FLOTATION OF QUARTZ WITH SOAPS OF BOMBAX MALABARICA OIL AND SHARK LIVER OIL AS COLLECTORS

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Abstract

An attempt has been made to use the indigeneous oils—Bombax Malabarica oil and Shark liver oil in the form of sodium soaps as collectors in the flotation of quartz using barium chloride as activator. The effect of pH, collector concentration and activator concentration on the flotation of quartz is studied in a Leaf and knoll flotation cell. The experiments show that it is possible to obtain 98.0 per cent of quartz as float using 10 mg. of Bombax Malabarica oil and Shark liver oil soaps at pH values of more than 7.0 and when barium ion concentration is in excess of that required to form barium soaps. Bombax Malabarica oil is found to be superior to Shark liver oil as collector in the flotation of quartz.

Introduction

Oils, natural as well as synthetic, have been used as collectors in the separation of minerals. Shale oil containing sulphur after treatment[1] and coal tar derivatives containing cresol and other phenol derivatives[2] have been used as collectors in the flotation process. A systematic study for the use of soaps of indigeneous oils as collectors for the flotation process of non-sulphide minerals occurring in India was undertaken in our laboratories. The present paper deals with some of the investigations conducted with the soaps of Bombax Malabarica oil and Shark liver oil as collectors for quartz. Since quartz is a common mineral associated with all the important ores, the investigation was conducted on quartz to start with. Bombax Malabarica and Shark liver oils produced indigeneously contain a high percentage of unsaturated fatty acids. Hence, the soaps of these oils could be good collectors for non-sulphide minerals. An attempt is made in this paper to show that indigeneous oils such as Bombax Malabarica oil and Shark liver oil readily available in the country could be used as collectors in flotation process.

Material

(1) *Preparation of pure quartz*:—Lumps of massive white quartz were crushed and passed through the roll crusher to obtain – 60 mesh material. The

crushed quartz was separated from its magnetic constituents using an electro-magnet and wet ground in a ball mill and wet sieved to collect 200/300 mesh fraction. The sized quartz was then leached with hot dilute hydrochloric acid (1 : 1) to remove iron. The acid leached material was repeatedly washed with hot distilled water till the supernatant water gave a negative test for iron and chloride. The quartz obtained thus was found to contain 99.6 per cent silica. Microscopic study (Plate I) showed the quartz grains to be sub-prismatic and subangular.

(2) *Reagents*: (*a*) *Collector*:—The physical and chemical properties of the oils used for the study are given in Table I. Preparation of the sodium soaps of the oils: About 1g. of the oil accurately weighed was transferred to a refluxing flask. 100 ml. of 0.2 per cent alcoholic solution of sodium hydroxide

TABLE I

Physical and Chemical Properties of the oils

Name of oil	Refractive index	Specific gravity	Iodine value	Fatty acids content %			
				Saturated		Unsaturated	
1. Bombax Malabarica oil[3]	1.4710	0.9755	103.8	Palmitic	9.8	Oleic	43.0
				Stearic	8.0	Linoleic	31.3
				Arachidic	1.2		
				Lignoceric	0.2		
2. Shark liver oil[4]	1.4685	0.9274	94.25	Lauric	0.4	Tetradec-9-enoic	1.1
				Myristic	3.3	Palmitoleic	11.2
				Palmitic	24.9	Oleic	19.6
				Stearic	11.1	Gadoleic	22.3
				Arachidic	1.2	Erucic	4.8

was added to the oil and mixed thoroughly. The contents were then refluxed for six hours on a water bath and saponified. Alcohol was then distilled off and the sodium soaps formed were diluted with water to give solutions of 1 mg. per ml. and 2 mg. per ml.

(*b*) *Activator*:—Barium chloride ($BaCl_2.2H_2O$ Merck grade) was dissolved in distilled water to give 1 per cent solution.

(*c*) *Frother*:—Terpineol was dissolved in alcohol to yield a one per cent solution.

(3) *pH Modifiers*:—Sodium hydroxide solutions and hydrochloric acid having strength of 1.0, 0.1 and 0.01N were used as modifiers.

EXPERIMENTAL PROCEDURE AND RESULTS

10g. of quartz was transferred from the stock material stored under water to a 100 ml. rubber stoppered glass cylinder. Desired amounts of the flotation reagents were added and the pulp diluted to 95 ml. mark. After adjusting the pH of the pulp to the required value in a Marconi pH meter, the cylinder containing the pulp was conditioned for half an hour in an automatic shaker to allow for the attainment of equilibrium conditions. The conditioned pulp was then fed slowly to the Leaf and Knoll cell[5]. The flotation concentrate and tails were collected separately, dried and weighed to determine the percentage of quartz floated. Experiments were conducted to study the effect of (1) pH, (2) collector concentration and (3) activator concentration.

Effect of pH on the flotation of quartz:—The effect of pH on the flotation of quartz was studied at constant concentrations of flotation reagents. It may be seen from the results presented in Fig. I that with Bombax Malabarica oil

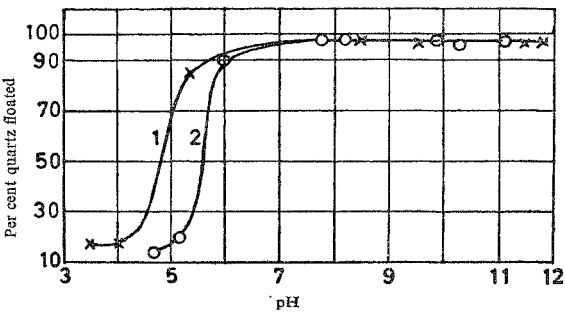

Fig. 1

Effect of pH on the flotation of quartz using 10 mg. of each of the soaps of Shark Liver oil (curve 1) and Bombax Malabarica oil (curve 2) and 10 mg. of barium chloride (activator) and 2 mg. of terpineol (frother).

soap as collector the percentage of quartz floated increased from 13.5 to 99.2 per cent as the pH was raised from 4.7 to 7.8. The experiments with Shark liver oil soap as collector also showed the same trend in that 17.1 per cent of quartz floated at a pH of 3.5 while 98.0 per cent of quartz was floatable at a pH of 8.5. It may be concluded that the flotation of quartz was generally good with pH values above 7.0 if the soaps of Bombax Malabarica oil and Shark liver oil were used as collectors.

Effect of Collector concentration on the flotation of quartz :—Flotation experiments were carried out to study the nature of quartz flotation with varying collector concentrations from 0.5 mg. to 100 mg. It was interesting to observe that even with as low a Bombax Malabarica oil soap concentration as 0.5 mg.

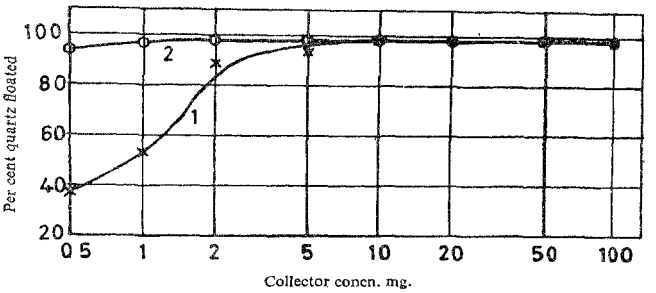

Fig II

Effect of varied concentrations of soaps of Shark Liver oil (curve 1) and Bombax Malabarica oil (curve 2) as collectors on the flotation of quartz with 10 mg. of barium chloride (activator) and 2 mg. of terpineol (frother) at pH 9.2

93.0 per cent of quartz was floatable with 10 mg. of barium chloride at 9.2 pH. With 2.0 mg. of the collector, 99.0 per cent of quartz could be floated under the same conditions. Further increase in collector concentration had no effect as seen from Fig. II. The recovery of quartz with Shark liver oil soap however, was lower as only 36.5 per cent of quartz was floatable in the presence of 0.5 mg. of collector.

Effect of activator concentration on the flotation of quartz :—Experiments were conducted to study the floatability of quartz with barium chloride concentrations ranging from 0.5—300 mg. at a constant collector concentration of 10 mg. and at pH values of 5.2 and 9.2. Results of the tests showed that varied concentrations of activator from 0.5 up to 50 mg. with Bombax Malabarica oil soap at pH 5.2 did not show considerable change in the percentage of quartz floated as seen from Fig. III. However, above 50 mg. of activator 87.0 per cent recovery of quartz could be obtained. Experiments at pH 9.2 were found to yield encouraging results as 57.7 per cent quartz could be floated with 0.5 mg. of barium chloride and the flotation efficiency increased with increasing activator concentrations as seen from Fig. III.

It was found that flotation of quartz with Shark liver oil soap in acid range was not beneficial in contrast to that of Bombax Malabarica oil soap as

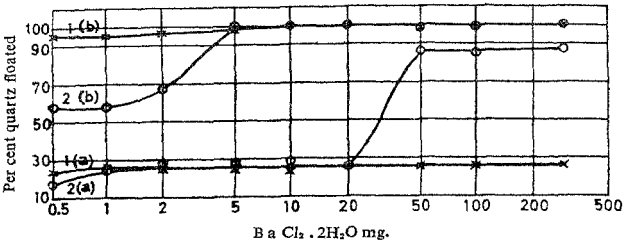

Fig. III

Effect of varied concentrations of barium chloride as activator on the flotation of quartz with 10 mg. of each of the soaps of Shark liver oil (curve 1) and Bombax Malabarica oil (curve 2) as collector and 2 mg. terpineol (frother) at pH 5.2 [curve (a)] and pH 9.2 [curve (b)].

there was little change in the floatability of quartz with increase in barium chloride concentration. However, in alkaline ranage (pH 9.2), 95.5 per cent of quartz floated in the presence of 0.5 mg. of activator. Further, the percentage recovery was found to increase with increasing activator concentration.

CONCLUSIONS

1. It was found that the amount of quartz floated increased from 13.5 to 99.2 per cent with increasing pH, *viz.*, 4.7 to 7.8 when the soap of Bombax Malabarica oil was used as collector while the percentage of quartz floated with Shark liver oil soap as collector increased from 17.1 to 97.6 with increase of pH from 3.5 to 8.5. The flotation was good at pH values above 7.0 when there was Ba^{++} ion concentration in excess of that required to form barium soaps.

2. The percentage of quartz floated increased with increasing collector concentrations of oil soaps as seen from Fig. II. The soap of Bombax Malabarica oil was superior to the soap of Shark liver oil as collector since 93.0 per cent of quartz was floated even with as low a collector concentration as 0.5 mg. Bombax Malabarica oil soap and only 36.5 per cent with Shark liver oil soap. This is understandable as the Bombax Malabarica oil contained 74.3 per cent unsaturated fatty acids as compared to 59 per cent unsaturated fatty acids in Shark liver oil (Table I).

3. The amount of quartz floated was found to increase with increasing activator ($BaCl_2,2H_2O$) concentration in alkaline pH (Fig. III).

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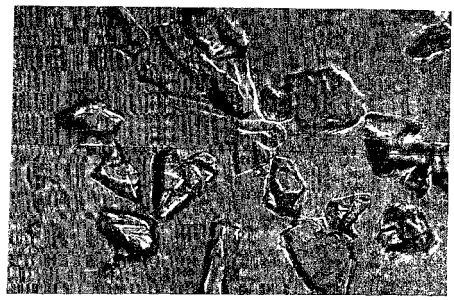

PLATE I

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