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RESEARCH WORK OF THE FOAM REGULATION MECHANISM IN FLOATATION OF CASSITERITE WITH OXYHYDRILLIC COLLECTORS

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ABSTRACT
Effective floatation dressing of cassiterite ore is yet an unsolved problem in the world practice. The main reason for it lies in the low selectivity of division of the cassiterite ore from the rock forming minerals. One of the ways to improve the division of casseterite from the rock forming minerals is the use of froth extinguishers. This article is devoted namely to this problem.
KEY WORDS: Froth regulators, froth extinguishers, slime waters, two-phase and three- phase froth, surface active substance (SAS), adsorption, coalescence.

INTRODUCTION

Traditionally cassiterite is floatated with oxyhydrillic collectors in acid floatation pulp (pH 2,5-3). Main obstacle for its effective selection from the remaining oxides and silicones is the abundant froth output, according to L.O.FILIPOV (1997, 2000). It carries away into three phase froth a number of rock forming minerals. Traditional drainage of slime waters in three phase froth is not sufficient to ensure selection of the minerals, according to A.BOTEVA (1992). In order to improve secondary floatation in a three phase froth layer, during performed research work the collector Aerosol 22 was used in a combination with silicone froth extinguisher. Achieved results under item (5) that while using oxyhydrillic collector containing sulphonate and carbonic functional groups (Aerosol 22) the most appropriate froth extinguisher is the silicone type.

An attempt is being made in this research work to draw up hypothesis, explaining the froth-depressing role of the silicone polymers.

RESEARCH METHODS

The following methods have been employed in the research work:
1) determining the angle of watering;
2)determining inter-phase pressure of the borderlines oil-water and oil-oil;
3)measuring time of destruction and the thickness of the froth layer in a two-phase froth.

Research is carried out on clean cassiterite as mineral sample. As oils are used: Aerosol 22, Sodium oleate, Bisilon AC 3099, Bisilon E Froth Depressor 7800, Froth Depressor DNE which represent mixtures of carbonyl acids and Hydrocarbons, and Bisilon E and Bisilon AC3099 are present on silicon base.

In measuring angle of watering θ the method of catching bubbles is employed. Surface pressure is measured by the method of the ring and the faculties of the two phase froth through barbotage with a certain amount of air to a water column with dissolved reagent in a glass cylinder.

RESEARCH RESULTS

As yet mentioned above the surface pressure along the borderlines of water-oil and collector-froth regulator (oil-oil) is measured by the ring method. Mutual penetration of oil phases in one another is appraised according to the (5) on inequalities.

$$E = \sigma_F + \sigma_{EF} - \sigma_E > 0; \ (1)$$
$$S = \sigma_F - \sigma_{EF} - \sigma_E > 0; \ (2)$$

where σ_F - surface pressure along the borderline water – froth output;

σ_E – surface pressure along the borderline water – froth regulator;

σ_{EF} - surface pressure along the borderline froth output – froth regulator;

E – rate of mutual penetration of the froth output and froth regulator;

S – rate of mutual mixing (spread out) of the froth output and froth regulator.

Measured parameters and calculated on their base values of E and S are matching those quoted in (5) values.

It has been interesting and rewarding to examine the impact of the two types of froth regulators – those based on organic silicone compounds and the others based on carbonic acids on the height of froth layer. It is characteristic for the two types of reagents that when its concentration in water solution grows the surface pressure along the borderlines oil-water falls down as at 10 mg /1 it reaches saturation and then remains unchanged. However, the impact of the two types on the height of the froth layer is fundamentally different.

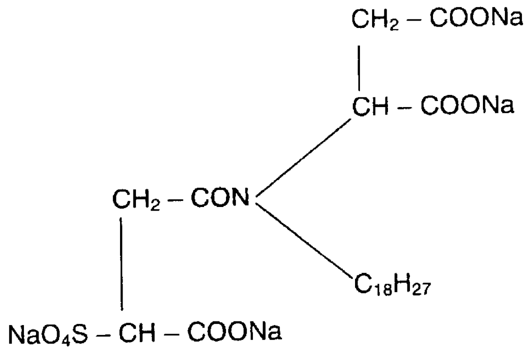
With regard to the organic silicone compounds the height of the froth layer falls dramatically with the increase of its concentration. Concerning the froth regulators based on carbonic acids the growth of its concentration almost does not affect the thickness of the froth layer. This very important fact shows difference in the mechanism of interaction of used collector Aerosol 22 with the two types of compounds and the fact that the surface pressure is not the determining factor influencing the froth regulators regarding the structure of the two phase froth.

As the measurements of the surface pressure answer the question about the interaction of the froth regulators and the collector Aerosol 22 along the boardeline water-air, as the angle of watering θ shows us the degree of absorption of considered surface active substances (SAS) along the borderline mineral-liquid phase. The angle of watering has been measured at pH2,5 (traditional, according to R.P.Allen and C.J.Vial (1988) pH for floatation of cassiterite with oxyhydrillic collectors), while using the natural cassiterite crystal. After each measurement the surface has been refreshed by polishing with chrome oxide and tenth times washing with distilled water. Under concentration 65 mg/1 of the Aerosol 22 the angle of watering θ reaches the maximum value of 71,5°. Additives of organic silicone froth regulators do not affect the angle of watering θ as for those based on carbonic acids.

It rises to 80°. It shows that organic silicone compounds cannot be absorbed on mineral surface, as in the case with carbonic acids and hydrocarbons there appears adsorption.

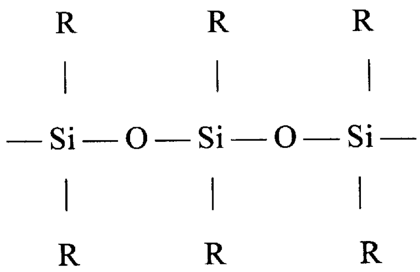
COMMENTS ON ACHIEVED RESULTS AND CONCLUSIONS

On the basis of achieved results regarding the synergy between the oxyhydrillic collectors and used reagents-froth regulators, one may come to the main conclusions, as follows:
1. Froth regulation role of the reagents is determined by the structure of the oxyhydrillic collector and the froth regulator. Oxyhydrillic collector as a strong SAS apart from the borderline mineral-water actively adsorbs also along the borderline air-water and forms with the collector associative groups tearing the link between the molecules of the collector and actively acts as froth depressor. In this case air bubbles easily coalesced and disrupted. When used froth regulator coalesces the molecules of the collector in an unbroken range the froth is stabilized and this reagent cannot act as a froth depressor.
2. The collector Aerosol 22 has the following structure [1]:



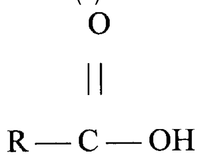
[1]

The froth depressors, which are silicone polymers, have the following structure [2]:



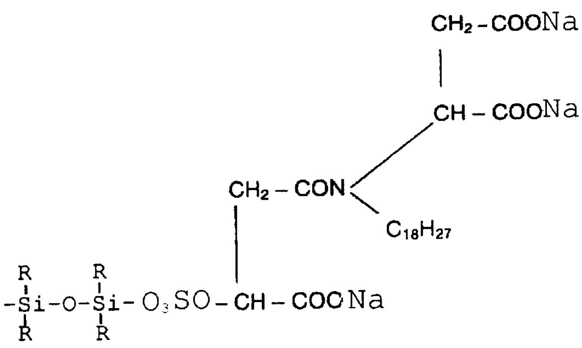
[2]

Froth depressors set up on the basis of highly molecule carbonic acids have the common
Formula (3):



[3]

In this way carbonic acids at pH2,5 coalesce in unbroken associates through hydrogen links the molecules of the carbon-sulpfonates and harden them probably through the following mechanism:



Hardening of the collector adsorbed along the borderline of liquid-gas-waters until easy disruption of the slime seams between the air bubbles, coalescence of the latter and disruption of the froth.

3. Easier separation of the slime liquid in a three phase froth leads to improvement of the selectivity. In this way carbonic acids at pH 2,5 coalesce in unbroken associates through hydrogen of floatation of the oxide with oxyhydrillic collectors.

4. In formation of a three phase perimeter of watering most probably the froth regulator which is adsorbed at the top of the mineral surface is sliding on the surface of the bubbles and thus additionally stabilizes the froth.
5. The chemical compounds used as froth stabilizers should meet the following criteria::

- To serve as a link between the molecules of the collector;
- Not to be adsorbed along the borderline liquid-mineral;
- Value of rate R does not affect considerably the work of froth depressors.

The value of rate S is of essential importance for the work of froth depressors.

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