

1

2,984,348

BENEFICIATION OF POTASH ORES

Albert Adams and William B. Dancy, Carlsbad, N. Mex.,
assignors to International Minerals & Chemical Cor-
poration, a corporation of New York

Filed Aug. 14, 1958, Ser. No. 755,111

12 Claims. (Cl. 209—12)

The present invention generally relates to the beneficia-
tion of potash ores. More particularly, it relates to an
improved process for the separation of sylvite from ores
of the sylvinite type, for example such ores as are mined
in the Carlsbad district of New Mexico.

As is well known, potash is of great economic impor-
tance. Extensive deposits of potash salts are found on
every continent. However, in practically no instance is
the potash salt found in a substantially pure form. On
the North American continent, one frequently encoun-
tered potash salt is sylvite (KCl). The KCl is not often
found in any appreciable quantities as pure sylvite ore but
is most often found as sylvinite ore, which is a mixture of
sylvinite and halite (NaCl). A typical analysis of a
sylvinite ore is as follows:

	Percent
Sylvite (KCl) -----	23
Halite (NaCl) -----	73
Other constituents or impurities consisting of silicates, sulfates, etc. -----	4

This invention is of particular value in connection with
processes of the general type disclosed in the Tartaron,
Cole and Duke Patent No. 2,288,497. Said patent de-
scribes a process which comprises suspending comminuted
sylvinite ore in a circulating saturated brine formed by
dissolving the soluble constituents of the ore in water
and then floating the particles of sylvite by means of a
suitable collector agent while permitting the particles of
halite to settle. The type of process to which this inven-
tion relates is thus distinguished from that type of process
disclosed in the Weinig Patent No. 2,222,331, issued
November 19, 1940, in which the halite is floated and the
sylvite is settled.

In processes of this general character, it has been the
general practice to grind the ore to a rather fine mesh,
for example, to a degree of fineness where at least 90%
of the ore would pass through a sieve of about 40 mesh.
Flotation of the valuable sylvite constituents of an ore
of such degree of fineness is not too difficult a problem,
and various types of collector agents for effecting such
flotation can be used. It is, however, very costly to
thoroughly size an ore so that substantially all of the ore
particles to the flotation process fall within a small size
range. Furthermore, the expense of fine grinding is rather
considerable and adds materially to the cost of the final
product.

In general, it may be stated that the flotation of ore
consisting of relatively large particles is attended with
considerably more difficulty than when the particles are
of relatively smaller dimensions. In other words, it is
generally more difficult to float relatively large size
sylvite particles than it is to float relatively smaller
particles. It has also been observed that the large sylvite
particles make up a substantial amount of the sylvite
which is not floated and which is, therefore, usually lost
in the tailings.

In a flotation operation, the ore is slurried in a liquid

2

to prepare a pulp of the ore. In a sylvite flotation process,
the potash ore is slurried in a saturated brine solution
to produce a brine slurry or pulp of from about 50% to
about 75% solids. The pulp is then reagentized with a
suitable collector, diluted with brine, and passed to a
flotation cell. In the flotation cell the pulp is kept in
circulation and is contacted with air. Air bubbles adhere
to the reagentized sylvite particles and float the sylvite
particles. The sylvite float is raked off of the top of the
flotation cell. Not all of the sylvite is floated off in
the first flotation cell and the remaining pulp is removed
as underflow from the first cell and is passed to a second
flotation cell. In the second cell, the flotation operation
is repeated, a sylvite concentrate is floated off, and the
remaining pulp may be passed to a third flotation opera-
tion. A flotation machine usually contains a plurality
of such cells associated together in series. After a series
of flotation operations, the remaining pulp, from which
substantial amounts of sylvite have been removed, is dis-
carded as a tailing. This initial flotation operation is
denominated a rougher flotation, the float product is
denominated a rougher float or rougher concentrate, and
the tailing is denominated a rougher tail.

The rougher concentrate, while containing substantially
all of the sylvite values in the charged pulp, also contains
a substantial amount of fine halite particles which were
removed with the sylvite. Therefore, it is conventional
practice to combine the rougher concentrate from the in-
dividual flotation cells and subject the combined rougher
concentrates to a cleaner flotation operation. In the
cleaner flotation operation, the rougher concentrate in a
pulp is subjected to flotation in a plurality of flotation
cells in series. The unfloated pulp recovered from the
last of the cleaner flotation cells is denominated a mid or
a middling and is usually recycled to the rougher cells.
The float product from the cleaner operation is recovered
as a high grade sylvite product, usually denominated a
cleaner concentrate.

Since it is more difficult to float the larger sylvite
particles as compared with the smaller sylvite particles,
in an operation as above described, considerable amounts
of sylvite are lost as large sylvite particles in the rougher
tailings. This loss, of course, tends to decrease the effi-
ciency of the flotation operation and it is with the problem
of increasing the efficiency that the present invention is
concerned.

It is accordingly an object of the present invention to
provide an improved process for the recovery of sylvite
from potash ores.

It is another object of the present invention to provide
an improved flotation process for the recovery of sylvite
from sylvinite ores.

It is a further object of the invention to provide an
improved process for the recovery of sylvite from sylvinite
ores, which process includes a flotation operation and a
sizing step.

These and other objects of the present invention will be
apparent to those skilled in the art as the description of
the present invention progresses.

In accordance with the present invention, it has been
discovered that eminently satisfactory beneficiation of
potash ores and minerals can be achieved by means of a
series of critical and interdependent process steps. Gen-
erally described, the present invention is a process for
beneficiating a potash ore which comprises slurrying a
potash ore containing sylvite with brine saturated at least
with respect to sylvite, reagentizing the slurried ore with
a reagent having a preferential affinity for the sylvite,
subjecting the reagentized slurry to a first flotation opera-
tion in a plurality of rougher flotation cells connected in
series, subjecting the flotation concentrate from at least
the first of the series of rougher flotation cells to a second

flotation operation, separately recovering the float product of said second flotation operation and the non-float product of said second flotation operation, subjecting the flotation concentrate from at least the last cells of the series of rougher flotation cells and at least a portion of the non-float product of said second flotation operation to a sizing operation, and separately recovering a fine fraction and a coarse fraction from the hydroconing operation. The coarse fraction is a sylvite material of high purity and may be recovered as a product of the process.

In this novel process, potash ore containing sylvite, for example, sylvinitic ore as received from the mine, is comminuted to economical liberation size to produce a granular feed material. The comminution of the ore to the liberation of the various constituents is effected to liberate a substantial amount of the various constituents. It may be desirable and economical to comminute the ore to liberate substantially all of the constituents; however, the ore may be liberated to a lesser extent, for example, to 70-80% liberation. This granular material is preferably sized to produce a granular feed of a particle size in the range of about -8 mesh. The comminution may be carried out dry or in a saturated brine and in any suitable comminuting apparatus such as a ball mill, rod mill, roller mill, hammer mill, or any other suitable type of grinding or crushing apparatus. When the ore is ground to the mesh size indicated, the sylvite values, halite values, and gangue values are substantially liberated from each other and the ore is ready for further treatment in accordance with this invention.

The ore while in a state of subdivision sufficient to substantially completely liberate the desired components from the gangue is slurried in a brine solution which is substantially saturated with respect to sylvite and also substantially saturated with respect to halite. The saturated brine is slurried with the comminuted ore to form a slurry of from about 50% to about 75% solids, and reagents are introduced into the slurry and dispersed by agitation. The reagents used are cationic agents and are added to selectively float the sylvite particles from the halite particles. Useful reagents are the collector agents selected from the class of primary aliphatic amines of about C-14 to C-20 length carbon chains and their acid addition salts, preferably the acetate or hydrochlorides, for example, octadecylamine acetate, hexadecylamine hydrochloride, and the like, of varying degrees of unsaturation depending upon the temperature of the brine in which the flotation operation is carried out. The amine reagents float potassium chloride.

After introducing the reagents having a preferential affinity for the sylvite constituents of the mixture, the slurry is diluted, preferably to a solids concentration between about 20% and about 35% solids, and the diluted slurry is passed to a rougher flotation cell. In the rougher flotation cell, in the presence of mechanical agitation and/or aeration, a froth is formed which carries the sylvite to the surface where the froth and its suspended solids are removed by overflow from the flotation cell. The removal of the floated solids as overflow from the cell is usually promoted by the use of paddles or rakes which skim over the surface of the brine in the cell and move the float off.

The flotation operation is carried out in a plurality of such flotation cells associated together in series. Thus, in the first flotation cell, a large portion of the sylvite may be floated out while still leaving in the pulp a substantial amount of sylvite, and this is substantially removed by a repetition of the flotation process in the succeeding cells to the end that the pulp passing from the final cell contains substantially none of the sylvite particles. Flotation machines having a plurality of flotation cells connected in series are commercially available and preferred machines are those referred to in the art as Fagergren flotation machines and Denver flotation

machines. The Fagergren flotation machines usually have five cells connected in series.

As hereinbefore set forth, it has been noted that the larger sylvite particles are more difficult to float as compared to smaller sylvite particles. Therefore, some larger size sylvite particles tend to remain in the latter of the flotation cells in series. In accordance with the present invention, the float products from this initial rougher flotation are separately collected in two float portions. Each float portion includes the float from one flotation cell or from a plurality of such cells in series. The first float portion which is separately collected includes at least the float product from the first cell of the series of cells and the second float portion which is separately collected includes at least the float product from the last cell of the series of cells. Further, in accordance with the present invention, the latter of the cells of the series, including the last cell, are preferably operated so that heavily overflowing conditions are maintained so as to float off larger sylvite particles.

The first float portion separately recovered from the rougher flotation operation contains sylvite and some halite. To upgrade this first float portion, it is passed to a cleaner flotation operation. The first float portion is of high solids content and, therefore, it is preferred to slurry it with saturated brine so as to obtain a slurry having a solids concentration of from about 20% to 35% solids. The first float portion usually has sufficient cationic reagent present so that additional cationic reagent is not necessary in the cleaner flotation; however, if desired, before diluting the first float portion, it may be conditioned with additional cationic reagent. The cleaner operation, like the rougher flotation operation, is usually performed in a series of flotation cells. The cleaner float is a product of high sylvite content and is usually recovered as a final product of the process. However, since the larger sylvite particles are more difficult to float, some of the larger sylvite particles are not floated in the cleaner operation. Following the steps of the present invention, however, the losses formerly encountered by the difficulty in floating these larger sylvite particles are substantially reduced.

In accordance with the present invention at least a portion of the non-floated portion from the cleaner flotation operation, usually denominated midds or middlings, is combined with at least a portion of the second float portion collected from the rougher flotation operation and the combined stream is subjected to a sizing or wet classification treatment. The combined stream contains substantial amounts of larger sylvite and fine halite particles. The sizing or wet classification or hydroclassification substantially separates the larger sylvite particles from the fine halite particles. The sizing or hydroclassification may be performed in any suitable manner such as by the use of rake classifiers, screens, etc.; however, the sizing is preferably performed in a hydroconing operation using at least one hydrocone. In a hydrocone a separation is made in the cone-shaped part of the hydrocone by the action of centrifugal and centripetal forces. The heavier material, which contains the major portion of the larger sylvite particles, leaves the cone as underflow. The lighter material, which contains the major portion of the fine halite particles, leaves the cone as overflow.

The underflow from the hydrocone is predominantly coarse sylvite. However, it usually still contains some fine halite. The fine halite may be further removed by a further sizing operation which preferably is a screening operation. The coarser fraction from the screening operation is substantially pure coarse sylvite. This coarse sylvite is preferably dewatered and dried and the dried material may be recovered as a product of the process.

In a preferred operation, at least a portion of the fine size fraction or cyclone overflow is recycled to the

5

rougher flotation operation. It is also preferred that at least a portion of the fine material which passed through the screen in the screening operation be recycled to the rougher flotation operation. The recycling feature makes maximum use of the saturated brine and increases recovery of sylvite.

Having generally described the process of the invention, a more specific and detailed description will be given with reference to the accompanying drawing which is a diagrammatic flow sheet illustrating the general application of the process of the invention.

Referring to the drawing, a reagentized sylvinitic flotation feed or pulp is introduced through line 7 into a first flotation cell 9 of a series of rougher flotation cells. The fresh feed in line 7 is combined with a recycle stream being recycled through line 11. The production of the recycle stream 11 will be hereinafter set forth. The fresh feed is prepared for flotation by first comminuting and screening a potash ore to obtain a -8 mesh fraction, desliming the comminuted ore, and conditioning the deslimed ore in saturated brine at 60% solids content for two minutes with about 1.0 pound of potato starch and 0.15 pound of aliphatic amine per ton of feed. The conditioned ore is then diluted to 25% solids with saturated brine and the pulp is passed through line 7 into the first flotation cell 9. A float fraction is withdrawn from the flotation cell 9 through line 13 and the remaining non-floated pulp is withdrawn through line 15 and passed to the second flotation cell 17. In the second flotation cell additional float product is withdrawn through line 19. The nonfloated pulp is withdrawn from cell 17 through line 21 and is passed to the third flotation cell 23. In the third flotation cell additional float fraction is produced and is withdrawn through line 25. The non-floated pulp is withdrawn from cell 23 through line 27 and is passed to a fourth flotation cell 29.

The float fractions in lines 13, 19 and 25 are combined in line 31 and the combined float fractions are diluted with brine entering through line 33 to produce a flotation feed containing 25% solids. The diluted combined float fractions are introduced through line 35 to a cleaner flotation operation in a series of cleaner flotation cells 37, 39, 41, 43 and 45. The float products from each of these cleaner cells are recovered and combined in line 47. The float product from the cleaner cells is of high purity and may be recovered as a sylvite product of the process. The non-floated fraction removed from the last of the cleaner cells 45, through line 49 contains substantial amounts of fine halite as well as substantial amounts of larger size sylvite and is further processed as is hereinafter set forth to recover the sylvite.

Referring back to the rougher flotation operation and specifically the flotation in the fourth rougher cell 29, the flotation operation in this cell 29 is conducted with a heavy overflow so as to facilitate the recovery of substantial amounts of the larger sylvite particles. The float fraction is withdrawn from cell 29 through line 51. The non-floated pulp is withdrawn from cell 29 through line 53 and is passed to the fifth and last rougher flotation cell 55. This last rougher cell is also operated with a heavy overflow so as to float substantial amounts of the larger sylvite particles. The remaining non-floated pulp is withdrawn from the last rougher cell 55 through line 57 and may be discarded as a waste tailing. The floated fraction is withdrawn from the last cell through line 59 and is combined with the float fraction from the fourth rougher cell 29 in line 61. The combined rougher float fractions, 51 and 59, in line 61 are also combined with the non-float fraction 49 of the last cleaner flotation cell and the combined fractions in line 63 are passed into a hydrocone 65 for a hydroconing operation. The hydrocone 65 is a closed top cyclone. The feed material in line 63 is fed tangentially into the hydrocone. The lighter portion of the feed introduced via line 63, which

6

consists of fine halite particles, leaves the cone 65 as overflow through line 67 and is recycled to the rougher flotation operation through lines 67 and 11.

The heavier portion of the feed material introduced via line 63, which consists of larger or coarse sylvite particles, leaves the cone 65 as underflow through line 69. The material in line 69 is screened in screening zone 71 to further separate the sylvite from the fine halite particles. A screening on about 24 mesh has proven satisfactory. The fine material passing through the screen 71 is withdrawn through line 73 and is combined with the hydrocone overflow in line 67 and the combined streams in line 11 are reintroduced to the rougher flotation operation as above described.

The coarse material retained on the screen 71 is withdrawn through line 75 and is dewatered and dried in zone 77. A coarse sylvite product is withdrawn from dewatering and drying zone 77 through line 79.

In the foregoing description five flotation cells were used in the rougher and cleaner operation; however, this was only for purposes of illustration and it is to be understood that any suitable plurality can be used in each of the flotation operations.

In a commercial embodiment of the present invention, an increase in sylvite production of 2% was obtained by using this process as compared to a conventional flotation process using only a rougher and cleaner flotation operation.

The following example is given to illustrate a specific application of the instant novel process and is not to be construed as limiting the invention thereto.

Example

A sylvinitic feed material has the following size and mineral analysis:

Mesh size analysis:	Percent
+8 -----	2
+10 -----	6
+14 -----	17
+20 -----	33
+100 -----	90
-100 -----	10

Mineral analysis:	Percent
Clay -----	1
Sylvite -----	23
Halite and other minerals -----	76

The sylvinitic feed material was slurred with a saturated brine solution to 60% solids. The slurried material was then conditioned for two minutes with one pound of potato starch and 0.15 pound of aliphatic amine hydrochloride per ton of feed. The aliphatic amine used is sold by Armour & Company under the trade name Armeen and was neutralized with hydrochloric acid. The conditioned ore was then diluted to 25% solids with saturated brine.

The diluted material was then subjected to a flotation operation at the rate of 4200 g.p.m. in a standard flotation machine which has five cells connected in series. The float sylvite products from the first three cells were separately recovered and combined. This combined material had the following size and mineral analysis:

Mesh size analysis:	Percent
+20 -----	15
+28 -----	35
-28 -----	65

Mineral analysis:	Percent
Sylvite -----	92
Halite -----	8

The float products from the last two cells were separately

recovered and combined. This combined material had the following size and mineral analysis:

Mesh Size	Weight Percent	Percent K ₂ O	Total Mineral Analysis
+14-----	28.0	60.3	Sylvite, 50%. Halite, 50%.
-14 +20-----	39.0	59.0	
-20 +28-----	16.0	45.0	
-28-----	17.0	8.0	

The combined float product from the first three rougher cells was diluted with saturated brine to 20% solids and was then subjected to a standard cleaner flotation operation at the rate of 1300 g.p.m. in a Fagergren flotation machine which has three cells in series. The sylvite float product recovered from the cleaner operation had the following analysis:

	Percent
Sylvite -----	97
Halite -----	3

The middling recovered from the cleaning flotation operation had the following analysis:

	Percent
Sylvite -----	80
Halite -----	20

The middling was combined with the float product from the last two flotation cells of the rougher flotation and the combined stream was hydroconed at 20% solids.

The overflow of the hydrocone was recycled to the rougher flotation operation and combined with the fresh sylvinitic feed material. The underflow of the hydrocone was screened at 24 mesh. The -24 mesh fraction analyzing about 12% sylvite was also recycled to the rougher flotation operation and combined with the fresh sylvinitic feed.

The +24 mesh fraction from the screening operation was dewatered and dried. The dried product analyzed:

Mesh size analysis:	Percent
+10 -----	3
-10 +14 -----	14
-14 +20 -----	62
-20 -----	21

Mineral analysis:	Percent
KCl -----	97
NaCl -----	3

The overall recovery of sylvite from the sylvinitic feed was 88%.

The description of the invention utilized specific reference to certain process details; however, it is to be understood that such details are illustrative only and not by way of limitation. Other modifications and equivalents of the invention will be apparent to those skilled in the art from the foregoing description.

Having now fully described and illustrated the invention, what is desired to be secured and claimed by Letters Patent is set forth in the appended claims.

We claim:

1. A process for the recovery of sylvite from potash ores containing sylvite which comprises slurrying a potash ore containing sylvite with brine saturated at least with respect to sylvite, reagentizing the slurried ore with a reagent having a preferential affinity for the sylvite, subjecting the reagentized slurry to a first flotation operation in a plurality of rougher cells connected in series, subjecting the flotation concentrate from at least the first of the series of rougher flotation cells to a second flotation operation, separately recovering the float product of said second flotation operation and the non-float product of said second flotation operation, subjecting the flotation concentrate from at least the last of the series of rougher flotation cells while employing a greater

overflow volume of brine than employed in at least the first of said series of rougher flotation cells and at least a portion of the non-float product of said second flotation operation to a sizing operation, and separately recovering a small size fraction and a larger size fraction from the sizing operation.

2. A process for the recovery of sylvite from a potash ore containing sylvite which comprises slurrying a potash ore containing sylvite, while in a state of subdivision sufficient to substantially completely liberate the sylvite from the other components of the ore with brine saturated at least with respect to sylvite, reagentizing the slurried ore with a reagent having a preferential affinity for the sylvite, subjecting the reagentized slurry to a first flotation operation in a plurality of rougher flotation cells connected in series, recovering the float products from said first flotation operation in at least two separate portions, one float portion including the float product from at least the first of the series of rougher flotation cells and the second portion including the float product from at least the last of the series of rougher flotation cells while employing a greater overflow volume of brine than employed in at least the first of said series of rougher flotation cells, subjecting said first portion to a second flotation operation, separately recovering the float product of said second flotation operation and the non-float product of said second flotation operation, subjecting the second float portion from said first flotation operation and at least a portion of the non-float product of said second flotation operation to a sizing operation, and separately recovering a small size fraction and a larger size fraction from the sizing operation.

3. A process for the recovery of sylvite from potash ores containing sylvite which comprises slurrying a potash ore containing sylvite with brine saturated at least with respect to sylvite, reagentizing the slurried ore with a reagent having a preferential affinity for the sylvite, subjecting the reagentized slurry to a first flotation operation in a plurality of rougher cells connected in series, subjecting the flotation concentrate from at least the first of the series of rougher flotation cells to a second flotation operation, separately recovering the float product of said second flotation operation, subjecting the flotation concentrate from at least the last of the series of rougher flotation cells while employing a greater overflow volume of brine than employed in at least the first of said series of rougher flotation cells and at least a portion of the non-float product of said second flotation operation to a hydroconing operation, and separately recovering as overflow from said hydroconing operation a fine fraction and as underflow from said hydroconing operation a coarse fraction of sylvite which is removed from the process as a finished concentrate, and recycling at least a portion of said fine fraction to said first flotation operation.

4. A process for the recovery of sylvite from sylvinitic ore which comprises slurrying a potash ore containing sylvite, while in a state of subdivision sufficient to substantially completely liberate the sylvite from the other components of the ore with brine saturated at least with respect to sylvite, reagentizing the slurried ore with a reagent having a preferential affinity for the sylvite, subjecting the reagentized slurry to a first flotation operation in a plurality of rougher flotation cells connected in series, recovering the float products from said first flotation operation in at least two separate portions, one float portion including the float product from at least the first of the series of rougher flotation cells and the second portion including the float product from at least the last of the series of rougher flotation cells while employing a greater overflow volume of brine than employed in at least the first of said series of rougher flotation cells, subjecting said first portion to a second flotation operation, separately recovering the float product of said

second flotation operation and the non-float product of said second flotation operation, subjecting the second float portion from said first flotation operation and at least a portion of the non-float product of said second flotation operation to a classification operation, and separately recovering a small size fraction and a larger size fraction from the classification operation, and recycling at least a portion of said small size fraction to said first flotation operation.

5. A process for the recovery of sylvite from sylvinite ore which comprises slurrying a potash ore containing sylvite, while in a state of subdivision sufficient to substantially completely liberate the sylvite from the other components of the ore with brine saturated at least with respect to sylvite, reagentizing the slurried ore with a reagent having a preferential affinity for the sylvite, subjecting the reagentized slurry to a first flotation operation and a plurality of rougher flotation cells connected in series, recovering the float products from said first flotation operation in at least two separate portions, one float portion including the float product from at least the first of the series of rougher flotation cells and the second portion including the float product from at least the last of the series of rougher flotation cells while employing a greater overflow volume of brine than employed in at least the first of said series of rougher flotation cells, subjecting said first portion to a second flotation operation, separately recovering the float product of said second flotation operation and the non-float product of said second flotation operation, subjecting the second float portion from said first flotation operation and at least a portion of the non-float product of said second flotation operation to a hydroconing operation, recycling at least a portion of the overflow from said hydroconing operation to said first flotation operation, screening at least a portion of the underflow from said hydroconing operation and recycling at least a portion of the screening underflow to said first flotation operation.

6. The process of claim 5 wherein said screening operation is on about 24 mesh.

7. A process for the recovery of sylvite from potash ores containing sylvite and halite which comprise slurry-

ing such an ore with brine saturated at least with respect to sylvite, reagentizing said slurried ore with a reagent having preferential affinity for the sylvite, subjecting said reagentizing slurry to a flotation operation in a plurality of rougher cells, connected in series, separately collecting an initial rougher flotation concentrate from at least the first of the series of rougher cells and a second rougher flotation concentrate from at least the last of the series of rougher flotation cells while overflowing a greater amount of brine from these cells than is overflowed from at least the first of the series of rougher flotation cells, and sizing the second rougher flotation concentrate into a sylvite fraction of large particle size and a halite fraction of small particle size.

8. A process as in claim 7 wherein the second rougher flotation concentrate is screened to separate sylvite from halite.

9. A process as in claim 7 wherein the second rougher flotation concentrate is subjected to a hydroconing operation to recover a sylvite fraction of large particle size and a halite fraction of small particle size.

10. A process as in claim 7 wherein the initial rougher flotation concentrate is subjected to a cleaner flotation operation in a plurality of cleaner flotation cells connected in series, the underflow middlings being sized into a small size fraction and a large size fraction, at least a portion of said small size fraction being reintroduced into the said rougher flotation operation and the overflow cleaner sylvite concentrate being processed to recover sylvite.

11. A process as in claim 10 wherein the second rougher flotation concentrate is screened to separate sylvite from halite.

12. A process as in claim 10 wherein the second rougher flotation concentrate is subjected to a hydroconing operation to recover a sylvite fraction of large particle size and a halite fraction of small particle size.

References Cited in the file of this patent

UNITED STATES PATENTS

2,746,604	Fontein	May 22, 1956
2,849,113	Bourne et al.	Aug. 26, 1958