PREPARATORY TREATMENT FOR FROTH FLOTATION


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13 Claims. (Cl. 209—11)

The invention relates to a method for the separation of a mineral from accompanying earthy material, or gangue, and more particularly, to the separation of tungsten and rare earth ores from gangue and includes correlated improvements and discoveries whereby such a separation may be advantageously accomplished.

An object of the invention is the provision of a method in accordance with which a marked recovery of a high concentration of mineral may be obtained from an earthy material containing a small percentage of such mineral.

A further object of the invention is to provide a method for recovering a desired mineral from earthy material as a high grade salable concentrate.

Another object of the invention is the provision of a method for the recovery of a mineral which may be readily, effectively and economically carried out.

A more particular object of the invention is to provide a method whereby a mineral concentrate may be separated from earthy material or gangue with distinctly high recoveries.

A specific object of the invention is the provision of a method which entails boiling a slurry of earthy material containing a mineral, e.g. Scheelite or Bastnasite, in the presence of adjuvants under adjusted pH conditions followed by cooling, and finally floating.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others thereof, which will be exemplified in the method hereinafter disclosed, and the scope of the invention will be indicated in the claims.

In the practice of the invention, a mineral may be selectively separated from accompanying earthy material or gangue by a method which comprises forming a slurry thereof with water, heating the slurry, suitably to about boiling temperature, and incorporating adjuvants which may be a depressing agent, a collecting agent and a frothing agent, including an acidified silicate of an alkali metal with sodium and potassium. The pH is adjusted, either before or after addition of adjuvants, to a value from about 8.5 to about 10.5, preferably about 10.0, by the addition of an alkaline reacting material, and the temperature of the slurry maintained at about boiling temperature for a critical minimum period of about 1 minute, and which period may be about 10 minutes, preferably for about 5 minutes, with agitation, which may be effected through the introduction of compressed air or steam, or by mechanical means. The slurry is then cooled to a temperature from about 70° F. to about 140° F., more particularly to about 100° F. and finally floated. More particularly, the adjuvants may include a member of the group consisting of acidified silicates and lignin sulfonates of an alkali metal.

Various mineral values may be selectively separated by the relatively high temperature procedure described hereinafter, and more especially, Scheelite, Arsenopyrite, Cobaltite, Monazite, and Bastnasite. Bastnasite is a mineral found at Mountain Pass, California, which contains rare earths as carbonates and fluorocarbonates. The acidified silicate of an alkali metal may be a sodium or a potassium silicate to which an amount of a mineral acid as sulphuric, hydrochloric, phosphoric acids or an organic acid such as oxalic, tartaric and citric acids, has been added to render the reagent acidic, preferably having a pH value from about 1.0 to about 4.0. Thus, the acidified silicate may be a sodium silicate to which sulphuric acid or other acid has been added to the desired pH.

The acidified silicate acts as a depressing agent; and as an additional depressant, employment may be made of a tannin containing material, especially tanning extracts prepared by treating tannin containing substances with water and evaporating the thick syrup or dryness, and as tannin containing materials, mention may be made of chestnut, sumac, larch, logwood, oak, hemlock, quebracho, palmetto and osage orange. As collecting and frothing agents, use may be made of mixtures of higher fatty acids such as a mixture of oleic and linoleic acids. The adjuvants may include an alkali metal, viz: sodium and potassium, lignin sulfonate, fluorsilicate and dichromate. Adjustment of the pH value may be effected through the addition of an alkaline reacting material which may be a carbonate, bicarbonate or hydroxide of sodium, potassium or calcium.

As an illustrative embodiment of a manner in which the invention may be practiced, the following examples are presented:

EXAMPLE I

Separation of Scheelite

An earthy material containing Scheelite is ground with water to form a slurry and the slurry thus produced is heated to boiling temperature. There are then incorporated into the slurry sodium silicate acidified with sulphuric acid, quebracho extract and a mixture of oleic and linoleic acids. The pH value of the slurry is adjusted through the addition of sodium carbonate to about 10.0 either before or after the addition of the desired reagents whereupon the slurry is maintained at boiling temperature with agitation for about 5 minutes. Thereby there is effected a conditioning for depression of calcite and other gangue materials and a collection of the desired Scheelite. The boiled slurry is then cooled to approximately 100° F. and separated or collected Scheelite removed by floating. The concentrate thus obtained may be cleaned by refloating with or without the addition of further reagents as found necessary.

EXAMPLE II

Separation of Bastnasite

An earthy material containing Bastnasite which contains rare earths largely in the form of carbonates and fluorocarbonates, is ground with water to form a slurry which is heated and the pH value thereof adjusted to about 9.0 by the addition thereto of sodium carbonate. Thereafter, the heated slurry is transferred to another receptacle into which sodium lignin sulfonate, acidified sodium silicate, potassium bichromate and a fatty acid substance, for example, a mixture of oleic and linoleic acids are introduced and the slurry boiled for about 5 minutes, suitably with stirring whereby a conditioning for collection of Bastnasite is effected. Earthy materials consisting largely of barite, barytocolite, calcite, dolomite, silice, and sulfides are thereby conditioned for depression. The slurry is then cooled by dilution with cool water to a temperature of about 120° F. and floated.
The mineral content of the concentrate thus produced may be concentrated further, i.e. cleaned by adding sodium lignin sulfonate and acidified sodium silicate, and refloating. As to the roles of the adjuvants, it may be mentioned that sodium lignin sulfonate depresses barite and barytocalcite and to some extent also calcite and dolomite; the acidified sodium silicate prepared by adding sufficient sulfuric acid to a silicate of sodium to render the silicate acidic, but suitably not more than equal proportions of sulfurous acid and the silicate of sodium by weight, depresses the fine gangue particles and condenses silice and silicates for depressing; the potassium bichro-

date depresses calcite and dolomite; the sodium fluoride effects a distinctive recovery of Bastnasite in the presence of the depressants and the mixture of oleic and linoleic acids serves as a collecting and frothing agent for the rare earths.

The foregoing procedures effect the separation of minerals, such as Scheelite and rare earths as Bastnasite from earthy or gangue material with the production of high-grade concentrates and with high recoveries. Thus, when an ore containing about 0.60 WO3 was treated, concentrates were obtained of at least 60% WO3 content and recoveries as high as 90% WO3 have been obtained.

Since certain changes may be made in carrying out the above method without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A method for selective separation of a mineral from accompanying earthy material which comprises preparing a slurry with water, heating said slurry approximately to the boiling temperature, adjusting the pH to a value from about 8.5 to about 10.5, incorporating adjuvants including an acidified silicate of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0, maintaining at boiling temperature for a minimum period of about 1 minute, cooling to a temperature from about 70° F. to about 140° F., and floating.

2. A method for selective separation of a mineral from accompanying earthy material which comprises preparing a slurry with water, heating said slurry approximately to the boiling temperature, adjusting the pH by the addition of an alkaline reacting material to a value from about 8.5 to about 10.5, incorporating adjuvants maintaining at boiling temperature for a minimum period of about 1 minute, cooling to a temperature from about 70° F. to about 140° F., and floating.

3. A method for selective separation of a mineral from accompanying earthy material which comprises preparing a slurry with water, heating said slurry approximately to the boiling temperature, adjusting the pH to a value from about 8.5 to about 10.5, incorporating adjuvants including an acidified silicate of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0, maintaining at boiling temperature for a minimum period of about 1 minute, cooling to a temperature from about 70° F. to about 140° F., and floating.

4. A method for selective separation of a mineral from accompanying earthy material which comprises preparing a slurry with water, heating said slurry approximately to the boiling temperature, adjusting the pH by the addition of an alkaline reacting material to a value from about 8.5 to about 10.5, incorporating adjuvants including an acidified silicate of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0, maintaining at boiling temperature for a minimum period of about 1 minute, cooling to a temperature from about 70° F. to about 140° F., and floating.

5. A method for selective separation of a mineral from accompanying earthy material which comprises forming a slurry of earthy material containing Scheelite with water, heating said slurry to about boiling temperature, adjusting the pH to a value from about 8.5 to about 10.5, incorporating adjuvants including an acidified silicate of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0, agitating at boiling temperature for a minimum period of about 1 minute, cooling to a temperature from about 70° F. to about 140° F., and floating.

6. A method for selective separation of a mineral from accompanying earthy material which comprises forming a slurry of earthy material containing Scheelite with water, heating said slurry to about boiling temperature, adjusting the pH to a value of about 10.0 by the addition of sodium carbonate, incorporating adjuvants including an acidified silicate of sodium, said acidification being to a pH value from about 1.0 to about 4.0, agitating at boiling temperature for a period of about 5 minutes, cooling to a temperature of about 100° F., and floating.

7. A method for selective separation of a mineral from accompanying earthy material which comprises forming a slurry of earthy material containing Scheelite with water, heating said slurry to about boiling temperature, adjusting the pH to a value of about 10.0 by the addition of sodium carbonate, incorporating adjuvants including an acidified silicate of sodium, said acidification being to a pH value from about 1.0 to about 4.0, agitating at boiling temperature for a period of about 5 minutes, cooling to a temperature of about 100° F., and floating.

8. In a method for selective separation of a mineral from accompanying earthy material, the improvement which comprises incorporating into a slurry of such a material having a pH value from about 8.5 to about 10.5, an acidified silicate of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0.

9. In a method for selective separation of a mineral from accompanying earthy material, the improvement which comprises incorporating into a slurry of such a material having a pH value from about 8.5 to about 10.5, a sodium silicate acidified with sulfurous acid, said acidification being to a pH value from about 1.0 to about 4.0.

10. In a method for selective separation of a mineral from accompanying earthy material, the improvement which comprises incorporating into a slurry of such a material having a pH value from about 8.5 to about 10.5, a sodium silicate acidified with sulfurous acid, said acidification being to a pH value from about 1.0 to about 4.0.

11. In a method for selective separation of a mineral from accompanying earthy material, the improvement which comprises incorporating into a slurry of such a material having a pH value from about 8.5 to about 10.5, a member of the group consisting of Bastnasite and Scheelite to about boiling temperature, and incorporating therewith of an acidified silicate of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0.

12. In a method for selective separation of a mineral from accompanying earthy material, the improvement which comprises incorporating into a slurry of such a material having a pH value from about 8.5 to about 10.5, incorporating adjuvants including a member of the group consisting of acidified silicates and lignin sulfonates of an alkali metal, said acidification being to a pH value from about 1.0 to about 4.0, maintaining at boiling temperature for a minimum period of about 1 minute, cooling to a temperature from about 70° F. to about 140° F., and floating.

13. In a method for selective separation of a mineral from accompanying earthy material, the improvement which comprises incorporating an alkali metal lignin sul-
fonate into a slurry of such a material substantially at the boiling temperature, said slurry having a pH value from about 8.5 to about 10.5.

References Cited in the file of this patent

UNITED STATES PATENTS

2,120,485 Clemmer et al. June 14, 1938

2,373,305 Gieseke Aug. 10, 1945
2,407,651 Clemmer et al. Sept. 17, 1946
2,471,414 Dasher May 31, 1949
2,607,479 Bates Aug. 19, 1952

OTHER REFERENCES