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FLOTATION FROTHER

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This invention relates to the flotation of ores for the recovery of the valuable minerals therein.

More particularly, this invention relates to a new and highly efficient means for producing froth in the flotation operation for the recovery of the minerals.

The practice of froth flotation of ores in order to obtain the desired minerals therein in concentrated form has been well established. It is customary to grind the ore to a suitable degree of fineness, add water thereto in sufficient amounts to produce a free flowing pulp and add flotation reagents thereto. Such reagents were generally of two types. The so-called promoters acted to give selective adhesion of the valuable ore particles to the froth and the so-called frothers were intended to provide the bubbles which floated to the surface of the pulp. These reagents were mixed with the pulp and the pulp subjected to aeration, whereby the froth was formed carrying the mineral particles to the surface where they were removed by various means from the remaining pulp.

The present invention is directed to a new frothing agent which has highly desirable properties. The frothing agent should effectively produce a large volume of froth, which is tough and which is capable of holding the ore particles. In accordance with the present invention we have found that certain aliphatic alcohols are capable of producing a large amount of froth in the pulp. These alcohols may be briefly described as having from 7 to 10 carbon atoms and have a boiling range from about 133° C. to 250° C. These alcohols are the primary, secondary and sometimes include the tertiary heptyl, octyl, nonyl and decyl alcohols. While we may use but a single alcohol as a frother we prefer to use mixtures of two or more of such alcohols and we have found that among such mixtures those containing substantial proportions of the octyl and nonyl alcohols give the best results.

We have further found that although these alcohols are excellent frothers they have a tendency to produce too much froth and this in turn results in the flotation of gangue as well as of the desired mineral. In other words, the over frothing tends to prevent the formation of a selective froth. We have found that this difficulty may be overcome by adding to the frother a hydrocarbon, either of the aliphatic series or of the terpene series.

Specifically we have found that a substantially saturated hydrocarbon fraction obtained from the treatment of petroleum oils, commonly called "naphtha", and having a boiling point within the extreme range of 300° F. to 500° F. serves as an excellent means for controlling and stablizing the froth obtained from the above named alcohols. We have also found that the hydrocarbon known as di-pentene having a formula of $C_{10}H_{16}$ and obtained from pine oil is suitable for our purpose. The alcohols may be mixed with the hydrocarbons in varying proportions over a relatively wide range. We have found that the amount of alcohol in the mixture may vary from 50% to 90% and the hydrocarbon from 50% to 10%.

As an example of a composition which we have used successfully, we provided a mixture of alcohols including methyl hexanol, di-methyl hexanol, methyl heptanol and di-methyl heptanol containing minor amounts of closely related alcohols and having an approximate boiling range of 160° C. to 202° C. 60% of this mixture was mixed with 40% of naphtha having a boiling range of 352° to 484° F. A lead ore was finely ground and made into a pulp with water. To the pulp was added .030 pound of ethyl xanthate per ton of ore as the promoter and the pulp was diluted to about 22% solids. To this was added the above named mixture in an amount of .081 pound per ton of ore. The pulp was agitated in a flotation machine for six minutes and the froth was skimmed from the pulp. The recovery of lead mineral was 96.28%.

In another test, a mixture of the above stated alcohols in the amount of 50% with 50% of di-pentene was added to the pulp of lead ore in the amount of .090 pound per ton of ore in conjunction with .030 pound of ethyl xanthate and a flotation operation conducted therewith. This resulted in a recovery of 96.16% of the mineral.

Under the same conditions, but using the old and well-known pine oil as a frother the recovery of lead ore was only 90.78%. The loss in the tailings in the test with pine oil as a frother was more than double that with the above mentioned mixture of the present invention. In other words, by utilizing the present invention the loss of ore in the tails was less than one-half of the loss when using the old frother.

While we have described our invention setting forth a few specific embodiments thereof, it is apparent that our invention is not limited to the details set forth. For instance the hydrocarbons mentioned for addition to the alcohols may be of various types and having different ranges of boiling points than those set forth

above. We may utilize aromatic hydrocarbons such as benzol, toluol, xylol, solvent naphtha and the like, all of which are included in the term "hydrocarbon" as used herein. The frothers described herein are adapted for use on a large variety of ores which are amenable to flotation and the usefulness thereof is not at all limited to lead ores. Various sources of alcohols may be used, but we have found that the alcohols of higher molecular weight within the stated range give somewhat better results. From the above it is apparent that our invention is not limited, but is of broadscope in accordance with the claims appended hereto.

The hydrocarbons described in the present invention operate as stabilizers of the froth produced by the alcohols and prevent over-frothing. The hydrocarbons, of course, operate as stabilizers when present in an amount sufficient to reduce the over-frothing of the alcohol. The amount of hydrocarbon necessary will vary somewhat with the composition of the alcohol mixture and with the particular flotation operation, but should always be present in amounts sufficient to exceed the stabilizing action. In the claims, the word "stabilizer" is used in the sense of an amount of material sufficient to result in stabilization of the frothing properties of the alcohol and will be used in no other sense.

What we claim is:

1. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated hydrocarbon in amounts sufficient to act as a stabilizer and an aliphatic alcohol having from 7 to 10 carbon atoms, and subjecting the pulp to a froth flotation operation.

2. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a naphtha fraction of petroleum in amounts sufficient to act as a stabilizer and an aliphatic alcohol having from 7 to 10 carbon atoms, and subjecting the pulp to a froth flotation operation.

3. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a naphtha fraction of petroleum in amounts sufficient to act as a stabilizer having an extreme boiling range within 300° F.–500° F. and an aliphatic alcohol having from 7 to 10 carbon atoms, and subjecting the pulp to a froth flotation operation.

4. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated petroleum hydrocarbon in amounts sufficient to act as a stabilizer and an aliphatic alcohol having from 7 to 10 carbon atoms, the amount of said alcohol being greater than said hydrocarbon, and subjecting the pulp to a froth flotation operation.

5. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of 10–50 parts of a saturated petroleum hydrocarbon and 90–50 parts of an aliphatic alcohol having from 7 to 10 carbon atoms, and subjecting the pulp to a froth flotation operation.

6. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated petroleum hydrocarbon in amounts sufficient to act as a stabilizer and an aliphatic alcohol having from 7 to 10 carbon atoms, the amount of frother being in excess of the collecting agent, and subjecting the pulp to a froth flotation operation.

7. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated petroleum hydrocarbon in amounts sufficient to act as a stabilizer and at least two of the following alcohols: heptyl, octyl, nonyl, decyl, and subjecting the pulp to a froth flotation operation.

8. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated petroleum hydrocarbon in amounts sufficient to act as a stabilizer and at least two of the following alcohols: heptyl, octyl, nonyl, decyl, the heptyl alcohol being in preponderance, and subjecting the pulp to a froth flotation operation.

9. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated petroleum hydrocarbon in amounts sufficient to act as a stabilizer and at least two of the following alcohols: heptyl, octyl, nonyl, decyl, and including the normal and secondary alcohols, and subjecting the pulp to a froth flotation operation.

10. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of a saturated petroleum hydrocarbon in amounts sufficient to act as a stabilizer and octyl and nonyl alcohols, and subjecting the pulp to a froth flotation operation.

11. A method of froth flotation of ores which comprises providing a pulp of ore with water, adding thereto a collecting agent and a frother, the latter comprising a mixture of an aliphatic alcohol having from 7 to 10 carbon atoms and a hydrocarbon taken from the aliphatic and terpene series in amounts sufficient to act as a stabilizer, and subjecting the pulp to a froth flotation operation.

12. A method according to claim 1 in which the collecting agent is an organic substituted xanthate.

13. A method according to claim 1 in which the collecting agent is an alkoxy xanthate.

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