Patented Oct. 3, 1939

2,175,093

UNITED STATES PATENT OFFICE

2,175,093

PROCESS OF CONCENTRATING ORES BY FROTH FLOTATION

Anderson W. Ralston and William O. Pool, Chicago, Ill., assignors to Armour and Company, Chicago, Ill., a corporation of Illinois

No Drawing. Application May 16, 1938, Serial No. 208,311

6 Claims. (Cl. 209—166)

This invention relates to flotation agents and processes of concentrating ores therewith, and it comprises as new flotation agents aliphatic dinitriles of the general formula $NC(CH_2)_xCN$, where x is four or more, and it further comprises processes of froth flotation using such agents.

Flotation agents are used in great quantities in the concentration of ores by froth flotation methods. These agents modify the surface of the desired values in the ore in such a way that the values are floated, leaving the gangue behind. Thus, for example, in the froth flotation of ores an aqueous pulp of the ore is first prepared, flotation agents are added thereto, and the mixture is aerated whereby metalliferous values in the ore collect as a froth which can be readily skimmed off and the metal values therein recovered.

The effectiveness of a flotation agent is largely judged by its ability to separate the various values of the ore and also to separate the metal values one from the other. Some agents require the presence of a frothing agent, such as cresol, etc., while others act as both frothing and collecting agents.

We have discovered that aliphatic dinitriles of the general formula $NC(CH_2)_xCN$ are excellent froth flotation agents. This is contarary to some generally accepted beliefs concerning flotation agents since it is the generally held view that compounds containing two polar groups at extreme ends of long carbon chain molecules are ineffective as flotation agents. This is true of aliphatic dicarboxylic acids, their sodium and potassium salts, etc., but we have discovered that the aliphatic dinitriles are an exception to this generalization. The compounds used by us include sebacodinitrile, pimelodinitrile, adipodinitrile, azelaodinitrile, 1,16-dicyanohexadecane and 1,12-dicyanododecane. The following examples can be given to show the effectiveness of these compounds as flotation agents;

Example 1

A 55-gram sample of ore analyzing 3.21% copper, 17.8% iron and 41.2% silica is mixed with water and ground in a ball mill for fifteen minutes. The pebbles are removed and the water and ground ore transferred to a two liter beaker. The slurry is agitated and then allowed to stand for two minutes. The slime is removed by suction. The ground ore is transferred to a University of Utah flotation cell (capacity 50 grams of ore) in such a manner that all coarse pieces of ore remain in the beaker. Water is added to the contents of the cell until the total amount of water is 200 cc. The cell contents is agitated with an electrically driven stirrer (1700 R. P. M.) and sebacodinitrile added from a medicine dropper, the tip of which has been drawn out to a hair-like capillary. The weight of sebacodinitrile per drop is known by calibration and has been found to be easily reproducible. The amount of sebacodinitrile added to the ore mixture in the cell in this experiment is 0.0098 g. The flotation is continued for fifteen minutes, the froth being removed by a Celluloid paddle whenever the froth presents a firm, metallic appearance. This concentrate is received in a beaker and dried to constant weight in an oven at 130° C. The tailing remaining in the flotation cell is also transferred to a beaker and dried at 130° C. The concentrate and tailing are then weighed separately and a 0.5 gram sample of each is analyzed for iron, copper and acid insoluble material. The following are the results which were obtained:

	Weight	Fe	Cu	Insoluble
	Grams	*Percent*	*Percent*	*Percent*
Concentrate	13.474	33.93	7.40	8.18
Tailing	25.805	9.69	0.82	65.48

Selectivity index Cu/Insoluble=8.5.

The following table summarizes the effect of varying the amount of sebacodinitrile added, the ore and procedure being the same as in the above example. In the last two cases in the table cresol was added as a frother but this is not necessary because the sebacodinitrile acts both as a collecting and frothing agent.

Lbs./ton sebacodinitrile	Lbs./ton cresol	Recoveries			Selectivity index Cu/Ins.
		Cu	Ins.	Fe	
0.13	None	77.6	8.0	54.1	6.3
0.5	None	70.2	4.7	54.2	6.9
1.2	None	63.2	3.6	49.6	6.8
0.14	0.30	77.3	6.7	60.6	6.8
0.16	0.16	82.7	6.1	63.5	8.5

For purposes of comparison potassium ethyl xanthate was used as the flotation agent upon the same ore. When 0.15 pound per ton of potassium ethyl xanthate and 0.16 pound per ton of cresol are used the recoveries are: copper 70.5%, insoluble 8.3%, and iron 41.1%, which gives a selectivity index of 5.1. The potassium ethyl xanthate requires a frothing agent, such as cresol, in order to function.

Example 2

Using the same ore and the experimental conditions as described under Example 1, pimelodinitrile in a concentration of 0.2 pound per ton effects a recovery of 74.8% copper, 61.3% iron and only 3.2% insoluble, giving a selectivity index of 6.2.

Example 3

Using the same ore and experimental conditions as above described a copper recovery of 80.2%, an iron recovery of 58.4% and a silica recovery of 2.8% is obtained with 0.2 pound per ton of 1.12-dicyanododecane. This gives a selectivity index of 7.8.

Example 4

An ore containing 6.7% zinc, 3.4% iron and 1.4% lead as sulfides is ground under conditions described in Example 1 and treated with sebacodinitrile in the flotation cell. When a concentration of sebacodinitrile corresponding to 0.18 pound per ton of ore is employed the following recoveries are obtained: iron 22.6%, zinc 58.1% and lead 86.5%. When the concentration of sebacodinitrile is increased to 1.7 pounds per ton the following recoveries are obtained: iron 13.6%, zinc 27.8%, and lead 81.3%.

We have given examples using pure dinitriles as flotation agents only for purposes of illustration. Mixtures of the above described dinitriles can, of course, be employed and we do not wish to be limited to the use of pure dinitriles. Also we have shown, as in Example 1, that these dinitriles may be mixed with frothing agents if desirable.

Having thus described our invention, what we claim is:

1. The process of concentration metalliferous ores which comprises subjecting the ore to froth flotation separation in the presence of an aliphatic dinitrile of the general formula

$$NC(CH_2)_xCN$$

where x is at least four.

2. In the froth flotation of metalliferous ores the step which comprises subjecting to froth flotation an aqueous pulp of the ore containing a mixture of aliphatic dinitriles of the general formula $NC(CH_2)_xCN$, where x is at least four.

3. The process as in claim 1 wherein the dinitrile is sebacodinitrile.

4. The process as in claim 2 wherein the dinitrile is sebacodinitrile.

5. In the froth flotation of sulfide ores the step which comprises subjecting to froth flotation an aqueous pulp of the sulfide ore containing a mixture of aliphatic dinitriles of the general formula $NC(CH_2)_xCN$, where x is at least four.

6. The process as in claim 5 wherein the dinitrile is sebacodinitrile.

ANDERSON W. RALSTON.
WILLIAM O. POOL.