UNITED STATES PATENT OFFICE.

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CONCENTRATION OF ORES.

1,417,263. Specification of Letters Patent. Patented May 23, 1922.

No Drawing. Application filed January 13. 1921. Serial No. 437,027.

To all whom it may concern:

Be it known that I, ROYER LUCKENBACH, a citizen of the United States, and a resident of the borough of Brooklyn, county of Kings, city and State of New York, have invented a certain new and useful Concentration of Ores, of which the following is a specification.

The invention relates to the concentration of ore by the flotation method whereby mineral values are separated from the valueless earthy or rocky gangue with which they are associated in nature, by taking advantage of the principles of surface tension of liquids and colloid chemistry, with whatever allied principles may be involved, by floating the valuable mineral content of the ore upon the surface of water or other fluid, while the valueless silicious gangue is induced to sink through the surface and settle separately, and wherein ore in finely divided condition is mixed with a liquid to form a pulp and the mixture is aerated in such a manner that air or other gaseous fluid is introduced into the mixture to form a froth, the bubbles of which have a preferential affinity for the mineral values which becomes attached to or in the bubbles and with them rise to the surface of the pulp and form a froth, which may be removed from the surface and the values recovered therefrom.

Broadly speaking the invention relates to the separation of mineral substances which have a greater affinity for the substances employed in the reagent used in the process than they have for water.

One object to the invention is to provide a process by means of which not only will mineral sulphides be concentrated as before, but by means of which free metals and carbonates, oxides and silicates of the metals, as well as certain non-metallic minerals, such as graphite and sulphur, will be gathered and raised.

A further object is to produce a heavily mineralized froth which will be free flowing and at the same time extremely tenacious, and which will not be liable to burst spontaneously and deposit the values carried thereby before the mineralized froth can be removed from the surface of the pulp.

These and further objects will more fully appear in the following specification and claims.

The gathering and frothing reagent of the present invention comprises broadly the reaction product of an alkali and a resin, and a liquefied normally unsaponifiable resinous substance. The preferred saponifiable resin is rosin (colophony). The preferred alkali is caustic soda. The preferred normally unsaponifiable substance is copal.

Instead of rosin other saponifiable resins such as lac in its various forms may be used. Other normally unsaponifiable resinous substances such as mastic, congo, caoutchouc, etc., may be used, but commercial Madagascar copal has been found to be admirably suitable for the purpose. Any suitable alkali other than caustic soda may be used, as well as carbonate of soda or borax. Lime, which has an alkaline reaction with various of the ingredients of the reagent may be employed in conjunction with them.

A reagent compounded of resinate of soda, and copal dissolved in alcohol may be employed to gather and float sulphide ores.

The addition of ammonia to the above will increase the volume of froth and produce a cleaner concentrate.

The addition of the reaction product of an alkali and a fatty acid, such for example as sodium oleate, to either of the above mentioned reagents will gather and float carbonates, oxides and silicates as well as the sulphides.

The addition of lime, which because of the water present will be in the form of calcium hydroxide, will improve the frothing and mineral gathering qualities of any of the reagents.

When sodium oleate is employed in the reagent the sodium resinate may be omitted in working certain ores.

When ammonia or lime or both are used in the reagent the caustic soda content may be reduced, or even eliminated. The ammonia and lime both have alkaline reactions in the mixture, and the expression alkali in the appended claims is intended to include both of these substances.

If desired, alcohol in addition to that required to liquefy the copal may be used.

A test made on 500 grams of Utah copper "capping" ore containing carbonate of copper and a very small percentage of copper sulphide crushed to 80 mesh, and with a pulp dilution of 4 parts water to 1 part ore, with 5 cc. of a reagent composed of

water 85 cc., ammonia 5 cc., alcohol 15 cc., sodium oleate 7.5 grams, and copal 5 grams, the result of a 15 minutes run in a Janney laboratory machine, was as follows:

Product.	Weight gr.	Assay per cent Cu.	Grains Cu. contained.	Per cent of total Cu. contained.
Feed	500.0	.78	3.90	100.0
Concentrates	28.2	3.24	.91	24.3
Middlings	133.4	1.41	1.88	48.2
Tails	334.8	.25	.84	21.5
	496.4	.....	.....	94.0

The recovery for the first 5 minutes of the run is given as concentrate, and the rest of the run as middlings.

In operation a pulp of the proper dilution is placed in any suitable flotation apparatus and aerated in any desired manner. The admixture of air with the water of the pulp will form bubbles throughout the pulp. The reagent in the envelope enclosing the air of the bubbles will have a strong preferential affinity for the mineral content of the ore, and the said mineral content, including free or virgin metal, sulphides, and carbonates, oxides and silicates, when present in the pulp, will be attracted by the bubbles, become attached thereto and be carried to the surface of the pulp and form a thick, stable and free flowing, heavily mineralized froth, which will float on the surface of the pulp. The froth is removed from the surface, and the values separated from the material of the bubble films in any desired manner.

When the bubbles are broken to release the values the liquid resulting will be nearly pure reagent, and may be separated from the mineral in any preferred manner, as by a press or a centrifugal separator. This liquid may then be reused as by mixing it with the fluid drained or otherwise removed from the tails, and which will contain a certain amount of the reagent. This liquor may be used to form a new pulp and, containing as it does a portion of some, at least, of the ingredients of the reagent, a smaller proportion of those ingredients need be added to the new pulp. This will greatly cheapen the process.

Instead of compounding the reagent as before stated, and adding it in bulk to the pulp, it may be made up in separate portions. The liquefied copal; the sodium oleate; the caustic soda; the alcohol; the ammonia and the lime may each be separately added to the pulp, or any suitable combination of them may be added, whereby the millman may readily change the reagent as the conditions of operation may require instead of being compelled to make a new batch to meet changed conditions.

The reagent, and various of the combinations used therein, being in colloidal form will readily mix with the water of the pulp without the necessity of being beaten into the same as in the oil flotation processes.

The amount of water used in compounding the reagent, or any of its reaction products, may vary considerably, and the bulk of the reagent compared to the amount of active agents present, may be great whereby great care in proportioning the reagent to the pulp will not be necessary.

It is obvious that the strength of the reagent may be varied. It may be made up in concentrated form in whole or in separate increments, and diluted on the job, or it may, if desired, be used in the concentrated form, but when so used more care must be exercised in introducing it into the pulp.

No hard and fast rule as to the amount of reagent per ton of ore can be made, because of the great differences in ores of different mines, and of different parts of the same mine, but the millman will know from the appearance of the froth, its thickness, flowing qualities, its burden of mineral, etc., when the proper amount of reagent is present in the plup.

On some ores the reagent of this application may be employed in conjunction with the gathering oils of prior processes. In such cases the reagent will act as a frother, and its gathering qualities will intensify the action of such oils.

This application is a continuation, in part of applicant's application entitled Concentration of ores, filed August 16, 1917, and numbered serially 186,641.

In accordance with the provisions of the patent statutes the principle of the invention has been described together with the process which is now considered to represent the best embodiment thereof, but it is to be understood that the process described is merely illustrative, and that the invention may be carried out in other ways.

The invention having been described what is claimed as new and desired to be secured by Letters Patent of the United States, is:—

1. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water an alkali and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

2. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water the reaction product of an alkali and a resin, and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

3. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water the reaction product of an alkali and rosin, and a liquefied normally unsaponifiable resin, aerating

the mixture to form a froth, and separating the froth from the pulp.

4. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water caustic soda and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

5. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water the reaction product of caustic soda and a resin, and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

6. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water the reaction product of caustic soda and rosin, and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

7. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water the reaction product of an alkali and a fatty acid, and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

8. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water the reaction product of an alkali and a fatty acid, the reaction product of an alkali and a resin, and a liquefied normally unsaponifiable resin, aerating the mixture to form a froth, and separating the froth from the pulp.

9. The process of concentrating ore, which comprises adding to a pulp composed of finely divided ore and water sodium oleate, sodium resinate and a normally unsaponifiable resin dissolved in alcohol, aerating the mixture to form a pulp, and separating the froth from the pulp.

10. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water sodium oleate, and copal dissolved in alcohol, aerating the mixture to form a froth, and separating the froth from the pulp.

11. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water sodium oleate, the reaction product of caustic soda and rosin, and copal dissolved in alcohol, aerating the mixture to form a froth, and separating the froth from the pulp.

12. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water sodium oleate, and liquefied copal, aerating the mixture to form a froth, and separating the froth from the pulp.

13. The process of concentrating ores, which comprises adding to a pulp composed of finely divided ore and water sodium oleate, the reaction product of caustic soda and rosin, and liquefied copal, aerating the mixture to form a froth, and separating the froth from the pulp.

This specification signed and witnessed this 12th day of January, 1921.

ROYER LUCKENBACH.

Witnesses:
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