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USE OF NAPHTHENIC AMINES IN PHOSPHATE FLOTATION

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The present invention relates to the flotation separation of silica gangue from valuable phosphate rock employing as cationic reagents the amines derived from both high and low boiling naphthenic acids. It is, therefore, an object of the present invention to provide a process of flotation separation of phosphate rock involving the use of naphthenic amines prepared from naphthenic acids.

Large volumes of phosphate rock have been beneficiated by cationic flotation. Long chain fatty amines have been used principally in these operations. The present invention involves the use of naphthenic amines for this purpose, the naphthenic amines possessing advantages over the fatty amines used heretofore.

The naphthenic acids from which the naphthenic amines are prepared, are obtained as sludges from the refining of petroleum with sulfuric acid and caustic. The naphthenic acids are a complex mixture of compounds and include both mono and bicyclic compounds. There is considerable variation in the boiling points of these acids depending upon the molecular weight. In general the naphthenic acids containing from 8 to 12 carbon atoms are predominantly monocyclic in structure and are relatively low-boiling. The acids containing from 13 to 22 carbon atoms are predominantly bicyclic and, accordingly, have higher boiling points. All of the compounds included in the general term "naphthenic acids" are useful for the preparation of amines and the amines useful for phosphate flotation.

The naphthenic amines may be prepared from the naphthenic acids by the conventional method employed for the preparation of the fatty amines. This generally involves the formation of the nitrile from the acid and the reduction of the nitrile to the amine either through conventional hydrogenation or by means of sodium reduction. The naphthenic amines possess the hydrophobic ring structure and the hydrophilic amine group and are, therefore, especially desirable as silica collectors.

The naphthenic acids are low-priced by-products from petroleum refining and, accordingly, the naphthenic amines are potentially very low in cost. In addition, they possess advantages in their physical properties. In general they are readily dispersible liquids and, therefore, can be dispersed in an aqueous medium for the flotation process without any particular difficulty. The fatty amines on the other hand are generally more difficult to disperse and require conversion to a more soluble form such as by neutralization with organic or mineral acids.

The naphthenic amines may be employed in the concentrations conventionally employed in flotation. Generally from 0.1 to 0.5 lbs. of the naphthenic amine per ton of ore is sufficient.

EXAMPLE 1

Five hundred parts of a Florida pebble phosphate ore, assaying 69.7% BPL and 12.2 HCl insolubles was conditioned at high percent solids with 0.4 pound per ton of sodium hydroxide, 0.31 pound per ton of naphthenic

amine (mean molecular weight 303), and 0.3 pound per ton of pine oil. The pulp was transferred to a Fagergren flotation machine, air introduced, and the silica tailing removed as froth. No attempt to clean the flotation products was made. The results are shown in Table I.

Table I

Phosphate Concentrate				Silica Tailing			Percent BPL Recovery
Percent Wt.	Percent BPL	BPL Units	Percent HCl Insol.	Percent Wt.	Percent BPL	BPL Units	
87.1	76.0	66.2	3.25	12.9	18.9	2.5	96.4

EXAMPLE 2

The procedure of Example 1 was repeated using 0.32 lb. per ton of naphthenic amines having a mean molecular weight of 350. The results are shown in Table II.

Table II

Phosphate Concentrate				Silica Tailing			Percent BPL Recovery
Percent Wt.	Percent BPL	BPL Units	Percent HCl Insol.	Percent Wt.	Percent BPL	BPL Units	
84.9	81.1	68.8	2.45	15.1	[1] 30.0	4.5	94.0

[1] Estimated.

EXAMPLE 3

Example 1 was repeated, but 0.37 lb. per ton of naphthenic amines of mean molecular weight 404 were used. The flotation results are shown in Table III.

Table III

Phosphate Concentrate				Silica Tailing			Percent BPL Recovery
Percent Wt.	Percent BPL	BPL Units	Percent HCl Insol.	Percent Wt.	Percent BPL	BPL Units	
86.7	74.6	64.6	4.38	13.3	29.2	3.9	94.3

All three of the above examples reveal the excellent ability of the naphthenic amines to remove silica from phosphate. Example 2 showed the excellent results in terms of highest grade and lowest content of HCl insolubles for the concentrate. In addition to the excellent performance of these amines for flotation they are potentially very inexpensive and also possess the requisite physical properties to make them readily dispersible without neutralization or further chemical modifiction.

Now, therefore, we claim:

1. A process for the treatment of phosphate ore for the separation of phosphate minerals from pulp mixtures containing the same together with silica and other impurities, which comprises adding to the pulp a small amount of a naphthenic amine, subjecting the mixture to a froth flotation operation, separating silica and other impurities as froth and recovering the phosphate minerals in the underflow.

2. A process according to claim 1 in which the naphthenic amine is employed in the ratio of about 0.1 to 0.5 pound per ton of ore.

References Cited in the file of this patent

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