IMPACT OF REAGENTS-REGULATORS ON FLOTATION

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Abstract. *A distinctive feature of the reagents of the group under consideration is the complexity and diversity of their impact on the process. Most often, the addition of regulators increases the difference in the surface hydration of the separated minerals, reducing the hydration of the particles being floated (activating their flotation) or increasing the hydration of the particles that are not subject to flotation (suppressing or "depressing" their flotation). The reasons for such an action of reagents-regulators on the surface of minerals, in turn, are diverse.*

Keywords: reagents-regulators, xanthates, collector, coagulation, surfaces of mineral particles, particles of useful minerals.

Introduction.

At present, in the scientific and technical literature, we often encounter the term flotation, which is used to purify water from organic substances and solid suspensions, separate mixtures, and accelerate settling in the chemical, oil refining, food, and other industries. Flotation is one of the main technological processes for beneficiation of most minerals, due to the separation of mixtures of fine particles. Flocculation processes have been successfully used in ore dressing processes for a long time, and probably the greatest theoretical and practical experience has been collected in this direction.

Flotation reagents are chemical compounds that promote the selective adhesion of air bubbles to mineral particles and the implementation of flotation of certain components.

Depending on the intended purpose, flotation agents are divided into three classes - collectors, foam concentrates, and regulators. The results of flotation enrichment are largely determined by the reagent mode of flotation - the assortment and method of using reagents; the same flotation result can be obtained with different reagent regimes. The reagent mode of flotation is mainly determined by the type and characteristics of the mineral, the degree of its grinding and the conditions imposed on the enrichment products.

The simplest reagent mode is determined by the dosage of one blowing agent or reagent with mixed functions of the collector-foaming agent. In modern flotation practice, such regimes are rare.

Usually, during flotation, several reagents are used simultaneously, the action of which is interconnected and depends on the concentration of each of them. Exceeding the required consumption of a reagent of one class requires an increase in the consumption of reagents of other classes and can lead to a deterioration in technological performance. The lowest possible consumption of reagents provides the lowest costs for the processing of mineral raw materials and the best flotation results. The required consumption of reagents is determined using laboratory flotation experiments, specified in semi-industrial and industrial conditions.

The flotation activity of reagents can be increased using physical, chemical, and other methods - emulsification, electrochemical oxidation, ultrasonic, thermal, and bacterial treatments,

mixing of various reagents, supplying the reagent in a vapor state or in the form of an aerosol, etc. The use of physical, chemical, etc. methods of influencing flotation reagents and their aqueous solutions contributes to improving the technical and economic indicators of flotation (reducing the consumption of reagents, increasing the extraction of valuable components, improving the quality of concentrates).

Along with the use of three classes of flotation reagents (collectors, foam concentrates, regulators) and various combinations of reagents within each class, the improvement of flotation of mineral raw materials is largely determined by technological methods, including the use of combinations of flotation reagents of various classes, methods for treating pulp with reagents, methods for processing reagents before flotation, combinations of flotation methods based on the use of reagents and non-flotation operations.

Purpose and classification of flotation reagents

It is well known that flotation is carried out due to the adsorption of air molecules to the mineral particles of the components under the influence of substances called "flotation reagents". The course of the flotation enrichment process and its result are largely determined by the reagent regime of flotation, i.e. assortment type and method of their application. This mode is mainly determined by the physicochemical characteristics of the mineral, the degree of its dispersion, as well as the conditions for finished products.

In the flotation process, for the best enrichment result, several flotation reagents are usually used, the action of which is interconnected and depends on the concentration of each of them. Therefore, the excess consumption of one reagent necessitates an increase in the consumption of other reagents, and in excess of an increase (or decrease) in their concentration can lead to a deterioration in the technological performance of the entire process. Experiments have shown that the lowest possible consumption of reagents provides lower costs for the processing of mineral raw materials and better results of the enrichment process. Despite the accumulated theoretical and practical experience, the required amount of reagents is always determined using laboratory flotation experiments, specified in industrial conditions for each mineral raw material.

The action of regulators is not limited to increasing the selectivity of the flotation process by changing the surface properties of minerals. In addition, they also perform another important function: they create conditions in the liquid phase of the pulp that are favorable for the action of other flotation reagents and, first of all, collectors.

Each flotation reagent acts effectively under certain conditions created in its environment. Thus, fatty acids interact well with floated minerals in a weakly alkaline medium. Reagents-regulators of pulp pH make it possible to create this optimal alkalinity for each reagent or acidity of the environment.

The ions present in the solution, which are capable of forming sparingly soluble compounds with flotation reagents and converting reagents into compounds with a reduced ability to interact with mineral particles, have a great influence on the flotation process. For collectors with a carboxyl group, such ions are calcium, magnesium, and iron ions; for xanthates - metal ions located in the side groups of the periodic system of Mendeleev. Reagents-regulators can remove a significant part of these ions from the liquid phase of the pulp in the form of insoluble precipitates and thereby improve the conditions for the interaction of the collector with mineral particles.

You can point to a third function of reagent-regulators: giving the flotation pulp a certain aggregative stability and, first of all, preventing the adhesion of particles of various minerals and

the formation of aggregates consisting of various minerals. As shown in part seven, the adhesion of small particles is especially strongly influenced by the stability of the hydrated layers surrounding the mineral particles. Under certain conditions, the process of particle adhesion can proceed very intensively. However, two cases must be distinguished. In the first case, stick together there will be particles of one of any mineral, as a result of which monomineral floccules will be formed. This process, as noted above, especially often occurs when the collector, selectively fixed on the particles of one mineral, sharply reduces the stability and sizes of hydration shells, which leads to particle adhesion.

In addition, the collector sometimes plays the role of a "gluing" layer between the particles. In the second case, particles of various minerals will stick together. This phenomenon is observed when there is too much collector in the pulp, which is not selectively fixed on particles of various minerals.

Aggregates can also be formed as a result of the coagulation process, which usually proceeds very intensively in those cases when the electrokinetic potentials of the particles decrease and especially when electrokinetic potentials of particles of various minerals become opposite.

The formation of monomineral floccules becomes detrimental to the flotation process only when these floccules are so large that air bubbles can no longer lift them into foam. The formation of polymineral aggregates worsens the conditions of the flotation process in all cases. It is especially harmful in the presence of a large amount of sludge in the pulp. The smallest particles of non-floating minerals stick to particles of useful minerals and thereby reduce the quality of concentrates or, by preventing particles of useful minerals from sticking to the air bubble, sharply increase the loss of useful minerals minerals in tailings.

Reagents-regulators, affecting the electrokinetic potential of mineral particles or the stability of the hydrate layers surrounding these particles, prevent the formation of polymineral aggregates. In real conditions of flotation of ores, all these different functions of the regulators are combined with each other: the same regulator can perform several functions at once. So, sodium sulfide during flotation lead or copper carbonates, fixing on the mineral, lowers the hydration of the surface of mineral particles. Interacting with heavy metal cations. in the liquid phase as a result of the dissolution of minerals. sodium sulfide removes these cations from the liquid phase in the form of insoluble substances, which prevents precipitation collector of "inevitable ions".

In addition, as a result of the hydrolysis of sodium sulfide, an alkaline environment is created in the pulp. Sometimes the different functions of regulators counteract each other in its effect on flotation. Thus, during the flotation of ores with oleic acid, liquid glass is used to suppress quartz, which, when dissolved in water, is hydrolyzed, and in addition to silicic acid ions, hydroxyl ions appear in the solution. Silicic acid anions suppress quartz, silicates and aluminosilicates; hydroxyl ions, on the contrary, activate the flotation of these minerals. The influence of liquid glass on flotation depends on which of these oppositely directed actions is stronger.

When a greater inhibitory effect is manifested, liquid glass is a suppressor, while under other conditions it exhibits its activating properties. Thus, the reagent-regulators are characterized by a variety of their functions, a large difference in the mechanisms of action and the ability of the same reagent to exert a depressing effect under certain conditions, and under others an activating effect on the flotation of certain minerals. It is more difficult to establish ways of influence on the flotation process of reagents-regulators than collectors. In the study of these reagents, as well as in their practical use in flotation, it is necessary to take into account as fully as possible the specific

conditions under which the flotation process is carried out. Below we consider the functions and mechanism of action of various reagents - flotation regulators. Various types of regulators are described as examples: alkalis, acids, salts containing flotation active cations, and salts containing flotation anions. First and the latter types of regulators are considered in more detail as reagents of particular importance in the practice of ore flotation. The mechanism of action of a group of regulators-non-electrolytes (carbohydrates, tannin) has been elucidated so far very little.

As noted, regulators are flotation reagents used in addition to collectors and frothers to increase flotation selectivity or increase mineral recovery. For the flotation of mineral raw materials, about four hundred regulators have been proposed. Depending on the intended purpose in the flotation process, in each case, regulators of an activating, depressing or suppressing action and regulators of the environment are distinguished.

Thus, this paper summarizes and analyzes some of the data presented in the scientific and technical literature on the creation of flotation reagents and their sorption abilities at the interface of adjoining phases. The similarity and distinctive properties of the studied objects confirm the possibility of further expanding the list of collectors and foaming agents. From this point of view, the question of further research of these objects, methods of their production, especially on the basis of industrial waste, remains open, which is relevant from a scientific point of view, as well as economically and environmentally beneficial.

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