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FROTH-FLOTATION CONCENTRATION OF SYLVITE FROM SYLVINITE ORES

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4 Claims. (Cl. 241—20)

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The present invention relates to froth-flotation concentration of sylvite from sylvinite ores.

Preparatory to the concentration of sylvite from sylvinite ores, in order to keep to a minimum the slimes produced by the grinding operation, it is customary to crush the sylvinite ore to about minus 10 mesh which is generally sufficient to liberate the sylvite constituents, after which substantial desliming of the ore is customary. In such crushed and deslimed sylvinite ore, about 70% may be minus 10 to plus 35-mesh, therefore, and about 30% may be minus 35-mesh. It has been found impossible to attain satisfactory results from simultaneous treatment by froth-flotation of both the coarser and the finer portions of the sylvinite ore. In the treatment of such sylvinite ore, the plus 35-mesh portion has generally been subjected to concentration operations on a shaking-table; while the minus 35-mesh portion has been subjected to concentration treatment in froth-flotation cells. However, since the tonnage capacity of shaking-tables is very low as compared to froth-flotation cells, it has been the practice to grind a considerable part of the plus 35-mesh material to minus 35-mesh in order to increase the proportion of froth-flotation cell feed to shaking-table feed. This further grinding has been done in spite of the fact that the production of sylvite in coarse granular form is commercially so desirable that in some cases fine sylvite concentrates, produced by froth-flotation operations, have been briquetted and then crushed in order to obtain a satisfactorily-sized sylvite concentrate for the market.

The general object of the invention is the accomplishment of satisfactory, efficient and economical concentration of sylvite from sylvinite ores, entirely by froth-flotation operations applied to the coarser as well as to the finer portions of the sylvinite ore.

The new methods of concentrating sylvite from sylvinite ores, hereinafter described, are the result of several discoveries. One of our discoveries is that satisfactory, efficient and economical concentration of the coarser sylvite particles in a sylvinite ore can be achieved by froth-flotation methods, provided the ore has to a large extent been freed of the finer ore particles before conditioning of the ore with suitable agents. Another of our discoveries is that, after the sylvinite ore has been freed of the finer ore particles, the ore may be effectively and advantageously conditioned for froth-flotation of the sylvite by the use of an oil immiscible in water and a froth flotation agent selected from the class of cationic surface-

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active agents consisting of aliphatic amines containing a straight chain alkyl group of at least 7 carbon atoms. These discoveries may be applied to sylvinite ore from which most of the finer particles have been removed by suitable classifying means. However, we have made the further discovery that treatment of the entire crushed (and preferably deslimed) sylvinite ore can be satisfactorily, efficiently and economically achieved by froth-flotation methods, without dividing the ore into fine and coarse feeds, by mixing with a pulp of that ore a froth flotation agent (such as an aliphatic amine of the kind above mentioned) capable of conditioning for froth flotation the finer ore particles, and by subjecting the thus conditioned pulp to froth-flotation treatment and removing the froth containing the finer sylvite; and by mixing with the residue of said pulp froth flotation agents (such as the oil and an aliphatic amine of the kind above mentioned) capable of conditioning for froth flotation the coarser ore particles, and by subjecting the thus conditioned residue of the ore pulp to froth-flotation treatment and removing the froth containing the coarser sylvite. By combining the sylvite containing froths from those froth-flotation operations, a sylvite concentrate of high grade, with a high recovery of the sylvite in the ore, is obtained economically in the form of a mixture of fine and coarse sylvite particles in which mixture the coarser particles largely predominate.

The straight-chain alkyl amines useful as collectors for sylvite in practicing the methods of the present invention, include the following aliphatic amines containing a straight-chain alkyl group of at least 7 carbon atoms: n-heptylamine, n-octylamine, n-nonylamine, n-decylamine, n-undecylamine, n-dodecylamine, n-tetradecylamine, n-hexadecylamine, n-heptadecylamine, n-octadecylamine, and n-octadecenylamine. The lower members of this series may be added to the ore pulp in the form of the free base or as the salts formed by their combination with acids which are themselves relatively devoid of surface active properties, such for example, as hydrochloric acid, nitric acid, acetic acid, etc. The higher members of the series, being much less soluble, are generally used in the form of their more soluble salts. These amine collectors may be used individually or as mixtures. The mixture need not necessarily consist only of aliphatic primary amines or their salts, but may also contain varying proportions of aliphatic secondary and tertiary amines or their salts, such as are commonly found in commercial products. For example, the

product of Armour and Company sold under the designation "Am. Ac. 1180–C" is very suitable and is understood to consist of approximately 73% mono-ocetadecylamine acetate, about 24% monohexadecylamine acetate, together with small quantities of secondary and tertiary amine acetates. Another suitable commercial product is that sold by E. I. duPont de Nemours & Company, Inc., as "D. P. 243" which is a 50% aqueous paste of technical laurylamine hydrochloride understood to contain approximately 18% octylamine hydrochloride, 10% decylamine hydrochloride, 55% laurylamine hydrochloride, 17% myristylamine hydrochloride, and traces of secondary and tertiary amines.

The water-immiscible oils useful in practicing the methods of the present invention may be petroleum oils such as fuel oil, kerosene, etc., which are preferred on account of their low cost. The frothing agent, when used, may be pine oil. Substantial desliming of the sylvinite ore after crushing is generally beneficial.

The advantages of the invention will be apparent from the following examples:

Example I.—Without fuel oil

This example shows the unsatisfactory results of an attempt to concentrate, in one froth-flotation operation after conditioning only with amine acetate, and pine oil, the sylvite contained in a sylvinite ore containing particles ranging from minus 10 to plus 28 mesh. This feed was prepared by grinding a sylvinite ore to pass a 10 mesh screen, after which the ground ore was dry-screened to separate out the minus 10 plus 28 fraction. (The minus 28 plus 65 mesh fraction was also separated by dry-screening and was used in Examples III and IV hereinafter described.' The sylvinite feed thus prepared was substantially deslimed in a saturated solution of the ore, and was conditioned for about one minute at 70% solids with 0.6 lb. Am. Ac. 1180–C and 0.14 lb. pine oil, each per ton of solids in the feed, after which the thus conditioned pulp was submitted to froth-flotation treatment at about 20% solids in a saturated solution of the ore. The results of this treatment were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	35.9	100.0
Concentrate	10.8	89.3	26.9
Tailing	88.3	29.4	72.4
Slime	0.9	29.2	0.7

Example II.—With fuel oil

In this example, the feed was the same as in Example I and the treatment was the same, except that 2.0 lbs. of fuel oil (per ton of solids in the feed) was first mixed into a dense pulp of the ore for one-half minute prior to the addition of the amine acetate and the pine oil. The results of this treatment were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	35.9	100.0
Concentrate	33.9	94.7	89.5
Middling	3.6	16.3	1.6
Tailing	61.9	4.8	8.3
Slime	0.6	36.1	0.6

Comparison of these results with the results in Example I, shows that the use of fuel oil with the amine acetate, on ore in the size range of minus 10 to plus 28 mesh, increased the grade by 5.4% Kcl and the recovery by 62.6%.

Example III.—Without fuel oil

In this example, the sylvinite feed was minus 28 plus 65 mesh, was prepared in the manner referred to in Example I, and the treatment was identical with the treatment described in Example I. The poor results of this treatment were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	36.1	100.0
Concentrate	6.7	65.4	12.1

Example IV.—With fuel oil

In this example, the sylvinite ore feed was minus 28 plus 65 mesh as in Example III, and the procedures were the same as in Example III, except that fuel oil in the amount of 2.0 lbs. (per ton of solids in the feed) was mixed into a dense pulp of the ore for one-half minute prior to the addition of the amine acetate and pine oil and conditioned for about one minute. The results of this treatment were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	36.1	100.0
Concentrate	33.7	92.7	86.6
Middling	4.8	14.0	1.9
Tailing	57.8	5.3	8.5
Slime	3.7	29.9	3.0

Comparison of these results with those in Example III, shows that the use of fuel oil with the amine acetate, on ore in the size range of minus 28 to plus 65 mesh, increased the grade by 27.3% KCl and the recovery by 74.5%.

Example V.—With fuel oil

This example shows the results of treating a sylvinite ore even as coarse as minus 8 plus 10 mesh after conditioning (in the manner described in Examples II and IV) with 2.9 lbs. fuel oil, 0.8 lb. Am. Ac. 1180–C and 0.2 lb. pine oil, each per ton of solids in the feed. The results of this treatment were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	38.5	100.0
Concentrate	31.9	93.6	77.6
Tailing	66.4	11.5	19.8
Slime	1.7	59.7	2.6

The results would have been better, except for the fact that the agitation in the froth flotation cell was not sufficient to keep all of the feed in suspension, with the result that part of the feed was not aerated. However, the results demonstrate the practicability of treating by froth-flotation a sylvinite ore even as coarse as minus 8 plus 10 mesh, after conditioning with fuel oil, amine acetate and a frothing agent such as pine oil. In an exactly comparable test, omitting the fuel oil, only 2.2% weight of the feed was floated.

The foregoing examples, particularly Examples II to IV, demonstrate the remarkable effectiveness of a water-immiscible oil, such as fuel oil, when used with amine acetate in the froth-flotation of sylvite from a sylvinite ore which has been presized and freed of the finer ore particles. The results of the foregoing tests led us to the

belief that a water-immiscible oil, such as fuel oil, when used with an aliphatic amine such as octadecyl amine acetate is ineffective in the froth-flotation of the finer part of a sylvinite ore; and this belief was confirmed by comparative tests, similar to the foregoing, applied to sylvinite ore in the size range of minus 65 to plus 100 mesh, and to ore which was composed of particles of various sizes all minus 35 mesh. On sylvinite ore in both of these size ranges, the results obtained when fuel oil was employed with the amine acetate showed no improvement over those obtained when the amine acetate alone was used. Therefore, it seems that we have made the discovery that a water-immiscible oil, such as fuel oil, is effective as an auxiliary agent in froth-flotation operations on a sylvinite ore containing no appreciable quantities of sylvite and halite particles less than (approximately) 65-mesh. Furthermore, in the light of the examples hereinafter given, it seems that we have also discovered that such a water-immiscible oil is effective as an auxiliary agent in froth-flotation operations on a sylvinite ore from which only the sylvite particles (without the halite particles) less than (approximately) 65-mesh have been removed; from which the conclusion seems justified that if the finer halite particles are left in the ore they do not interfere with the utilization of a water-immiscible oil as an auxiliary agent in the froth-floating of the coarser sylvite.

The foregoing examples deal with the froth-flotation concentration of sylvinite ore which has been pre-sized and freed of the finer particles. The examples which follow deal with the froth-flotation concentration of sylvite from sylvinite ore which contains all particles minus 10 mesh, that is, a sylvinite feed which has not been pre-sized but merely (preferably) substantially deslimed prior to conditioning with the froth flotation reagents.

Example VI.—One treatment. No fuel oil

This example shows the unsatisfactory results of an attempt to concentrate, in one froth-flotation operation and without fuel oil, the sylvite in a mixture of fine and coarse particle sizes contained in a sylvinite ore which had been ground to minus 10 mesh and had been substantially deslimed. The sylvinite ore was conditioned, in a saturated aqueous solution of the ore, with 0.8 lb. Am. Ac. 1180–C, and 0.3 lb. pine oil, each per ton of solids in the feed, at 20% solids for about 10 seconds. The thus conditioned pulp was then subjected to froth-flotation treatment, and the sylvite-containing froth was removed as the sylvite concentrate. The results are shown in the following table:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	31.8	100.0
Concentrate	15.0	88.1	41.6
Tailings	81.0	21.3	54.3
Slime	3.9	34.0	4.1

It will be noted that the results of this operation are very unsatisfactory as regards recovery, which was only 41.6%.

Example VII.—Two treatments. No fuel oil

This example shows the results of subjecting the same minus 10 mesh ore as that treated in Example VI to froth-flotation treatment in two stages, and without the use of an immiscible oil

such as fuel oil. In this case, the ore which had been substantially deslimed was first conditioned in a saturated aqueous solution of the ore constituents with 0.4 lb. Am. Ac. 1180–C and 0.15 lb. pine oil each per ton of solids in the feed, at 20% solids. The thus conditioned pulp was then diluted and subjected to a froth-flotation treatment and the sylvite-bearing froth float was removed. The residue of that treatment was then conditioned with the same amounts of both agents at 70% solids and subjected to froth-flotation treatment, and a second sylvite-bearing froth float was removed. The two froth floats thus produced were combined and were considered to be the desired sylvite concentrate. The results of this treatment were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	30.6	100.0
First Froth Product	13.1	79.9	34.2
Second Froth Product	8.7	91.5	26.0
Conc. Total Froth Product	21.8	84.5	60.2
Tailings	76.4	15.2	37.9
Slime	1.8	32.3	1.9

This example shows the benefit of first floating off the finer sylvite, reconditioning and then floating off the coarser sylvite, as compared to the single float procedure of Example VI using the same reagents.

Example VIII.—Two treatments. Fuel oil in both treatments

In this example, the feed was the same as in Example VII; and the reagents were the same as in Example VII except that in the first conditioning 1.1 lbs. of fuel oil was added, and in the second conditioning 2.2 lbs. of fuel oil was added, in each case per ton of solids in the feed. The small amount of reagents used in the first conditioning was sufficient in quantity to condition adequately only the finer ore particles, whereas in the second conditioning the amount of fuel oil was twice the amount used in the first conditioning and in that case the reagents used were sufficient in quantity to condition adequately the coarser ore particles. The results of the two operations are shown in the following table:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	31.7	100.0
First Froth Product	11.8	81.2	30.3
Second Froth Product	21.0	88.4	58.6
Conc. Total Froth Product	32.8	85.8	88.9
Tailings	63.6	3.4	6.9
Slime	3.6	37.0	4.2

It will be apparent that in this case the results obtained were far more satisfactory than either in Example VI or VII, because the recovery was increased to 88.9% although the grade decreased slightly. This example demonstrates strikingly the advantage of using fuel oil in the conditioning of the coarser ore particles. It will be noted, from a comparison of the first froth products of Examples VII and VIII, that the use of fuel oil did not improve the froth-flotation of the finer ore particles.

Example IX.—Two treatments. No fuel oil

This example shows unsatisfactory results in the attempted concentration of sylvite by a two-float procedure but in the absence of a water-immiscible oil in either flotation step, and will serve as a basis of comparison for Example X.

The same minus 10 mesh ore, ground and deslimed as in the preceding examples, was conditioned with 0.6 lb. Am. Ac. 1180–C and 0.14 lb. pine oil, both per ton of feed, at 20% solids for 10 seconds. A first float was made and removed, and then the remainder of the pulp was thickened, conditioned, diluted and a second float made, all as explained in Example VII except that the reagents added after the first float were 0.6 lb. Am. Ac. 1180–C and 0.14 lb. pine oil. The results are shown in the following table:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	30.2	100.0
First Froth Product	12.4	66.5	27.3
Second Froth Product	12.1	79.5	31.7
Conc. Total Froth Product	24.5	72.7	59.0
Tailings	72.1	15.5	37.0
Slime	3.4	35.3	4.0

Example X.—Two treatments. With kerosene in second treatment

The ore, procedure and reagents were the same as in Example IX except that 4.7 lbs. per ton of kerosene was added with the other reagents after the first float when the remainder of the pulp was being reconditioned. With the addition of kerosene the following results were obtained:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	31.4	100.0
First Froth Product	14.4	70.8	32.5
Second Froth Product	18.8	85.3	51.1
Conc. Total Froth Product	33.2	79.0	83.6
Tailings	61.7	5.2	10.2
Slime	5.1	38.2	6.2

It will be noted that in this case recovery was increased, over Example IX, by 24.6% and grade was increased by 6.3%.

Example XI.—One treatment. No fuel oil

In this and the next example, D. P. 243 was used in place of Am. Ac. 1180–C as the amine collector. No water-immiscible oil was used in this example, and only one froth-flotation treatment was employed. The feed was all minus 10 mesh, and the only reagent used in this example was 2.3 lbs. D. P. 243, per ton of solids in the feed. The results were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	37.2	100.0
Froth Product	20.3	86.4	47.0
Tailing	75.8	23.9	48.7
Slime	3.9	37.2	4.3

It will be seen that recovery was poor, being only 47%.

Example XII.—Two treatments. Fuel oil in the second treatment

In this example, the minus 10-mesh feed was subjected to two treatments in both of which D. P. 243 was employed as the amine collector. In the first conditioning, the only reagent employed was 1.15 lbs. D. P. 243; and in the second conditioning, the reagents employed were 2.4 lbs. fuel oil, 1.15 lbs. D. P. 243 and 0.14 lb. pine oil,

each per ton of solids in the feed. The results are shown in the following table:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	37.4	100.0
First Froth Product	12.4	83.6	27.8
Second Froth Product	18.8	82.6	41.4
Conc. Total Froth Product	31.2	83.0	69.2
Tailings	65.1	15.6	27.3
Slime	3.7	35.0	3.5

It will be seen that the total amount of D. P. 243 used was the same as in the single froth flotation method of Example XI but that the addition of the fuel oil and a second froth flotation increased recovery by 22.2%, grade decreasing slightly but still being sufficiently high.

Example XIII.—Two treatments followed by cleaning of the concentrate. No fuel oil

This example is for comparison with Example XIV, in both of which the feed was a sylvinite ore which had been ground to minus 10 mesh and had been substantially deslimed. In this example, no fuel oil was employed. The feed was conditioned in a saturated solution of the ore at about 20% solids with 0.4 lb. Am. Ac. 1180–C and 0.14 lb. pine oil, each per ton of solids in the feed, was diluted and subjected to froth-flotation treatment and a first froth float was removed. Then the remaining pulp was conditioned at 70% solids with 0.6 lb. Am. Ac. 1180–C and 0.14 lb. pine oil, each per ton of solids in the feed, was subjected to froth-flotation treatment and a second froth float was removed, leaving the tailing as the machine discharge. The first and second froth products were then combined and, without addition of additional reagents, were subjected to froth-flotation treatment which resulted in a cleaned sylvite concentrate. The residue from this cleaning treatment would be regarded as a middling. The results were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	37.6	100.0
Concentrate	21.5	96.1	54.9
Middling	6.7	69.4	12.4
Talling	68.7	16.1	29.4
Slime	3.1	40.9	3.0

Example XIV.—Two treatments followed by cleaning. With fuel oil in the second treatment

In this example, the procedure was the same as in Example XIII, except that 3.0 lbs. of fuel oil was used along with the amine acetate and pine oil in the second treatment. The results were as follows:

Product	Per cent wt.	Per cent KCl	Per cent KCl rec.
Feed	100.0	36.9	100.0
Concentrate	36.2	93.4	91.6
Middling	2.6	20.5	1.4
Talling	58.1	2.5	3.9
Slime	3.1	36.4	3.1

It will be obvious that the use of fuel oil, in the second froth-flotation operation which produced the froth float of the coarser particles, increased the total recovery by 36.7%. This example shows the excellent grade and recovery obtainable by the processes of the invention, when the first and second froth floats are combined and then cleaned by subjecting them to froth-flotation treatment.

It will be understood that the grade of concentrates obtained in the other examples could be improved by cleaning in the same way.

What is claimed is:

1. The method of concentrating sylvite, in the form of a mixture of the finer and coarser particles, from sylvinite ore by froth-floation treatments, which comprises crushing the ore sufficiently to substantially liberate the sylvite in a mixture of the finer and coarser particles of the ore; first subjecting said mixture of the finer and coarser particles of sylvinite ore, in a pulp made with a saturated aqueous solution of the ore, to froth-flotation treatment in the presence of an aliphatic amine containing a straight chain alkyl group of from 7 to 18 carbon atoms in an amount effective to produce a froth product containing most of the sylvite particles finer than about 65-mesh; and then subjecting the residue of the original ore pulp, in a pulp made with a saturated aqueous solution of the ore, to froth-flotation treatment in the presence of an aliphatic amine containing a straight chain alkyl group of from 7 to 18 carbon atoms and an oil immiscible in water in amounts effective to produce a froth product containing most of the coarser sylvite particles; and combining said froth products; thereby producing entirely by froth-flotation treatments a sylvite concentrate which is a mixture of the finer and the coarser sylvite particles in the sylvinite ore.

2. The method set forth in claim 1, wherein the aliphatic amine used in both flotation steps is octadecylamine acetate.

3. The method of concentrating sylvite in coarse granular form from sylvinite ore by froth-flotation treatment, which comprises crushing the ore sufficiently to substantially liberate the sylvite in a mixture of fine and coarse particles of the ore; first removing from the crushed ore most of the sylvite particles finer than about 65-mesh; and then subjecting the residue of the original ore pulp, in a pulp made with a saturated aqueous solution of the ore, to froth-flotation treatment in the presence of an aliphatic amine containing a straight chain alkyl group of from 7 to 18 carbon atoms and an oil immiscible in water in amounts effective to produce a froth product containing most of the coarser sylvite particles; thereby in said froth product producing a sylvite concentrate principally composed of the coarser sylvite particles in the sylvinite ore.

4. The method set forth in claim 1 wherein the aliphatic amine is octadecylamine acetate.

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The following references are of record in the file of this patent:

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2,288,497	Tartaron	June 30, 1942
2,222,728	Tartaron	Nov. 26, 1940
2,340,523	Ferris	Feb. 1, 1944

OTHER REFERENCES

Bureau of Mines report of Investigation No. 3271, Feb. 1935, pages 11 to 13.

In re Ferris 61, U. S. P. Q. 490.

Certificate of Correction

Patent No. 2,420,476. May 13, 1947.

ERNEST W. GREENE ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 1, line 11, strike out the word and comma "therefore," and insert the same after "ore," and before "the" in line 17; same column, line 46, and column 2, line 9, after "achieved" insert *entirely*; same column 2, lines 15 and 21, before "ore" insert *sylvite*; line 31, after the word and period "predominate." insert the following sentence *Other discoveries are later mentioned.*; column 3, line 39, strike out the apostrophe after "scribed." and insert instead a closing parenthesis; column 4, line 2, for "Kcl" read *KCl*; column 10, line 15, for the claim reference numeral "1" read *3*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of July, A. D. 1947.

[SEAL]

LESLIE FRAZER,
First Assistant Commissioner of Patents.

It will be understood that the grade of concentrates obtained in the other examples could be improved by cleaning in the same way.

What is claimed is:

1. The method of concentrating sylvite, in the form of a mixture of the finer and coarser particles, from sylvinite ore by froth-floation treatments, which comprises crushing the ore sufficiently to substantially liberate the sylvite in a mixture of the finer and coarser particles of the ore; first subjecting said mixture of the finer and coarser particles of sylvinite ore, in a pulp made with a saturated aqueous solution of the ore, to froth-flotation treatment in the presence of an aliphatic amine containing a straight chain alkyl group of from 7 to 18 carbon atoms in an amount effective to produce a froth product containing most of the sylvite particles finer than about 65-mesh; and then subjecting the residue of the original ore pulp, in a pulp made with a saturated aqueous solution of the ore, to froth-flotation treatment in the presence of an aliphatic amine containing a straight chain alkyl group of from 7 to 18 carbon atoms and an oil immiscible in water in amounts effective to produce a froth product containing most of the coarser sylvite particles; and combining said froth products; thereby producing entirely by froth-flotation treatments a sylvite concentrate which is a mixture of the finer and the coarser sylvite particles in the sylvinite ore.

2. The method set forth in claim 1, wherein the aliphatic amine used in both flotation steps is octadecylamine acetate.

3. The method of concentrating sylvite in coarse granular form from sylvinite ore by froth-flotation treatment, which comprises crushing the ore sufficiently to substantially liberate the sylvite in a mixture of fine and coarse particles of the ore; first removing from the crushed ore most of the sylvite particles finer than about 65-mesh; and then subjecting the residue of the original ore pulp, in a pulp made with a saturated aqueous solution of the ore, to froth-flotation treatment in the presence of an aliphatic amine containing a straight chain alkyl group of from 7 to 18 carbon atoms and an oil immiscible in water in amounts effective to produce a froth product containing most of the coarser sylvite particles; thereby in said froth product producing a sylvite concentrate principally composed of the coarser sylvite particles in the sylvinite ore.

4. The method set forth in claim 1 wherein the aliphatic amine is octadecylamine acetate.

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