PROCESSING OF SYLVINITE ORES AND ITS PHYSICAL AND CHEMICAL PROPERTIES

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Abstract. For flotation sylvinite, it is neecssary to grind the ore to the size of 1-2 mm to 3 mm as much as possible, and more fineness will lead to the loss of a part of the product mixed with the slag during flotation and the deterioration of the product quality. But in this case, the level of NaCl in the sylvin sample should exceed 85-90% as much as possible.

Keywords: In order to ensure the optimal state of the solution environment (pH), environment controllers - alkali or acid - are used. Flotation of sylvinite can be carried out without special reagents - foam generators. Saturated solutions of KCl and NaCl also have the property of foaming if air is passed through them.

In the industry of potassium salts, production by foam flotation method is widely used. This method is based on the separation of water-soluble minerals from the ore by flotation (or flotogravitational) in a salt solution. As a result of selective hydrophobization of the surface of potash ores with cleaning reagents, they adhere to air bubbles and foam[1]. The main component of sylvinite ore differs by the amount of additives and ground materials and the size of the particles. The technological schemes and devices of their processing are also different[2].

Ore processing and production process consists of the following stages:

1. Grinding ore. The primary ore is crushed to a particle size that ensures the formation of a mechanical mixture of minerals. For flotation sylvinite, it is necessary to grind the ore to the size of 1-2 mm to 3 mm as much as possible, and more fineness will lead to the loss of a part of the product mixed with the slag during flotation and the deterioration of the product quality. But in this case, the level of NaCl in the sylvin sample should exceed 85-90% as much as possible[3]. If the size of the flotation particles is smaller than 1.0-0.6 mm, it is called fine-grained, and if it is larger than 1 mm, it is called large-grained[4]. Preparation for sylvinite flotation is carried out in the dry state in rotor (roller, reciprocating, hammer, etc.) mills (particle size up to 14-15 mm), in dry or wet state in solutions of saturated salts of ore components with stergen or involves fine grinding in ball mills. Automatic oscillating sieves, arc sieves, hydrocyclone sieves and other types of sieves are used to sort the particles at each stage[5].

2. Separation of crushed ore from inclusions - small dispersed soil-carbonate inclusions that interfere with the flotation process and suspension separation. It is carried out by flotation (before the main flotation process), hydraulic (separation of crushed ore suspension based on the difference in the sedimentation rate of soil-

carbonate and salt minerals), flotation-hydraulic, gravity and other methods[6]. If the amount of slag in the ore is small, reagent-depressors are used in the flotation process in order to eliminate their negative effect, i.e. absorption of flotation reagents on the surface of the slag. Separation of wet crushed sylvinite suspension from slag is carried out in hydrocyclone and hydroseparators[7]. To ensure that the particle size in the ore is less than 3 mm, the suspension (C:K = 6-10:1) is first separated in a hydrocyclone with a diameter of 700-750 mm. 75-85% of the slurry is separated from the suspension. It is sent to a hydroseparator (Ø = 18 m). After the suspension is divided into fractions, sands with particles smaller than 1.0 mm are sent back to the hydrocyclone. The slurry is sent to a spiral separator, and the slurry is condensed and washed in condensers with a diameter of 30 meters[8]. Distilled and washed water is returned to the technological cycle and is discharged. The treated raw materials from the hydrocyclone (stage 2) and spiral separator are sent to flotation, and the wastewater is returned to the cycle[9].

3. Separation of ore minerals by flotation process. Sylvin particles are used as a hydrophobizer - as collectors and as a substance ensuring adhesion to air bubbles, cationic (cationic surfactant) and nonionic (non-ionic surfactants) - apolar high molecular organic compounds - primary aliphatic amines acetates or chlorides and paraffinic, naphthenic aromatic and heterocyclic hydrocarbons are used[10]. Addition of cationic surfactants (octadecylamine, fetamine, etc.) and nonionic compounds (obtained during oil refining) allows the flotation of large (up to 3 mm) fractions of sylvan[11]. The reagent reduces the sorption of modifiers on the surface of minerals that do not require flotation, ensures flocculation of earthy soot and activates sylvin flotation[12]. Inorganic (poly- and metaphosphates of alkaline substances and colloidal solutions of silicic acid) and organic substances (polyacrylamide, carboxymethylcellulose, lignosulfonates, urea formaldehyde resin, etc.) are used as flocculants. In order to ensure the optimal state of the solution environment (pH), environment controllers - alkali or acid - are used. Flotation of sylvinite can be carried out without special reagents - foam generators. Saturated solutions of KCl and NaCl also have the property of foaming if air is passed through them (by bubble method). But additional foaming agents (pine oil, dioxane and pyran alcohols, etc.) increase the dispersion of air bubbles and ensure the formation of stable foam. These reagents are sorbed at the boundary of phases (liquid phase - air and liquid phase - mineral) and hydrophobize the surface of mineral particles[13]. The technological scheme of flotation of potash ores differs sharply depending on the mineralogical and granular composition of raw materials. There are a number of advantages of schemes that ensure the production of products with large grains (up to 3-4 mm)[14]. In these schemes, it is possible to reduce the cost of grinding and granulation, washing and storage of lumps, increase the level of extraction of KCl due to the reduction of the amount of lumps and moisture of the product, and increase the agrochemical properties of the fertilizer[15]. In such processes, separate flotation of ores with large (+0.9 mm) and small (-0.9 mm) fractions is carried out.

In the separate flotation process of large and small fraction ores, in the small fraction flotation, the pre-mechanically deflocculated concentrate is flotation twice and the waste is controlled once. In this case, tallow oil with amine is used as a collector, and carboxylmethylcellulose is used as a depressor[16]. The intermediate product is sent to additional grinding and returned to the main flotation. The concentrate is separated in a centrifuge and sent to a "fluidized bed" dryer[17].

In large-fraction flotation, the concentrate is re-purified once and controlled flotation of waste is carried out[18]. The concentrate is separated in a vacuum filter and sent to a dryer

4. The suspension is separated by condensation and filtration (by dewatering), processing of the wet product into a finished product (fertilization and granulation of the fine fraction) is required.

For ores that do not contain a lot of fines (up to 3%), the main and re-cleaning — flotation technology is used. As reagents, FR-2 Quayt-alcohol oxidation product) picker and polyacrylamide flocculant are used. The rate of conversion of the curd to the foaming product is 80-90%

The chamber product (sylvinite and halite particles) is sent to the sylvinite flotation cycle. After passing through re-flotation, the ground slurry is condensed and washed. However, the foam formed during flotation breaks down and interferes with this process, causing a certain amount of potassium chloride to escape (lose) with the liquid phase. In order to reduce the loss of potassium chloride, if the halite suspension is heated to a temperature of 60-70°C, KCl dissolves. Then the waste is separated and removed. The solution is cooled in a vacuum crystallizer and KCl crystals are separated.

This method is used in the processing of high-quality ores. If the ore contains a large amount of slag, the viscosity of the suspension increases, which results in a high consumption of flotation reagent, a decrease in the rate of leaching of the slag, and a decrease in the KCl extraction rate. In this case, flotation beneficiation is combined with galurgic separation of KCl. In addition to these methods, there are also gravity enrichment methods.

As physico-chemical basis of sylvinite ores processing.

Separation of potassium chloride and sodium chloride in sylvinite is based on their solubility at different temperatures. Between 0°C and 100°C, the practical solubility of sodium chloride is practically independent of temperature. The solubility of potassium chloride increases significantly with increasing temperature. At 26°C, the solubility curves of KCl and NaCl intersect, meaning that both salts have the same solubility at this temperature. The solubility of KCl below 26°C is lower than that of NaCl, and the opposite is true above 26°C. Thus, when a mixture of potassium chloride and sodium chloride salts is melted around 100°C, the amount of potassium chloride in the solution is almost twice as much as the amount of NaCl. When such a solution (saturated at 100°C) is cooled, only potassium chloride crystals precipitate.

In short, the separation of potassium chloride and sodium chloride in sylvinite is based on their solubility at different temperatures. The process is carried out from 0°C to 100°C. The practical solubility of sodium chloride is almost independent of temperature, but the solubility of potassium chloride increases significantly with increasing temperature. The solubility of KCl and NaCl at 26°C is almost the same, but below 26°C the solubility of KCl is less than the solubility of NaCl, and at temperatures above 26°C it is the opposite. When a mixture of potassium chloride and sodium chloride salts is melted around 100°C, the amount of potassium chloride in the solution is almost twice as much as the amount of NaCl.

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