

UNITED STATES PATENT OFFICE

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FLOTATION CONCENTRATION OF METALLIFEROUS MINERALS

No Drawing. Application filed March 19, 1931, Serial No. 523,928, and in Great Britain January 31, 1930.

This invention relates to flotation concentration of metalliferous minerals in ores.

In the form of the invention herein illustrated certain flotation agents are added to the ore pulp, in addition to the usual frothing agents, so that certain desired constituents of the ore are more effectively selected and floated by a mineral-bearing froth, while undesired constituents are more effectively rejected.

10 We have found that a number of compounds of arsenic are particularly useful for this purpose and may be used with advantage in the differential flotation of many complex
15 ores either alone or in conjunction with flotation agents already known for the purpose of obtaining relatively rich separate concentrates of the different economically valuable metals contained in the ores.

20 The compound of arsenic employed may be a compound of arsenic with an alkali metal, for example sodium. Preferably the arsenic compound also contains sulphur, for example as an alkali thio-arsenate. Alternatively,
25 arsenious oxide or arsenious sulphide may be added, together with an alkali or an alkaline sulphide, to the ore pulp. Thus, for example, separation of a lead froth-concentrate from a mixed lead-zinc ore was obtained by
30 the use of arsenious sulphide as the flotation agent in conjunction with sodium polysulphide, the zinc being thereafter separated as a zinc froth-concentrate on the addition of copper sulphate in the known manner.

35 The flotation agent may be added to the ore pulp in a conditioning tank or the like, but generally it is preferably added in the grinding mill.

40 The following examples set forth specific applications of the invention in practice:—

Example I

400 grammes of lead-zinc sulphide ore from the mines of Broken Hill, Australia, were
45 crushed to 100 mesh in a pebble mill in 200

c. c. of water to which were added the following reagents:—

	Lbs. per ton of ore
Sodium thio-arsenate.....	1
Sodium carbonate.....	2
Cresylic acid.....	0.3

The freshly ground ore was then diluted with water to form a 4 to 1 pulp and was submitted to agitation and aeration in a
50 minerals separation subaeration flotation machine and the froth which formed was taken off as a lead concentrate. The original ore contained:—Pb=13.5%, Zn=15.1%. The concentrate contained:—Pb=72.3%, Zn=6.6%, showing a recovery of 82.5% of the
60 lead, and leaving 93.2% of the blende unfloated. It will be noted that not only was the galena effectively separated from the blende during flotation, but that the lead
65 concentrate was of excellent grade showing substantial absence of the other constituents of the ore.

Thereafter the zinc blende was floated as a separate concentrate in a subsequent operation
70 after the addition of copper sulphate to the pulp at the rate of 1 lb. per ton of ore and of a small amount of frothing agent in the customary manner.

Example II

75 Sulphide ore from Broken Hill was crushed and treated in a similar manner to that described in Example I, excepting that, in place of sodium thio-arsenate, sodium polysulphide and arsenious sulphide were added to the pebble mill in quantities calculated to theoretically produce by reaction an amount of the salt sodium thio-arsenate equal to 1 lb. of the salt per ton of ore. The re-
80 sults were as follows:—The original ore assayed:—Pb=14.4%, Zn=15.3%. The lead concentrate contained:—Pb=73.0%, Zn=5.3% showing a recovery of 92.0% of the total lead and leaving 93.8% of the blende

unfloated. In the subsequent flotation operation this blende was substantially recovered as a high grade zinc concentrate.

Example III

400 grammes of lead-zinc tailings, assaying Pb=10.7%, Zn=10.3%, from a Durham mine, were recrushed to pass 80 mesh I. M. M. in the pebble mill to which were added lime equal to 2 lbs. per ton of ore, and arsenic sulphide equal to 0.75 lbs. per ton of ore. The freshly ground ore was then transferred to a testing flotation machine and diluted with water to form a 4 to 1 pulp. Cresol was added equal to 0.5 lb., and xanthate equal to 0.05 lb. per ton of ore, and the mixture agitated and aerated. A lead concentrate was separated which weighed 50 grammes and assayed Pb=77.0%, Zn=2.5% and contained 90.0% of the total lead. The remaining pulp was further treated with the addition of copper sulphate equal to 1 lb., creosote equal to 0.2 lb., and xanthate equal to 0.1 lb. per ton of original ore, and a zinc concentrate was separated weighing 68 grammes and assaying Pb=3.4%, Zn=55.5%, accounting for 91.5% of the total zinc in the ore. The flotation residues assayed Pb=0.8% Zn=0.8%,—the Pb being largely in an oxidized condition.

In a similar test on the above tailings the pulp was treated with reagents as in the above test for 15 minutes in an agitating tank, without any regrinding, and the results obtained were practically identical with the above.

While the invention has been described hereinabove in connection with the separation of lead from zinc, it is also applicable to the separation of copper or other sulphides from associated minerals, particularly from zinc.

Copper sulphate, as above described, is found to be effective when added to a pulp as a reagent to assist the flotation of a zinc concentrate after the removal of lead.

Thio-arsenites have been found to be effective in producing results like those obtained with thio-arsenates.

Having thus described certain embodiments of our said invention, what we claim is:

1. The process of concentrating an ore containing two floatable minerals which consists in agitating a pulp of the ore under such conditions that a float is formed in the presence of an arsenic compound containing sulphur.

2. The process of concentrating an ore containing two floatable minerals which consists in agitating a pulp of the ore under such conditions that a float is formed in the presence of a salt of a thio-acid of arsenic.

3. The process of concentrating an ore containing two floatable minerals which con-

sists in agitating a pulp of the ore under such conditions that a float is formed in the presence of a salt of thio-arsenious acid.

4. The process of concentrating an ore containing two floatable minerals which consists in agitating a pulp of the ore under such conditions that a float is formed in the presence of a salt of thio-arsenic acid.

5. The process of concentrating an ore containing two floatable minerals which consists in agitating a pulp of the ore under such conditions that a float is formed by the use of substances which normally unite to form a salt of a thio-acid of arsenic.

6. The process of concentrating an ore containing two floatable minerals which consists in agitating a pulp of the ore under such conditions that a float is formed in the presence of an alkaline substance and a sulfide of arsenic.

7. The process of concentrating an ore containing two floatable minerals which consists in agitating a pulp of the ore under such conditions that a float is formed in the presence of lime and arsenic sulfide.

In testimony whereof, we have signed this specification.

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