SEPARATION OF POTASSIUM CHLORIDE FROM SYLVINITES BY FLOTATION METHOD

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Abstract. *This article provides information on extracting potassium chloride from syvinites by flotation, gallurgic methods of potassium ore processing and gallurgic beneficiation of sylvinite ores, properties of flotation agents used in beneficiation of sylvinite.*

Keywords: *potassium, sylvinite, gallurgy, flotation, amine* S_{16} *and* S_{18}*, depressor, glycal ether, oxal, apolar (catalytic gasoil), flocculant, industrial oil, diffusion.*

The composition of the plant includes more than 70 elements, but 16 of them are very important for life. For example, such elements include the so-called organogens: carbon, oxygen, hydrogen and nitrogen. In addition, this series includes phosphorus, potassium, calcium, magnesium and sulfur - ash elements and metalbdenum, copper, boron, zinc, cobalt - trace elements, iron and manganese. Each element performs its function in the plant, and therefore one element cannot be replaced by another element. The main elements passing through the atmosphere to blue-green (green) plants are carbon. Oxygen and hydrogen are considered. These three elements account for 93.5% of the plant's dry weight: that is, carbon - 45%, oxygen - 42%, and hydrogen - 6.5%.

Potassium (K) - plays the most important physiological role in plant carbohydrate and protein metabolism, improved the conditions of absorption of nitrogen in ammonia form. Feeding plants with potassium is a powerful factor for the development of individual plant organs. Potassium creates an opportunity for the shaker plant in the juice of the host, which increases the winter resistance of the plant, allows the development of vascular bundles and the development of hosts. In addition, it increases the strength of the stems and increases their resistance to lodging.

From August 26, 2010, phosphorus, nitrogen, and potassium fertilizers are produced from microfertilizers in the Republic of Uzbekistan. However, according to scientific data, the demand for potash fertilizers in our republic is 282,000 per year. The production of 200,000 tons of potassium chloride per year by the unitary enterprise "Dehkhanabad Potash Fertilizer Plant", which is currently the only one in Central Asia, is not even enough to satisfy the needs of our republic. For Suning, increasing production capacity to 400,000 tons, i.e., total production capacity to 600,000 tons, is one of the urgent problems of today.

On May 1, 2007, the decision of the First President of the Republic of Uzbekistan I.A. Karimov "On the organization of the construction of the plant of potash fertilizers at the base of the Tubegatan mine of potash salts" was issued.

Gallurgic method of potassium ore processing.

Gallurgy is a branch of chemical technology, consists of natural salting, composition and properties of raw materials, as well as methods of obtaining mineral salts from it. [6] There are the following main types of raw materials for the gallurgy industry:

Natural salts (potassium and magnesium), mineralized waters, natural brines formed as a result of evaporation of seawater, saline ash brines, underground brines [7].

The main tasks of gallurgy are as follows: studying the formation conditions of salt deposits, their mineral composition and structures; physico-chemical properties of salts and their solutions: creation of artistic methods of production of various products from salt deposits as follows: K_2SO_4, KCl, $MgSO_4$, $MgCl_2$, Na_2SO_4, NaCl, Na_2CO_3, boron, iodine, bromine and other elements compounds [8].

To solve these problems, gallurgy is used as a method of physical-chemical analysis. Processes that take place in concentrations of water-salt systems are studied using solubility diagrams. The same diagrams are used to create gallurgy production. Gallurgy is described with the complex use of raw materials. Sodium, magnesium, potassium chlorides and sulfates are produced from slag. [9]

Production of potassium chloride from sylvinite ore in the gallurgy method is carried out by melting and separate crystallization. This process is based on the difference in solubility of KCl and NaCl in water.

The melting process is carried out at a temperature of 90 - 1000 C, and then the temperature is reduced to 20 - 250 C [10].

In solutions saturated with both salts, with increasing temperature from 20-250 C to 90-1000 C, the amount of potassium chloride approximately doubles, while the amount of sodium chloride decreases. This property of KCl and NaCl solutions was used in the cyclic process of obtaining potassium chloride from sylvinite.

The main stages of the production of potassium chloride in a closed cycle:

1. Grinding of sylvinite ore.
2. Extraction of potassium chloride from sylvinite with a hot circulating solution.
3. Separation of the hot curd from the sediment and its removal from the salty and muddy slurry.
4. Crystallization of potassium chloride when the solution is cooled.
5. Separate potassium chloride crystals from the solution and dry them.
6. Heat the solution and return it to the sylvinite solution.

This technological scheme for the production of potassium chloride from sylvinite ores by the method of melting and crystallization serves as the basis. Some differences in process regimes and technological schemes are related to changes in the composition of raw materials and the use of different construction devices [11].

The properties of the KCl - NaCl - H_2O system serve as the basis for the production of potassium chloride by the method of melting and crystallization.

Comparison of isotherms at 25 and 1000 C shows that the amount of eutonic solution sodium chloride increased at low temperatures.

According to the composition of E100 eutonic solution at 1000 C, the figurative point of the system is in the field of potassium chloride crystallization.

Therefore, as a result of cooling a solution saturated with KCl and NaCl, only KCl falls to the sediment, adding solid NaCl to the saturated solution of KCl, a part of KCl is squeezed out of the solution into the sediment [2].

When the 1000 eutonic solution is cooled from 100 to 250 C, the composition of the solution changes as a result of KCl precipitation, its figurative point of crystallization goes up to n along the Sn - E100 line. After separating the precipitate of KCl, if the solution is heated to 1000C, it becomes strongly unsaturated with potassium chloride and slightly unsaturated with sodium chloride. Therefore, when sylvinite is treated with this hot solution, it dissolves mainly with potassium chloride [13]. But it depends on the conditions of processing slivinite with a solution in the opposite flow. In the case of a solution containing almost all potassium chloride, more sodium chloride dissolves than potassium chloride, then only potassium chloride dissolves, and therefore sodium chloride precipitates from the solution. After separation of solid sodium chloride, a hot E100 eutonic solution is obtained, and potassium chloride is separated as a result of its cooling. From this, sylvinite can be separated into KCl and NaCl using a cyclic process.

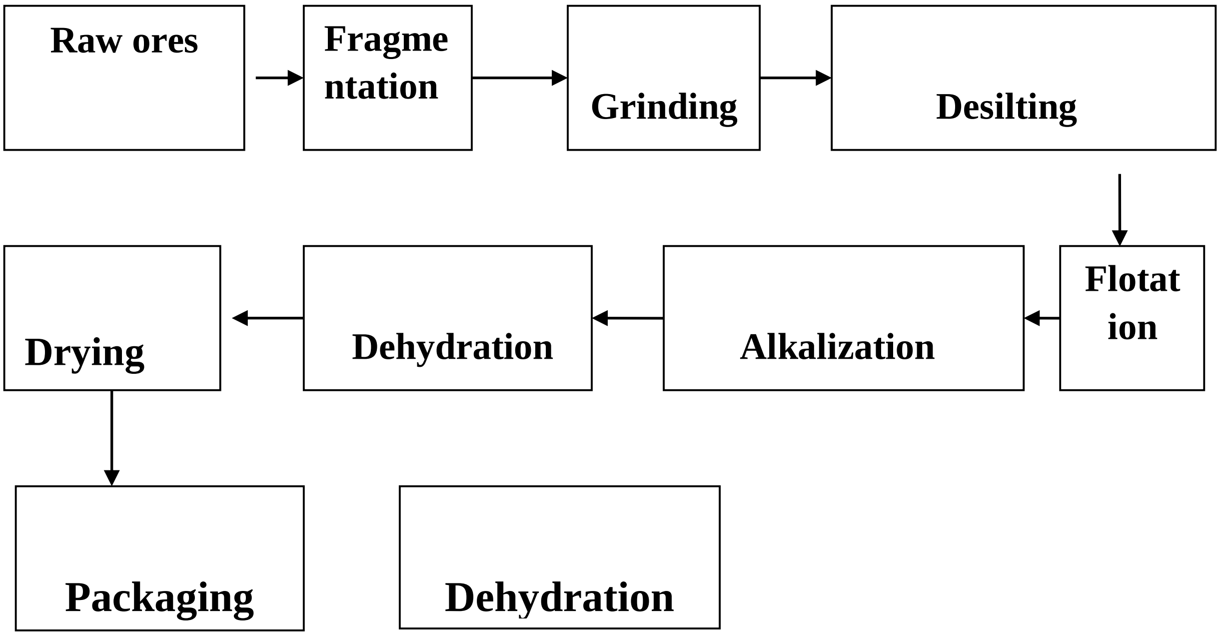
General information and protective measures.

The working days of the processing complex are 330 days. Production and auxiliary production systems work in 3 shifts a day, each shift consists of 8 hours. The processing complex has 701 employees.

The area of the processing complex is 20.16.

According to this project, it is planned to produce 200,000 tons of potassium chloride for agriculture using flotation technology. As a raw material, potassium salts from the Tyubegatan mine, located in the Kashkadarya region, are used as a raw material.

The technological scheme of the production system is presented below:



All production processes are carried out at normal temperature, only the drying process takes place at high temperature.

Raw materials for production: ore of potassium salts, flotation reagent, hydrogen hydrochloric acid, water preparation reagents.

Fuel: Natural gas

Auxiliary materials: oxygen acetylene, electrode, steel materials, diesel fuel, gasoline, grease, bags for packing.

Finished product: potassium chloride for agriculture.

The manufactured product, its characteristics and technical and operational requirements.

Potassium chloride KCl is a colorless crystal with a cubic lattice (α = 0.629 nm, z = 4 Fm3m group); At 2980 C and 1.95 MPa, a cubic modification similar to Cs Cs is formed. Boiling temperature 15000 C density 1.989 g/cm3; C0r = 51.30 Dj.

The raw materials used in this scientific work are: sylvinite from the Tubegatan mine, flotation reagents, starting water, natural gas, diesels, gasoline, lubricants and bags.

The electrical supply of the facility is provided by I and II buses of 6 kv with PS 110/35/6 kv under construction.

The chemical composition of the initial (raw) ore is as follows (%): KCl – 31,93; NaCl – 64,46; $MgCl_2$ - <0,35; $CaSO_4$ - <1,26;е. к - < 2,0.

The following enrichment reagents are used in this processing complex: depressor (SL - 1), collector (amine S16 and S18), multiformer (glygal ether or oxal), apolar (catalytic gasoyl,) flocculant (PAA 23 - with a molecular mass of 17 million a.e.t.), dust suppressant (industrial oil U-40), hydrogen chloride acid (30%).

Initial water is taken from the Pachkamar reservoir in the volume of 669.97 m3/d. It is necessary to purify domestic and industrial water, because the original water contains large amount of salts.

Medical gas is used as household and industrial fuel. In the normal mode of operation, the consumption of natural gas is 1030 st.m3 /g (annual consumption of gas is 4.8*106, output pressure is 0.6 Mpa).

Large grain flotation technology is used in this work. The size of raw ores entering the flotation process is 1 mm.

The flotation process comes after crushing, crushing, classification and de-slurrying of raw ores. For the flotation process, basic flotation and triple retreatment are used. From the basic flotation foam product classification, the first re-cleaning of the product under the grid is used. From the main flotation foam product classification, the under-grid product is fed to the first retreatment, and the under-grid product and the foam product of the re-treatment III are mixed and the initial potassium chloride is formed.

The results obtained

Technology of beneficiation of sylvinite deposits by gallurgical method

If melting is carried out in an isothermal condition at 100°C, NaCl will lie on the saturation line at point S1, and thus the melting of NaCl from the ore will end. At point X, the system consists of liquid phase and undissolved NaCl. We determine the composition of the liquid phase by building Ax (the crystallization light of NaCl) and continuing until it intersects the KE line. Thus, if the substance is added to the liquid phase, KCl dissolves in the compound.

NaCl remains undissolved. Figurative point of the liquid phase is moved along the S1 UE curve. In this case, the amount of NaCl in the liquid phase decreases not only due to the weight fraction concentration (because the S1 UE curve has a negative slope everywhere), but also because the amount of water does not change, KCl turns NaCl into crystals.

S_1 V beam S_1 mixture of solution with KCl S_1 U_1 U_2 section enters the internal field of selection of NaCl. Accordingly, the addition of KCl to the S_1 solution leads to the crystallization of NaCl. Halite grains do not grow when crystallizing NaCl is removed from the solution, but a thin dispersed phase of salt is formed.

Thus, the dissolution of KCl from sylvinite ore is carried out with the formation of a saline dispersed phase, and its amount is greater the smaller the melting radius of the ore is in the S0 S1 section. The formation of salty sludge during the melting of sylvinite ore is not desirable and is determined by the kinetics of salt dissolution.

The figurative point of salt without water is at infinity. In this case, it causes inconvenience in observing processes involving anhydrous or wet crystals. But, in initial cases, such diagrams have advantages.

The saturation line of NaCl (crosses the vertical axis of the coordinate) has a negative slope, and therefore it is concluded that NaCl crystallized in the presence of KCl.

On the other hand, the saturation line of KCl (cuts the horizontal line of the coordinate) is not vertical and has a minus curvature.

Therefore, salt solubility decreases in the presence of KCl-NaCl. However, the decrease in NaCl concentration in the presence of KCl is more dramatic than the decrease in KCl concentration in the presence of NaCl. The effect of NaCl on the desalination of KCl is much stronger than the effect of KCl on the desalination of NaCl. You can follow the evaporation process with the help of the diagram below.

Thus, if the initial solution f1 is at temperature t2 (for example, 75°C), after evaporation, its composition is f2, temperature t3, it can be seen from the location of points f1 and f2 relative to the isotherm t3 that f1- to ``undissolved solution, f2- suspension of KCl crystals, because the point f1 is located to the left of the isotherm t3. To determine the composition of the liquid phase in the f2 suspension (solution), we draw a horizontal straight line - the crystallization ray of KCl and find the horse point where it intersects with the isotherm.

The difference between the abscissas of points f2 and m resulting from evaporation of solution f1 based on 1 kg of water m solution gives the weight of KCl crystals.

After that, the total weight of KSl crystals is equal to (m.f2).

The amount of evaporated water is found according to the lever rule: if we take the barycentric component of the water system for the conditional weight of the complex:

$|H^*| : |f_1^*| = (f_1\ f_2) : (H\ f_2)$ 4.1

there $|H^*|$, $|f_1^*|$ - $|H|$ - weight of water in steam and (f1) vaporized solution; $(f_1\ f_2)$, $(H\ f_2)$ – the length of the evaporation ray.

As before, the ratio of the lengths of f1f2 and Hf2 segments can be replaced by the difference in the projection of points on the abscissa axis. When the mass of crystallized NaCl is isothermally evaporated at temperature t2, the solution q1 is evaporated, the state where the amount of crystallized NaCl is represented by the point q2 is determined by the length of the piece q2R, the weight of water I R*\ by the final composition of the complex R, and {d2 R)-\ R* is equal to the product \. When evaporating v\ solution to e2 state at 1g temperature, co-crystallization of KC1 and N001 salts occurs, because point e2 is located at a right angle with end E and consists of vertical and horizontal lines. It also forms the field of co-crystallization of salts. e2-1-E - crystallization path. e2 shows the amount of crystallized KCl in the 1st part. 1E - e2, I or YE complexes show the amount of #gS/ crystallized in 1 kg of water.

The quoted values are equal to the difference between the coordinates of SHS1 and KC1 axis. The first is a defining diffusion phenomenon, the crystals on the surface of the molten raw material are transferred to the volume of the liquid phase. Movement has an imperceptible effect.

Due to the continuous formation of primary crystals and their growth, all products of crystallization are always polydisperse. The presence of foreign substances in the solution (for example, the presence of NaCl in the crystallization of KCl) slows down the mixing processes, leads to the appearance of small dispersed crystals, and especially slows down the crystallization of KCl from eutonic solutions.

During crystallization, increasing the size of crystals is carried out by placing a tube, organizing the circulation of the crystal suspension from the crystallizers, and removing the large dispersed fractions.

Increasing the average size of the crystals can be achieved by gradually cooling the solution. The physico-chemical characterization of KCl-NaCl-H_2O systems is used to select the technological mode of production of potassium chloride.

One of the most important operations of production of KCl by galurgy method is smelting - melting of ore in heated (alkali) re-alkali, clarification (typing) of salt suspension, vacuum-crystallization obtained in the previous stages, separation of KCl crystals in strong alkali.

Summary

1. Methods of beneficiation of sylvinite ore were analyzed.
2. Processes of beneficiation of sylvinite ore by gallurgic and flotation methods were studied.
3. The properties of flatoreagents used in beneficiation of sylvinite were studied.
4. The effect of slurry on beneficiation of sylvinite ore was studied.
5. The environmental impact of Dehkhanabad potash fertilizer factory waste was studied.

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