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著者	OYAMA Tadashi, TANAKA Sakae
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On the Emulsification of the Flotation Reagents by Means of Ultrasonic Waves

Tadashi ÔYAMA* and Sakae TANAKA

The Research Institute for Scientific Measurements

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Synopsis

The method utilizing frothers as a flotation reagent, emulsified in water by means of ultrasonic waves of a suitable frequency and intensity, was investigated. The object is to obtain high selectivity for the differential flotation with the lowest economical comsumption of the flotation reagents. By this process, the ore minerals to be required can be collected with high efficiency which is due to the increase of the floating action, even if the reagents are hardly mixing with water, the emulsion can be readily intermixed into the pulp.

I. Introduction

In the flotation process, if the flotation reagents are hard to be dissolved into water, the satisfactory action for the flotation will be hardly expected, because the rotation of the impeller of ordinary agitator is not so speedy that the reagents can not be uniformly distributed into the pulp.

An aim of this investigation is that the flotation reagents are emulsified by ultrasonic waves, in order to overcome the defect above mentioned.

Although the ore minerals have similar floatability, there is noticeable difference in the actual flotation. Such fact is due to that the flotation reagents will not be dispersed uniformly. Thus it is necessary that each ore mineral should be collected with the same probability to the bubbles which are distributed in abundance in the pulp. For such purpose, the emulsification of the flotation reagents may be desirable.

II. Experimental results

The emulsion obtained by the ordinary mechanical agitation contains the oil particles of about 18–20 microns in size and also partially coarse grains of about 150 microns. Such mixing state is lacking in stability, so that it should be separated into two layers after a while.

On the other hand, the emulsion mixed by ultrasonic waves contains of uniform particles of about one micron, and this state is as stable as to preserve for about one week. The emulsion is poured into the pulp and agitated by ordinary flotation machine. Then a beneficial action of the flotation reagents will be expected.

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* The Dep. of Mining Eng., Tôhoku Univ.

The emulsive reagents obtained by ultrasonic waves and the non-emulsive reagents were experimentally compared on the recovery for the ores. Examples of the results obtained are as follows;

Flotation machine:	M. S.-Type.
Water:	50 gr.
Amount of ore:	700 c.c.
Sodium ethyl xanthates:	50 gr/ton.
Frother:	50 gr/ton.

(1) *Ashio.* Pure Chalco-pyrite.

Recovery.	Duration of flotation.	
	Emulsive F. R.	Non-emulsive F. R.
73.4 %	2 min.	5 min.
82.2 %	3.5 min.	10 min.
88.9 %	5 min.	15 min.

As shown in above resuls, by using the emulsion, the duration of flotation expended to obtain recovery of 88.9% will be decreased to one-third of the non-emulsive reagents.

(2) *Dzira.* Pure Galena.

Duration of flotation.	Recovery	
	Emulsive F. R.	Non-emulsive F. R.
5 min.	93 %	58.0 %
10 min.	100 %	62.8 %
15 min.	100 %	62.8 %

In the case using the emulsion, perfect recovery is obtained, that is 93 % for 5 min. and 100 % for 10 min., but in the non-emulsive case, recovery is 62.8 % for 10 min. or 15 min., and does not increase after that. In this case, therefore, it is clear that the flotation reagents should be wasted in part.

An example for the emulsification by ultrasonic waves is as follows;

Transmitter: X-cut quartz crystal. (Mounted in an oil vessel.)
Natural frequency, 450 K. C.
Diameter, 40mm. Thickness, 6mm.
Exciting voltage, about 2 K. V.

Oscillator: Oscillator tubes, SX-852 2
Rectifier tubes, HX-966B 2

Optimum sound power: About 4 Watts/cm^2.

Saturation degree of emulsion: 1/200 (Weight)

Stability of emulsion: For one week.

Size of oil particle: Oil in water type. Uniformly one micron.

For the purpose of commercial production, it may be more desirable to use special siren or magnetostriction generator.

Summary

From the foregoing resuls, the features of this investigation can be summarized as follows:

1. Floating duration can be reduced, so that the efficiency of the flotation machine will be increased.

2. Recovery for the mineral ore can be increased.

3. High selectivity for the differential flotation will be expected with the lowest economical comsumptions of the flotation reagents.

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