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FLOTATION REAGENT

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This invention relates to froth flotation reagents for the concentration of oxide ore minerals, and more particularly to stable aqueous colloidal dispersions, or emulsions, of mixtures of fatty acids and mineral oils, as collecting reagents. It is of especial utility for the selective, differential separation of fine oxide ore minerals from pulps containing a substantial proportion of slimes, and particularly to obtain satisfactory separations at low pulp temperatures, in the practice of the process described and claimed in my Patent No. 2,163,702, of which the present application is a continuation-in-part.

The reagent, and a maximum of the advantages that may be derived therefrom, can best be explained by reference to its use in the flotation concentration of fine calcite, for purposes of cement manufacture, from pulps of argillaceous limestones, marls and chalks. Such pulps are usually extreme examples, with respect to the proportion of slimes, but it is to be understood that the invention is of utility in treating coarser pulps, and for the recovery of other oxide ore minerals.

As an example of the latter, reference will be made hereinafter to the beneficiation of Florida pebble phosphate materials and an example will be given to illustrate the recovery of phosphate from a de-slimed pulp typical of the pulps now treated by froth flotation in the Florida district.

In many of the natural limestones, marls and chalks, the constituent minerals are so fine that extremely fine grinding is necessary to free the mineral bonds, or at least to release a sufficient proportion of the mineral or minerals occurring in excessive quantity, to permit the desired elimination. The resulting pulps are not readily amenable to froth flotation, under usual conditions, because of the abundance of slimes. A limited de-sliming is usually undesirable, in view of weight losses, and is impractical in the many cases where the natural mineral particle sizes are so fine that the actual calcite separations are made in the lower micron size fractions. The calcite and quartz slimes are especially desirable in cement manufacture, as intimate contact of fine particles is essential to produce uniform and complete reactions in burning the ultimate mixture to clinker, and accordingly, under such conditions, the slimes should be subjected to flotation to recover the calcite at least.

Most of the natural materials contain alumina in too great abundance to make them suitable for the manufacture of modern types of cements in which the proportion of tri-calcium aluminate is low. In the raw materials, all tangible quantities of alumina are silicates, especially the micas, but several silicates may be present in the same material, other common forms being the feldspar minerals, kaolin or kaolinite. The natural fineness of the micaceous matter and the ease with which it is reduced in grinding causes serious contamination of the froth, as the fine particles are easily trapped, probably mechanically, not only due to fineness but also because of the shape of the particles which gives them a much slower settling rate than the other tailing minerals.

It has been discovered that light stage oiling flotation circuits are essential to effect satisfactory differential separations of calcite from such pulps. In relatively warm pulp, oleic acid is a satisfactory collector, but, as the temperatures are reduced, dispersion is incomplete and the consequent partial over-oiling causes decreased grades of concentrates due to the heavy flocculation. Its disadvantages include the difficulty in obtaining accurate control and dispersion of the small quantity used at each oiled stage, and the cost of the reagent relatively to the low commercial value of Portland cement. The less expensive high titre fatty acids, such as fish oil acid, have high collecting power but are unsatisfactory as they cannot be uniformly dispersed and controlled in quantity. The heavy flocculation occurring in pulps of normal temperatures makes them unsatisfactory, as little improvement can be made in the grade and the concentrates are too heavily matted for satisfactory froth cleaning. Fish oil fatty acid compares favorably with oleic acid in relatively coarse de-slimed pulps, at water temperatures above average.

The common emulsions of fatty acids are unsatisfactory collectors for use in calcite pulps of the types described. Those stabilized by amine soaps produce heavy, matted froths of low-grade, difficult to clean by froth flotation and difficult to thicken, the scum floating on the surface of the thickener frequently carrying up to 5% of the weight of the calcite. Fatty acid emulsions stabilized by the sodium soaps produce excessive froths that cannot be controlled in stage oiling circuits and these emulsions are usually unstable, particularly in cold weather. Similarly, emulsions stabilized by sulphonated alcohols produce excessive frothing and low-grade concentrates. Emulsions stabilized with the sulphonated oils, as described and claimed in my Patent No. 2,163,701, are satisfactory with respect to froth-

ing characteristics and grade and weight recoveries.

The sodium soap collectors, such as sodium oleate, usually produce excessive froths of low grade. An exception to this is saponified refined talloel, as described and claimed in Vogel-Jorgensen Patent No. 2,165,268. When the pulp does not contain excessive quantities of the finer slimes, the collecting power of this reagent can be increased and its frothing characteristics reduced and controlled by the use of increasing quantities of a mineral oil.

It is accordingly among the purposes of the invention to provide stable oil in water emulsions of mixtures of fatty acids and mineral oils, that can be used in high water dilutions to effect complete dispersion in the pulp and to permit accurate and uniform control of the small quantities introduced at each of the oiled stages, to the end that selective differential separation can be made of the oxide ore mineral. It is a further purpose to provide collecting reagents of high selectivity and collecting power, but of low cost. It is also a purpose to control the frothing characteristics, whereby the froth balance of the cells can be controlled by additions of the usual frothing agents such as crysilic acid and alcohol frothing agents, especially in stage oiling circuits. It is a further purpose to provide collecting reagents that can be used at all ranges of pulp temperatures, including temperatures just above freezing. These reagents may be prepared from common materials without special equipment.

In general, the invention comprises oil in water emulsions of mixtures of fatty acids and mineral oils as collecting reagents for calcite and other oxide ore minerals. The oil in water ratios are preferably relatively high to obtain accuracy in control of the small quantities introduced at each flotation stage and to obtain rapid and complete dispersion in the pulp. Relatively high ratios are also desirable for convenience in handling and also to avoid possible instability as well as inversion to water in oil emulsions at low temperatures, particularly when the proportion of mineral oil is relatively large and equals or approaches the proportion of fatty acid oil. In such cases, the preferred ratio is 1:33, but ratios are satisfactory down to 1:20. Greater ratios offer no apparent advantage in dispersion and the increased volume is less convenient to handle. Lower ratios are difficult to disperse in fine pulps, and the fullest advantages of the emulsions are not obtained. Usually, such emulsions of oil in water ratios in the neighborhood of 1:10 and lower are partially unstable at average temperatures, a light scum being formed sometimes with floating granules or agglomerates of soapy appearing matter. However, if these emulsions are used promptly or under conditions of agitation little decrease in efficiency results from the moderate separation. Reboiling and stirring the emulsion disperses the separated matter and it is preferable to increase the dilution to avoid re-separation. Such emulsions prepared with low water ratios should be diluted while still hot, as at ratios of about 1:5 and lower, an apparent inversion to a water in oil emulsion takes place or at least dense greasy soap-like masses form which cannot readily be handled or dispersed. However, when the proportion of mineral oil is relatively low, for example, less than half the weight of the proportions of fatty acid oils, emulsions with much lower water ratios are stable and can be stored over long periods.

Although saponified fatty acids are not miscible in mineral oils to produce stable aqueous emulsions, I have discovered that apparently complete and permanently stable colloidal dispersions can be produced by dissolving or mixing the fatty acid in the mineral oil and afterward introducing a soap-forming reagent selected from the class consisting of caustic alkalies and ammonium hydroxide. The resulting diluted emulsions are translucent, and when medium and light fuel oils are used in the mixture, sometimes transparent, each of the emulsions showing no tendency toward separation after storage for several months.

Although the term "emulsion" has been applied to these reagents, it is possible that at least some of them are not true emulsions in the generally accepted sense. Just what effects produce stability in water is not fully understood. Of the emulsions described in the first example appearing hereinafter, a 1:33 oil in water emulsion of equal weights of talloel and medium fuel oil has the appearance of a solution, being clear, bright orange-yellow, whereas those produced similarly with oleic or fish acid are translucent or cloudy but highly dispersed. The emulsions in which the mineral oil component is a heavy fuel oil such as commercial oil No. 6 or "bunker C" have a dense green color and the appearance is that of the usual emulsions.

The emulsions are prepared by stirring the mixture of fatty acid and mineral oil, the relative proportions of which will be described hereinafter, and then adding a caustic alkali or ammonium hydroxide in quantities at least equal to that necessary to saponify the fatty acid and preferably a considerable excess. The usual saponifying reagents such as sodium, potassium and ammonium hydroxide may be used, but sodium hydroxide is preferred for economy and convenience and also because the resulting emulsions appear to have greater selectivity. The preferred proportions of sodium hydroxide by weight, for example, technical grades of 94% purity, range from 20 to 25% by weight to the total weight of the fatty acid oil and mineral oil. A proportion of about 25% is preferred as the resulting emulsion is clearer or more highly dispersed and is stable at all temperatures above freezing. Proportions of sodium hydroxide below 20% usually do not produce permanently stable or substantially clear emulsions. For example, an emulsion prepared with equal parts of talloel and fuel oil, to be described more fully hereinafter, is clear in an oil to water ratio of 1:33 but has a milky appearance if the quantity of sodium hydroxide is limited to that necessary to saponify the talloel itself. The latter emulsion, however, will remain stable for practical periods particularly if agitated. Accordingly, an excess of sodium hydroxide beyond that necessary to saponify the talloel is desirable and preferably in proportions of 20 to 25% by weight.

Mineral oils throughout a wide range of specific gravities, as from kerosene to bunker C, are satisfactory for use as a component of the mixture. However, those of medium weight such as commercial fuel oils Nos. 3 and 4 produce the most satisfactory flotation results, especially in fine pulps, and are easily dispersed. The heavy grades, such as No. 6, can be dispersed but more care is necessary in mixing as the sodium hydroxide solution is added, as described hereinafter. These emulsions are relatively heavy and are less satisfactory than those described above,

but no loss in efficiency is apparent in connection with coarse pulps.

The sodium hydroxide is first dissolved in from 4 to 10 parts of water, and while still warm, or after heating, is slowly added and vigorously stirred into the mixture. When several of the fatty acids, and particularly talloel, are a part of the mixture, large soapy masses tend to form and should immediately be broken down by the addition of quantities of water sufficient substantially to disperse these masses, to avoid the presence of lumps suspended in the final emulsion, and the remainder of the sodium hydroxide solution added to provide for final stability. The mixture is then brought to the boiling point and slowly boiled usually from 3 to 5 minutes, stirring being continued during this time. When lumps have disappeared, the desired oil in water dilution is made simply by adding the necessary quantity of cold water, preferably before the mixture has cooled. The heavier fuel oils that have not been substantially decarbonized require especial care while the sodium hydroxide solution is added, for, if additional water is not added when lumps tend to form, a heavy carbonaceous sludge, carrying soapy masses, will separate from the emulsion. When prepared as above described however, the carbonaceous matter separates freely as a thin scum floating on the surface, which may readily be removed by skimming, or syphoning the emulsion from below the carbonaceous film.

When the proportion of mineral oil is to be low, with relation to the proportion of talloel, the preparation of the emulsion is somewhat simpler and less critical. For example, a completely stable, clear emulsion comprising 20 parts of ordinary unfiltered talloel, 8 parts of No. 3 fuel oil, 2.7 parts of technical grade sodium hydroxide (13.5% on the weight of the talloel or 10.5% on the weight of the total oil mixture), and 50 parts of water, the "parts" in each case being by weight, may be prepared as follows:

The talloel is heated, not necessarily to boiling, and the fuel oil is added and continuously stirred into complete mixture, heating and stirring being continued until solution appears complete. A solution of sodium hydroxide, preferably at 25% strength, is prepared, using half of the water referred to above, and brought to boiling. The remainder of the water is separately heated also preferably to boiling. About one-third of the solution is then added to the oil mixture while heating of the latter is continued. Additional solution is then slowly stirred into the mixture until the latter turns darker and clearer, which occurs when about 75% of the total solution has been introduced. At this time the addition of the caustic solution should, and in some cases must be stopped for otherwise a stiff jell forms that is almost insoluble and cannot readily be dispersed when the remainder of the caustic and water is added. When this change in color and clarity takes place, about one-third of the hot water is added, and this again lightens the color. If all of the water, or a large proportion of it, is added at this time, a similar stiff jell is formed, so stiff that it cannot be stirred. A small quantity of the caustic solution is added, and small flecks of clear jelly will form. More water is added and stirring continued to keep the mass plastic or pasty. The remainder of the water is then added, and if the mixture remains pasty, it will become liquid as soon as the remainder of the sodium hydroxide solution is stirred into it. It will be seen that the oil in water ratio of this emulsion is 29:30. At this dilution, the emulsion remains dark and clear indefinitely. If the dilution is increased later, it may turn cloudy but will not break or stratify. If filtered talloel is used, a clear jelly, instead of the paste described above, may be formed together with some clear liquid, a condition that may continue after all of the solution and hot water have been added. However, if stirring is continued for a short time the jelly will disperse in what appears as a clear solution, time being the most important factor.

In addition to the precautions set forth above, for the preparation of the reagent as a clear, stable emulsion, the following general precautions should also be observed. The proportion of caustic soda, by weight, must be at least slightly greater than that necessary to saponify completely the proportion of talloel, or other fatty acid. If a lesser quantity of sodium hydroxide is used, the mineral oil will separate promptly and float to the surface. In all forms of the emulsion, the proportions of the ingredients including the water are somewhat critical. As the proportion of mineral oil is increased relatively to the fatty acid, the quantity of water in which the oils are dispersed must also be increased, i. e. the oil to water ratio must be increased. Thus, the low dilution described immediately above is stable if the mineral oil does not substantially exceed 8 parts to 20 parts of talloel, for example. Increased proportions of mineral oil require greater volumes of water or larger proportions of sodium hydroxide or both. As the relative proportions approach the opposite extreme, high dilutions are necessary for stability, as when 60 parts of light fuel oil and 20 parts of talloel are stabilized by 13.5% of sodium hydroxide on the weight of the talloel, an oil in water ratio of about 1:30 is necessary for stability and even at this dilution the emulsion may be cloudy, usually milk-white, but had the proportion of sodium hydroxide been in the neighborhood of 20 to 25% on the weight of the mixed oils, this emulsion would have been clear or would at least approach clarity. Although clarity is not essential to the proper functioning of the reagent, if it is used within a reasonable time, the clear emulsions are more stable and less liable to instability resulting from changes in temperature.

The preferred relative proportions of fatty acid and mineral oil depend upon the character of the pulp and particularly its fineness. In general, the collecting power of the emulsion increases with increasing proportions of mineral oil up to a proportion equal to the weight of the fatty acid, and without reducing, and in some cases improving, the grade of the concentrate, as will appear hereinafter. Greater than equal proportions of fuel oil result in rapidly decreasing calcite weight recovery. Further, the preferred proportions of mineral oil also depend upon the frothing characteristics of the fatty acid, and especially the increased frothing effect produced by saponification. One of the important features of the prevent invention is the control of froth volume by properly proportioning the mineral oil, increasing quantities sharply reducing the froth volumes produced. Especially in light stage oiling circuits, it is desirable to use relatively large proportions of mineral oil whereby the froth balance of the cells can be controlled accurately by additions of normal froth-

ing agents, such as crysilic acid and an alcohol frothing agent identified hereinafter. Under average conditions, the most satisfactory weight recoveries, with reference to grade of concentrates, and under satisfactory frothing conditions, are produced by emulsions comprising approximately equal proportions of fatty acid and mineral oil. In the presence of the fatty acid, the mineral oils have high collecting power, and with relation to grade, the collecting power of the emulsion is greater than that of the equivalent of its fatty acid content, and in some cases greater than an equal weight of fatty acid, such as oleic acid.

In general, emulsions produced from mixtures comprising more than 70% of mineral oil tend to become unstable. When the proportion substantially exceeds 50%, the resulting emulsion is unsatisfactory for calcite recovery, as described above, but is satisfactory for the beneficiation of phosphates, particularly when additional mineral oil and sodium hydroxide are added to the pulp as will be indicated in the second example to be given hereinafter.

Further, it will be obvious that large proportions are desirable in view of the relatively high cost of fatty acid as compared with mineral oil.

For a better understanding of the use of the reagent, reference is made to the following examples:

First Example

The first example comprises seven comparative tests, made under equivalent flotation conditions. Three representative fatty acids were used, namely oleic acid of 98% free fatty acid content; fish oil fatty acid, derived from fish scrap, of 78% free fatty acid content, by titration, and acid refined talloel, derived from the black liquor soap of the sulphate process waste liquor, in cellulose and paper manufacture. The use of talloel as a collecting reagent for oxide ore minerals is described more fully in Hasselstrom Patents 1,986,816 and 1,986,817. It is a mixture of fatty and resin acids, usually of about 50% free fatty acid content, and has, when properly employed, excellent qualities with reference to both grade and weight recoveries, actually exceeding oleic acid, which is commonly believed to be the most effective collector of oxide compounds of alkaline earth metals.

Two emulsions of each of the fatty acids were used in the tests, one each being a mixture with commercial No. 3 fuel oil and the other a mixture with commercial kerosene. In all cases equal proportions of fatty acid and mineral oils were mixed as previously described, and 25% by weight of sodium hydroxide in 25% solution in water was added to the mixture, together with additions of water during the mixing period, to make the aqueous dispersion complete. The oil in water ratio was 1:33.

The material treated was an argillaceous limestone and the test specimens were identical in chemical composition and physical analysis. It may be characterized as one of "medium fineness," by comparison with those described above. The physical analysis was as follows:

	Percent
Plus 100 mesh	2.7
Minus 100 mesh plus 200 mesh	17.5
Minus 200 mesh plus 325 mesh	13.6
Minus 325 mesh	66.1

The pulp temperatures were 60° F., dilutions were 20% dry solids and the pulps had a normal alkalinity of pH 7.8. Rougher flotation time in a Fagergren flotation machine was five minutes, the emulsions being added in five stages at one minute intervals. The frothing agent used was a mixture of branched and straight chain aliphatic monohydric alcohols boiling between about 152° C. and about 162° C. obtainable along with methanol by the catalytic hydrogenization of carbon oxides. It is especially satisfactory in fine pulps of this type as it has little or no collecting capacity and disperses rapidly in pulps. It is especially to be noted that the quantity of frother used in each case is approximately 25% more than would be used in normal fatty acid flotation, including the use of oleic acid, thereby demonstrating the control of frothing characteristics that may be exercised with large proportions of mineral oil. The quantities of collecting reagents, under the heading "Reagents" in the last column of the table, mean the total weight of both the fatty acid oil and the mineral oil. The average $CaCO_3$ content of each test specimen was 69.5%, by titration.

Test No.	Concentrates			Rejects			Lbs./ton		Emulsions of—
	Percent weight	Percent $CaCO_3$	Percent weight $CaCO_3$	Percent weight	Percent $CaCO_3$	Percent weight $CaCO_3$	Frother	Reagent	
1	79.7	83.8 (90.5)	93.6	20.3	22.7	6.4	0.04	0.6	Talloel and fuel oil.
2	76.0	84.1 (90.0)	91.6	24.0	24.3	8.4	0.04	0.5	Talloel and fuel oil.
3	71.2	85.0 (91.3)	84.7	28.8	30.3	12.6	0.04	0.5	Fish acid and fuel oil.
4	67.9	85.3 (90.5)	82.0	32.1	39.5	18.0	0.04	0.5	Oleic acid and fuel oil.
5	71.5	83.1 (89.7)	87.0	28.5	31.2	13.0	0.04	0.5	Talloel and kerosene.
6	69.2	84.4 (91.9)	85.0	30.8	33.6	15.0	0.04	0.5	Fish acid and kerosene.
7	65.4	84.5 (90.5)	80.6	34.6	39.2	19.4	0.04	0.5	Oleic acid and kerosene.

The figures in parentheses are the grade of the froth concentrates after cleaning by froth flotation without the addition of collecting reagents. It will be seen, from test No. 1, that the emulsion of talloel and medium fuel oil produced the most effective concentration by reference to both grade and weight recoveries. A slightly greater quantity of this emulsion is required to complete the rougher concentration, but it will be seen in test No. 2, in which a lesser quantity was used, equal to that required for the most efficient of

the other emulsions, that this reagent is superior to the others. This is of especial interest as it is the least expensive of the three fatty acids used. It will be seen from test No. 3 that the emulsion of fish oil and fuel oil is superior to emulsions of oleic acid in pulps of this character. It will also be apparent that the emulsions including fuel oil are more efficient than those in which kerosene was used.

Second Example

The material treated was Florida pebble phosphate rock, believed to be a typical specimen of the district, and is of a type now being recovered by froth flotation methods. All test conditions parallel, as closely as possible, present commercial technique in the recovery of this material. The pulp was de-slimed to the usual degree and the flotation cell feed had the following physical analysis:

	Percent
Plus 28 mesh sieve	4.31
Plus 35 mesh sieve	15.70
Plus 48 mesh sieve	22.38
Plus 65 mesh sieve	29.77
Plus 100 mesh sieve	17.94
Plus 150 mesh sieve	8.89
Minus 150 mesh sieve	1.01

The emulsion was prepared from a mixture of equal weights of talloel and No. 4 fuel oil and had an oil in water ratio of 1:15. This was added to a dense pulp, of 70% dry solids, together with sufficient additional fuel oil to bring the total quantity of the latter up to 4.0 lbs. per ton of feed, and additional NaOH to bring the total quantity of the caustic soda up to 0.5 lb. per ton of feed. These additions were made to make the reagent quantities identical in proportions to those normally used commercially at a plant operating in the Florida District, so that the results to be given hereinafter would be comparative. The talloel component of the reagents was .57 lbs. per ton. The pulp was conditioned for 5 minutes and then diluted to 22% dry solids for flotation, the flotation time being 2 minutes. The results were as follows:

	Wt. gr.	Percent wt.	Percent B. P. L.	Percent rec.
Feed	601.2	100.	28.78	
Conc	172.0	28.61	75.39	74.95
Midd	24.2	4.02	46.19	6.46
Tail	405.0	67.37	7.94	18.59

These recoveries compare favorably with those produced with other reagents. As compared with raw talloel, fuel oil and sodium hydroxide, the grade of the concentrate is somewhat higher but with a corresponding decrease in weight recovery. However, cleaning was much better because the froth was light.

Although the pulps used as calcite test specimens have been described heerin as of "medium fineness", and others as relatively "coarse" it is to be understood that the latter calcite pulps are actually largely "slimes" as this term is used in the art, by comparison with commercial pulps of other oxide ore minerals, such as the deslimed phosphate pulp described above, as will appear more fully by reference to the physical analyses of the two examples.

I claim:

1. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous pre-formed emulsion of a mixture of a fatty acid and a mineral oil stabilized by a quantity of a soap forming reagent selected from the class consisting of caustic alkalies and ammonium hydroxide equivalent to 20 to 25% of sodium hydroxide of the weight of the mixture.

2. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous pre-formed emulsion of a mixture of a fatty acid and a mineral oil stabilized by a quantity of sodium hydroxide equal to about 25% of the weight of the mixture.

3. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of refined talloel and a mineral oil stabilized by a quantity of soap forming reagent selected from the class consisting of caustic alkalies and ammonium hydroxide equivalent to 20 to 25% of sodium hydroxide of the weight of the mixture.

4. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of refined talloel and a mineral oil, in which the quantity of talloel is at least equal to the mineral oil, by weight, stabilized by a quantity of soap forming reagent selected from the class consisting of caustic alkalies and ammonium hydroxide in excess of that necessary to saponify the talloel.

5. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of refined talloel and a mineral oil, of substantially equal quantities, by weight, stabilized by 20 to 25% of sodium hydroxide of the weight of the mixture.

6. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of approximately 8 parts of a mineral oil and 20 parts of a fatty acid, by weight, stabilized by a quantity of a soap forming reagent selected from the class consisting of caustic alkalies and ammonium hydroxide.

7. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of approximately 8 parts of a mineral oil and 20 parts of a fatty acid, by weight, stabilized by a quantity of a soap forming reagent selected from the class consisting of caustic alkalies and ammonium hydroxide, and in which the proportion of water is at least substantially equal to the proportion of said mixture.

8. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of approximately 8 parts of a mineral oil and 20 parts of a fatty acid, by weight, stabilized by a quantity of a soap forming reagent at least slightly in excess of that necessary to saponify the proportion of fatty acid and selected from the class consisting of caustic alkalies and ammonium hydroxide.

9. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of approximately 8 parts of a mineral oil and 20 parts of refined talloel, by weight, stabilized by a quantity of a soap forming reagent at least slightly in excess of that necessary to saponify the talloel and selected from the class consisting of caustic alkalies and ammonium hydroxide, and in which the proportion of water is at least substantially equal to the proportion of said mixture.

10. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of approximately 8 parts of a mineral oil and 20 parts of refined tal-

loel, by weight, stabilized by a quantity of a soap forming reagent at least equal to the equivalent of 13.5% of sodium hydroxide on the weight of the talloel and selected from the class consisting of caustic alkalies and ammonium hydroxide, and in which the proportion of water is at least substantially equal to the proportion of said mixture.

11. A froth flotation collecting reagent for oxide ore minerals comprising an aqueous preformed emulsion of a mixture of mineral oil and refined talloel in which the proportion of talloel is in excess of twice the proportion of mineral oil, by weight, stabilized by a quantity of a soap forming reagent at least slightly in excess of that necessary to saponify the talloel and selected from the class consisting of caustic alkalies and ammonium hydroxide, and in which the proportion of water is at least substantially equal to the proportion of said mixture.

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