

UNITED STATES PATENT OFFICE.

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PROCESS OF CONCENTRATING ORES BY FLOTATION.

No Drawing.

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

5 It has been shown in United States Patents Nos. 1,364,307, 1,364,308, 1,364,859 and 1,415,899 that aryl-substituted thio-ureas and particularly thio-carbanilide may be used advantageously in the flotation of minerals. While thio-carbanilide has been used commercially as a flotation reagent, it has been necessary to use it in solution in approximately four parts of ortho-toluidine, and at the present time its use is negligible, 15 it having been replaced by much more efficient reagents.

I have discovered that very highly selective flotation agents are formed if, in the formation of substituted thio-ureas, aliphatic amines are employed instead of aromatic amines. The invention consists broadly, therefore, in a process for the flotation of ores by the aid of alkyl-substituted thio-ureas.

25 My new flotation agents have the following general graphical formula:



where R and R' represent the same or different substituted or unsubstituted aliphatic radicals such as ethyl, propyl, isopropyl, butyl, isobutyl, amyl, etc.

A specific example of my new class of flotation agents is dibutyl-thio-urea. This compound is made by heating 2 molecular proportions of normal-primary-butyl amine with one molecular proportion of carbon disulphide in the presence of .01 mol. of sulphur at the refluxing temperature for 5-6 hours. At the end of the reaction any unconsumed carbon disulphide and butylamine are removed by steam distillation and the product is heated, in the presence of alcohol if necessary, until all dithio-carbamate has been transposed to the thio-urea. After filtration the dibutyl-thio-urea is dried and is ready for use.

This reagent was used for the flotation of Phelps-Dodge Corporation Copper queen ore in the following manner: 500 gms. of minus 28 mesh ore were ground for 20 minutes in a pebble mill with 500 cc. of H₂O, 0.6 gms. of lime, and .025 gms. of dibutyl-thio-urea. The lime and the dibutyl-thio-

urea are in the proportion of 2.4 pounds and 0.10 pounds respectively per ton of ore. The pulp from the pebble mill was transferred to a Janney laboratory flotation machine, diluted to about 2 liters and a rougher concentrate removed for 10 minutes, water being added as needed. The following results were obtained, comparative results with thio-carbanilide being included:

	Pounds reagent per ton	Per cent Cu in concentrate	Per cent Cu in tailings	Per cent of Cu recovered
Dibutyl-thio-urea.....	0.10	8.69	0.34	80.0
Thio-carbanilide.....	0.40	4.62	1.30	16.9
T. T. mixtures.....	{ 0.40 thio 2.30-tol }	6.52	0.49	72.3

No frothing agent was used when employing dibutyl-thio-urea since it functions both as a selective and a frothing reagent. With other ores, however, it may be necessary to employ a frothing agent.

Although, in illustrating my new process, reference has been made specifically to copper ore, to a certain dibutyl-thio-urea, and to various specific conditions of operation, it will be understood that my invention is not limited to these specific substances or conditions, but includes generally processes of recovering values from ores by flotation in which the flotation agents are alkyl-substituted thio-ureas.

Although my flotation agents are effective to a certain extent in an acid pulp, better results are usually obtainable by operating with a non-acid pulp, that is, one which has been rendered neutral or alkaline, preferably with lime. A frothing agent, as for example terpeneol, will also be desirable where the particular dialkyl-thio-urea used has little, or no, frothing power.

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 flotation operation in the presence of a substance having the following general molecular formula:



where R and R' represent unsubstituted aliphatic radicals.

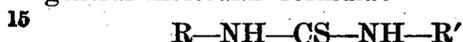
2. In the process of concentrating ores and minerals by flotation, the step which

comprises subjecting the ore in the form of a pulp to a flotation operation in the presence of a substance having the following general molecular formula:



where R and R' represent aliphatic hydrocarbon radicals.

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 flotation operation in the presence of a substance having the following general molecular formula:



where R and R' represent butyl radicals.

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 flotation operation in the presence of di-normal-primary-butyl-thio-urea.

5. In the process of concentrating ores and minerals by flotation, the step which com-

prises subjecting the ore in the form of a non-acid pulp to a flotation operation in the presence of a di-alkyl-thio-urea.

6. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of a pulp made alkaline by the addition of lime to a flotation operation in the presence of a di-alkyl-thio-urea.

7. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of an alkaline pulp to a flotation operation in the presence of a di-alkyl-thio-urea.

8. A process as defined in claim 7 in which the alkyl groups of the di-alkyl-thio-urea each contain from 1 to 6 carbon atoms.

9. In the process of concentrating ores and minerals by flotation, the step which comprises subjecting the ore in the form of an alkaline pulp to a flotation operation in the presence of a di-butyl-thio-urea.

In testimony whereof, I affix my signature.

HAROLD W. ELLEY.