

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, MICHIGAN COLLEGE OF MINING AND TECHNOLOGY]

## Normal Oximes as Flotation Reagents

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In the previous paper<sup>1</sup> it was shown that salicylaldoxime, a compound of known chelate structure, had possibilities as a flotation reagent for heavy metal carbonates, oxides, and sulfides. The present paper presents quantitative data on the behavior of heptaldoxime and octaldoxime as flotation reagents for the same minerals.

At the outset, all of the normal oximes including octyl oxime were tested qualitatively<sup>2</sup> as flotation agents for oxides and carbonates of heavy metals. It was found that with the exception of hexaldoxime none of the lower oximes give any promise as flotation reagents. Normal propyl, butyl and amyl oximes, however, showed promise as frothing agents and as gangue depressors when used in conjunction with known mineral collecting agents. The recoveries obtained with the use of normal hexaldoxime do not, at present, merit publication.

The method of preparation and flotation of the synthetic ores has already been given in the previous paper.

The heptaldoxime was prepared and purified according to Bousquet.<sup>3</sup>

Octaldoxime was prepared in substantially the same manner from octaldehyde obtained by the method of Stephens<sup>4</sup> from heptyl cyanide. It was purified carefully and the oxime finally obtained had a melting point of 58–59°. Only a small amount of the octyl oxime was obtained. How-

TABLE I

FLOTATION OF MINERALS BY *n*-HEPTALDOXIME

pH	Oxime, g.	Lb. oxime per ton	G. concn.	Cu recov., %
Chalcocite				
4.6	0.0000	0.00	1.013	0.54
4.5	.005	.2	0.952	96.8
4.6	.01	.4	.907	97.8
4.4	.01	.4	.951	98.7
4.5	.05	2.0	.964	97.8
Malachite				
5.5	0.0000	0.00	0.825	2.3
4.9	.005	.2	.471	6.14
5.2	.01	.4	.537	5.74
4.8	.05	2.0	.646	89.6

(1) C. C. De Witt and F. von Batchelder, *THIS JOURNAL*, **61** 1247 (1939).

(2) Unpublished data obtained by the senior author in this Laboratory.

(3) Bousquet, *Org. Syntheses*, **11**, 54 (1931).

(4) H. Stephens, *J. Chem. Soc.*, **127**, 1874 (1925).

Covellite					
4.8	0.0000	0.00	1.152	71.5	
4.7	.005	.2	1.020	93.4	
4.7	.01	.4	0.869	93.5	
4.7	.05	2.0	.944	95.4	
Azurite					
4.6	0.0000	0.00	0.947	1.88	
4.9	.005	.2	.573	1.96	
4.8	.05	2.0	.731	85.5	
5.0	.10	4.0	.729	83.8	
4.7	.10	4.0	.717	75.0	
Cuprite					
4.8	0.0000	0.00	0.662	0.44	
5.0	.01	.4	.535	57.8	
4.9	.05	2.0	.653	84.5	
4.8	.05	2.0	.819	96.2	
5.0	.10	4.0	.761	96.8	

TABLE II

FLOTATION OF COPPER ORES WITH NORMAL OCTALDOXIME

	pH	G. oxime	Lb. oxime per ton	G. concn.	% Cu recovered
Chalcocite	4.6	0.05	2.0	0.940	97.2
Malachite	4.5	.05	2.0	.669	92.4
Covellite	4.5	.05	2.0	.728	96.5
Azurite	4.6	.05	2.0	.801	87.0
Cuprite	4.4	.05	2.0	.752	96.4

ever, the results reported indicate the possible usefulness of the reagent as a collector for oxide, carbonate and sulfide copper ores.

### Discussion

The tendency of the oximes to depress the gangue material is very noticeable. The reagent appears to work more effectively at the lower pH values. The reagent has been almost equally effective in the recovery of other natural metallic carbonates and oxides from similar gangues. Comparatively, heptaldoxime appears to be a better reagent than salicylaldoxime. The results obtained with octaldoxime are in line with those obtained with heptaldoxime.

### Summary

Evidence is presented which shows that both heptaldoxime and octaldoxime are satisfactory reagents for the separation of oxide, carbonate, and sulfide ores of copper from siliceous gangue material.

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RECEIVED MARCH 10, 1939