May 17, 1960 W. P. WILSON ET AL 2,936,887

PROCESS FOR RECOVERING FLOTATION REAGENT

Filed Sept. 27, 1957

FIG. 1.

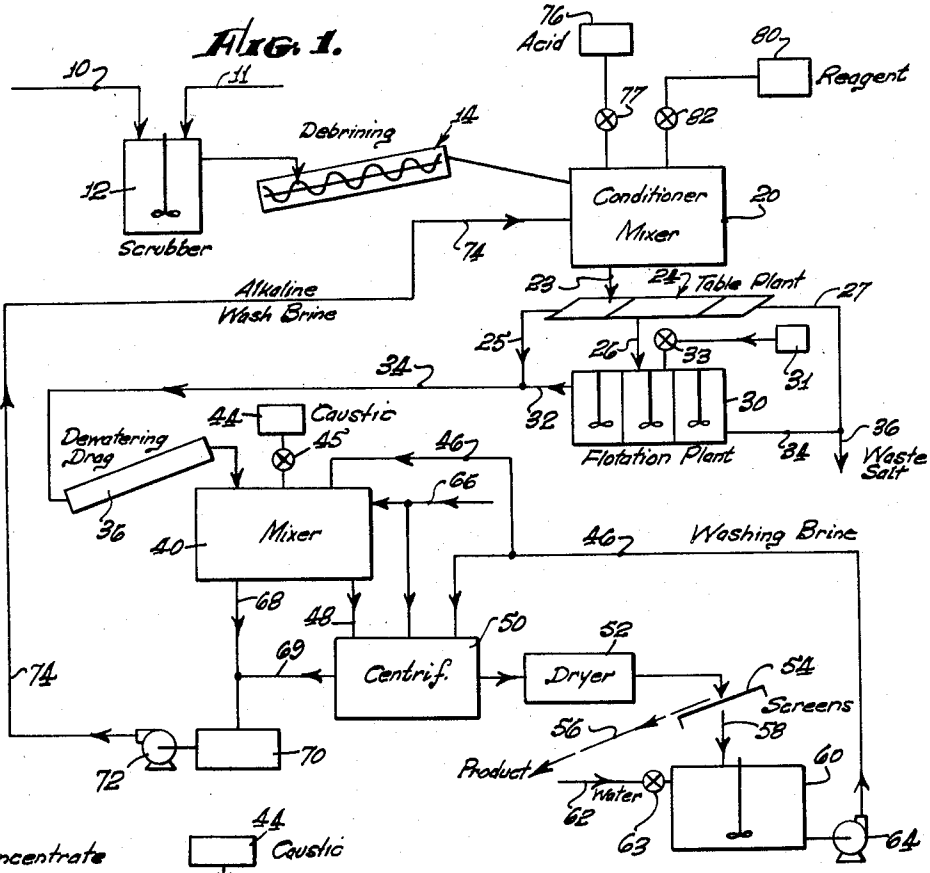
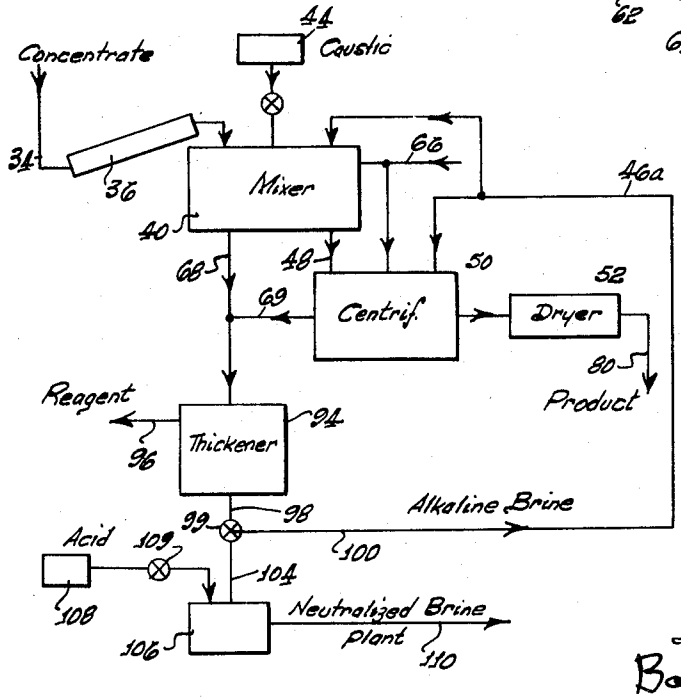


FIG. 2.



WILLIAM PAGE WILSON,
THOMAS M. CRAMER,
INVENTORS.

By Berdahl & Lewis

United States Patent Office 2,936,887 Patented May 17, 1960

2,936,887

PROCESS FOR RECOVERING FLOTATION REAGENT

William P. Wilson and Thomas M. Cramer, Carlsbad, N. Mex., assignors to United States Borax & Chemical Corporation, Los Angeles, Calif., a corporation of Nevada

Application September 27, 1957, Serial No. 686,748

4 Claims. (Cl. 209—166)

This invention relates to processes for separating the components of a particulate mineral mixture in an aqueous medium by virtue of differential action produced with the aid of one or more reagents. Such reagents adhere differentially to the respective components of the mixture and thereby modify their performance in the medium.

A primary object of the invention is to provide a convenient and economical process for removing such reagents from the particles of the mixture after the desired separation has been achieved.

A further object of the invention is to permit recovery of the reagent in such form that it can be reused, as for conditioning and separating another charge of the mineral mixture.

The invention further provides overall cyclic processes which are particularly effective, convenient and economical and which have additional advantages over previously available procedures, as will appear, particularly when one or more of the components of the mineral mixture are water soluble.

The invention relates more particularly to cationic reagents which include an amine group, and to other reagents such as kerosene and other oils which are commonly used to supplement their action. Typical amine reagents comprise salts of primary alkyl amines in which the alkyl radicals are straight chains containing from 8 to 22 carbon atoms. Such alkyl amines, which may be fully saturated or partially unsaturated, are usually prepared from natural mixtures of fatty acids, and their exact composition depends upon the origin of those materials. Illustrative of such reagents are those derived from tallow fatty acids, typically comprising both saturated and unsaturated chains of 16 or 18 carbon atoms; those derived from soya fatty acids, typically containing a greater proportion of unsaturated groups than the tallow amines; and those derived from coconut oil fatty acids, comprising a more diverse mixture of chain lengths extending down to 8 carbon atoms and typically substantially saturated.

Salts of such amines, for example their acetates or hydrochlorides, ionize in water, and the long chain cation adheres selectively to mineral surfaces which are characterized by negative surface charges. The resulting surface coating of amine reagent, supplemented in some instances by one or more secondary reagents, is hydrophobic. With suitable conditioning of a mineral mixture, air bubbles accumulate on the reagent-coated surfaces, reducing the effective specific gravity of the coated particles relative to that of the uncoated components of the mixture.

The actual separation of the conditioned mineral mixture may be accomplished by any of a variety of known operations. Such separation may be accomplished, for example, by an actual flotation process in water or saturated solution in which the coated particles predominantly float and the uncoated particles predominantly sink. As a further example, the components may be separated by

table agglomeration, in which the conditioned aqueous slurry is subjected to a shaking motion on an obliquely riffled, slightly sloping table having such an angle of slope that the heavier uncoated granules tend to be retained behind the riffles while the coated granules tend to wash over the riffles. By means of suitable diversion gates, the discharge may be collected as two or more separate products, at least one of which is appreciably concentrated with respect to the desired product. In actual practice, separation of a granular mixture after conditioning with a reagent may involve a relatively complex series of steps, sometimes including several successive flotation steps or including both flotation and table agglomeration or jigging and other mechanical means. Conditioning agents for any such processes will be referred to for convenience as flotation reagents.

Separation of the components of the initial mixture by such procedures may be virtually complete, or may be only partial. In many instances the initial mixture typically includes some particles which contain both the desired and the undesired components of the mixture, so that the gravity separation in aqueous medium cannot, in practice, be complete. The term "separation," as employed in the present specification and claims, includes partial as well as complete separation of two or more components, and thus includes operations more commonly referred to as "concentration."

Amine flotation reagents are used in the described manner for separating the components of particulate mineral mixtures of many different types, the primary requirement being that the reagent will absorb selectively on surfaces of at least one mineral component of the mixture. Illustrative instances of such selective adsorption are the coating of feldspar surfaces in preference to silica, permitting separation of a particulate mixture of those minerals; the coating of silica in preference to phosphate rock, whereby the phosphate is typically recovered as the sink fraction; the coating of vermiculite in preference to particles of silicate or silica; the coating of mica and silica in preference to beryl ores; and the coating of potassium chloride in preference to sodium chloride.

For the sake of clarity and definiteness, the invention will be illustratively described primarily with specific reference to the use of amine flotation reagents for the latter purpose, as exemplified in obtaining a potassium concentrate from sylvinite ore. Long chain alkyl amine salts are particularly useful as flotation reagents for that purpose, tallow amine acetate and tallow amine hydrochloride being illustrative. Such reagents adhere selectively to potassium chloride surfaces and form thereon a coating that is not wet by water. Surfaces of sodium chloride are not so coated by the amine reagent. With suitable conditioning treatment, which typically includes agitation of an aqueous slurry of properly sized and scrubbed sylvinite ore in the presence of the flotation reagent, air bubbles form on the coated potassium chloride surfaces, reducing the effective specific gravity of the potassium-rich particles of the mixture. The potassium-poor particles, which consist primarily of sodium chloride, retain substantially their normal specific gravity in the aqueous medium.

For conditioning sylvinite ore, especially when it includes particles coarser than about 20 mesh, Tyler Standard, it is usually desirable to use a flotation reagent comprising in combination a suitable amine reagent and an oil, such as crude oil or diesel oil. The oil is generally believed to be adsorbed on the layer of amine reagent on the potassium chloride surfaces, thereby forming a more complete and effective water repelling coating on the potassium-rich granules. The combination of an alkyl amine salt and oil is illustrative of the manner in which one chemical substance may be employed to sup-

plement the action of another. Such a combination of distinct substances may be considered to constitute a flotation reagent.

In previous practice, a disadvantage of all aqueous separation process of the type described has been the difficulty in separating the adhered flotation reagent from the particles of the separated product. That disadvantage has been particularly serious in the present illustrative instance in which sylvite is separated from the salt component of sylvinite ore with the aid of an amine flotation reagent which may include oil. When the separated product from such a process has been dried at temperatures of 250 to 350° F., for example, the residual amines on the particles tend to be converted to amides, or other organic compounds which have a higher boiling point. When such organic compounds and the crude oil, if any, distill off the particles during normal drying, they tend to condense on surrounding surfaces, such as the walls of chutes and stacks. Although the total concentration of flotation reagent in the product is usually very small, typically less than 0.1%, such deposits accumulate steadily and eventually form a potential fire hazard. Furthermore, the deposit remaining on the particles tends to blind the openings in screens used to remove the fines from the concentrated product.

Those difficulties may be overcome by heating the product to about 500 to 550° F., at which temperature the more volatile oil and other compounds are carried off and the remaining tarry residue is charred to a sooty coating. Although the fire hazard and screen blinding are thereby eliminated, the resulting dark color of the product may not be desirable. Moreover, the sooty coating releases dust at each handling of the product. That dusty condition is very persistent since it is not removable by screening.

In accordance with the present invention, all such disadvantages are avoided economically and conveniently by removing the flotation reagent from the separated mineral product while the latter is wet. That is accomplished by treating the coated particles with an alkaline aqueous solution. We have discovered that such treatment causes the flotation reagent to release from the particle surfaces. The released reagent may then be removed with the aqueous medium from the solid particles. The solid concentrate thus obtained is substantially free of reagent, and may be dried and further processed in any desired manner without difficulty.

The alkaline solution for thus treating the adhered flotation reagent may be provided conveniently by adding a suitable quantity of an alkali metal or alkaline earth metal hydroxide, either in solid form or as an aqueous solution, directly to the wet mineral product as it comes from the aqueous separation process. For example, sodium or potassium hydroxide or calcium hydroxide may be employed for that purpose. It is preferred in general to employ, if possible, a hydroxide of a metal already present in the system. Before adding the alkali, the slurry resulting from the aqueous separation process is preferably partially de-watered so that it forms a relatively dense slurry or pulp, comprising typically approximately 80% solids and 20% aqueous medium. After addition of the alkaline reagent, the mixture is thoroughly mixed in any suitable manner to carry the reaction to completion. The reaction may be accelerated, if desired, by heating moderately, for example to about 180 to 220° F. The released flotation reagent, such, for example, as an amine compound or a combination of amine and oil, is typically water insoluble and forms a suspension in the aqueous component of the mixture. That suspension is readily rinsed away from the mineral product, as by washing with additional aqueous medium. That medium is preferably alkaline but may be substantially neutral. Hence the mineral product can be separated from the suspension of reagent and aqueous medium in any suitable type of washing and de-watering equipment.

Since the resulting mineral product is substantially free of flotation reagent, it can be dried at normal drying temperatures, such as 250 to 300° F., without creating inconvenient deposits on adjacent surfaces. Conventional screening of the dry product, as to remove undesired fines, can be carried out without difficulty. Moreover, if it is desired for any reason to heat the product to higher temperatures, such as 500 to 550° F., that can be done without discoloring the product or causing undesirable dustiness.

In accordance with a further aspect of the invention, removal of the coating of flotation reagent facilitates washing of the product. That is of particular importance when the mineral product may be contaminated with a material that is soluble in a suitable aqueous medium. In the illustrative instance of producing a potassium concentrate from sylvinite ore, the concentrated product is usually contaminated with sodium chloride, much of which is present in particles which consist primarily of potassium chloride. By washing such products with water or with a solution not saturated with the contaminating salt, it has previously been possible to remove a small proportion of the contaminant. We have now discovered that the effectiveness of such washing of the product can be greatly increased by removing the flotation reagent before carrying out the washing step. The reason for the improved effectiveness is believed to be that the coating of flotation reagent, although it adheres preferentially to potassium chloride surfaces, tends to shield an appreciable part of the sodium chloride surfaces also, particularly when the latter comprise small areas nearly surrounded by potassium chloride.

Because of the greater potential utility of a washing operation when carried out on a concentrated product that is free of flotation reagent, the detailed manner of carrying out that washing operation acquires increased importance. It has previously been recommended that potassium concentrates from sylvinite ore should be further concentrated by washing with a solution that is substantially free of sodium chloride and is saturated with potassium chloride. We have discovered that improved results are obtained when the washing solution is initially only partially saturated with potassium chloride. Such a partially saturated solution has the advantage that it dissolves the sodium chloride contamination more rapidly and is capable of dissolving a larger concentration of sodium chloride before becoming saturated. And, perhaps of even greater importance, if the washing solution is initially saturated with potassium chloride, we have found that, as sodium chloride is taken up by the solution, the latter rapidly becomes supersaturated with respect to potassium chloride. Very fine crystals of potassium chloride are thereby precipitated. Such fine precipitate is often troublesome to handle, and, at best, results in a fine dust in the final product, which must be removed as by screening. When washing is performed with a solution that is initially only partially saturated with potassium chloride, the washing solution does not become supersaturated, and the described difficulties are thus completely avoided. The most effective results are obtained with a washing solution that contains initially less than about 10% of saturating concentration of sodium chloride and between about 30% and about 70% of saturating concentration of potassium chloride.

In accordance with a further aspect of the invention, we have discovered that the reagent, after its separation as a suspension in aqueous medium from the solid concentrate, can be recovered and its utility as a reagent restored. Such reactivation of the recovered alkaline reagent can be accomplished by neutralizing it with any suitable acid. That neutralization restores to the reagent its initial property of adhering selectively to one component of the mineral mixture that is being separated. Such neutralization of the released reagent, which is typically in the form of a suspension in alkaline solution,

may be accomplished by addition of acid of any convenient type. That acid may, for example, be an inorganic acid such as hydrochloric acid, phosphoric acid or sulfuric acid, or may be an organic acid such as acetic acid or citric acid. It is ordinarily preferably to employ an acid of which the anion is already present in the system. Sufficient acid is added to substantially neutralize the mixture of released reagent and aqueous suspending medium, that is to reduce the pH of that medium to approximately 7.2 to 7.8.

Thus, in the present illustrative operation, the tendency of the amine flotation reagent to adhere selectively to potassium chloride and not to sodium chloride is destroyed by treatment with hydroxide, and is restored by neutralization with acid. The invention thus presents for the first time the possibility of re-using the same flotation reagent in sucessive cycles of operation, leading to great economy in the overall system. That advantage is obtainable in addition to the marked improvement in the final product, already described.

It has been found desirable, in order to obtain maximum efficiency of the reactivated reagent when oil is present, to perform the described acid treatment only when the released reagent is actually or substantially in the presence of the fresh charge of mineral mixture that is to be conditioned. If the alkaline oil-amine suspension of reagent is neutralized while isolated from that fresh mixture, the reactivated reagent tends to form thick greasy curds, which only become further condensed upon application of heat. It is believed that such behavior is due to the tendency of the reactivated reagent to adsorb on itself. However, when the neutralization is performed in the presence of a fresh charge of mineral mixture, the reactivated agent adsorbs in a normal manner on one component of the mixture and effectively performs its intended function. The small proportion of reagent that is lost during each cycle of operation can readily be made up by suitable addition of fresh reagent to the conditioning apparatus.

A full understanding of the invention and of its further objects and advantages will be had from the following description of certain illustrative systems by which it may be carried out. Those descriptions, and the accompanying drawings which form a part of them, are intended for illustration only and not as a limitation upon the scope of the invention, which is defined in the appended claims.

In the drawings:

Fig. 1 is a schematic drawing representing an illustrative system by which sylvinite ore may be treated in accordance with the invention; and

Fig. 2 is a schematic drawing illustrating a modified system.

As represented in Fig. 1, sylvinite ore is introduced at **10**. Such ore consists primarily of potassium chloride, sodium chloride, and a relatively small proportion of insoluble clay. The ore at **10** may be considered to have been suitably sized, as by crushing and screening, to a particle size that will typically pass an 8 mesh screen and be held on a 20 mesh screen. Most of the clay in the ore is released by scrubbing in a saturated brine, supplied at **11**, in apparatus of any suitable type, indicated schematically at **12**. The released clay is removed with most of the brine, as by the de-brining screw indicated schematically at **14**.

The ore is then introduced into the conditioner **20**, which may, for example, comprise a rotating drum type of mixer, where it is treated with a suitable flotation reagent. That reagent, as already indicated, typically comprises an alkyl amine salt, having a chain length of 8 to 22 carbon atoms, such as tallow amine acetate or tallow amine hydrochloride, and an oil, such as crude oil. From one to four pounds of amine reagent and from one to five pounds of oil per ton of ore may be considered typical of the present type of operation. The ore and reagent are thoroughly mixed as a heavy slurry in saturated brine, causing the reagent to adsorb on the surfaces of potassium chloride. Air bubbles produced by the agitation form on the amine and oil surfaces in the manner already described.

The conditioned ore is then transferred at **23** to a riffled, slightly sloping table, indicated schematically at **24**, where it is subjected to a shaking motion. The uncoated sodium chloride tends to retain behind the riffles and be washed along the length of the table, while the particles of potassium chloride, with their coating of amine and oil, tend to wash over the riffles. By means of suitable diversion gates the discharge is typically collected in three products: (1) concentrated potassium chloride at **25**, typically containing an amount of potassium corresponding to more than 60% K_2O; (2) middlings at **26**, containing the finer sized particles of potassium chloride and the coarser sized particles of sodium chloride, as well as particles which contain mixed sodium chloride and potassium chloride; and (3) tailings at **27**, consisting primarily of sodium chloride and containing typically about 2% K_2O.

The middling product at **26** may be further refined, as by treatment in a battery of flotation cells, indicated schematically at **30**, usually after addition of a small amount of frothing agent, such, for example, as isocarbinol supplied from a source indicated at **31** via the valve **33**. Such flotation treatment typically divides the mixture into a float concentrate at **32**, containing typically about 59% K_2O, and sink tailings at **34**, which may contain as much as 4% K_2O. The tailings at **34** are combined with the tailings at **27** from the tabling operation and sent to a storage pile at **36**, or otherwise disposed of. The flotation product at **32** is combined with the potassium-rich product at **25** from the tabling operation. In previous practice that product at **34** was dewatered and dried to produce the final product of the operation. That product suffered in one respect or another from the presence of residual flotation reagent, as has been described.

In accordance with the present invention the combined product at **34** is preferably de-watered, as in the dewatering drag indicated at **36**, and is then delivered to mixing apparatus indicated at **40**. Mixer **40** may represent a wide variety of detailed structures, such, for example, as a rotary log washer-type tumbler, which is typically turned at 12 to 16 r.p.m. With the preliminary brine removal indicated at **36**, the feed to mixer **40** comprises a heavy slurry containing typically less than about 20% of brine. Free hydroxide ion is supplied to the heavy slurry in mixer **40**, as by adding alkali metal or alkaline earth metal hydroxide as a concentrated aqueous solution directly to the mixer, as from a suitable storage container **44**. The amount of alkali added is controlled, as by the valve **45**, and is sufficient to cause release of substantially all of the amine reagent reaching mixer **40** with the concentrated potash product **34**.

The most effective and most economical amount of alkali for any particular conditions of operation, type of ore, and detailed flotation conditioning of the ore can readily be determined by trial, the amount of alkali being gradually increased until substantially all of the flotation reagent is released from the ore. Usually, from about one half to about ten pounds of sodium or potassium hydroxide per ton of ore concentrate will be found to give satisfactory results, an appreciably smaller quantity being required when the treatment is carried out at moderately elevated temperature, such as 150 to 190° F., rather than at room temperature. As a specific example, with typical sylvinite from the beds at Carlsbad, New Mexico, which has been conditioned by addition of one pound of tallow amine acetate and four pounds of crude oil per ton of ore, satisfactory release of the flotation reagent from the potassium concentrate has been obtained by addition of four pounds of sodium hydroxide per ton of concentrate at mixer **40** at room temperature, or by one pound of so-

dium hydroxide when the mixture is treated at 190° F.

After treatment with alkaline brine solution in mixer 40 the potassium concentrate is rinsed by brine supplied via the line 46. The solid particles are thereby partially freed from the flotation reagent, which typically forms a suspension in the aqueous phase of the slurry. The mixture may then be delivered via the line 48 to suitable apparatus, shown schematically as the centrifuge 50, for further washing and de-watering. The potassium concentrate emerges from centrifuge 50 substantially free of flotation reagent and may be delivered directly to a drying apparatus of any suitable type, as represented at 52. The dried product is preferably screened, as at 54, to remove any undesired fines, and is typically then delivered ready for shipment at 56. The separated fines 58 may be disposed of in any desired manner.

A particularly effective way of utilizing such fines is to dissolve them, as in a dissolver of conventional type indicated at 60, in water which is supplied at 62 to make up a deficit of water removed from the system. That water is supplied via control means such as the valve 63 at such a rate that the resulting solution contains a concentration of potassium chloride corresponding to approximately 50% saturation. That solution, which typically is less than 10% saturated with respect to sodium chloride, is then supplied, as by the pump 64, to line 46, and is used as washing brine in mixer 40. A portion of the same solution may be supplied via the line 47 as washing brine in centrifuge 50. Additional plant brine may be supplied to mixer 40 and to centrifuge 50 if required, as indicated by the line 66.

As has already been indicated, we have discovered that the utilization of a solution of the described type for washing the potassium concentrate provides a marked improvement in the degree by which the potassium concentration of that product can be increased. For example, in the described type of operation, the release of reagent from the potassium concentrate followed by washing of the concentrate with brine of the described type has been found to result in an overall increase in the recovery of potassium from the ore of approximately 3% as compared with the best available previous practice.

The released reagent is carried as a suspension in the alkaline brine from mixer 40 at 68 and from centrifuge 50 at 69. That reagent suspension may be delivered via the surge tank 70 by a pump 72 to the return line 74. In preferred form of the system, a mixture of that alkaline brine and released reagent is supplied to conditioner 20, together with a suitable quantity of neutralizing acid, which may be admitted from a storage container 76 via suitable valve means 77. Acid is thus supplied to conditioner 20 in sufficient quantity to reduce the pH of the alkaline brine and its contained flotation reagent to approximately 7.2 to 7.8. That is typically accomplished by an amount of acid approximately equivalent to the alkali added at 45. With the described procedure, that neutralization takes place in the presence of granular ore introduced from de-brining screw 14. Under those conditions the neutralized reagent is found to react satisfactorily with the fresh charge of ore even when an appreciable amount of oil is present, selectively adhering in normal fashion to the potassium surfaces of the ore. Additional reagent may be supplied from a source 80 via valve 82 to conditioner 20 to make up any loss of reagent which may occur in the described circuit. That reagent circuit includes movement from conditioner 20 to mixer 40 as a coating on the potassium surfaces, and movement from mixer 40 back to conditioner 20 in the form of an inactivated suspension in an alkaline brine.

Fig. 2 represents schematically a modified system which illustrates the wide variety of different manners in which the released reagent may be handled. For clarity of illustration, the portion of the system corresponding to the upper part of Fig. 1 is omitted in Fig. 2. Potassium concentrate is delivered at 34 from a concentrating plant which may utilize any suitable type of aqueous process, for example that described and shown in the upper part of Fig. 1. That concentrate, with its coating of reagent, is de-watered at 36 and processed in mixer 40, centrifuge 50, and dryer 52 in the manner already described in connection with Fig. 1.

The dry potassium concentrate obtained at 80 may then be further processed as may be required. The reagent released from the potassium surfaces in mixer 40 as a result of caustic treatment is obtained as a suspension in an alkaline brine at 68 and 69, as already described. In the present system that alkaline brine is delivered to a thickening tank 94. The reagent is removed by skimming at 96 and the alkaline brine is recovered as a substantially clear solution by bottom withdrawal at 98. The relatively dense mixture of reagent and brine at 96 may then be discarded if desired, or, for example, may be re-used with suitable acid treatment in the manner already described in connection with Fig. 1.

The clean alkaline brine at 98 may be divided, as by a control valve 99, into two portions. One of those portions is supplied via the line 100 to line 46*a*, and is used as washing solution in mixer 40 and centrifuge 50, where it may supplement or replace washing solutions of the type described in connection with Fig. 1. It is noted particularly that the alkaline condition of the brine so obtained is desirable, since it tends to reduce the alkali needed from 44 and insures maintenance of the inactivated condition of the released reagent while the latter is being separated from the potassium concentrate. The other portion of the clean brine at 98, which typically comprises any excess over that required for the described washing operation, may be directed by valve 99 to the line 104 and the tank 106. Such brine may be neutralized in tank 106, as by addition of a suitable quantity of acid from a supply 108 via a control valve 109. The resulting neutralized brine may be returned via the line 110 for general use in the plant at any desired location, for example at 11 of Fig. 1. In typical practical operation of a plant of the described type, the brine requiring such neutralization, if any, typically comprises only about 10% of the total clean brine delivered at 98 from thickener 94. Hence the recirculation of washing brine from 98 to line 46*a* without neutralization permits a great reduction in the amount of acid consumed.

It will be understood that a thickener such as 94 may, if desired, be introduced into line 74 of Fig. 1, and part or all the resulting clean alkaline brine may then be combined with washing brine from pump 64 of Fig. 1 in any proportions desired. Many other changes may be made in particulars of the systems that have been described, which systems are intended only for illustration and not as a limitation upon the scope of the invention.

We claim:

1. A flotation process for separating potassium chloride from ore containing potassium chloride, sodium chloride and insoluble clay, which comprises pulping said ore in an aqueous brine, adding to said pulped ore a flotation reagent which selectively adheres to and coats the potassium chloride particles in said ore, said reagent comprising an alkyl amine salt having an alkyl radical of from about 8 to about 22 carbon atoms and an oil, separating the reagent coated potassium chloride particles from the uncoated portions of said ore, contacting the reagent coated potassium chloride particles with an aqueous alkaline solution whereby the reagent is separated from the potassium chloride and recovering the resultant potassium chloride from the separated reagent.

2. The process of claim 1 which includes the steps of admixing the separated flotation reagent with additional potash ore and neutralizing said admixture whereby the flotation reagent selectively adheres to the potassium chloride in said admixture.

3. A process for separating potassium chloride from ore containing potassium chloride, sodium chloride and

insoluble clay, which comprises crushing said ore, pulping the crushed ore in an aqueous brine, separating the pulped ore from the insolube clay, treating the separated ore with a flotation reagent which selectively adheres to and coats the potassium chloride particles in said ore, said reagent comprising an alkyl amine salt having an alkyl radical of from about 8 to about 22 carbon atoms and an oil, subjecting the treated ore to a flotation treatment, recovering the reagent coated potassium chloride from said flotation treatment, contacting the coated potassium chloride particles with an aqueous alkaline solution whereby the reagent is separated from the potassium chloride particles and recovering the potassium chloride particles from the separated reagent.

4. The method of separating potassium chloride particles from an adhering coating of a flotation reagent comprising an alkyl amine salt having an alkyl radical of from about 8 to about 22 carbon atoms and an oil, which comprises slurrying the coated potassium chloride particles with an aqueous alkaline solution containing a material selected from the group consisting of alkali metal hydroxides and alkaline earth metal hydroxides, whereby the flotation reagent is released from said particles of potassium chloride and separating the resulting substantially uncoated potassium chloride from the released flotation reagent.

References Cited in the file of this patent

UNITED STATES PATENTS

2,195,724	Gaudin	Apr. 2, 1940
2,313,360	Ralston et al.	Mar. 9, 1943
2,699,377	Dancy et al.	Jan. 11, 1955
2,757,796	Schoeld	Aug. 7, 1956