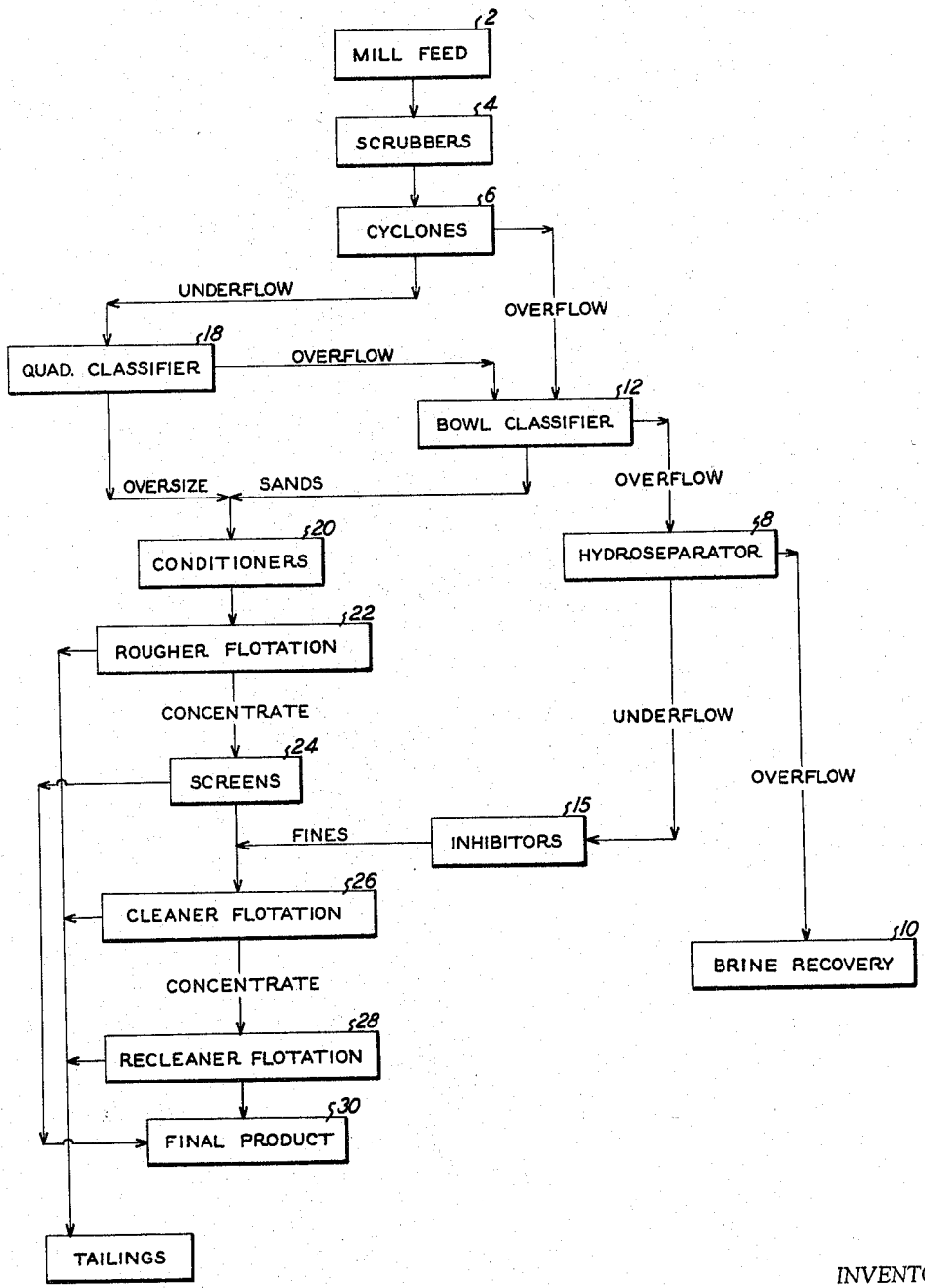
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SYLVITE RECOVERY PROCESS

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SYLVITE RECOVERY PROCESS

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This invention relates to the beneficiation of nonmetallic mineral ores and especially potash ores containing mixtures of oceanic salts and clays of which sylvite (potassium chloride) is a normal constituent.

More particularly, the present invention relates to an improved procedure for the separation and concentration of the nonmetallic sylvite values of sylvinite ores, which sylvinite ores in their naturally occurring state contain small, but nevertheless, objectionable amounts of insoluble clay-like minerals which form slimes that interfere with the concentration of the sylvite content of such ores by flotation and other standard recovery procedures. A major and illustrative source of sylvite (KCl) in North America is that occurring in the mineral deposits of the Permian Basin, and particularly those found in the vicinity of Carlsbad, New Mexico.

The sylvinite ore is characteristically mined from the appropriate geological strata and subjected to a preliminary crushing. In concentrating the potash values of such sylvinite ores by flotation, it is standard practice to include a preliminary desliming step involving wash scrubbing of the crushed ore to remove the worst of the objectionable slimes therefrom. Thus, a brine saturated with the constituents of the ore is normally added to the sands and coarser particles of the crushed ore to produce a pulp. The pulp so produced is thereafter subjected to various forms of violent agitation known as scrubbing in order to release the slimes from the salt crystals of the sands and coarser particles of the ore with consequent suspension of the residual slimes in the brine. Thereafter the pulp is treated and classified prior to flotation in such conventional equipment as cyclones, rake classifiers, stationary or vibrating screens, settling cones, bowl classifiers, hydroseparators and the like. Heretofore, both the coarser and the finer pulp resulting from the treatment afforded by the foregoing classification were subjected to conditioning with slime inhibiting reagents, collecting, frothing and froth modifying reagents and the resulting conditioned pulp passed through a rougher flotation and a cleaner flotation operation before a finished product was secured. The auxiliary slime inhibiting reagents were added in the conditioning step to inhibit the adverse effect of the residual slimes remaining in the pulp after completion of the desliming operation; the complete removal of the aforesaid slimes by standard mechanical procedures proving impractical.

Still, a difficulty of the foregoing procedure resides in the detrimental effect manifested by the residual slimes present in substantial quantities, particularly in the finer pulp, which prevents to a significant extent the flotation, and therefore the recovery, of the coarser particles of sylvite values, even where an inhibiting agent is included in the conditioning step.

Accordingly, it has now been discovered that by separately treating the fine pulp secured from the classifying

means and inhibiting the slimes contained therein separately with a suitable inhibiting reagent and routing the fine pulp including residual but inhibited clay slimes directly to the cleaner flotation step, there is sufficient excess collecting and froth modifying reagents present in the rougher concentrate secured from the coarser pulp treated in the rougher flotation step to efficiently condition the fine pulp fraction and to thus effect excellent recovery of sylvite values therefrom and from the coarser pulp fractions, as well.

By foregoing or bypassing the rougher flotation step therefore, with respect to the fine pulp fraction, significantly increased froth flotation efficiency with respect to recovery of the coarse particles of sylvite values is secured. Too, omission of the rougher flotation step, in the manner indicated, results in a marked decrease in the amount of reagents needed to effect efficient separation of values from the gangue. Other objects and advantages of the present invention will become evident in the course of the description appearing hereinafter.

Thus, in accordance with the present invention, the mill feed, a comminuted nonmetallic mineral ore, particularly a sylvinite ore, is subjected to a preliminary scrubbing to effect a release of slimes from the salt crystals preparatory to the desliming operation. Sequentially, the ore is separated into a plurality of fractions, at least two, in any event. In a preferred manifestation the comminuted ore is divided into so-called undersize particles, preferably of 65 mesh or finer and a coarser fraction of plus 65 mesh.

The fine fraction of the ore presents a highly diluted pulp containing most of the residual slimes which have been separated from the coarser fraction of the ore in addition, illustratively, to the desired sylvite values residing therein. The undersize or finely sized values are desirably separated from the slimes by means of a hydroseparator or like classifying equipment wherein the overflow contains a large percentage of the residual slimes and a relatively low percentage of the sylvite values. The underflow of the hydroseparator or like mechanism contains, in turn, a substantial percentage of the sylvite values submitted to the device and a relatively low percentage of the slimes.

The oversize or coarser particles of ore form a high density pulp from which further but reduced quantities of undersize particles, i.e., 65 mesh or finer, and slime may be abstracted in the course of sizing or classifying the particles of the high density pulp during their passage through a plurality of such devices as cyclones, agitating and/or stationary screens and the like. The abstracted fine particles and residual slime are then introduced into a hydroseparator with the originally separated fine fraction.

The coarser or high density pulp is then conditioned by treatment with slime controllants, collecting, frothing and froth modifying components immediately prior to the initial flotation procedure, referred to hereinabove and conventionally as the rougher flotation step.

Hitherto the partially deslimed hydroseparator underflow containing the finely sized values was reintroduced into the coarser deslimed pulp having a high solids content immediately prior to the foregoing conditioning step. In the process of the present invention this step is eliminated and finely sized partially deslimed pulp is

delivered, after introduction of suitable inhibiting reagents therein, directly to the cleaner flotation step which constitutes the second flotation step for the coarser pulp fractilon.

The conditioning and rougher flotation steps are therefore applied solely to the coarser or oversize high density pulp and the conditioning reagents having an affinity for the nonmetallic mineral values, i.e. sylvite values, added exclusively thereto according to the practice herein described. Suitable cationic mineral collectors for effecting the concentration from sylvinite ore of the desired sylvite values are surface active agents chosen from water soluble amine salts such as the quaternary ammonium salts, e.g. cetyl pyridinium bromide; heptadecylamine hydrochloride; the water-soluble salts of monoalkyl substituted guanidines in which the alkyl substituent is a normal, primary, aliphatic radical having 6 or more carbon atoms e.g. dodecylguanidine hydrochloride; and the acid addition salts of normal primary, secondary or tertiary aliphatic amines, saturated or olefinically unsaturated, containing from 8 to 22 carbon atoms inclusive. Primary amines are normally preferred, however. Illustrative of the foregoing amine salts are stearyl amine hydrochloride, lauryl amine hydrochloride, octyl amine hydrobromide, myristyl amine hydrochloride, pentadecyl amine hydrochloride, octyl amine hydrochloride, and like salts of margaryl amine, myristoleyl amine, palmitoleyl amine, oleyl amine, and linoleyl amine.

Other suitable salts are also prepared from the foregoing amines by reaction with sulfuric acid, phosphoric acid, and the like. For further reference to suitable conditioning reagents, attention is directed to Kirby Patent 2,088,325 and Lenher Patent 2,132,902.

The foregoing collecting reagents are added directly to the coarser pulp as such or are introduced with water immiscible oils such as fuel oil, kerosene, or pine oil, or a frothing agent of commercial grade such as methyl isobutyl carbitol, which cooperate with the foregoing amine salt flotation reagents. It is also desirable in some instances to employ certain dilute inorganic acids or alkalis in order to adjust the pH of the condition pulp to an appropriate value for effecting maximum concentration of the particular mineral sought, i.e. sylvite.

In the rougher flotation step, alluded to above, which follows the conditioning of the coarser pulp, substantial quantities of the floatable sylvite values, for example, are separated from the gangue and appear on the surface of the rougher flotation cells employed, as a frothy pulp concentrate referred to as rougher concentrate. The rougher concentrate contains the broad spectrum of coarser sylvite particle sizes originally present in the ore excepting, of course, the slimes earlier removed in the preliminary desliming step or abstracted with the undersize particles for separate treatment prior to reintroduction and admixture in the cleaner flotation step to follow. Also omitted from the rougher concentrate, but in very minimal quantities according to the practice of the present invention, is any residue of particles of sylvite which do not float in the rougher flotation step but are otherwise removed with the gangue or rougher tailing.

In addition to sylvite values exclusively, the rougher concentrate recovered from the rougher flotation step contains fine particles of gangue which are mechanically entrained in the rougher concentrate froth. This gangue residue represents, of course, a contamination of the sylvite values. To remove these undesired contaminants, the rougher concentrate is subject to a second flotation operation known as cleaner flotation. As has been known heretofore, the coarser fractions of the rougher concentrate do not normally respond to flotation in the second or cleaner flotation step. Thus it is useful to provide, an intermediate screening between the foregoing rougher flotation and cleaner flotation steps employing, for example, a screen cloth having a mesh size sufficiently large to permit the desired fractions of the sylvite concentrate as well as gangue particles of like size passage therethrough, yet sufficiently small to prevent the residue of larger and more coarse fractions of the sylvite concentrate to pass. The recovered less coarse fractions of the rougher concentrate are then submitted to cleaner flotation with the underflow of fine pulp recovered from the hydroseparator referred to hereinabove. Residual gangue is removed in this second flotation step in a manner similar to that of the foregoing rougher flotation step. The cleaner flotation is accomplished without the introduction of further collecting and froth modifying reagents into the rougher concentrate or fine pulp feeds, for it has been found that sufficient excess collection and froth modifying reagents are present in the rougher concentrate pulp feed to efficiently condition the hydroseparator underflow pulp in situ in the cleaner flotation and to provide excellent recovery of the desired mineral, i.e. sylvite, values therefrom.

As noted above, it has become the standard practice to inhibit the adverse effect of the residual slimes upon collection, particularly of the coarser values, by adding an auxiliary inhibiting reagent to the conditioning step. In the present instance, this auxiliary reagent is added to the finer pulp after its withdrawal as underflow from the hydroseparator and immediately prior to the introduction of the fines values and residual slime to the cleaner flotation cells. Illustrative of such inhibiting reagents are starch, dextrin, the polyglycols and their ethers disclosed in Patent 2,724,499 of Smith et al., and the water-soluble acrylonitrile polymers of Patent 2,919,026 of Smith et al.; that is, by way of further illustration, a water-soluble acrylonitrile polymer in which at least one nitrile group has been modified by alcoholysis to produce the corresponding ester and/or alkaline hydrolysis to produce the corresponding salt. Representative of these polymers is the commercial products sold by Dow Chemical Company under the trade designation NP–10 and NP–20 which are understood to consist essentially of a water-soluble acrylonitrile polymer which has undergone partial but incomplete saponification of reactive carboxyl groups. These polymers are of relatively high molecular weight increasing with higher numbers.

The foregoing acrylonitrile polymers are effectively employed as auxiliary reagents in combination with the aforesaid polyglycols, the ethers thereof, e.g. methoxy polyethylene glycol having a molecular weight of about 750 (MPG–750), or a polymer consisting essentially of mannose units such as a mannogalactan derived, for example, from the endosperm of guar seeds.

While, as observed, the coarser particles of sylvite float with greater difficulty than finer particles because of the increased ratio of mass to surface area of the former, the presence of slimes in the pulp, which tends to inhibit the flotation of fine sylvite particles, is particularly detrimental to the coarser particles such as those having a size 14 mesh (1190 microns) or larger. Consequently, the omission of the fine pulp with the residual slimes contained therein from the rougher flotation step results in significantly enhanced flotation efficiency with respect to the coarser fraction of stylvite values recovered in the rougher flotation step and incorporated in the rougher concentrate referred to hereinabove. Thus, were the hydroseparator underflow pulp containing a variable quantity of residual slimes entrained with the coarser pulp conditioned with reagents prior to the rougher flotation, as in the recovery procedures known heretofore, the incorporated slimes would have an inhibitory effect upon the flotation of the coarser fractions of the sylvite values; thus partially defeating the objectives of the rougher flotation. Hitherto, this inhibiting action of the slimes has been partially counteracted by the use of increased quantities of inhibiting, collecting and froth modifying reagents and by maintaining the density of the hydroseparator underflow, with respect to solids, as high as

feasible. Thus, by failing to subject the fine hydroseparator underflow pulp to the rougher flotation step, a marked decrease in the amount of reagents needed to effect an efficient separation of sylvite values from the gangue is had.

A third flotation may be, and most desirably is, performed with sylvinite ores. This third or recleaner flotation step is accomplished in the same manner as the prior flotation procedures referred to hereinabove. The concentrate of sylvite is recovered from the recleaner flotation steps and removed.

The froth-flotation techniques employed herein are standard procedures requiring standard apparatus. Thus, the flotation cells of the type designated as Turbo-cells, Denver Equipment Company cells, Mineral Separation cells, and Forrester Air-Lift cells, as well as deep air cells and laboratory models such as the Fagergren flotation machine can also be employed for this purpose. While the subject process is particularly feasible in the concentration and recovery of sylvite from sylvinite ores mined in the vicinity of Carlsbad, New Mexico, it is, of course, entirely applicable as well to any similar potassium chloride containing deposits which may be beneficiated by froth flotation methods, such, for example, as those deposits present in the vicinity of Trona, California, and Bonneville, Utah.

The accompanying figure is a diagrammatic flow sheet illustrating further the practice of the present invention and includes, in addition, and for the purpose of comparison, reference to the procedure utilized widely heretofore in the field under consideration.

Accordingly, in concert with the foregoing diagram wherein like numbers indicate like steps and procedures and with particular reference to the concentration of sylvite from sylvinite ore, the mined ore is preliminarily comminuted in standard manner employing conventional grinding and milling apparatus whereby the ore is initially crushed and passed through a hammermill, pebble mill, rodmill or the like to liberate the sylvite constituents of the ore. The crushing and grinding operation is carried out with substantially dry ore normally. The resulting mill feed **2** is then admixed with a brine solution saturated with the constituents of the ore in an amount sufficient to produce a pulp which is then subjected to various forms of violent agitation in a scrubbing operation **4** wherein substantial quantities of the slimes present are released from the salt crystals and suspended in the brine. Following this preliminary scrubbing step, the sylvinite pulp is passed to sizing and classifying apparatus. While the classifying procedure is subject to a variety of modifications, as shown in the instant diagram, the pulp recovered from the initial scrubbing step is passed to cyclones **6** wherein the comminuted sylvinite ore is divided initially and substantially into two fractions; the one containing undersize particles of 65 mesh or finer and a second fraction of plus 65 mesh. The former or first fraction contains undersize particles of sylvite as well as a substantial quantity of slimes. This first fraction is passed as a suspension to a bowl classifier **12**. The bowl classifier overflows to a hydroseparator **8** from which an appreciable concentration of slimes and minimal amounts of sylvite suspended in brine are removed as overflow to the brine recovery system.

Concurrently the oversized coarser pulp, i.e. plus 65 mesh, initially recovered from the cyclones **6** is passed to a quadruple rake classifier **18** to separate the coarsest fraction from the pulp. The coarser pulp normally of high density and containing the so-called oversize values is then subject to conditioners **20** for the flotation operations which follow. The undersize particles in the overflow of the quadruplex rake classifier **18** is incorporated with the fine pulp recovered from the cyclone overflow for introduction into the bowl classifier **12**. The coarser particles or sands recovered from the bowl classifier **12** are then subject to conditioners **20** for the subsequent flotation operations.

The conditioning of the coarser pulp is accomplished by the addition of slime inhibiting reagents, collecting, frothing and froth modifying reagents, i.e. an acid addition salt, such as the commercial product of Armour & Co. sold under the trade designation Armac TD and understood to consist of the water-soluble acetate salts of the normal hexadecyl, octadecyl and octadecenyl amines in the approximate and respective proportions by weight of 30, 25 and 45 parts, and such cooperating reagents as fuel oil, kerosene, pine oil and methyl isobutyl carbitol (MIBC). The conditioning step is completed by agitation of the aforesaid pulp and reagents in the conditioners **20** for a period of at least twenty seconds. Agitation is effected either mechanically or by means of a current of air or other unreactive gas.

In accordance with the invention as described herein, only 0.100 pound to 0.230 pound of amine reagent per ton of mill feed solids, i.e. crushed sylvinite ore, initially subject to the scrubbing operation **4**, and 0.03 to 0.05 pound of flotation oil reagent (e.g. #634 from Allied Chemical and Dye—a by-product crude from the manufacture of cresol) per ton of mill feed solids are required for the conditioning step **20**.

In like manner, the amount of MPG–750, NP–10 and MIBC required are in the ranges, respectively, of 0.11 to 0.20, 0.005 to 0.020, and 0.040 to 0.050 pound per ton of mill feed. Where NP–20 is also employed, optionally, it normally will not exceed 0.025 pound per ton of mill feed. Accordingly, the total amount of reagents added during the conditioning step and in accordance with the practice of this invention is within the range of 0.28 to 0.59 pound per ton of mill feed.

The collecting, frothing and froth modifying reagents thus introduced are of immediate utility in the rougher flotation step **22** which follows conditioning.

In the rougher flotation as practised before this invention, all of the floatable sylvite values are separated from the gangue and appear on the surface of the rougher flotation cells as a frothy pulp which is recovered and constitutes the rougher concentrate and contains all of the recoverable coarser sylvite particles, i.e. plus 270 mesh, originally present in the sylvinite ore with the exception of the extremely fine sizes removed in the preliminary desliming and scrubbing steps, and those few particles which do not float in the rougher flotation step but appear rather with the gangue removed in the rougher tailing or are so large and coarse as to not respond characteristically to known flotation techniques employed in the cleaner flotation step. As a result, various techniques have been utilized to avoid loss of unfloatable but coarse particles in the clean flotation step.

Thus, a preferred procedure as shown herein is the use of screens **24** wherein the cloth mesh size is sufficiently large, i.e. plus 28 mesh, to permit recovery of the larger and coarser particles of sylvite while permitting the finer fractions of the rougher concentration to pass to the cleaner flotation apparatus **26**. These coarser fractions recovered in the screening step **24** are then suitably dewatered to provide coarse sylvite values.

The finer fractions of the coarser pulp delivered to the cleaner flotation step **26** from the screens **24** are admixed in the former step with the underflow of fine pulp transmitted directly from the hydroseparator **8**. To this underflow of fines values and residual clay slimes is added at **15**, prior to the introduction thereof into the cleaner flotation apparatus, an auxiliary inhibiting reagent, such as described hereinabove, for the purpose of neutralizing the adverse effect of the residual slimes upon the flotation of the sylvite values and particularly any coarser parti-

cles thereof, i.e. 14 mesh or larger (1190 microns or greater), present in the underflow pulp.

The concentration of the water-soluble acrylonitrile polymer utilized as an auxiliary reagent, is at rates of 0.004 to 0.01 pound per ton of sylvinite mill feed.

The sylvite values recovered as overflow from the cleaner flotation cells **26** are subjected sequentially and desirably to a third or recleaner flotation **28** in which any residual slimes still remain as well as any aqueous component are removed to provide sylvite values of high concentration as final product **30**.

It will be apparent by reference to the diagrammatic representation of the accompanying figure that in the conventional methods employed heretofore, the underflow from the hydroseparator **8** is delivered to the conditioners **20** for admixture with the coarser pulp therein and, after such conditioning, in which the auxiliary inhibiting reagent is included, is passed to the rougher flotation **22** and screening **24** steps prior to cleaner flotation **26**. Thus, the reagentized less coarse fractions of the rougher concentrate and the underflow from the hydroseparator **8** containing the fines values and residual slimes are subjected to both the rougher and cleaner flotations **24** and **26**, respectively, as indicated hereinabove.

The following examples are further illustrative of the invention.

EXAMPLE 1

In a full-scale plant operation, four of several tons of a sylvinite ore mined in the vicinity of Carlsbad, New Mexico, and containing about 22.9% K_2O (equal to 36.25% sylvite) are comminuted by means of Pennsylvania impactors in closed circuit with Tyler vibrating screens. The resulting mill feed is subjected individually and sequentially to scrubbing for the purpose of effecting a preliminary desliming thereof after introduction of saturated brine therein to form a pulp. The saturated brine employed is prepared from another portion of comminuted sylvinite ore by agitation thereof with water at room temperature until no more is dissolved. Thus, the brine used is saturated with the constituents of the ore itself and, is in fact, prepared in the course of the instant process and recycled as described hereinafter. Its specific gravity is about 1.240. The preliminary scrubbing or desliming is permitted to proceed for a period of about thirty minutes. The pulp submitted to the aforesaid scrubbing operation contains about 60 percent by weight of suspended solids. The resulting pulp is thereafter classified initially and substantially into two fractions of about 15 percent 65 mesh or finer and 85 percent plus 65 mesh by submission thereof to a series of cyclones. The undersize particles, i.e. 65 mesh or finer, are removed and the pulp containing substantially coarser particles, i.e. plus 65 mesh, are further resolved by submission to a quad classifier. The residue of undersize particles recovered from this latter step is then removed for admixture with the fine pulp containing the undersize particles separated in the cyclones initially. The four-samples of coarser pulp containing the oversize particles recovered from the quad classifier are then submitted to conditioners wherein each of the foregoing samples, i.e. (a) to (d), receive reagents in the amounts indicated in Table I appearing hereinafter (lbs. per ton of mill feed).

Agitation is sustained in the conditioners after addition of the foregoing reagents for a period of about eight minutes.

The finer pulp recovered from the foregoing cyclones is separately treated by introduction into a bowl classifier which serves to further remove residual slimes therein. The overflow from the quad classifier is also introduced into the bowl classifier for a similar separation. The residue of sands from the bowl classifier is then submitted to conditioner prior to flotation. The overflow from the bowl classifier is then submitted to a hydroseparator from which the overflow of residual slimes and brine is removed. The underflow of the hydroseparator is then treated with 0.004 to 0.01 pound per ton of mill feed of a slime inhibiting reagent, the water soluble acrylonitrile polymer, NP–10, and the trated pulp is then transmitted to flotation cells of the cleaner flotation step. The brine is recovered from the slime removed from the hydroseparator for recycling.

The conditioned coarser pulp is then subjected to an initial rougher flotation operation in a modified Turbo flotation machine wherein substantially all of the floatable sylvite values present therein are separated from the gangue which is recovered as tailings. The floatable sylvite values recovered as overflow provide the rougher concentrate which is then passed through cloth screens of 28 mesh to remove the coarest fractions (i.e. plus 28 mesh) of sylvite values, which would tend to be unresponsive to flotation in the cleaner operation to follow. The coarsest fractions recovered at this point are dewatered in standard manner to provide the desired sylvite values. The brine saturated with sylvinite ore constituents that is recovered is recycled for use in forming a pulp with subsequent portions of sylvinite ore. The remainder of the rougher concentrate is then passed to the cleaner flotation cells which are similar to those used in the rougher flotation step. The fine pulp from the hydroseparator and the concentrate of coarser pulp are admixed at this point; additional gangue being removed from the admixture by means of the collecting and froth modifying reagents present in the concentrate of coarser pulp and remaining from the rougher flotation step. The concentrate of sylvite values recovered from this step is then subjected to a recleaner flotation for the further removal of residual gangue and the gangue recovered from this and the cleaner flotation are removed as tailings. The sylvite values resolved from the recleaner flotation are then dewatered in the standard manner to yield the desired sylvite values. The flotation recoveries from the foregoing samples of ore are recited in Table II wherein the designations (a) to (d) correspond respectively to the samples conditioned under the like designations in Table I above.

Table II

Sample	Percent K_2O			Percent Recovery of K_2O Equivalent
	Heads	Concentrate	Tails	
(a)	25.24	58.60	0.76	98.26
(b)	21.88	58.59	0.55	98.41
(c)	21.66	58.45	0.46	98.65
(d)	22.83	58.48	0.70	98.11

Table I

Sample	MPG 750	NP–10	Amine	MIBC	Flot. Oil #634	NP–20	Test Reagents	Test Total
(a)	.1921	.0062	.2177	.0474	.0474	----------	.0158	.5266
(b)	.1220	.0100	.1488	.0400	.0400	----------	.0370	.3938
(c)	.1216	.0104	.1510	.0400	.0400	.0024	.0031	.3685
(d)	.1108	.0160	.1479	.0400	.0400	----------	.0098	.3645

EXAMPLE 2

Eight samples of sylvinite ore, as described in Example 1, are scrubbed, deslimed, classified and are subjected to conditioning in a manner similar to that described therein, except that the fine pulp underflow from the hydroseparator is subject to conditioning in admixture with the coarser pulp; the reagents and quantities thereof used in the conditioning of the respective samples (e) to (1), being those indicated in Table III.

Table III

Sample	MPG 750	NP-10	Amine	MIBC	Flot. Oil #634	NP-20	Test Reagents	Test Total
(e)	.3000	.0110	.2600	.0500	.0400	----------	----------	.6610
(f)	.3000	.0110	.2600	.0500	.0400	----------	----------	.6610
(g)	.3047	.0121	.2616	.0500	.0416	----------	----------	.6700
(h)	.3020	.0074	.2625	.0500	.0399	----------	.0224	.6842
(i)	.3016	.0110	.2686	.0500	.0444	----------	----------	.6756
(j)	.2974	.0121	.2408	.0489	.0497	----------	----------	.6489
(k)	.2833	.0137	.2678	.0417	.0463	----------	.0077	.6605
(l)	.2883	.0121	.2452	.0496	.0500	----------	----------	.6452

In addition to the foregoing, the auxiliary inhibiting reagent, the water-soluble acrylonitrile polymer, NP–10, of Example 1 is added to the admixed coarser and finer pulp during the conditioning step in an amount by weight of 0.010 to 0.012 pound per ton of sylvinite mill feed, in each instance.

The admixed and conditioned fine and coarse samples are then transmitted to rougher flotation, screening, cleaner flotation and recleaner flotation in the manner described in Example 1 to yield the flotation recovery indicated in the percentages of Table IV, wherein the sample designations (e) to (l) inclusive correspond with samples (e) to (l) referred to in Table III above.

Table IV

Sample	Percent K_2O			Percent Recovery of K_2O Equivalent
	Heads	Concentrate	Tails	
(e)	23.03	58.35	1.27	96.59
(f)	22.95	58.38	1.42	96.15
(g)	21.17	58.31	1.51	95.34
(h)	24.03	58.51	1.45	96.35
(i)	23.01	58.31	1.30	96.50
(j)	23.65	58.70	1.82	96.26
(k)	24.32	58.80	2.19	94.52
(l)	26.73	58.73	2.09	95.58

It will be apparent from the foregoing examples, in which Example 1 illustrates the practice described herein and Example 2 demonstrates the practice commonly utilized heretofore, that the present invention provides significantly greater efficiency in the recovery of sylvite from sylvinite ores with a corresponding decrease in the amounts of conditioning reagents employed; thus permitting material saving in a field where cost is critical and the quantities of materials employed and treated are very great.

Various modifications of the invention can be made, and to the extent that such modification and variations incorporate the spirit of this invention, they are intended to be included within the scope of the appended claims.

What is claimed is:

1. A process for improving the recovery of sylvite values from ores comprising comminuting the ore containing said mineral values, admixing said comminuted ore with a saturated brine thereof, dividing said ore-brine admixture into a first fraction of relatively small particles and at least one other fraction of relatively larger particles, only conditioning said other fraction with reagent having affinity for said mineral values, only submitting said conditioned fraction of larger particles to a rougher froth flotation and producing a rougher concentrate of said fraction therefrom, separating part of the slimes occurring in said first fraction therefrom, introducing an auxiliary slime inhibiting reagent in said partially deslimed first fraction, admixing said rougher concentrate with said partially deslimed first fraction, submitting said admixture to, and recovering a sylvite value concentrate from, a cleaner froth flotation step.

2. In a flotation process for improving the recovery of sylvite values from ores comprising comminuting, conditioning, and submitting to flotation, sylvinite ore, the improvement in combination therewith of dividing said comminuted ore into a fraction of relatively small particles and a fraction of relatively large particles conditioning said large fraction only, only subjecting said conditioned fraction to a rougher froth flotation, recovering a coarse concentrate of sylvite values as first product from said rougher flotation, admixing an intermediate concentrate from said rougher flotation with said small fraction, submitting said admixture to, and recovering sylvite value as second product from, a cleaner froth flotation step.

3. A process of claim **2** wherein said small fraction is treated with slime inhibitors prior to said admixing.

4. A process for effecting the flotation concentration of sylvite comprising a comminuting sylvinite ore, admixing said comminuted ore with a saturated brine thereof, dividing said ore-brine admixture into a first fraction of relatively small ore particles and a second fraction of relatively large particles, conditioning said second fraction only with a cationic mineral collector, only subjecting said conditioned fraction of large particles to rougher froth flotation, to produce a cencentrate from said rougher flotation, dividing said rougher concentrate into coarse and fine portions, removing said coarse portion as sylvite value, separating clay slimes from said first fraction, admixing said deslimed first fraction with slime inhibiting reagent, admixing said fine portion and said inhibited first fraction, submitting said fine portion-first fraction admixture to, and recovering a concentrate of sylvite values from, a cleaner froth flotation step.

5. The process of claim **4** wherein said cleaner flotation concentrate is subjected to a recleaner flotation.

6. The process of claim **4** wherein the division between said first and second fractions is about 65 mesh.

7. The process of claim **6** wherein the division between said coarse and fine portions of said rougher flotation concentrate is about 28 mesh.

8. The process of claim **7** wherein said rougher flotation concentrate is separated with a screen of about 28 mesh size.

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