22 Speed up cells. Ro. and cl. cells on aux. air.
17	4496	67.0	42.6	93.5	36.0	Armac-T 1.93, 0.24 Slowed cells. Aux. air 1 & 2 cells.
18	4496	66.2	63.9	93.4	54.3	Armac-T 2.08, 0.27 Eliminated fittings from air header.
19	4496	77.4	85.5	95.5	70.5	Armac-T 0.46 Reduced reagents to batch level.
20	4496	71.8	91.9	92.1	89.8	Armac-T 0.56 All cells aux. air increased vol.
21	4496	88.9	94.8	98.1	77.7	Armac-T 0.53 1/2" sand relief 1st cl. cell to cell.
22	4496	82.5	96.3	97.4	78.7	Armac-T 0.47 Open trough.
23	4496	76.6	77.1	97.5	59.8	Amine 180, 1.09
24	4511	76.5	82.0	93.9	74.6	Amine 2642-1, 0.84

(continued on next page)

TABLE A

HARRIS MINING COMPANY

PILOT PLANT SUMMARY

(continued from previous page)

P.P. No.	Lab No.	Mica Conc. Grade	Mica Conc. Rec. %	Screened Conc. Grade	Screened Conc. Rec. %	Remarks
25	4517	36.3	67.8	41.7	56.8	Amine 2642-1 New ore. 2-ro. cells. Lots of clay.
26	4517	53.3	69.2	87.3	56.6	Amine 2642-1, 1.41 4 ro. cells.
27	4517	55.9	83.6	84.3	72.2	Amine 2642-1, 0.91
28	4517	71.8	36.6	91.5	31.1	Amine 2642-1, 0.56 Sub-A.
29	4517	64.3	71.8	87.4	62.0	Armac-T 0.46 Changed amine.
Average pilot plant test		68.3	69.3	89.1	59.4	
Average of 6 best pilot plant tests		82.3	86.6	96.4	74.5	Test Nos. 19, 20, 21, 22, 23, 24
Average batch tests		86.6	94.6	93.5	63.3	

TABLE B

EXAMPLE OF IDEAL PILOT PLANT RUN (Test No. 21)

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	9.7	88.9	94.8	
Tailings	78.8	0.6	5.2	
-150 M, Slimes	11.5	-	-	
Plant Feed	100.0	9.1	100.0	
+65 M Mica Concen.	7.3	98.1	77.7	82.0
-65 M Mica Concen.	2.4	65.4	17.1	18.0
Total Mica Concen.	9.7	88.9	94.8	100.0
+100 M Mica Concen.	8.0	96.9	85.9	90.6
-100 M Mica Concen.	1.7	47.3	8.9	9.4
Total Mica Concen.	9.7	88.9	94.8	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	15.5	65	-	480	1.56	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	10.0	52	2.0	740	-	4.45	1.73	-	-
Rougher Float	14.3	17	2.4	490	-	-	-	0.53	0.31
Cleaner Float	-	-	2.5	700	-	2.39	-	-	-
Cleaner Float	-	-	3.4	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 620 lbs per hour
Ratio of concentration - 10.3
Installed large stopper with 1/2" d. hole in intake of No. 1 cleaner cell from No. 2 cell.

APPENDIX A

PILOT PLANT TESTS

TABLE 1

PILOT PLANT TEST NO. 1

Lab. No. 4483 Date: 3/28/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.9	71.1	73.9
Tailings	86.7	2.0	26.1
-150 M, Slimes	6.4	-	-
Plant Feed	100.0	6.6	100.0

				Mica Screen Dist %
+65 M Mica Concen.	-	-	-	-
-65 M Mica Concen.	-	-	-	-
Total Mica Concen.	-	-	-	-

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	10.2	43	-	480	1.84	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.8	41	2.2	740	-	5.24	1.70	-	-
Rougher Float	6.0	7	3.2	700	-	-	-	0.96	0.24
Cleaner Float	-	-	3.6	700	-	-	-	-	-
Cleaner Float	-	-	4.5	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 529 lbs per hour
Ratio of concentration - 14.3
Pilot plant adjustment

TABLE 2

PILOT PLANT TEST NO. 2

Lab. No. 4483 Date: 3/30/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.0	77.5	56.2
Tailings	84.6	3.1	43.8
-150 M, Slimes	9.4	-	-
Plant Feed	100.0	8.3	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.0	99.3	48.1	85.5
-65 M Mica Concen.	2.0	33.6	8.1	14.5
Total Mica Concen.	6.0	77.5	56.2	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	11.6	54	-	480	1.61	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	9.2	53	2.6	740	-	4.56	1.47	-	-
Rougher Float	8.0	11	2.8	700	-	-	-	1.57	0.31
Cleaner Float	-	-	2.8	700	-	4.56	-	-	-
Cleaner Float	-	-	3.4	700	-	-	-	-	-

Remarks and Changes:

Feed rate - 612 lbs per hour
Ratio of concentration - 16.6
Rougher cells - open trough.
Stand pipes - Sub A.
Cleaner tailings - circulated through rougher cells.
Baffles in conditioner.
Added H_2SO_4 to cleaner cell.
Lowered scrubber discharge to center pipe.

TABLE 3

PILOT PLANT TEST NO. 3

Lab. No. 4483 Date: 4/5/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	9.3	75.0	79.0
Tailings	84.1	2.2	21.0
-150 M, Slimes	6.6	-	-
Plant Feed	100.0	8.8	100.0

				Mica Screen Dist %
+65 M Mica Concen.	6.0	91.8	67.6	85.6
-65 M Mica Concen.	3.3	28.0	11.4	14.4
Total Mica Concen.	9.3	75.0	79.0	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	10.3	55	-	480	1.36	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.5	51	2.4	740	-	3.84	1.05	-	-
Rougher Float	7.5	12	2.7	700	-	-	-	1.39	0.27
Cleaner Float	-	-	2.6	700	-	3.84	-	-	-
Cleaner Float	-	-	3.2	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 713 lbs per hour
Ratio of concentration - 10.8
Replace 3/8" d. vortex finders on No. 1 and No. 2 cyclones with 3/4" d. Converted rougher cells from open trough to Sub-A.

TABLE 4

PILOT PLANT TEST NO. 4

Lab. No. 4485 Date: 4/12/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	10.6	72.9	73.5
Tailings	79.4	3.5	26.5
-150 M, Slimes	10.0	-	-
Plant Feed	100.0	10.5	100.0

	Mica Assay %	Mica Dist %	Mica Screen Dist %
+65 M Mica Concen.	92.5	54.5	74.2
-65 M Mica Concen.	45.4	19.0	25.8
Total Mica Concen.	72.9	73.5	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	8.8	60	-	480	1.02	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	6.2	55	2.4	740	-	2.87	0.93	-	-
Rougher Float	8.2	17	2.7	700	-	-	-	1.03	0.13
Cleaner Float	-	-	2.7	700	-	2.87	-	-	-
Cleaner Float	-	-	3.1	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 960 lbs per hour
Ratio of concentration - 9.4
Auxiliary air provided to cells.
Increased vortex finders to No. 1 and No. 2 cyclones to 1" d.

TABLE 5

PILOT PLANT TEST NO. 5

Lab. No. 4485 Date: 4/14/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	8.0	76.0	65.6
Tailings	77.8	4.1	34.4
-150 M, Slimes	14.2	-	-
Plant Feed	100.0	9.3	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.6	80.5	56.4	86.0
-65 M Mica Concen.	3.4	17.7	9.2	14.0
Total Mica Concen.	8.0	76.0	65.6	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	12.8	58	-	480	1.57	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.8	48	2.3	740	-	4.42	1.43	-	-
Rougher Float	7.8	11	2.6	700	-	-	-	1.58	0.20
Cleaner Float	-	-	2.6	700	-	4.42	-	-	-
Cleaner Float	-	-	3.3	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 625 lbs per hour
Ratio of concentration - 12.5
Installed additional cyclone following scrubbing.
Removed baffles from conditioner.

TABLE 6

PILOT PLANT TEST NO. 6

Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	7.0	72.4	62.5
Tailings	80.1	3.8	37.5
-150 M, Slimes	12.9	-	-
Plant Feed	100.0	8.1	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.6	93.5	53.0	84.8
-65 M Mica Concen.	2.4	32.2	9.5	15.2
Total Mica Concen.	7.0	72.4	62.5	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	10.8	56	-	480	1.41	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.7	51	2.1	740	-	5.92	1.29	-	-
Rougher Float	5.0	8	2.6	490	-	-	-	1.45	0.25
Cleaner Float	-	-	2.7	490	-	5.92	-	-	0.25
Cleaner Float	-	-	4.1	-	-	-	-	-	-

Remarks and Changes:

Feed rate - 697 lbs per hour

Ratio of concentration - 14.3

Reduced rpm of flotation cells from 740 to 490. Removed large stopper from divider between No. 1 and No. 2 cleaner cells. Used 1/4" sand relief stoppers in all cells. Air compressor quit before 11:00, opened air intake to atmospheric air on cells, but air insufficient due to low rpm.

TABLE 7

PILOT PLANT TEST NO. 7

Lab. No. 4487 Date: 4/25/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	8.2	62.4	59.8
Tailings	74.8	4.6	40.2
-150 M, Slimes	17.0	-	-
Plant Feed	100.0	8.6	100.0

				Mica Screen Dist %
+65 M Mica Concen.	5.4	84.8	53.9	90.1
-65 M Mica Concen.	2.8	17.9	5.9	9.9
Total Mica Concen.	8.2	62.4	59.8	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-62
Deslime	-	-	-	-	-	-	-	-	-
Scrub	10.5	53	-	480	1.47	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.9	50	2.1	740	-	6.24	1.36	-	-
Rougher Float	4.6	7	2.6	490	-	-	-	1.54	0.29
Cleaner Float	-	-	2.6	490	-	6.24	-	-	0.29
Cleaner Float	-	-	3.7	490	-	-	-	-	-

Remarks and Changes:
Feed rate - 659 lbs per hour
Ratio of concentration - 12.2
Feed rougher cells via divider gate into diffuser instead of on top of water. Started new ore. Three-eighths inch d. sand relief stoppers installed.

TABLE 8

PILOT PLANT TEST NO. 8

Lab. No. 4487 Date: 4/27/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	17.8	46.2	89.4
Tailings	64.9	1.5	10.6
-150 M, Slimes	17.3	-	-
Plant Feed	100.0	9.2	100.0

				Mica Screen Dist %
+65 M Mica Concen.	9.1	77.7	76.9	86.0
-65 M Mica Concen.	8.7	13.2	12.5	14.0
Total Mica Concen.	17.8	46.2	89.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	8.1	55	-	480	1.06	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	6.1	52	2.3	740	-	4.55	0.98	-	-
Rougher Float	9.2	18	2.9	490	-	-	-	1.09	0.21
Cleaner Float	-	-	-	490	-	-	-	-	-
Cleaner Float	-	-	-	490	-	-	-	-	-

Remarks and Changes:

Feed rate - 907 lbs per hour
Ratio of concentration - 5.6
Run rougher flotation only, no circulating middlings, no cleaners. Installed second froth-remover blades on all cells. Feed entering near front of rougher cell on top of pulp. Replaced diffuser in No. 4 cell, three teeth were missing.

TABLE 9

PILOT PLANT TEST NO. 9

Lab. No. 4487 Date: 5/1/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	6.5	73.9	51.0	
Cl. Tailings	23.2	18.6	45.8	
Ro. Tailings	49.9	0.6	3.2	
-150 M, Slime	20.4	-	-	
Total	100.0	9.4	100.0	
+65 M Mica Concen.	5.0	87.5	46.5	91.1
-65 M Mica Concen.	1.5	28.4	4.5	8.9
Total Mica Concen.	6.5	73.9	51.0	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-I	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	11.2	57	-	480	1.40	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.5	50	2.3	740	-	5.93	1.29	-	-
Rougher Float	7.0	11	3.0	490	-	-	-	1.43	0.27
Cleaner Float	-	-	2.7	490	-	5.93	-	-	0.27
Cleaner Float	-	-	4.3	490	-	-	-	-	-

Remarks and Changes:

Feed rate - 695 lbs per hour
Ratio of concentration - 15.4
Cleaner tailings caught in drum, not circulated.
Installed froth control water at back of cleaner cells.

TABLE 10

PILOT PLANT TEST NO. 10

Lab. No. 4487 Date: 5/1/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	13.0	65.4	87.6
Tailings	70.3	1.7	12.4
-150 M, Slimes	16.7	-	-
Plant Feed	100.0	9.7	100.0

				Mica Screen Dist %
+65 M Mica Concen.	9.6	83.7	82.6	94.3
-65 M Mica Concen.	3.4	14.4	5.0	5.7
Total Mica Concen.	13.0	65.4	87.6	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-I	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	14.0	61	-	480	1.59	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	8.9	52	2.3	740	-	6.76	1.47	-	-
Rougher Float	10.3	14	3.0	490	-	-	-	1.62	0.31
Cleaner Float	-	-	2.8	490	-	6.76	-	-	0.31
Cleaner Float	-	-	4.0	490	-	-	-	-	-

Remarks and Changes:
Feed rate - 616 lbs per hour
Ratio of concentration - 7.7
Circulated cleaner tailings to No. 2 pump and back through 2 cyclones, spiral classifier and conditioner.

TABLE 11

PILOT PLANT TEST NO. 11

Lab. No. 4487 Date: 5/9/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	13.6	61.9	81.4	
Tailings	68.8	2.8	18.6	
-150 M, Slimes	17.6	-	-	
Plant Feed	100.0	10.4	100.0	
+65 M Mica Concen.	8.4	86.9	70.7	86.8
-65 M Mica Concen.	5.2	21.3	10.7	13.2
Total Mica Concen.	13.6	61.9	81.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	11.4	60	-	480	1.32	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	8.6	57	2.1	740	-	5.60	1.22	-	-
Rougher Float	6.0	10	2.6	490	-	-	-	1.35	0.26
Cleaner Float	-	-	2.6	490	-	5.60	-	-	0.26

Remarks and Changes:

Feed rate - 738 lbs per hour

Ratio of concentration - 7.4

Cut out No. 2 cleaner cell and circulated No. 1 cleaner cell tailings through rougher cells.

TABLE 12

PILOT PLANT TEST NO. 12

Lab. No. 4490 Date: 5/23/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	7.0	74.2	53.3	
Tailings	84.0	5.4	46.7	
-150 M, Slimes	9.0	-	-	
Plant Feed	100.0	9.7	100.0	
+65 M Mica Concen.	4.7	94.8	45.9	86.2
-65 M Mica Concen.	2.3	31.0	7.4	13.8
Total Mica Concen.	7.0	74.2	53.3	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	13.1	67	-	480	1.27	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	8.0	56	1.9	740	-	10.71	1.16	-	-
Rougher Float	7.5	13	2.5	490	-	-	-	1.20	0.21
Cleaner Float	-	-	2.6	490	-	3.53	-	-	-

Remarks and Changes:
Feed rate - 774 lbs per hour
Ratio of concentration - 14.3
New ore. Amine fed to all cells. One cleaner stage. Scrubber discharge changed from middle outlet to bottom outlet.

TABLE 13

PILOT PLANT TEST NO.13

Lab. No. 4490 Date: 5/25/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.7	67.2	62.4
Tailings	82.1	3.3	37.6
-150 M, Slimes	7.2	-	-
Plant Feed	100.0	7.2	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.3	91.5	54.2	86.9
-65 M Mica Concen.	2.4	24.8	8.2	13.1
Total Mica Concen.	6.7	67.2	62.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	16.6	67	-	480	1.59	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	9.8	55	2.0	740	-	13.35	1.45	-	-
Rougher Float	14.6	19	2.7	490	-	-	-	1.49	0.31
Cleaner Float	-	-	2.7	490	-	8.81	-	0.43	0.43

Remarks and Changes:
Feed rate - 614 lbs per hour
Ratio of concentration - 15.0
Converted rougher cells to open trough. Circulated cleaner tails to No. 2 pump. One cleaner only.

TABLE 14

PILOT PLANT TEST NO. 14

Lab. No. 4490 Date: 5/29/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	12.3	59.2	77.3	
Cl. Tailings	2.5	26.9	7.1	
Ro. Tailings	73.5	2.0	15.6	
-150 Slimes	11.7	-	-	
Total	100.0	9.4	100.0	
+65 M Mica Concen.	7.1	87.7	66.0	85.4
-65 M Mica Concen.	5.2	20.5	11.3	14.6
Total Mica Concen.	12.3	59.2	77.3	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	14.5	66	-	480	1.46	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	8.8	55	2.1	740	-	12.03	1.31	-	-
Rougher Float	13.9	20	2.7	490	-	-	-	1.42	0.28
Cleaner Float	-	-	2.5	490	-	7.93	-	-	0.23

Remarks and Changes:

Feed rate - 681 lbs per hour
Ratio of concentration - 8.1
Converted rougher cells to cell to cell. Plugged leaks in level control gates. Ran cleaner cell on self-generated air, others on auxiliary air. Changed No. 1 cleaner cell standpipe so it will not pull through No. 2 cleaner cell. Increased sand-relief holes in rougher cells to 1/2" d. Cleaner tailings caught in drum and not circulated. Cleaner cell ran flooded.

TABLE 15

PILOT PLANT TEST NO. 15

Lab. No. 4490 Date: 6/1/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	4.7	69.3	34.1	
Cl. Tailings	9.1	46.7	44.5	
Ro. Tailings	76.0	2.7	21.4	
-150 Slimes	10.2	-	-	
Total	100.0	9.6	100.0	
+65 M Mica Concen.	2.9	93.8	28.3	83.1
-65 M Mica Concen.	1.8	30.8	5.8	16.9
Total Mica Concen.	4.7	69.3	34.1	100.0

Procedure

Process	Conditions: Time (min)	Conditions: % Solids	Conditions: pH	Conditions: rpm	Reagents (lbs per ton of ore): NaOH	Reagents: H_2SO_4	Reagents: F.O.	Reagents: Amine Ar-T	Reagents: Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	12.1	66	-	480	1.22	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.4	55	1.8	740	-	13.47	1.09	-	-
Rougher Float	13.0	22	2.5	490	-	-	-	1.52	0.23
Cleaner Float	1.1	8	2.2	490	-	6.73	-	0.32	0.20
Cleaner Float	-	-	2.6	490	-	-	-	-	-

Remarks and Changes:
Feed rate - 815 lbs per hour
Ratio of concentration - 21.3
Installed second cleaner. Both cleaner tailings caught in drum.
Rougher cells on compressor air, cleaner cells on atmospheric air.
Froth-control gates leaks sealed. Amine added to No. 1 and No. 2 rougher cells and No. 1 cleaner cell.

TABLE 16

PILOT PLANT TEST NO. 16

Lab. No. 4490 Date: 6/5/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	4.5	69.6	32.3	
Cl. Tailings	12.7	37.5	49.1	
Ro. Tailings	71.8	2.5	18.6	
-150 Slimes	11.0	-	-	
Total	100.0	9.7	100.0	
+65 M Mica Concen.	2.7	95.9	26.9	83.3
-65 M Mica Concen.	1.8	28.8	5.4	16.7
Total Mica Concen.	4.5	69.6	32.3	100.0

Procedure

Process	Conditions: Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore): NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	12.3	64	-	480	1.32	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	7.2	52	1.9	740	-	14.57	1.18	-	-
Rougher Float	9.0	15	2.7	700	-	-	-	1.74	0.25
Cleaner Float	0.8	6	2.4	700	-	7.28	-	0.22	0.24
Cleaner Float	-	-	3.2	700	-	-	-	-	-

Remarks and Changes:

Feed rate - 763 lbs per hour
Ratio of concentration - 22.2
Two cleaner stages. Speeded up cells from 490 to 700 rpm. Amine in cleaner changed from surface addition to partition addition. Syphon breaker pipe installed on cleaner tailings line. Cleaner cells converted to auxiliary air. Slimes were generated and showed up in mica concentrate drum.

TABLE 17

PILOT PLANT TEST NO. 17

Lab. No. 4496 Date: 6/20/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	4.0	67.0	42.6
Cl. Tailings	8.7	35.5	49.1
Ro. Tailings	74.0	0.7	8.3
-150 M, Slimes	13.3	-	-
Total	100.0	6.3	100.0

				Mica Screen Dist %
+65 M Mica Concen.	2.4	93.5	36.0	84.6
-65 M Mica Concen.	1.6	25.5	6.6	15.4
Total Mica Concen.	4.0	67.0	42.6	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	15.8	69	-	480	1.44	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	10.0	54	1.3	740	-	16.40	1.32	-	-
Rougher Float	10.8	14	2.1	490	-	-	-	1.93	0.30
Cleaner Float	-	6	2.2	490	-	11.00	-	0.24	0.23

Remarks and Changes:
Feed rate - 675 lbs per hour
Ratio of concentration - 25.0
Slowed down all cells to 490 rpm. Auxiliary air to No. 1 and No. 2 rougher cells. Self induced air to No. 3 and No. 4 rougher cells. One cleaner only. Baffles installed in corners of all cells to reduce turbulence. Three-fourth inch d. sand relief holes in cells.

TABLE 18

PILOT PLANT TEST NO. 18

Lab. No. 4496 Date: 6/22/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	7.1	66.2	63.9
Cl. Tailings	7.1	33.2	32.0
Ro. Tailings	75.6	0.4	4.1
-150 M, Slimes	10.2	-	-
Total	100.0	7.4	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.3	93.4	54.3	84.9
-65 M Mica Concen.	2.8	25.5	9.6	15.1
Total Mica Concen.	7.1	66.2	63.9	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	16.8	68	-	480	1.57	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	9.6	51	1.5	740	-	12.30	1.74	-	-
Rougher Float	11.4	14	2.3	490	-	-	-	2.08	0.33
Cleaner Float	-	6	2.3	490	-	7.82	-	0.27	0.26

Remarks and Changes:
Feed rate - 620 lbs per hour
Ratio of concentration - 14.1
Auxiliary air used in rougher and cleaner cells.
Reduced amount of pipe fittings from air header.
Raised conditioner outlet to middle outlet.
Each cleaner cell pulled 6 CFM of air.
Each rougher cell pulled 8 CFM of air.

TABLE 19

PILOT PLANT TEST NO. 19

Lab. No. 4496 Date: 6/22/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	9.0	77.4	85.5	
Cl. Tailings	5.6	16.9	11.7	
Ro. Tailings	76.1	0.3	2.8	
-150 Slimes	9.3	-	-	
Total	100.0	8.2	100.0	
+65 M Mica Concen.	6.0	95.5	70.5	82.4
-65 M Mica Concen.	3.0	40.7	15.0	17.6
Total Mica Concen.	9.0	77.4	85.5	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	15.4	68	-	480	1.43	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	8.5	50	1.9	740	-	4.08	1.59	-	-
Rougher Float	8.7	12	2.8	490	-	-	-	0.46	0.30
Cleaner Float	-	7	2.7	490	-	2.04	-	-	-

Remarks and Changes:
Feed rate - 677 lbs per hour
Ratio of concentration - 11.1
Reduced reagent rates to near batch tests.
Same physical set-up as Pilot Plant No. 18.

TABLE 20

PILOT PLANT TEST NO. 20

Lab. No. 4496 Date: 6/27/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	13.4	71.8	91.9
Tailings	77.1	1.1	8.1
-150 M, Slimes	9.5	-	-
Plant Feed	100.0	10.4	100.0

				Mica Screen Dist %
+65 M Mica Concen.	11.0	96.1	85.5	93.0
-65 M Mica Concen.	2.4	33.2	6.4	7.0
Total Mica Concen.	13.4	71.8	91.9	100.0
+100 M Mica Concen.	12.2	92.1	89.8	97.7
-100 M Mica Concen.	1.2	21.6	2.1	2.3
Total Mica Concen.	13.4	71.8	91.9	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Deslime	-	-	-	-	-	-	-	-	-
Scrub	17.7	68	-	480	1.66	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	10.6	53	2.1	740	-	4.69	1.83	-	-
Rougher Float	15.7	18	2.6	490	-	-	-	0.56	0.32
Cleaner Float	-	-	2.4	700	-	2.34	-	-	-
Cleaner Float	-	-	3.0	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 589 lbs per hour
Ratio of concentration - 7.5
All cells on auxiliary air and increased air volume.
Conditioner discharge material going to back of No. 1 rougher cell.
Batch reagent rates.

Pilot Plant Test No. 21 has been used as an example of the ideal pilot plant run. Please refer to Page 17, Table B.

TABLE 21

PILOT PLANT TEST NO. 22

Lab. No. 4496 Date: 7/20/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	12.3	82.5	96.3
Tailings	77.8	0.5	3.7
-150 M, Slimes	9.9	-	-
Plant Feed	100.0	10.5	100.0

				Mica Screen Dist %
+65 M Mica Concen.	8.5	97.4	78.7	81.7
-65 M Mica Concen.	3.8	48.9	17.6	18.3
Total Mica Concen.	12.3	82.5	96.3	100.0
+100 M Concen.	9.8	95.3	88.5	91.9
-100 M Concen.	2.5	32.7	7.8	8.1
Total Mica Concen.	12.3	82.5	96.3	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	16.6	66	-	480	1.63	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	10.3	52	2.0	740	-	4.65	1.51	-	-
Rougher Float	11.8	14	2.4	490	-	-	-	0.47	0.32
Cleaner Float	-	-	2.5	700	-	2.49	-	-	-
Cleaner Float	-	-	3.1	700	-	-	-	-	-

Remarks:
Feed rate - 594 lbs per hour
Ratio of concentration - 8.1
Open trough cells with DR standpipes and supercharged air.

TABLE 22

PILOT PLANT TEST NO. 23

Lab. No. 4496 Date: 7/24/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	11.7	76.6	77.1
Tailings	76.0	3.5	22.9
-150 M, Slimes	12.3	-	-
Plant Feed	100.0	11.6	100.0

				Mica Screen Dist %
+65 M Mica Concen.	7.2	97.5	59.8	77.6
-65 M Mica Concen.	4.7	43.1	17.3	22.4
Total Mica Concen.	11.7	76.6	77.1	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ-180	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	15.9	67	-	480	1.53	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	11.4	57	2.0	740	-	4.19	1.41	-	-
Rougher Float	15.0	18	2.2	490	-	-	-	1.09	0.28
Cleaner Float	-	-	2.2	700	-	2.09	-	-	-
Cleaner Float	-	-	2.9	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 634 lbs per hour
Ratio of concentration - 8.5

Same as PP-22 except changed amines.

TABLE 23

PILOT PLANT TEST NO. 24

Lab. No. 4511 Date: 8/24/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	7.4	76.5	82.0
Tailings	86.4	1.44	18.0
-150 M, Slimes	6.2	-	-
Plant Feed	100.0	6.90	100.0

				Mica Screen Dist %
+80 M Mica Concen.	5.5	93.9	74.7	91.1
-80 M Mica Concen.	1.9	26.6	7.3	8.9
Total Mica Concen.	7.4	76.5	82.0	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine 2642-1	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	16.5	68	-	480	1.48	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	9.8	54	1.9	740	-	4.24	1.42	-	-
Rougher Float	9.0	12	2.6	490	-	-	-	0.84	0.30
Cleaner Float	-	-	2.6	700	-	2.12	-	-	-
Cleaner Float	-	-	3.9	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 631 lbs per hour
Ratio of concentration - 13.5

Changed conditioner hose to discharge into partition between 1st cleaner cell and rougher cell instead of on surface of rougher pulp. Changed to amine 2642-1 and H-26 frother.

TABLE 24

PILOT PLANT TEST NO. 25

Lab. No. 4517 Date: 9/6/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	11.4	36.3	67.8
Tailings	75.0	2.6	32.2
-150 M, Slimes	13.6	-	-
Plant Feed	100.0	6.1	100.0

				Mica Screen Dist %
+80 M Mica Concen.	8.3	41.7	56.7	83.7
-80 M Mica Concen.	3.1	21.7	11.1	16.3
Total Mica Concen.	11.4	36.3	67.8	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine 2642-1	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	15.4	65	-	480	1.60	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	10.5	53	2.0	740	-	4.42	1.72	-	-
Rougher Float	6.4	15	2.5	490	-	-	-	0.74	0.30
Cleaner Float	-	-	2.4	700		4.42	-	-	-
Cleaner Float	-	-	3.1	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 625 lbs per hour
Ratio of concentration - 8.8

Changed to new ore. Eliminated Nos. 3 and 4 rougher cells. Air turned off on 3 and 4 rougher cells to lower froth and pulp level. Coarse mica drops out in tailings due to short circuiting. Batch flotation and screening of tailings show coarse mica in tails. Scrubber solids too low, slime noted in mica concentrate.

TABLE 25

PILOT PLANT TEST NO. 26

Lab. No. 4517 Date: 9/7/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	9.8	53.3	69.2
Tailings	75.1	3.1	30.8
-150 M, Slimes	15.1	-	-
Plant Feed	100.0	7.6	100.0

				Mica Screen Dist %
+80 M Mica Concen.	4.9	87.3	56.6	81.8
-80 M Mica Concen.	4.9	19.4	12.6	18.2
Total Mica Concen.	9.8	53.3	69.2	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine 2642-1	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	15.9	68	-	480	1.58	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	11.5	57	2.2	740	-	4.24	1.65	-	-
Rougher Float	11.5	14	2.6	490	-	-	-	1.41	0.30
Cleaner Float	-	-	2.4	700	-	4.24	-	-	-
Cleaner Float	-	-	3.0	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 651 lbs per hour
Ratio of concentration - 10.2

Changed back to 4 rougher cells, otherwise same as PP-25. Changed cond. discharge hose into top of No. 1 rougher cell. All cells running flooded. Appear to be better recovery.

TABLE 26

PILOT PLANT TEST NO. 27

Lab. No. 4517 Date: 9/8/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	17.6	55.9	83.6
Tailings	66.7	2.9	16.4
-150 M, Slimes	15.7	-	-
Plant Feed	100.0	11.8	100.0

				Mica Screen Dist %
+80 M Mica Concen.	10.1	84.3	72.2	86.4
-80 M Mica Concen.	7.5	17.8	11.4	13.6
Total Mica Concen.	17.6	55.9	83.6	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine 2642-1	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	18.5	66	-	480	1.75	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	13.3	55	2.2	740	-	5.17	2.01	-	-
Rougher Float	14.1	14	2.7	490	-	-	-	0.91	0.30
Cleaner Float	-	-	2.6	700	-	2.58	-	-	-
Cleaner Float	-	-	2.8	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 534 lbs per hour
Ratio of concentration - 5.7

Reduced amine, otherwise same as PP-26. Cond. discharge into partition between cleaner and rougher cells.

TABLE 27

PILOT PLANT TEST NO. 28

Lab. No. 4517 Date: 9/21/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	7.8	71.8	36.6
Tailings	74.2	13.2	63.4
-150 M, Slimes	18.0	-	-
Plant Feed	100.0	15.5	100.0

				Mica Screen Dist %
+80 M Mica Concen.	5.2	91.5	31.1	85.0
-80 M Mica Concen.	2.6	32.4	5.5	15.0
Total Mica Concen.	7.8	71.8	36.6	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine 2642-1	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	17.0	64	-	480	1.76	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	12.6	53	2.0	740	-	5.01	1.95	-	-
Rougher Float	15.8	20	2.4	700	-	-	-	0.56	0.03
Cleaner Float	-	-	2.4	700	-	2.50	-	-	-
Cleaner Float	-	-	2.5	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 551 lbs per hour
Ratio of concentration - 12.8
Painted inside of cells. Rougher cells reset as Sub-A.
Amine 2642-1. Used 3 rougher cells, 2 cleaners.

TABLE 28

PILOT PLANT TEST NO. 29

Lab. No. 4517 Date: 9/21/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	15.9	64.3	71.8
Tailings	68.0	5.9	28.2
-150 M, Slimes	16.1	-	-
Plant Feed	100.0	14.2	100.0

				Mica Screen Dist %
+80 M Mica Concen.	10.1	87.4	62.0	86.4
-80 M Mica Concen.	5.8	23.9	9.8	13.6
Total Mica Concen.	15.9	64.3	71.8	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother H-26
Deslime	-	-	-	-	-	-	-	-	-
Scrub	13.1	62	-	480	1.44	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Deslime	-	-	-	-	-	-	-	-	-
Condition	8.6	48	2.1	740	-	4.08	1.59	-	-
Rougher Float	10.4	17	2.4	700	-	-	-	0.46	0.15
Cleaner Float	-	-	2.4	700	-	2.04	-	-	-
Cleaner Float	-	-	2.4	700	-	-	-	-	-

Remarks and Changes:
Feed rate - 676 lbs per hour
Ratio of concentration - 6.3
Same as Pilot Plant 28 except changed amines.
No apparent slime in concentrate drum.

APPENDIX B

BATCH FLOTATION TESTS

TABLE 29

STANDARD FLOTATION PROCEDURE

Batch Test No. 3 (Pilot Plant 1)
Lab. No. 4483 Date: 3/20/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.5	90.8	90.7
2nd Cl. Tailings	0.6	7.3	0.6
1st Cl. Tailings	2.5	2.4	0.9
Ro. Tailings	84.2	0.6	7.8
-325 M Slimes	6.2	-	-
Total	100.0	6.5	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	65	-	1700	2.0	-	-	-	-
Deslime 2 X 325 M	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.3	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	20	3.0	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

Chemical Analyses

	CaO	K_2O	Na_2O	LOI	Fe_2O_3	Al_2O_3	SiO_2	MgO
Rougher Tailings	0.95	0.32	3.1	0.33	0.13	8.9	86.2	0.01
Head Feed	1.00	1.06	2.8	1.10	0.73	11.7	81.4	0.10

TABLE 30

PILOT PLANT RETENTION TIMES FOR SCRUBBING AND CONDITIONING

Batch Test No. 6 (Pilot Plant 1)
Lab. No. 4483 Date: 3/20/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.0	89.2	96.5
2nd Cl. Tailings	0.8	1.9	0.2
1st Cl. Tailings	3.2	0.3	0.2
Ro. Tailings	82.7	0.2	3.1
-325 M Slimes	7.3	-	-
Total	100.0	5.5	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	19	65	-	1700	2.0	-	-	-	-
Deslime 2 X 325 M	-	-	-	-	-	-	-	-	-
Cond. in Beaker	9	45	2.4	700	-	2.0	1.5	-	-
Condition in Cell	1	20	-	1200	-	-	-	0.5	0.25
Rougher Float	1.25	10	3.0	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

Remarks:

Batch flotation test using pilot plant retention times for scrubbing and conditioning.

TABLE 31

AMINE TYPE SERIES (AR-T)

Batch Test No. 7 (Pilot Plant 1)
Lab. No. 4483 Date: 8/11/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	6.2	90.3	98.8	
2nd Cl. Tailings	0.3	9.8	0.5	
1st Cl. Tailings	1.5	2.7	0.7	
Ro. Tailings	78.9	Nil.	-	
-200 M Slimes	13.1	-	-	
Total	100.0	5.67	100.0	
+80 M Mica Concen.	4.7	95.0	78.8	79.8
-80 M Mica Concen.	1.5	75.6	20.0	20.2
Total Mica Concen.	6.2	90.3	98.8	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	-	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 32

AMINE TYPE SERIES (AZ 2642-1)

Batch Test No. 8 (Pilot Plant 1)
Lab. No. 4483 Date: 8/11/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	4.0	96.9	87.4
2nd Cl. Tailings	0.2	73.8	3.4
1st Cl. Tailings	0.8	10.1	1.8
Ro. Tailings	82.9	0.4	7.4
-200 M,Slimes	12.1	-	-
Total	100.0	4.44	100.0

				Mica Screen Dist %
+80 M Mica Concen.	3.0	97.9	66.2	75.8
-80 M Mica Concen.	1.0	93.9	21.2	24.2
Total Mica Concen.	4.0	96.9	87.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	-	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 33

AMINE TYPE SERIES (AZ-180)

Batch Test No. 9 (Pilot Plant 1)
Lab. No. 4483 Date: 8/11/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	3.1	98.4	64.1
2nd Cl. Tailings	0.9	89.8	17.0
1st Cl. Tailings	1.1	27.8	6.5
Ro. Tailings	84.1	0.7	12.4
-200 M,Slimes	10.8	-	-
Total	100.0	4.8	100.0

				Mica Screen Dist %
+80 M Mica Concen.	2.3	98.5	47.7	74.4
-80 M Mica Concen.	0.8	98.0	16.4	25.6
Total Mica Concen.	3.1	98.4	64.1	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ-180	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	-	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 34

BATCH FLOTATION OF PILOT PLANT FEED TO CONDITIONER USING PILOT PLANT REAGENTS, PERCENT SOLIDS, AND RETENTION TIMES

Batch Test No. 1 (Pilot Plant 3)

Lab. No. 4483 Date: 4/5/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	9.9	69.1	88.4
2nd Cl. Tailings	0.7	25.0	2.3
1st Cl. Tailings	2.7	10.0	3.5
Ro. Tailings	86.7	0.5	5.8
Total	100.0	7.7	100.0

				Mica Screen Dist %
+65 M Mica Concen.	6.4	91.8	75.8	85.7
-65 M Mica Concen.	3.5	28.0	12.6	14.3
Total Mica Concen.	9.9	69.1	88.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Cond. in Beaker	9	45	2.1	700	-	4.6	1.5	-	-
Condition in Cell	1	8	-	1200	-	-	-	1.5	0.3
Rougher Float	-	-	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	4.6	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 35

STANDARD TEST

Batch Test No. 1 (Pilot Plant 4)
Lab. No. 4485 Date: 4/12/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.0	81.9	95.0
2nd Cl. Tailings	0.7	12.6	1.7
1st Cl. Tailings	1.7	1.0	0.4
Ro. Tailings	74.8	0.2	2.9
-200 M, Slimes	16.8	-	-
Total	100.0	5.2	100.0

				Mica Screen Dist %
+65 M Mica Concen.	3.0	91.7	53.2	56.0
-65 M Mica Concen.	3.0	72.1	41.8	44.0
Total Mica Concen.	6.0	81.9	95.0	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	65	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.0	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	-	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 36

STANDARD TEST (DESLIME 150 MESH)

Batch Test No. 1-A (Pilot Plant 4)
Lab. No. 4485 Date: 4/12/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	5.4	79.0	95.8
2nd Cl. Tailings	0.5	5.3	0.7
1st Cl. Tailings	2.3	0.9	0.4
Ro. Tailings	71.7	0.2	3.1
-150 M, Slimes	20.1	-	-
Total	100.0	4.5	100.0

				Mica Screen Dist %
+65 M Mica Concen.	3.1	88.5	61.6	64.3
-65 M Mica Concen.	2.3	66.0	34.2	35.7
Total Mica Concen.	5.4	79.0	95.8	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	65	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.7	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.50	0.25
Rougher Float	-	20	3.4	1200	-	-	-	-	-
Cleaner Float	-	-	3.5	1200	1.0	-	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 37

STANDARD TEST (DESLIME 200 MESH)

Batch Test No. 2 (Pilot Plant 4)
Lab. No. 4485 Date: 5/11/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	7.6	74.4	99.5	
2nd Cl. Tailings	1.0	1.2	0.1	
1st Cl. Tailings	3.9	0.2	0.2	
Ro. Tailings	72.8	0.2	0.2	
-200 Slimes	14.7	-	-	
Total	100.0	5.7	100.0	
+65 M Mica Concen.	3.8	88.0	58.9	59.2
-65 M Mica Concen.	3.8	60.6	40.6	40.8
Total Mica Concen.	7.6	74.4	99.5	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.9	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	20	3.2	1200	-	-	-	-	-
Cleaner Float	-	-	3.0	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 38

BATCH FLOTATION OF PILOT PLANT ROUGHER CELL FEED

BATCH CELL RPM-1800

Batch Test No. 3 (Pilot Plant 5)

Lab. No. 4485 Date: 4/17/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	17.9	49.9	94.0
Ro. Tailings	82.1	0.7	6.0
Total	100.0	9.5	100.0

				Mica Screen Dist %
+65 M Mica Concen.	8.8	82.7	76.4	81.3
-65 M Mica Concen.	9.1	18.3	17.6	18.7
Total Mica Concen.	17.9	49.9	94.0	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	12.8	58	-	480	1.57	-	-	-	-
Cond. in " "	7.8	48	2.3	740	-	4.42	1.43	-	-
Cond. " " "	1.0	-	-	-	-	-	-	1.58	0.20
Rougher Float(Batch)	-	25	-	1800	-	-	-	-	-

*Reagents added in pilot plant.

TABLE 39

BATCH FLOTATION OF PILOT PLANT ROUGHER CELL FEED

BATCH CELL RPM -1200

Batch Test No. 4 (Pilot Plant 5)

Lab. No. 4485 Date: 4/17/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	24.0	42.5	99.2
Ro. Tailings	76.0	0.1	0.8
Total	100.0	10.3	100.0

				Mica Screen Dist %
+65 M Mica Concen.	12.5	68.3	83.3	84.0
-65 M Mica Concen.	11.5	14.2	15.9	16.0
Total Mica Concen.	24.0	42.5	99.2	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	12.8	58	-	480	1.57	-	-	-	-
Cond. in " "	7.8	48	2.3	740	-	4.42	1.43	-	-
Cond. " " "	1.0	-	-	-	-	-	-	1.58	0.20
Rougher Float	-	25	-	1200	-	-	-	-	-

*Reagents added in pilot plant.

TABLE 40

BATCH FLOTATION OF PILOT PLANT TAILINGS

Batch Test No. 5 (Pilot Plant 5)
Lab. No. 4485 Date: 4/17/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	5.4	34.5	52.2	
Ro. Tailings	94.6	1.8	47.8	
Total	100.0	3.6	100.0	
+65 M Mica Concen.	2.0	70.5	39.8	76.2
-65 M Mica Concen.	3.4	12.8	12.4	23.8
Total Mica Concen.	5.4	34.5	52.2	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	*Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	12.8	58	-	480	1.57	-	-	-	-
Cond. " " "	7.8	48	2.3	740	-	4.42	1.43	-	-
Cond " " "	1	-	-	-	-	-	-	1.58	0.20
Rougher Float	-	-	-	-	-	-	-	-	-
Batch Float	-	10	-	1200	-	-	-	-	-

Remarks:

Sample of pilot plant tailings placed in batch flotation cell and floated without adding reagents. *Reagents were added in pilot plant.

TABLE 41

BATCH FLOTATION OF PILOT PLANT ROUGHER CELLS FEED

Batch Test No. 6 (Pilot Plant 5)

Lab. No. 4485 Date: 4/17/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	18.2	53.70	96.8
Cl. Tailings	4.7	0.94	0.4
Ro. Tailings	77.1	0.35	2.7
Total	100.0	10.10	100.0

				Mica Screen Dist %
+65 M Mica Concen.	10.4	80.5	83.1	85.8
-65 M Mica Concen.	7.8	17.7	13.8	14.2
Total Mica Concen.	18.2	53.7	96.9	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	12.8	58	-	480	1.57	-	-	-	-
Cond. in " "	7.8	48	2.3	740	-	4.42	1.43	-	-
Cond. " " "	1	-	-	-	-	-	-	1.58	0.20
Rougher Float (Batch)	-	-	-	1200	-	-	-	-	-
Cleaner Float (Batch)	-	-	-	1200	-	-	-	-	-

*Reagents were added in pilot plant.

TABLE 42

BATCH FLOTATION OF PILOT PLANT FEED TO CONDITIONER (STANDARD TEST)

Batch Test No. 1 (Pilot Plant 6)
Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	13.4	66.90	88.5
2nd Cl. Tailings	1.1	29.40	3.2
1st Cl. Tailings	5.1	7.60	3.9
Ro. Tailings	80.4	0.56	4.4
Total	100.0	10.10	100.0

				Mica Screen Dist %
+65 M Mica Concen.	8.4	88.8	88.5	100.0
-65 M Mica Concen.	5.0	0.0	0.0	0.0
Total Mica Concen.	13.4	66.9	88.5	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	-	-	-	-	-	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	-	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.50	0.25
Rougher Float	-	-	2.9	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	2.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

*Reagents added in batch.

TABLE 43

BATCH FLOTATION OF PILOT PLANT DESLIMED ORE (LONG RETENTION TIME)

Batch Test No. 2 (Pilot Plant 6)
Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	10.6	67.4	-
2nd Cl. Tailings	0.7	-	-
1st Cl. Tailings	3.2	-	-
Ro. Tailings	85.5	1.81	-
Total	100.0	-	-

				Mica Screen Dist %
+65 M Mica Concen.	6.7	85.4	-	79.0
-65 M Mica Concen.	3.9	39.1	-	21.0
Total Mica Concen.	10.6	67.4	-	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10.8	56	-	480	1.41	-	-	-	-
Deslime in Pilot P.	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.1	700	-	2.0	1.5	-	-
Condition in Cell	8	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	16	2.9	-	-	-	-	-	-
Cleaner Float	-	-	-	-	-	-	--	-	-
Cleaner Float	-	-	-	-	-	-	-	-	-

*NaOH added in pilot plant, other reagents added in batch.

TABLE 44

BATCH FLOTATION OF PILOT PLANT DESLIMED ORE (LONG RETENTION TIME)
FROTHER ADDED AFTER CONDITIONING

Batch Test No. 3 (Pilot Plant 6)
Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	11.6	69.3	-	
2nd Cl. Tailings	0.9	-	-	
1st Cl. Tailings	2.1	2.5	-	
Ro. Tailings	85.4	1.6	-	
Total	100.0	-	-	
+65 M Mica Concen.	6.8	86.8	-	73.7
-65 M Mica Concen.	4.8	44.0	-	26.3
Total Mica Concen.	11.6	69.3	-	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	*Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	10.8	56	-	480	1.41	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.1	700	-	2.0	1.5	-	-
Condition in Cell	8	20	-	1200	-	-	-	0.50	-
Rougher Float	-	-	-	1200	-	-	-	-	0.25
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

*NaOH added in pilot plant, other reagents added in batch.

TABLE 45

BATCH FLOTATION OF PILOT PLANT DESLIMED ORE

REMOVE FROTH ONE MINUTE, AGITATE 3 MINUTES THAN REMOVE REMAINING FROTH IN ROUGHER FLOAT

Batch Test No. 5 (Pilot Plant 6)

Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	12.8	65.8	-
2nd Cl. Tailings	1.0	-	-
1st Cl. Tailings	3.3	-	-
Ro. Tailings	82.9	0.9	-
Total	100.0	-	-

				Mica Screen Dist %
+65 M Mica Concen.	8.0	86.1	-	81.9
-65 M Mica Concen.	4.8	31.7	-	18.1
Total Mica Concen.	12.8	65.8	-	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	10.8	56	-	480	1.41	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.1	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	-	-	-	-	-	-	-	-
Cleaner Float	-	-	-	-	-	-	-	-	-
Cleaner Float	-	-	-	-	-	-	-	-	-

*NaOH added in pilot plant, other reagents added in batch.

TABLE 46

BATCH FLOTATION OF DESLIMED ORE (STANDARD TEST EXCEPT FLOAT AT 25% SOLIDS)

Batch Test No. 6 (Pilot Plant 6)
Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	11.6	65.3	-
2nd Cl. Tailings	1.7	-	-
1st Cl. Tailings	3.2	-	-
Ro. Tailings	83.5	1.4	-
Total	100.0	-	-

				Mica Screen Dist %
+65 M Mica Concen.	6.6	86.0	-	75.1
-65 M Mica Concen.	5.0	37.5	-	24.9
Total Mica Concen.	11.6	65.3	-	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	10.8	56	-	480	1.41	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.5	700	-	2.0	1.5	-	-
Condition in Cell	0.5	30	-	1200	-	-	-	0.5	0.25
Rougher Float	-	25	-	-	-	-	-	-	-
Cleaner Float	-	-	-	-	-	-	-	-	-
Cleaner Float	-	-	-	-	-	-	-	-	-

*NaOH added in plant plant, other reagents added in batch.

TABLE 47

BATCH FLOTATION OF DESLIMED PILOT PLANT ORE (8 MIN COND. 1800 rpm)

Batch Test No. 7 (Pilot Plant 6)
Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	10.0	62.2	-
2nd Cl. Tailings	1.7	-	-
1st Cl. Tailings	4.1	-	-
Ro. Tailings	84.2	1.7	-
Total	100.0	-	-

				Mica Screen Dist %
+65 M Mica Concen.	5.5	82.6	-	73.1
-65 M Mica Concen.	4.5	37.2	-	26.9
Total Mica Concen.	10.0	62.2	-	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	10.8	56	-	480	1.41	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.2	700	-	2.0	1.5	-	-
Condition in Cell	8	20	-	1800	-	-	-	0.5	0.25
Rougher Float	-	16	3.0	1200	-	2.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

*NaOH added in pilot plant, other reagents added in batch.

TABLE 48

BATCH FLOTATION TEST OF DESLIMED PILOT PLANT ORE
(LONG RETENTION TIME, AZ-AMINE, NO FROTHER)
Batch Test No. 8 (Pilot Plant 6)
Lab. No. 4485 Date: 4/18/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	1.6	63.0	-
2nd Cl. Tailings	2.9	-	-
1st Cl. Tailings	5.5	-	-
Ro. Tailings	90.0	3.0	-
Total	100.0	-	-

				Mica Screen Dist %
+65 M Mica Concen.	0.6	80.9	-	48.5
-65 M Mica Concen.	1.0	51.7	-	51.5
Total Mica Concen.	1.6	63.0	-	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ	Frother None
Scrub in Pilot Plant	10.8	56	-	480	1.41	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.2	700	-	2.0	1.5	-	-
Condition in Cell	8	20	-	1200	-	-	-	0.5	-
Rougher Float	-	16	3.0	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

*NaOH added in pilot plant, other reagents added in batch.

TABLE 49

BATCH FLOTATION TEST OF DESLIMED ORE
(LONG RETENTION TIME AND PINE OIL FROTHER)
Batch Test No. 15 (Pilot Plant 6)
Lab. No. 4485 Date: 4/24/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	3.8	87.5	-	
2nd Cl. Tailings	6.0	-	-	
1st Cl. Tailings	4.4	-	-	
Ro. Tailings	85.8	1.4	-	
Total	100.0	-	-	
+65 M Mica Concen.	2.7	94.5	-	76.8
-65 M Mica Concen.	1.1	70.0	-	23.2
Total Mica Concen.	3.8	87.5	-	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	*Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother Pine Oil
Scrub in Pilot Plant	10.8	56	-	480	1.41	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.2	700	-	2.0	1.5	-	-
Condition in Cell	8	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	-	3.0	-	-	-	-	-	-
Cleaner Float	-	-	-	-	-	2.0	-	-	-
Cleaner Float	-	-	-	-	-	-	-	-	-

*NaOH added in pilot plant, other reagents added in batch.

TABLE 50

STANDARD BATCH FLOTATION TEST (DESLIME ON 150 M)

Batch Test No. 1-A (Pilot Plant 11)
Lab. No. 4487 Date: 5/10/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	8.4	81.3	98.4	
2nd Cl. Tailings	0.7	2.5	0.3	
1st Cl. Tailings	2.9	1.1	0.4	
Ro. Tailings	63.5	0.1	0.9	
-150 M, Slimes	24.5	-	-	
Total	100.0	6.9	100.0	
+65 M Mica Concen.	4.9	88.4	62.4	63.4
-65 M Mica Concen.	3.5	71.4	36.0	36.6
Total Mica Concen.	8.4	81.3	98.4	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	60	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	3.1	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	-	3.6	1200	-	-	-	-	-
Cleaner Float	-	-	3.6	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 51

STANDARD BATCH FLOTATION TEST (DESLIMED ON 200 M)

Batch Test No. 2 (Pilot Plant 11)
Lab. No. 4487 Date: 5/11/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	18.2	57.4	91.4	
2nd Cl. Tailings	1.7	13.3	2.0	
1st Cl. Tailings	5.4	6.6	3.1	
Ro. Tailings	57.8	0.7	3.5	
-200 M, Slimes	16.9	-	-	
Total	100.0	11.4	100.0	
+65 M Mica Concen.	8.0	86.6	60.5	66.2
-65 M Mica Concen.	10.2	34.7	30.9	33.8
Total Mica Concen.	18.2	57.4	91.4	100.0

Procedure

Process	Conditions: Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore): NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.4	700	-	2.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.25
Rougher Float	-	20	3.1	1200	-	-	-	-	-
Cleaner Float	-	20	3.1	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 52

BATCH FLOTATION TEST OF PILOT PLANT ROUGHER CELL FEED

Batch Test No. 3 (Pilot Plant 11)
Lab. No. 4487 Date: 5/11/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	15.8	58.2	89.0
2nd Cl. Tailings	-	-	-
1st Cl. Tailings	5.1	8.3	4.1
Ro. Tailings	79.1	0.9	6.9
Total	100.0	10.3	100.0

				Mica Screen Dist %
+65 M Mica Concen.	9.2	85.5	76.4	85.8
-65 M Mica Concen.	6.6	19.7	12.6	14.2
Total Mica Concen.	15.8	58.2	89.0	100.0

Procedure

	Conditions				*Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub in Pilot Plant	11.4	60	-	480	1.32	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in " "	8.6	57	2.1	740	-	5.60	1.22	-	-
Cond. " " "	1	10	-	-	-	-	-	1.35	0.26
Rougher Float (Batch)	-	-	-	-	-	-	-	-	-
Cleaner Float (Batch)	-	-	-	-	-	1.0	-	-	-

*All reagents added in pilot plant except H_2SO_4 in batch cleaner.

TABLE 53

STANDARD BATCH FLOTATION TEST (HIGH SOLIDS SCRUB)

Batch Test No. 1 (Pilot Plant 12)
Lab. No. 4490 Date: 5/17/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	7.0	95.5	95.3
2nd Cl. Tailings	0.6	17.8	1.6
1st Cl. Tailings	3.8	1.2	0.7
Ro. Tailings	73.7	0.2	2.4
-200 M, Slimes	14.9	-	-
Total	100.0	7.0	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.1	96.2	56.2	59.0
-65 M Mica Concen.	2.9	94.5	39.1	41.0
Total Mica Concen.	7.0	95.5	95.3	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	-	2.5	1200	-	-	-	-	-
Cleaner Float	-	-	2.7	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 54

STANDARD BATCH FLOTATION TEST (LOW SOLIDS SCRUB)

Batch Test No. 2 (Pilot Plant 12)
Lab. No. 4490 Date: 5/17/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	10.3	92.8	96.5	
2nd Cl. Tailings	0.6	9.4	0.6	
1st Cl. Tailings	4.4	1.7	0.7	
Ro. Tailings	73.7	0.3	2.2	
-200 M, Slimes	10.8	-	-	
Total	100.0	9.9	100.0	
+65 M Mica Concen.	7.4	95.8	71.6	74.2
-65 M Mica Concen.	2.9	85.3	24.9	25.8
Total Mica Concen.	10.3	92.8	96.5	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	60	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	2.0	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	2.6	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 55

STANDARD BATCH FLOTATION TEST (HIGH SOLIDS SCRUB)

Batch Test No. 1 (Pilot Plant 17)
Lab. No. 4496 Date: 6/16/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	7.9	80.1	89.8	
Cl. Tailings	2.9	0.8	0.3	
Ro. Tailings	77.8	0.9	9.9	
-200 M, Slimes	11.4	-	-	
Total	100.0	7.1	100.0	
+65 M Mica Concen.	3.6	96.9	49.4	55.0
-65 M Mica Concen.	4.3	66.2	40.4	45.0
Total Mica Concen.	7.9	80.1	89.8	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.7	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	2.5	1200	-	-	-	0.5	0.1
Rougher Float	-	20	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 56

STANDARD BATCH FLOTATION TEST (LOW SOLIDS SCRUB)

Batch Test No. 2 (Pilot Plant 17)
Lab. No. 4496 Date: 6/16/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	10.6	83.1	96.6
Cl. Tailings	3.3	0.1	0.0
Ro. Tailings	78.3	0.4	3.4
-200 M, Slimes	7.8	-	-
Total	100.0	9.1	100.0

				Mica Screen Dist %
+65 M Mica Concen.	6.1	97.4	65.3	67.6
-65 M Mica Concen.	4.5	63.3	31.3	32.4
Total Mica Concen.	10.6	83.1	96.6	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	10	60	-	1700	2.0	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.8	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	2.5	1200	-	-	-	0.5	0.1
Rougher Float	-	20	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 57

BATCH FLOTATION TEST (HIGH SOLIDS SCRUB)
WITH FERRIC SULFATE ADDED TO FLOAT

Batch Test No. 3 (Pilot Plant 17)
Lab. No. 4496 Date: 6/16/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.6	94.4	97.3
1st Cl. Tailings	1.4	1.0	0.2
Ro. Tailings	78.5	0.2	2.5
-200 M, Slimes	13.5	-	-
Total	100.0	6.4	100.0

				Mica Screen Dist %
+65 M Mica Concen.	3.8	97.5	57.9	59.5
-65 M Mica Concen.	2.8	90.3	39.4	40.5
Total Mica Concen.	6.6	94.4	97.3	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)					
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65	Ferric Sulfate
Scrub	10	70	-	1700	2.0	-	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.7	700	-	3.0	1.5	-	-	-
Condition in Cell	2	20	-	1200	-	-	-	0.5	0.1	0.1
Rougher Float	-	-	-	1200	-	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-	-

TABLE 58

BATCH FLOTATION (VARIABLES SAME AS PP 19)

Batch Test No. 4 (Pilot Plant 17)
Lab. No. 4496 Date: 7/13/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	8.4	96.8	97.1
1st Cl. Tailings	3.2	2.8	1.0
Ro. Tailings	79.7	0.2	1.9
-200 M, Slimes	8.7	-	-
Total	100.0	8.4	100.0

				Mica Screen Dist %
+65 M Mica Concen.	4.1	97.2	47.6	49.0
-65 M Mica Concen.	4.3	96.5	49.5	51.0
Total Mica Concen.	8.4	96.8	97.1	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine Ar-T	Frother F-65
Scrub	12	68	11.2	1700	1.5	-	-	-	-
Deslime 2 X 200 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	7.4	47.2	1.6	700	-	4.1	1.6	-	-
Condition in Cell	0.5	20	2.2	1200	-	-	-	0.5	0.3
Rougher Float	-	12	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	2.1	-	-	-

TABLE 59

BATCH FLOTATION TEST (AMINE RATE SERIES)

Batch Test No. 3 (Pilot Plant 24)
Lab. No. 4511 Date: 8/16/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	4.6	91.8	97.9	
2nd Cl. Tailings	0.5	11.0	1.4	
1st Cl. Tailings	3.5	0.9	0.7	
Ro. Tailings	79.4	-	-	
-150 M, Slimes	12.0	-	-	
Total	100.0	4.3	100.0	
+80 M Mica Concen.	3.3	96.9	74.2	75.8
-80 M Mica Concen.	1.3	78.7	23.7	24.2
Total Mica Concen.	4.6	91.8	97.9	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.7	0.1
Rougher Float	-	20	2.4	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 60

BATCH FLOTATION TEST (AMINE RATE SERIES)

Batch Test No. 4 (Pilot Plant 24)
Lab. No. 4511 Date: 8/16/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	5.2	87.2	98.1	
2nd Cl. Tailings	0.6	9.9	1.3	
1st Cl. Tailings	3.6	0.8	0.6	
Ro. Tailings	79.7	nil	-	
-150 M, Slimes	10.9	-	-	
Total	100.0	4.6	100.0	
+80 M Mica Concen.	3.5	95.3	72.2	73.6
-80 M Mica Concen.	1.7	70.4	25.9	26.4
Total Mica Concen.	5.2	87.2	98.1	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.9	0.1
Rougher Float	-	-	-	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 61

BATCH FLOTATION TEST (AMINE RATE SERIES)

Batch Test No. 5 (Pilot Plant 24)
Lab. No. 4511 Date: 8/16/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.0	76.8	98.7
2nd Cl. Tailings	0.8	5.6	0.9
1st Cl. Tailings	3.8	0.4	0.4
Ro. Tailings	78.0	nil	-
-150 M, Slimes	11.4	-	-
Total	100.0	4.7	100.0

				Mica Screen Dist %
+80 M Mica Concen.	3.8	90.6	73.3	74.3
-80 M Mica Concen.	2.2	53.9	25.4	25.7
Total Mica Concen.	6.0	76.8	98.7	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother F-65
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	1.1	0.1
Rougher Float	-	20	2.4	1200	-	-	-	-	-
Cleaner Float	-	-	2.7	1200	-	1.0	-	-	-
Cleaner Float	-	-	4.5	1200	-	-	-	-	-

TABLE 62

BATCH FLOTATION TEST (PINE OIL FROTHER)

Batch Test No. 6 (Pilot Plant 24)
Lab. No. 4511 Date: 8/22/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	4.2	90.4	96.4
2nd Cl. Tailings	0.3	30.5	2.3
1st Cl. Tailings	3.1	1.7	1.3
Ro. Tailings	79.9	nil	-
-150 M, Slimes	12.5	-	-
Total	100.0	3.9	100.0

				Mica Screen Dist %
+80 M Mica Concen.	3.3	93.2	77.9	80.8
-80 M Mica Concen.	0.9	81.0	18.5	19.2
Total Mica Concen.	4.2	90.4	96.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother P.Oil
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	2.4	1200	-	-	-	-	-
Cleaner Float	-	-	-	1200	-	1.0	-	-	-
Cleaner Float	-	-	-	1200	-	-	-	-	-

TABLE 63

BATCH FLOTATION TEST (HUNTICOL-26 FROTHER)

Batch Test No. 7 (Pilot Plant 24)
Lab. No. 4511 Date: 8/22/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	Mica Screen Dist %
Mica Concentrate	4.5	89.5	98.8	
2nd Cl. Tailings	0.5	8.5	1.0	
1st Cl. Tailings	3.3	0.2	0.2	
Ro. Tailings	79.3	nil	-	
-150 M, Slimes	12.4	-	-	
Total	100.0	4.1	100.0	
+80 M Mica Concen.	3.2	95.7	79.5	80.5
-80 M Mica Concen.	1.3	56.6	19.3	19.5
Total Mica Concen.	4.5	89.5	98.8	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother H-26
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	2.4	1200	-	-	-	-	-
Cleaner Float	-	-	2.7	1200	-	1.0	-	-	-
Cleaner Float	-	-	4.4	1200	-	-	-	-	-

TABLE 64

BATCH FLOTATION TEST (HARRIS MINING COMPANY REAGENTS)

Batch Test No. 2 (Pilot Plant 25)
Lab. No. 4517 Date: 8/31/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %	
Mica Concentrate	3.4	96.5	47.3	65.6
2nd Cl. Tailings	1.4	90.7	18.3	
1st Cl. Tailings	4.2	53.6	32.4	
Ro. Tailings	70.5	0.2	2.0	
-150 M, Slimes	20.5	-	-	
Total	100.0	6.9	100.0	

				Mica Screen Dist %
+80 M Mica Concen.	2.6	98.1	36.8	77.7
-80 M Mica Concen.	0.8	90.9	10.5	22.3
Total Mica Concen.	3.4	96.5	47.3	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	Na_2SiO_3	H_2SO_4	F.O.	Amine AZ-2642	Frother P.Oil
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.9	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	-	2.3	1200	-	-	-	-	-
Cleaner Float	-	-	2.7	1200	-	1.0	-	-	-
Cleaner Float	-	-	3.7	1200	-	-	-	-	-

TABLE 65

STANDARD BATCH FLOTATION TEST (AZ-AMINE, H-26 FROTHER)

Batch Test No. 3 (Pilot Plant 25)
Lab. No. 4517 Date: 8/31/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	6.7	87.6	94.4
2nd Cl. Tailings	0.8	22.6	2.9
1st Cl. Tailings	3.8	4.4	2.7
Ro. Tailings	71.0	nil	-
-150 M, Slimes	17.7	-	-
Total	100.0	6.2	100.0

				Mica Screen Dist %
+80 M Mica Concen.	4.4	94.2	66.6	70.5
-80 M Mica Concen.	2.3	75.2	27.8	29.5
Total Mica Concen.	6.7	87.6	94.4	100.0

Procedure

	Conditions				Reagents (lbs per ton of ore)				
Process	Time (min)	% Solids	pH	rpm	NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother H-26
Scrub	10	70	-	1700	2.0	-	-	-	-
Deslime 2 X 150 M	1	-	-	-	-	-	-	-	-
Cond. in Beaker	3	45	1.8	700	-	3.0	1.5	-	-
Condition in Cell	0.5	20	-	1200	-	-	-	0.5	0.1
Rougher Float	-	20	2.4	1200	-	-	-	-	-
Cleaner Float	-	-	2.6	1200	-	1.0	-	-	-
Cleaner Float	-	-	3.5	1200	-	-	-	-	-

TABLE 66

BATCH FLOTATION OF FEED TO PILOT PLANT

Batch Test No. 4 (Pilot Plant 26)
Lab. No. 4517 Date: 9/14/78

Material Balance

Sample	Sample Wt %	Mica Assay %	Mica Dist %
Mica Concentrate	12.8	64.5	91.7
1st Cl. Tailings	7.3	7.7	6.2
Ro. Tailings	64.8	0.3	2.1
-150 M, Slimes	15.1*	-	-
Total	100.0	9.0	100.0

				Mica Screen Dist %
+80 M Mica Concen.	8.8	83.3	81.5	88.8
-80 M Mica Concen.	4.0	23.1	10.2	11.2
Total Mica Concen.	12.8	64.5	91.7	100.0

Procedure

Process	Conditions Time (min)	% Solids	pH	rpm	Reagents (lbs per ton of ore) NaOH	H_2SO_4	F.O.	Amine AZ-2642	Frother H-26
Scrub in Pilot Plant	15.9	68	-	480	1.58	-	-	-	-
Deslime " "	-	-	-	-	-	-	-	-	-
Cond. in " "	11.5	57	2.2	740	-	4.24	1.65	-	-
Cond. " " "	1	-	-	-	-	-	-	1.41	0.30
Rougher Float (Batch)	-	-	-	-	-	-	-	-	-
Cleaner Float (Batch)	-	-	-	-	-	-	-	-	-

*Assumed same weight percent as pilot plant test.

APPENDIX C

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION OF BATCH TESTS AND PILOT PLANT TESTS

TABLE 67

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Batch Test 3 (Pilot Plant No. 1)

Lab. No. 4483 Date: 3/20/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	-	-	-	-	-	-	1.3	81.5	1.1	0.9	4.4	5.1
-14+20	-	-	-	-	-	-	5.0	98.0	5.4	5.2	1.8	11.5
-20+28	-	-	-	-	-	-	10.6	97.3	11.3	12.4	0.5	7.7
-28+35	-	-	-	-	-	-	13.4	98.6	14.5	19.4	0.5	12.8
-35+48	-	-	-	-	-	-	14.4	97.8	15.5	21.8	0.8	21.9
-48+65	-	-	-	-	-	-	11.9	97.3	12.7	16.9	0.9	19.3
-65+100	-	-	-	-	-	-	9.7	96.4	10.4	9.9	0.9	11.5
-100	-	-	-	-	-	-	33.7	78.2	28.9	13.5	0.6	10.2
Total	-	-	-	-	-	-	100.0	90.8	100.0	100.0	0.8	100.0

TABLE 68

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 2

Lab. No. 4483 Date: 3/30/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	1.6	37.7	9.1	1.7	38.2	9.4	1.6	99.7	2.1	0.9	36.7	10.8
-14+20	4.5	15.2	10.3	5.6	14.9	12.0	6.4	99.8	8.2	3.5	9.1	10.5
-20+28	11.9	11.3	20.2	14.6	10.7	22.5	14.2	99.8	18.3	11.1	7.6	27.5
-28+35	18.3	7.6	21.0	21.0	7.0	21.2	16.9	99.5	21.7	18.7	3.2	19.6
-35+48	20.6	6.0	18.8	22.6	5.3	17.3	16.5	99.2	21.1	22.7	2.1	15.7
-48+65	16.5	5.3	13.2	16.4	4.6	10.8	11.2	98.0	14.2	19.2	1.2	7.5
-65+100	9.7	4.2	6.2	8.7	4.0	5.1	7.2	93.1	8.6	11.2	1.2	4.2
-100	16.9	0.5	1.2	9.4	1.3	1.7	26.0	17.2	5.8	12.7	1.0	4.2
Total	100.0	6.6	100.0	100.0	6.9	100.0	100.0	77.5	100.0	100.0	3.0	100.0

TABLE 69

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 3

Lab. No. 4483 Date: 4/5/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	-	-	-	2.0	32.3	9.3	1.7	100.0	2.3	1.1	28.7	14.5
-14+20	-	-	-	6.2	14.1	12.4	5.0	100.0	6.7	4.5	9.6	19.5
-20+28	-	-	-	15.5	10.7	23.7	12.0	99.8	16.0	12.8	5.4	31.1
-28+35	-	-	-	20.6	7.4	21.7	14.5	99.7	19.2	19.7	2.2	19.4
-35+48	-	-	-	21.1	6.4	19.3	15.0	98.7	19.1	22.2	1.2	12.2
-48+65	-	-	-	14.7	3.7	7.7	11.6	94.3	14.6	17.4	0.3	2.3
-65+100	-	-	-	7.9	3.8	4.3	8.7	87.6	10.2	9.7	0.1	0.5
-100	-	-	-	12.0	0.9	1.6	31.5	26.9	11.3	12.6	0.1	0.5
Total	-	-	-	100.0	7.0	100.0	100.0	75.0	100.0	100.0	2.2	100.0

TABLE 70

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 8

Lab. No. 4487 Date: 6/12/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	1.6	66.2	1.2	1.0	71.6	8.1	1.7	97.5	4.2	0.6	39.6	20.7
-14+20	2.0	38.5	8.6	1.7	32.1	6.2	2.5	98.0	6.2	1.5	13.4	17.2
-20+28	6.6	27.1	19.9	6.4	21.4	15.5	6.5	96.5	15.8	5.3	5.4	25.1
-28+35	12.1	16.5	22.2	13.0	14.9	21.9	9.8	89.9	22.2	12.7	2.0	21.6
-35+48	17.0	13.2	24.8	19.1	10.9	23.4	13.3	73.8	24.7	19.8	0.6	10.3
-48+65	17.0	5.7	10.8	19.6	5.9	13.1	13.1	42.0	13.9	21.9	0.2	3.4
-65+100	11.7	5.2	6.8	13.9	5.3	8.4	10.9	34.8	9.6	15.1	0.1	1.7
-100	32.0	1.6	5.7	25.3	1.2	3.4	42.2	3.2	3.4	23.1	0.0	0.0
Total	100.0	9.0	100.0	100.0	8.9	100.0	100.0	39.7	100.0	100.0	1.2	100.0

TABLE 71

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 10

Lab. No. 4487 Date: 6/13/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	1.0	73.5	6.3	1.0	64.7	6.2	2.5	98.1	3.7	0.6	57.4	22.7
-14+20	1.8	35.3	5.4	2.0	29.0	5.5	4.1	99.5	6.2	1.3	15.6	13.3
-20+28	6.0	26.5	13.5	7.0	21.8	14.5	10.6	97.1	15.6	5.9	7.1	28.1
-28+35	11.3	18.4	17.7	12.2	16.7	19.4	14.9	94.8	21.4	12.1	2.4	19.3
-35+48	16.0	15.3	20.8	16.7	13.9	22.1	17.7	86.9	26.0	19.2	0.8	10.0
-48+65	16.3	11.6	16.0	16.9	9.3	14.9	14.0	71.6	15.2	21.1	0.4	5.3
-65+100	12.0	9.5	9.7	12.6	5.2	6.3	9.4	42.8	6.1	15.4	0.1	1.3
-100	35.6	3.5	10.6	31.6	3.7	11.1	26.8	14.3	5.8	24.4	0.0	0.0
Total	100.0	11.8	100.0	100.0	10.5	100.0	100.0	66.0	100.0	100.0	1.5	100.0

TABLE 72

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 19

Lab. No. 4496 Date: 6/30/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	2.0	43.1	9.8	-	-	-	4.9	99.2	6.1	2.2	9.1	37.7
-14+20	4.5	13.7	7.1	-	-	-	5.8	99.7	7.3	5.2	1.9	18.9
-20+28	9.4	12.9	13.8	-	-	-	11.2	99.5	14.1	12.0	1.1	24.5
-28+35	13.0	10.7	15.9	-	-	-	13.4	98.2	16.6	16.0	0.4	11.3
-35+48	15.2	10.4	18.0	-	-	-	15.7	95.8	19.2	18.0	0.1	3.8
-48+65	15.0	10.2	17.5	-	-	-	13.4	86.4	14.6	16.1	0.1	3.8
-65+100	11.7	7.2	9.6	-	-	-	10.2	70.2	9.0	12.2	0.0	0.0
-100	29.2	2.5	8.3	-	-	-	25.4	41.0	13.1	18.3	0.0	0.0
Total	100.0	8.8	100.0	-	-	-	100.0	79.2	100.0	100.0	0.5	100.0

TABLE 73

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 20

Lab. No. 4496 Date: 6/29/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	2.0	43.1	9.8	1.8	34.4	8.4	1.6	97.1	2.3	1.7	21.5	33.6
-14+20	4.5	13.7	7.1	3.9	12.8	6.8	6.6	99.7	9.6	4.9	4.4	20.0
-20+28	9.4	12.9	13.8	9.8	11.4	15.2	9.7	99.4	14.1	10.2	2.0	18.2
-28+35	13.0	10.7	15.9	13.8	10.1	18.9	13.3	98.8	19.2	14.5	1.3	17.3
-35+48	15.2	10.4	18.0	16.8	9.3	21.1	16.1	96.3	22.6	17.1	0.5	8.2
-48+65	15.0	10.2	17.5	16.7	7.9	17.9	13.6	87.8	17.5	16.8	0.2	2.7
-65+100	11.7	7.2	9.6	12.4	5.2	8.7	9.6	63.1	8.9	12.7	0.0	0.0
-100	29.2	2.5	8.3	24.8	0.9	3.0	29.5	13.5	5.8	22.1	0.0	0.0
Total	100.0	8.8	100.0	100.0	7.4	100.0	100.0	68.4	100.0	100.0	1.1	100.0

TABLE 74

SCREEN ANALYSES, MICA CONTENT, AND MICA DISTRIBUTION

Pilot Plant No. 21

Lab. No. 4496 Date: 7/6/78

Screen Size Tyler Mesh	Ore Feed			Flotation Feed			Concentrate			Tailings		
		Mica			Mica			Mica			Mica	
	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %	Wt %	Assay %	Dist %
+14	2.2	49.8	10.9	1.7	44.2	8.2	4.0	99.0	4.6	1.3	24.0	35.8
-14+20	3.3	16.2	5.2	3.0	15.1	4.9	5.2	99.2	6.0	3.2	4.1	14.9
-20+28	7.9	15.7	12.3	7.6	14.7	12.3	11.2	99.6	13.0	7.6	2.0	17.2
-28+35	11.2	13.0	14.5	11.4	12.4	15.5	14.8	99.2	17.1	11.3	1.2	16.1
-35+48	13.9	13.8	19.0	15.1	11.4	18.9	18.6	98.2	21.3	14.3	0.5	8.0
-48+65	14.7	11.9	17.3	16.8	10.1	18.8	15.7	94.8	17.3	16.2	0.4	6.9
-65+100	12.1	8.4	10.1	13.3	6.9	10.1	10.2	85.4	10.1	13.7	0.1	1.1
-100	34.7	3.1	10.7	31.1	3.3	11.3	20.3	45.0	10.6	32.4	0.0	0.0
Total	100.0	10.1	100.0	100.0	9.1	100.0	100.0	86.0	100.0	100.0	0.9	100.0

APPENDIX D

PILOT PLANT EQUIPMENT DESCRIPTION

PILOT PLANT EQUIPMENT DESCRIPTION

Belt Feeder

Laboratory-constructed, 13 ft. long, 10 in. wide, speed 14 ft. per minute, capacity 2000 pounds per hour, V-belt, gear reducer and chain drive, 1/2 hp single-phase 220 volts, 1725 rpm.

No. 1 Pump

Deming 1 1/2 M, 10" diameter impeller, 1050 rpm, 12 gpm, 3 hp three-phase motor, 220 volts, 1740 rpm.

No. 1 Cyclone

Dorr Company, 3-inch diameter, intake opening 1" x 1/2", vortex opening 1" diameter, intake pressure 5 psi, adjustable apex.

No. 1 Spiral Classifier

Denver Equipment Company, 12" diameter, 8 ft. long, 12 rpm, V-belt, gear reducer drive, 3/4 hp three-phase motor, 220 volt, 1725 rpm.

Scrubber

Wemco Equipment Company, three 1-cu. ft. pots, 480 rpm, 3 hp three-phase motor, 220 volt, 955 rpm each.

No. 2 Pump

Denver Equipment Company, vertical, 1400 rpm, 12 gpm, V-belt drive, 1 hp three-phase motor, 220 volts, 1735 rpm.

No. 2 Cyclone

Dorr Company, 3-inch diameter, intake opening 1" x 1/2", vortex opening 3/4" diameter, intake pressure 5 psi, adjustable apex.

No. 3 Pump

Deming 1 1/2 M, 10" diameter impeller, 900 rpm, 13 gpm, 3 hp three-phase motor, 220 volts, 1740 rpm.

No. 3 Cyclone

Dorr Company, 3-inch diameter, intake opening 1" x 1/2", vortex opening 1" diameter, intake pressure 5 psi, adjustable apex.

No. 2 Spiral Classifier

Denver Equipment Company, 9" diameter, 8 ft. long, 15 rpm, V-belt, gear reducer drive, 1/2 hp motor three-phase, 220 volt, 1740 rpm.

Conditioner

Laboratory-designed, 2 compartments, 15" diameter x 20" high each, 1.74 cu. ft. total capacity, one 4-bladed impeller of 7" diameter each, running at 740 rpm, V-belt drive, 3 hp three-phase motor, 220 volts, 1750 rpm.

Flotation Cells

Denver Equipment Company No. 8, cell volume 2.75 cu. ft. each, impeller speed 490 or 700 rpm, V-belt drive in tandem by 1 1/2 hp single-phase motor, 220 volts, 1715 rpm.

No. 4 Pump (Tailings)

Denver Equipment Company, Denver SRL 1 1/2" x 1 1/4", 1500 rpm, 24 gpm, 3 hp three-phase motor, 220 volts, 1750 rpm.

No. 4 Cyclone

Humphrey, 3" diameter, intake opening 1" diameter, vortex 1 1/4" diameter. Apex adjustable, used 1/2" diameter.

Reagent Feeders

Denver Equipment Company, 10-cup disk feeder running at 4 rpm, belt, gear reducer drive, 1/20 hp single-phase motor, 150 volts, 1725 rpm.

Brosites Machine Company, Inc., 6-tube reagent feeder, 110 volt.

APPENDIX E

REAGENT COST

REAGENT COST
(Pilot Plant No. 21)

	lb/ton of feed	$/lb	$ Cost
NaOH	1.56	0.130	0.20
H_2SO_4	6.84	0.019	0.13
Fuel Oil	1.73	0.045	0.08
Armac-T	0.53	0.560	0.30
Frother F-65	0.31	0.500	0.16

Total cost per ton of feed $0.87

Total cost per ton of mica product (ratio of conc.-10.3) $8.96

(Ore-Rod Milled, Minus 9 Mesh, Partially Deslimed)

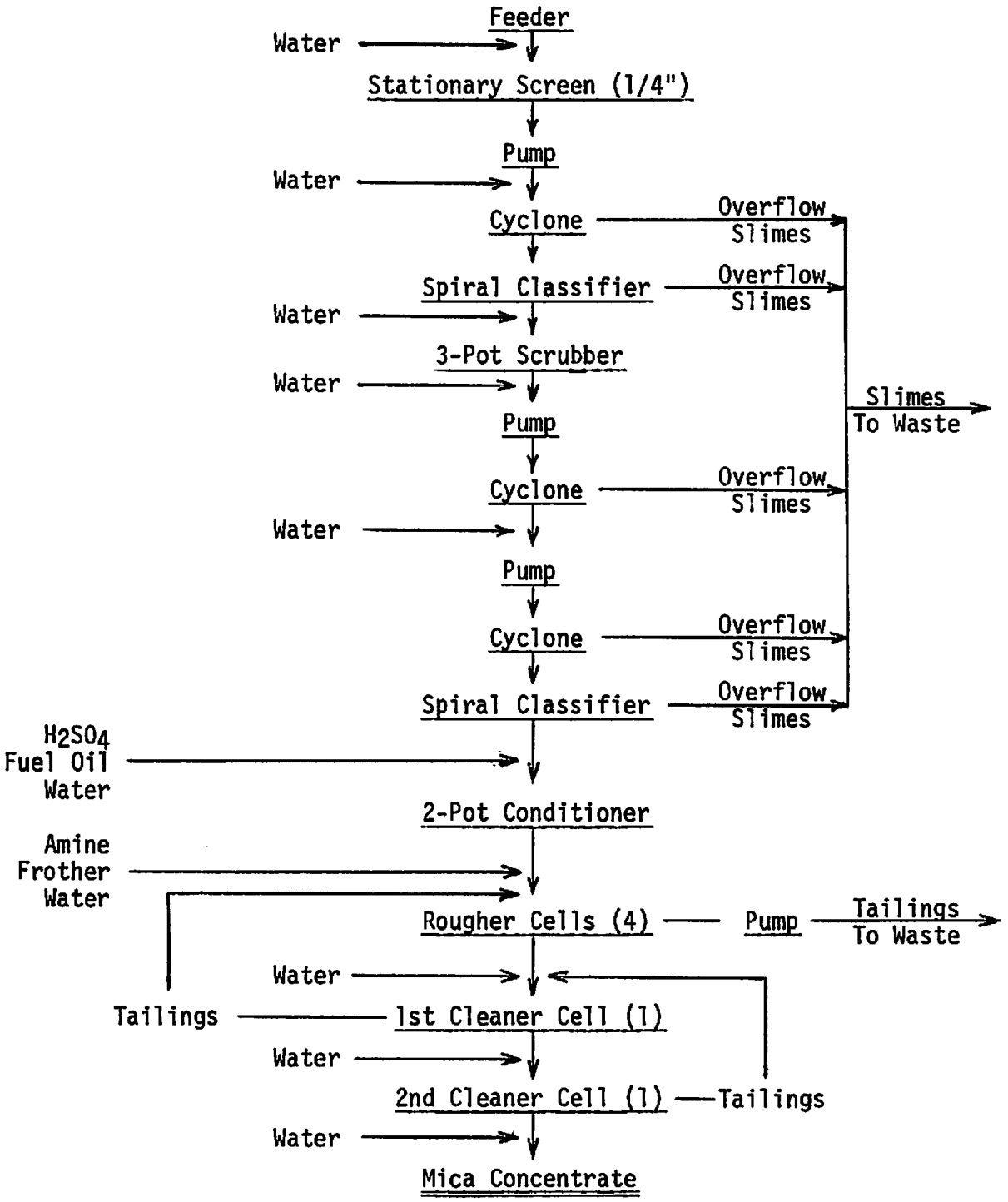


Figure 1. Pilot plant flowsheet

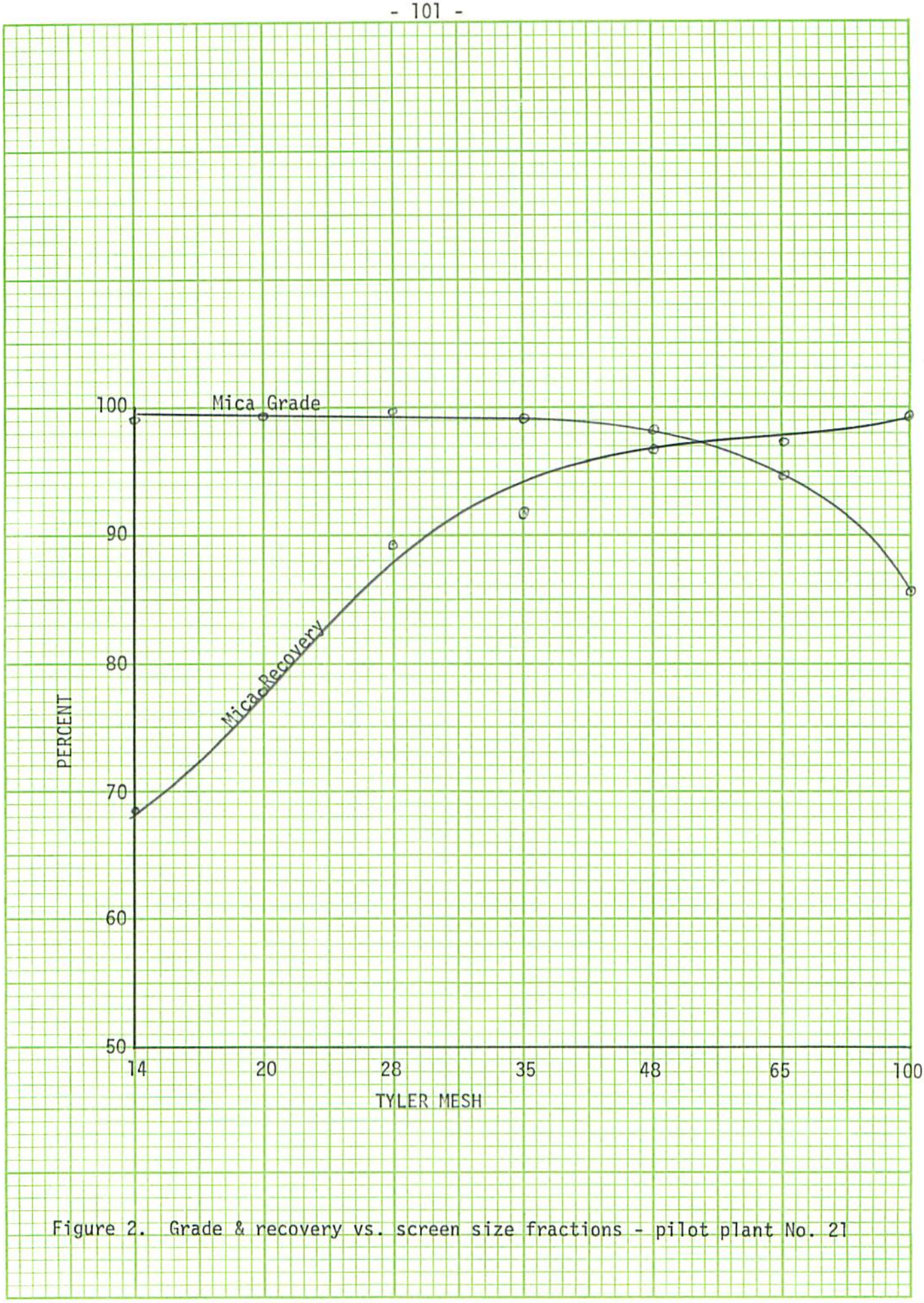
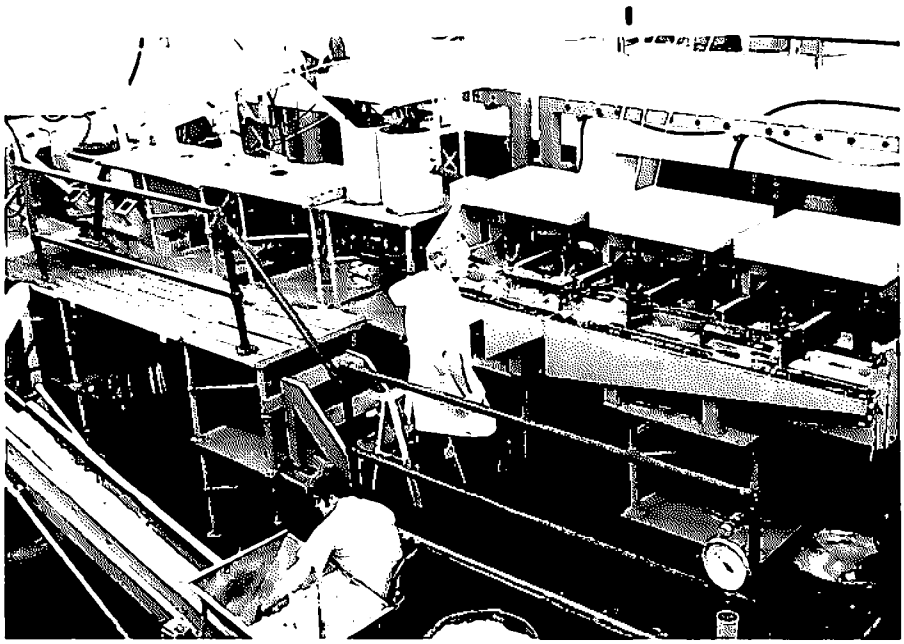


Figure 2. Grade & recovery vs. screen size fractions - pilot plant No. 21

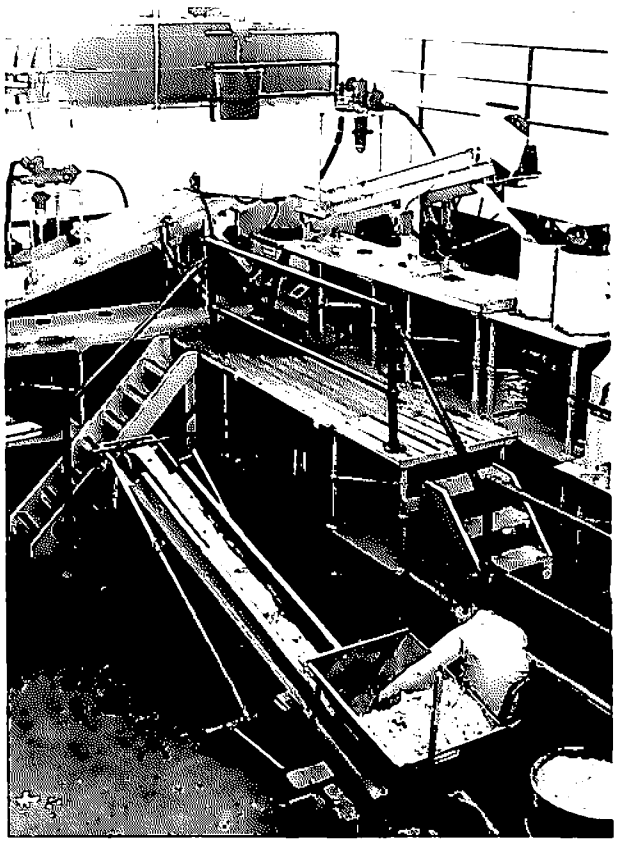
ACKNOWLEDGMENTS

Much appreciation is extended to Harris Mining Company personnel, particularly Mr. Ben Robinson and Mr. James Tanner for their cooperation, suggestions, and patience during this project. Appreciation is also extended to the Minerals Research Laboratory staff under the guidance of Mr. Immo Redeker, Chief Engineer, for their contributions and consultations.

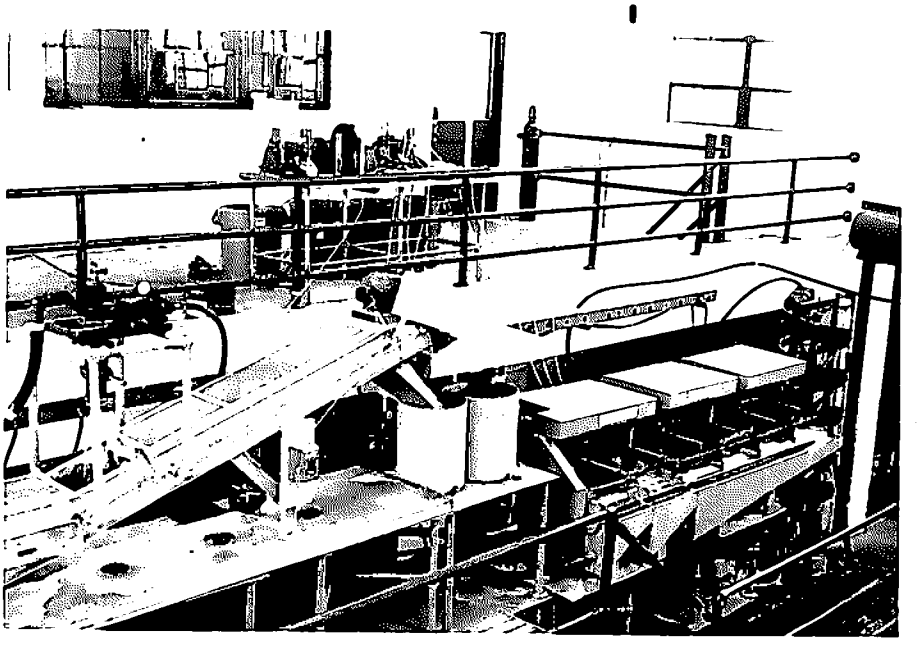
PHOTOGRAPHS



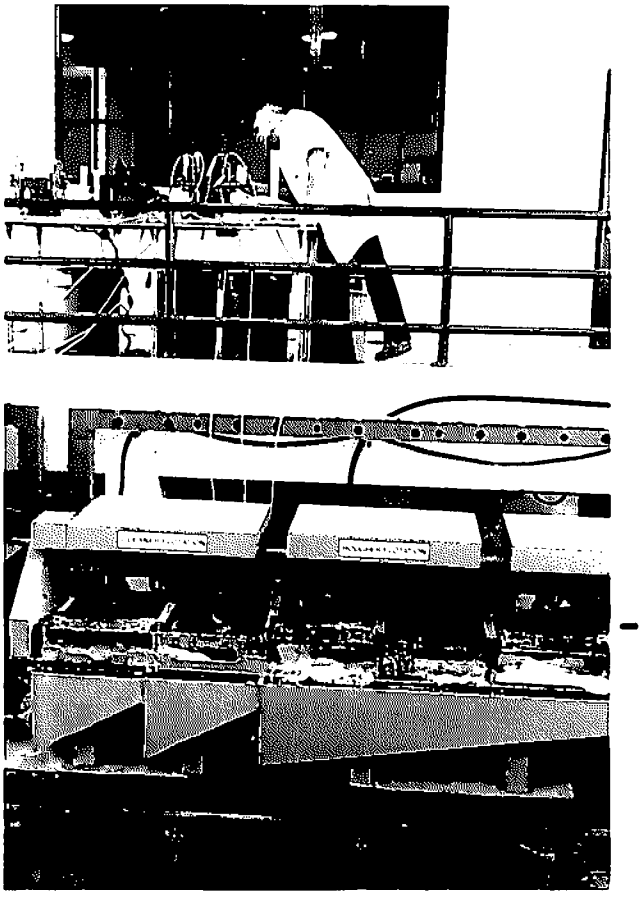
Ore Feed and Flotation



Ore Feed and Scrubbing and Desliming



Conditioning and Flotation



Reagent Feeding and Flotation