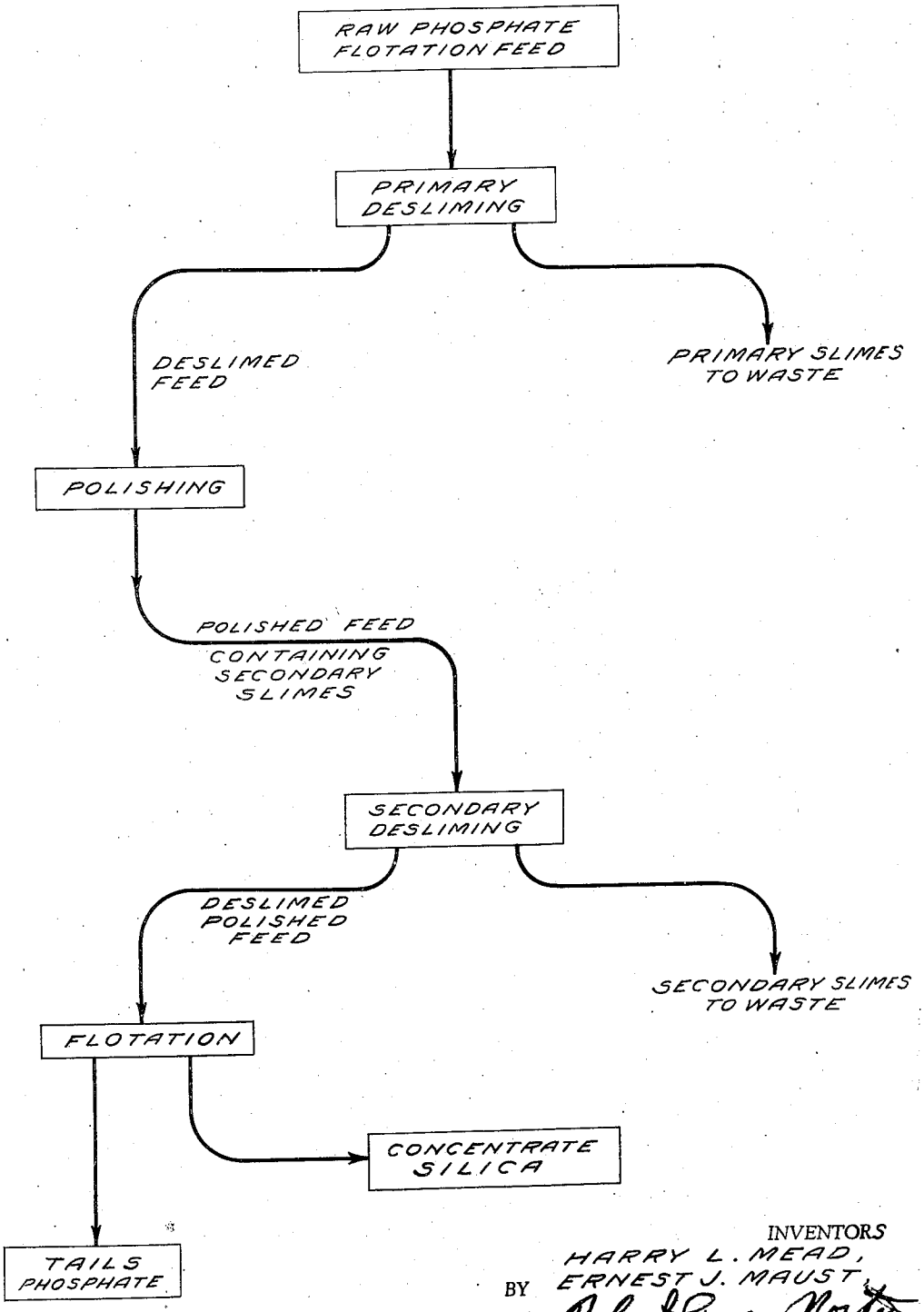
Sept. 24, 1940. H. L. MEAD ET AL 2,216,040

BENEFICIATION OF PHOSPHATE ROCK BY FROTH FLOTATION

Filed March 29, 1940



INVENTORS
HARRY L. MEAD,
ERNEST J. MAUST,
BY Robert Ames Norton
ATTORNEY.

Patented Sept. 24, 1940 2,216,040

UNITED STATES PATENT OFFICE

2,216,040

BENEFICIATION OF PHOSPHATE ROCK BY FROTH FLOTATION

Harry L. Mead and Ernest J. Maust, Brewster, Fla., assignors to American Cyanamid Company, New York, N. Y., a corporation of Maine

Application March 29, 1940, Serial No. 326,660

4 Claims. (Cl. 209—166)

This invention relates to the beneficiation of phosphate ore by flotation and more particularly to phosphate flotation processes in which the silicious gangue is floated away from the phosphate.

Beneficiation of phosphate rock by flotation processes was first effected by floating the phosphate away from the silicious gangue using reagents capable of promoting the flotation of such compounds. The problem of slime in the ordinary phosphate flotation was not a particularly serious one and the simple methods of partial desliming which are current in ore dressing practice were sufficient to produce a satisfactory feed that could be handled in flotation machines. When, however, it was attempted to float the silica away from the phosphate using the silica promoters which have been developed in recent years, it was found that slime played a much more important and much more critical part than it does in ordinary phosphate flotation, and the ordinary desliming methods which are entirely satisfactory for ore dressing operation in general, were totally inadequate for silica flotations because less than 1% of slime can have a very serious adverse effect on the efficient flotation of silica. This problem was appreciated and various processes of silica flotation involving a very complete desliming were tried with markedly improved results. The present case is not concerned broadly with the complete desliming of raw phosphate rock prior to flotation, this forming the subject matter of the copending application of Erickson, Serial No. 325,011, filed March 20, 1940, and the particular methods of desliming being described in our copending application Serial No. 320,121, filed February 21, 1940.

In spite of the marked improvement which was obtained by a very complete desliming of the phosphate feed, it was found that there was still a tendency for interference with the flotation operation by slime formed in the flotation machine itself due to the agitation of the phosphate particles which removes a small amount of slimy material from their surfaces. Further investigations showed that this formation of secondary slime was largely confined to the surface of the particles, that is to say, phosphate rock particles contain a rather thin film on the surface of readily disintegratable material which forms slime very readily, but underneath this layer the rock is relatively more resistant and it is based on this work that the process of the present invention was developed.

According to the present invention phosphate feed is first deslimed more or less completely, so as to recover the major portion of primary slime. It is then subjected to an agitation, for example in a flotation machine without the introduction of air or any other similar device which effects a polishing of the surface of the phosphate particles removing the layer of slime forming material. This operation is then followed by the very complete desliming of the secondary slime producing a feed which is relatively unaffected by the further agitation of ordinary flotation procedures.

It might appear at first examination as though the same result could be obtained if the raw feed were subjected to a polishing action followed by desliming and in point of fact in ordinary operation on phosphate rock which contains some coarse material, there is a considerable degree of rubbing in the log washers which might be thought at first to effect polishing. We have found, however, that the primary slimes appear to have lubricating or protecting action on the surface of the phosphate particles and except where commercially impractical polishing times are used, it is not feasible to remove the secondary slime forming material from the surfaces of the phosphate particles without preliminary desliming to remove the major portion of the primary slime.

In the three steps of the present invention, that is, removing primary slime, polishing, and then removing secondary slime, the first step may be carried out in any suitable apparatus which is capable of removing a major portion of slime. It is an advantage of the present invention that it utilizes standard equipment such as classifiers, a hydroseparator or thickener, centrifuges, screens, and the like, and no new equipment or type of procedure is necessary. Again in the second step, the polishing can be effected in any suitable device which will subject the surface of the phosphate particles to suitable friction. Thus, agitators, mixers, mechanical flotation machines, and similar devices may be used and again it is not necessary to employ any critical technique and standard ore dressing equipment can be used.

The third step of the process requires a very complete desliming and for this purpose it is necessary to use procedures and apparatus which are capable of desliming to the desired degree, preferably leaving less than ½% of secondary slime. While the invention is not limited in this step to any particular design of apparatus, we have found that very effective desliming can be

carried out by using a hindered settling classifier and desliming as is described in conjunction with removal of primary slime in our copending application Ser. No. 320,121 above referred to. The use of a hindered settling classifier for complete desliming of secondary slime is therefore the preferred method of carrying out the present invention.

The invention is illustrated in greater detail by the drawing which is a diagrammatic flow sheet of the process.

The improvements which are obtained by the use of the present invention are well brought out by the following examples based on comparative tests and using identical feed from Florida pebble phosphate rock.

Example 1

Florida pebble phosphate was subjected to polishing in a mechanical flotation machine without admission of air for a period of two minutes. The feed was then deslimed as completely as possible in a hindered settling classifier and was subjected to froth flotation in a Fagergren flotation machine using about .46 of a pound of a higher aliphatic amine per dry ton of feed as a flotation promoter, in conjunction with sufficient frother to produce a satisfactory froth. 489 parts by weight of feed gave a silica concentrate of 123 parts and a phosphate tail of 263 parts containing 11% of insoluble material. Such a phosphate tailing would represent a relatively poor flotation efficiency.

Example 2

The same feed was subjected to preliminary desliming leaving only a per cent or two of primary slime. This deslimed material was then subjected to polishing in the same mechanical flotation machine as was used in Example 1 and for the same period of time. Thereupon this polisned material was subjected to desliming in a hindered settling classifier reducing the amount of slime to the minute per cent as in Example 1. insoluble and was therefore of a very good commercial grade.

In the examples an ordinary aliphatic amine flotation promoter is described. The invention is not limited to the use of any promoter but is generally applicable to all promoters for silica such as those described in the copending applications of Erickson, Jayne and Day, Serial No. 326,953, filed March 30, 1940, and Christmann, Jayne and Erickson, Serial No. 326,952, filed March 30, 1940, the quaternary ammonium salts described in the Lenher Patent No. 2,132,902 and the like. It is an advantage of the present invention that improved results are obtained with any of the normal silica promoters. The exact grade and recoveries will of course vary from promoter to promoter.

What we claim is:

1. A method of beneficiating phosphate ore by flotation of a silica containing concentrate therefrom which comprises subjecting phosphate rock to a preliminary desliming operation to separate primary slime, polishing the deslimed material to remove the secondary slime forming the surfaces of the phosphate particles, desliming the polished material and subjecting this deslimed material to froth flotation in the presence of a promoter for silica.

2. A method of beneficiating phosphate ore by flotation of a silica containing concentrate therefrom which comprises subjecting the phosphate rock to a preliminary desliming operation to separate primary slime, polishing the deslimed material in a mechanical flotation machine from which the air has been shut off to remove the secondary slime forming the surfaces of the phosphate particles, desliming the polished material and subjecting this deslimed material to froth flotation in the presence of a promoter for silica.

3. A method according to claim 1 in which the removal of the secondary slime is effected in a hindered settling classifier.

4. A method according to claim 2 in which

DISCLAIMER

2,216,040.—*Harry L. Mead* and *Ernest J. Maust*, Brewster, Fla. BENEFICIATION OF PHOSPHATE ROCK BY FROTH FLOTATION. Patent dated September 24, 1940. Disclaimer filed June 4, 1942, by the assignee, *American Cyanamid Company*.

Hereby disclaims claim 1.

[*Official Gazette June 30, 1942.*]