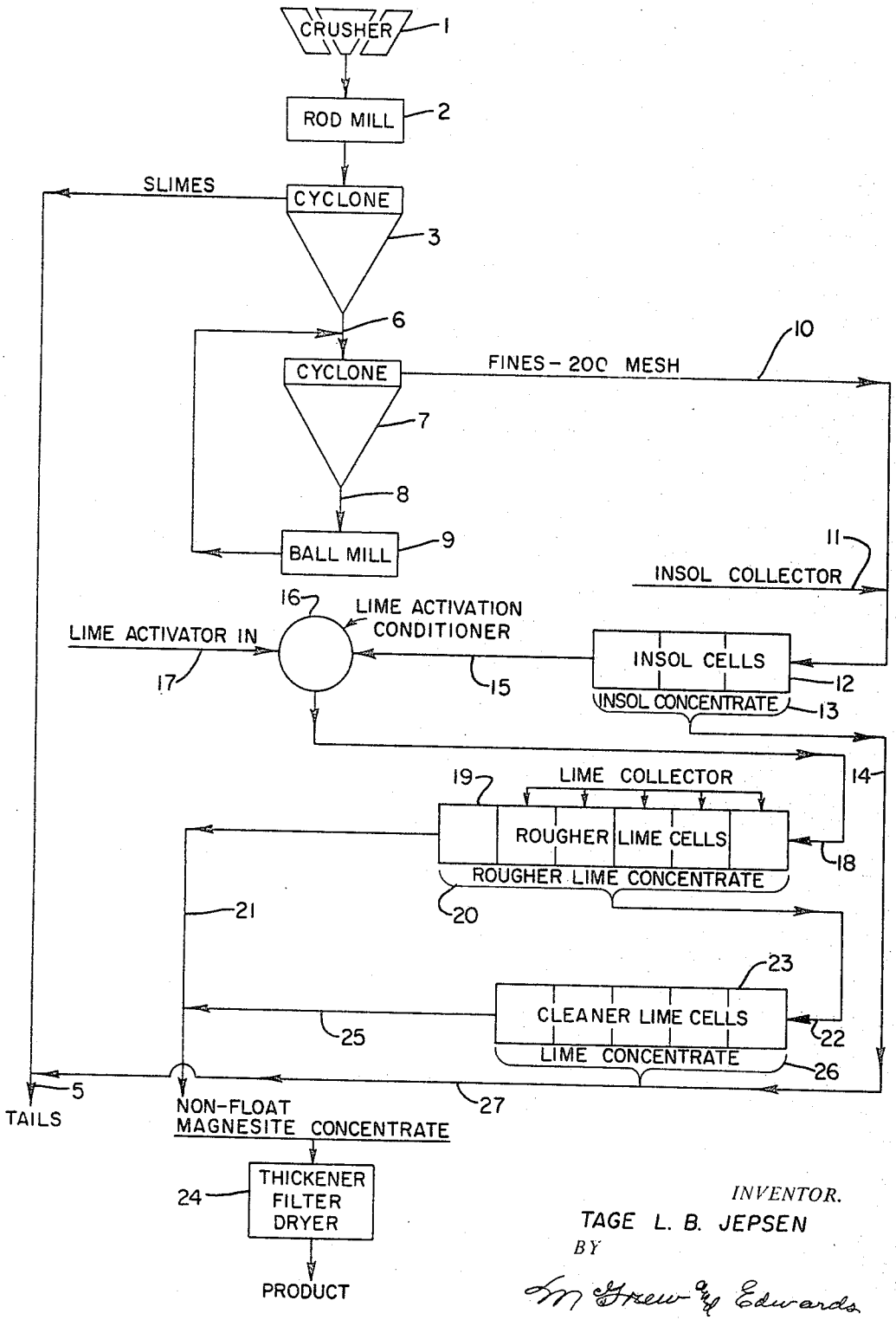
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SELECTIVE FLOTATION OF DOLOMITE AWAY FROM MAGNESITE

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INVENTOR.

TAGE L. B. JEPSEN

BY

Drew & Edwards

ATTORNEYS

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SELECTIVE FLOTATION OF DOLOMITE AWAY FROM MAGNESITE

Tage Loumann Book Jepsen, Gabbs, Nev., assignor to Basic Incorporated, Cleveland, Ohio, a corporation of Ohio

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ABSTRACT OF THE DISCLOSURE

Froth flotation treatment of magnesite ores containing calcite and dolomite. Impurities are float separated from ore in a first stage. Cleaned ore conditioned with lime activator agent and passed through a second multistage flotation in which a collector reagent for calcite and dolomite is stage added in starvation amounts to float off portions of the calcite and dolomite content at each stage with magnesite content passing through stages as nonfloated concentrate residue.

This invention relates to the beneficiation of magnesite ores, such as the ores mined at Gabbs, Nye County, Nev., in a treatment in which lime and insolubles are collected as a float product of a froth flotation treatment leaving magnesite as a nonfloated residue or underflow product of relatively high grade.

Magnesite, ores, and particularly the ores mined at Gabbs, usually contain magnesium carbonate as the valuable constituent and other minerals, such as dolomite, calcite, tremolite, forsterite, brucite, hydromagnesite, serpentine, talc, pyrophyllite, chlorite, quartz, alumina compounds, clays, graphite and soluble salts, essentially all of which must be eliminated or reduced in quantity to yield a final product of the separation which is suitable for use in the production of refractories.

Certain preliminary steps and treatments are provided in the practice of this invention which improve the efficiency of the flotation separation and reduce the cost of treatment. The ore being treated is first crushed to a size of one-half inch or smaller, after which soluble salts, slimes and some other contaminant material are removed prior to concentration and collection of product. Such ores contain slimes, particularly clays, for which the collector reagent has an affinity and removal of a substantial portion of this content before the ore reaches the concentration stages reduces the quantity of collector reagent required in the treatment. Slimes preferably are removed in a desliming operation before the ore is subjected to final size reduction.

Following desliming, the ore is introduced into a grinding stage for reduction to a suitable fineness to completely liberate the different components of the ore. When treating the Gabbs ores, I obtain a size reduction to approximately minus 200 mesh in a circuit providing a first grinding of crushed ore in a rod mill or ball mill, desliming and final sizing utilizing a ball mill or rod mill operating in closed circuit with a classifier, preferably a cyclone separation. The fines of the cyclone separation are taken as the flotation feed and comprise a product which essentially will pass minus 200 mesh. This feed is pulped to about 35% solids by water addition or drainage and then is conducted to a first flotation stage for removal of floatable impurities, after which the pulp so cleaned is conducted through the final separation stages of the treatment.

It is an object of my invention to provide an efficient and economical concentration of the magnesite content of magnesite ores by elimination of unwanted materials of the ore in initial ore preparation stages of the treatment

followed by a flotation separation in which remaining lime and insolubles are removed as a froth product and relatively high grade magnesite is recovered as a nonfloated residue of the flotation separation and is the concentrate product of the treatment.

Another object of my invention is the provision of a novel lime activation procedure permitting flotation of lime and insolubles away from the magnesite content of a magnesite ore pulp leaving magnesite as essentially the only unfloated constituent of the ore.

A further object of my invention is to provide a novel collector reagent introduction procedure resulting in a selective flotation of lime and insolubles away from the magnesite content of a magnesite ore pulp in which magnesite remains as essentially the only unfloated constituent of the ore.

Other objects reside in novel steps and treatments for an improved magnesite ore concentration, all of which will be set forth in the course of the following description.

The practice of my invention will be described with reference to the accompanying flow sheet, as applied to the treatment of a low grade magnesite ore, such as the Gabbs, Nev., ore. The ore taken for treatment contained 2.0% insolubles principally siliceous contaminants and 4.0% CaO also designated "calcium-bearing minerals." After crushing to approximately one-half inch size in a suitable crusher **1**, the magnesite ore charge is delivered to a grinding mill, here shown as rod mill **2**, and the discharge of mill **2** is fed to a desliming unit, preferably a cyclone separator **3** as shown in the flow sheet. The undersize of the cyclone separator **3** contains most of the separated slimes of the ground ore and the slimes are discharged through a line **4** to the final tailings discharged at **5**.

The oversize or underflow of separator **3** is discharged through a line **6** into another classifier **7** or separator of a grinding circuit. The underflow of cyclone separator **7** discharges at **8** into a ball mill **9**, and the mill discharge is recycled as part of the feed to cyclone separator **7**. The undersize or overflow product of separator **7** is essentially minus 200 mesh, and being desilmed is a suitable flotation feed. However, it contains a minor amount of floatable impurities, which, if removed, will improve the efficiency of the final flotation separation in which the magnesite concentrate is formed.

The minus 200 mesh product from separator **7** is conducted through a line **10** and fed into insoluble flotation cells **12** and a collector reagent for the insolubles is introduced at **11**. I have found that it is advantageous to remove the insolubles as a concentrate of the first flotation stage **12**. "Insolubles" as referred to in this specification applies particularly to acid insoluble material, such as silica. In order to effect the flotation, I use a reagent mixture of ⅓ frother, preferably American Cyanamid Frother #77, ⅓ fuel oil, such as diesel fuel, and ⅓ amine collector, preferably Aeromine 3035. If desired, the pulp will be heated in advance of the initial flotation stage to establish a temperature of about 90° F. in the pulp at the flotation stage.

The impurities are floated at stage **12** in one or a plurality of treatment stages. As the impurities collected and removed at this stage float readily when treated with the reagent described above, only a single stage reagent introduction as shown at **11** will be sufficient whether the flotation is performed in a single stage or in a plurality of stages or cells as shown in the flow sheet. The insoluble concentrate overflowed at **13** is conducted through a line **14** to the tailings discharge **5**.

The underflow or nonfloated content of the initial flotation stage **12** is discharged through a line **15** into a conditioner stage **16** in which a lime activator is intro-

duced at 17. Ferrous salts may be employed as the activator and a preferred activator composition is acidified ferrous sulfate. Manganous sulfate also may be used as an activator. I have found that if the ferrous sulfate composition is introduced at a rate of about 5 grams per ton of ore and has been acidified with sufficient sulfamic acid, sulfuric acid or hydroxyacetic acid to establish a pH of from 5.0 to 6.0 in the final flotation stages, best results will be attained. For most purposes, sulfamic acid will be the preferred composition to acidify the ferrous sulfate. The reagent consumption at this stage of the treatment will be on the order of 10 pounds $FeSO_4$ and 5 pounds acid per ton of ore treated.

The deslimed ore conditioned at 16 comprises feed introduced at 18 into the first cells of the final flotation concentration stage of the treatment. As shown, flotation feed 18 is introduced into a rougher flotation section 19 usually comprising a plurality of cells, and a collector reagent for lime and insolubles is stage-added at a plurality of stages or cells in starvation amounts, so as to float less than the entire lime and insoluble content at any stage but collectively floating a major portion of the lime and insolubles. For this treatment, I prefer to use lauryl amine hydrochloride as the collector reagent fed to the plurality of stages with American Cyanamid Frother #77, at a rate of about 0.50 pound amine, 0.30 pound HCl and 0.10 pound frother per ton of ore treated.

The froth product 20 of cells 19 contains a minor portion of magnesite and a major portion of lime and insolubles because the flotation action in the first few cells of stage 19 is so intense that some magnesite may be entrained in the lime and insolubles moving into the froth. Some magnesite also may reach the froth because of the activity of the collector reagent, and the froth concentrate collected at 20 is delivered at 22 into a flotation cleaner section 23, preferably comprising a plurality of cells or stages. Collector reagent is stage-added in starvation amounts in cleaner cells 23.

The nonfloated residue or underflow of rougher flotation 19 discharging at 21 is essentially clean magnesite and is conducted to a final dewatering and drying stage 24. Nonfloated residue from cleaner section 23 discharges from line 25 into the dewatering and drying stage 24 and is an essentially clean magnesite product. Most of the lime and insoluble content of feed 22 is removed as froth product or concentrate 26. This concentrate being a waste product is conducted through a line 27 for final discharge with the tailings at stage 5. As shown, line 27 is an extension of line 14 conducting the insoluble concentrate from cells 12 to tailings discharge 5.

Stage 24 has been described as a dewatering and drying stage. Preferably, it will include a thickening step as in a mechanical thickener, with the underflow of thickening passing to a filter where the separated solids in the cake are discharged as a dewatered product and then are conducted into a drying stage, such as a rotary kiln drier where surface and contained moisture are driven off from the magnesite product which is discharged as a dried product of the treatment.

The treatment procedure just described provides a slimes elimination before final size reduction, rejection of floatable impurities in the deslimed ore charge, final size reduction and a flotation of floatable insolubles following the final size reduction. After such ore preparation, the ore in a flotation size range is conditioned to activate the lime and insoluble content for the final flotation separation, in which the lime and insolubles are removed as a froth product while the nonfloated magnesite is concentrated by removal of contaminant material, with the result that a relatively high grade of magnesite is discharged from the treatment.

Treatment of Gabbs, Nev., magnesite ores as described above has resulted in better than 75% weight recovery at a grade of 1.10% insol and 1.90% CaO from feed containing 2.0% insol and 4.0% CaO.

I claim:

1. A froth flotation treatment of magnesite ores containing calcium-bearing minerals and siliceous contaminants which comprises grinding such a crushed magnesite ore to a flotation size range, desliming the ground ore, subjecting a pulped discharge of the grinding stage to froth flotation in the presence of a reagent mixture of a frother, fuel oil and an amine collector for removal of floatable impurities from the pulp in a froth, conditioning said pulp after impurity removal with a lime activator reagent, introducing the conditioned pulp into a final flotation separation having a plurality of treatment stages, and stage adding a collector reagent for the calcium-bearing minerals and siliceous contaminants in starvation amounts at said stages so as to promote flotation of portions of the total calcium-bearing mineral and siliceous contaminant content at the respective stages while magnesite remains in the pulp passing through said stages as a nonfloated concentrate residue.

2. A treatment as defined in claim 1 in which the lime activator reagent is acidified ferrous sulfate.

3. A froth flotation treatment of magnesite ores containing calcium-bearing minerals and siliceous contaminants which comprises grinding such a crushed magnesite ore to a flotation size range, desliming the ground ore, subjecting a pulped discharge of the grinding stage to froth flotation in the presence of a reagent mixture of a frother, fuel oil and an amine collector for removal of floatable impurities from the pulp in a froth, conditioning said pulp after impurity removal with a lime activator reagent, introducing the conditioned pulp into a final flotation separation having a plurality of treatment stages, and stage adding a lauryl amine as a collector reagent for the calcium-bearing minerals and siliceous contaminants in starvation amounts at said stages so as to promote flotation of portions of the total calcium-bearing mineral and siliceous contaminant content at the respective stages while magnesite remains in the pulp passing through said stages as a nonfloated concentrate residue.

4. A treatment as defined in claim 2, in which the ferrous sulfate is acidified with sufficient acid selected from the group consisting of sulfamic, sulfuric and hydroxyacetic acids to maintain a pH of from 5.0 to 6.0 in the flotation pulp.

5. A treatment as defined in claim 3, in which the lauryl amine collector is introduced as a solution of lauryl amine neutralized with hydrochloric acid and dissolved in water.

6. A treatment as defined in claim 3 in which the lime activator is acidified ferrous sulfate and the collector reagent for calcium-bearing minerals and siliceous contaminants is an aqueous solution of neutralized lauryl amine.

7. A treatment as defined in claim 1, in which the nonfloated magnesite of the final flotation separation is discharged from the treatment as a dried concentrate product.

8. A treatment as defined in claim 3, in which the reagent consumption in the final flotation treatment is on the order of 0.50 pound amine, 0.30 pound HCl and 0.10 pound frother per ton of ore treated.

9. A froth flotation treatment of magnesite ores containing calcium-bearing minerals and siliceous contaminants which comprises grinding such a crushed magnesite ore to a flotation size range, desliming the ground ore, conditioning a pulp of said deslimed ore with a lime activator reagent, introducing the conditioned pulp into a final flotation separation having a plurality of treatment stages, and stage adding an amine collector reagent for the calcium-bearing minerals and siliceous contaminants in starvation amounts at said stages so as to promote flotation of portions of the total calcium-bearing mineral and siliceous contaminant content at the respective stages while magnesite remains in the pulp passing through said stages as a nonfloated concentrate residue.

10. A treatment as defined in claim 9, in which the activator reagent is ferrous sulfate and the collector reagent is lauryl amine hydrochloride.

11. A treatment as defined in claim 9, in which the activator reagent is manganous sulfate.

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HARRY B. THORNTON, *Primary Examiner.*

ROBERT HALPER, *Assistant Examiner.*

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209—166