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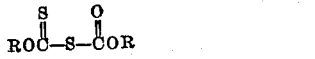
PROCESS OF CONCENTRATING ORES AND MINERALS BY FLOTATION.

No Drawing. Application filed October 25, 1926. Serial No. 144,194.

This invention relates to the recovery of valuable ores and minerals by flotation, and comprises more particularly the concentration of such ores and minerals by means of a certain class of organic flotation agents.

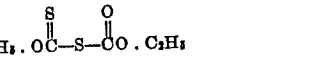
It is one of the objects of the present invention to carry out flotation processes in an efficient manner by the use of a class of flotation compounds having highly selective properties. It is a further object to carry out the flotation processes by the use of flotation agents which are suitable for use in a neutral, alkaline or acid flotation circuit.

I have discovered that these and other objects may be attained by using in the flotation process alkyl xanthogen formates. These compounds are characterized by having the following general structural formula:



in which R is an alkyl group.

Ethyl xanthogen ethyl formate is a superior flotation agent and is representative of the class of compounds described. It has the following formula:



As illustrative of the complete flotation process the following procedure may be carried out:

500 grams of ore and 350 cc. of water are ground in a ball mill for 20 minutes and are then transferred to a Janney laboratory flotation machine. The pulp is diluted in the machine so as to obtain a 38.5% solid pulp. The ethyl xanthogen ethyl formate and a frothing agent (pine oil) are added to the pulp and the mixture preagitated for one minute. The pulp is diluted to about a 20% solid content, causing circulation and froth formation. The froth is removed over a seven-minute period.

Using Utah Copper Company and Anaconda Copper Mining Company ores, respectively, the following results were obtained:

Ore (per cent copper).	Utah (1.06).	Anaconda (1.90).
Flotation reagent.	Ethyl xanthogen ethyl formate.	Ethyl xanthogen ethyl formate.
Amount of flotation reagent pounds per ton	0.10	0.02
Amount of lime, pounds per ton	8.4	2.6
Per cent copper in concentrate	12.42	10.80
Per cent copper in tailings	0.18	0.15
Per cent recovery of copper	84.30	93.40

Using the same flotation reagent in the proportion of 0.10 pound per ton of ore, and carrying out the flotation process in the described manner with an Anaconda ore in a neutral circuit, the following results were obtained:

Assay of heads=1.86% Cu.
Assay of Conct.=8.05% Cu.
Assay of tails=0.15% Cu.
Percent of total Cu recovered=93.6%.

In carrying out the flotation process with Anaconda ore in an acid circuit containing sulfuric acid in the ratio of 8.0 pounds per ton of ore, and using as the flotation reagent, ethyl xanthogen ethyl formate in the ratio of 0.1 pound per ton of ore, the following results were obtained:

Assay of heads=1.86% Cu.
Assay of Conct.=10.35% Cu.
Assay of tails=0.085% Cu.
Percent of total Cu recovered=96.2%.

These results are typical of results obtainable by using other alkyl xanthogen formates such as, for instance, the xanthogen formates of propyl, butyl, amyl, etc. By using these agents in the flotation process excellent results are obtained and the process is susceptible of wide application.

The flotation reagents used in the present process may be prepared with comparative ease. For example, ethyl xanthogen ethyl formate may be made by suspending 21

grams of potassium xanthate in 75 cc. of benzene. To this suspension are slowly added 10 grams of ethyl chlor formate, vigorous agitation being employed. The mixture is heated and held at the refluxing temperature for four hours and then filtered to remove any unconverted potassium xanthate and the potassium chloride which is formed during the reaction. The benzene is removed by vacuum distillation, the residual oil being the ethyl xanthogen ethyl formate. Any other suitable method may be used for preparing the flotation agents.

In illustrating the present process, reference has been made specifically to certain ores and reagents, and to various specific conditions of operation. It will be understood that the present process is not limited to the specific substances or details of procedure mentioned, but includes generally processes of recovering values from ores by flotation in which the flotation agents are compounds of the class described. Suitable modifications and changes may be made without departing from the spirit and scope of the invention.

I claim:

1. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of a pulp to a froth flotation operation in the presence of an alkyl xanthogen formate.

2. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of a pulp to a froth flotation operation in the presence of a substance having the following general structural formula:

in which R and R′ represent alkyl groups.

3. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of a pulp to a froth flotation operation in the presence of ethyl xanthogen ethyl formate.

4. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of a pulp to a froth flotation operation in the presence of a substance having the following general structural formula:



in which R and R′ represent the same alkyl groups.

In testimony whereof I affix my signature.

WILLIAM A. DOUGLASS.