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PROSPECTS FOR RATIONAL USE OF MINERAL RESOURCES OF THE DZHAKSY-KLYCH DEPOSIT, THE ARAL REGION

Abstract. Rational use of mineral resources is becoming an important task for the development and economic growth of Kazakhstan. The purpose of the research was to study the state of salt-containing raw materials to determine the prospects for rational use of mineral resources of the Dzhaksy-Klych Deposit, one of the salty halite lakes of the Aral region. Exploration studies have shown that the Deposit is layered, where the halite layer is underlain by a sulfate layer: astrakhanite, mirabilite, tenardite, located on a layer of silt, the bed of salt deposits is dark brown clays, less often - clay Sands. Mineralogically, the halite formation is represented by, %: halite – 90-96, epsomite -1,2-2,6, mirabilite -0,2-1,9, gypsum-0,2-1,4. The production of table salt results in waste containing 65.5% chlorides, 24.5% sulfates, 6.5% sodium carbonates, and 3.5% sodium silicates, which can be used for pharmaceutical and medical purposes. Bottom silty mud by its origin and chemical composition belongs to the mainland silt-sulfide type and can be used for Spa and balneological treatment. The reserves of sulphate salts in the field are significant, with the average thickness of the sulphate reservoir in the southern basin being 0.87 m, and in the Northern basin 0.91 m. Intergranular and surface brine containing sodium and magnesium chloride-sulfate salts is of particular interest. Analysis of the state of mineral resources of the Dzhaksy-Klych Deposit revealed prerequisites for expanding the range of opportunities for using salt-containing raw materials. A promising direction for the development of the mineral resource base is the production of soda based on sodium chloride, as well as the production of a commercial product based on sodium sulfate and magnesium chloride. Microbiological examination showed the presence of non-pathogenic forms of halophilic bacteria in the salt-containing raw materials, which indicates safety for use in pharmaceutical and medical practice. In the Aral sea region, there is every reason for the development of the cosmetology industry, where a wide range of cosmetology and pharmaceutical products can be produced based on a combination of salt-containing and local vegetable raw materials.

Key words: Dzhaksy-Klych Deposit, salt-containing raw materials, halite salt, sulfate salt, brine, natural resources.

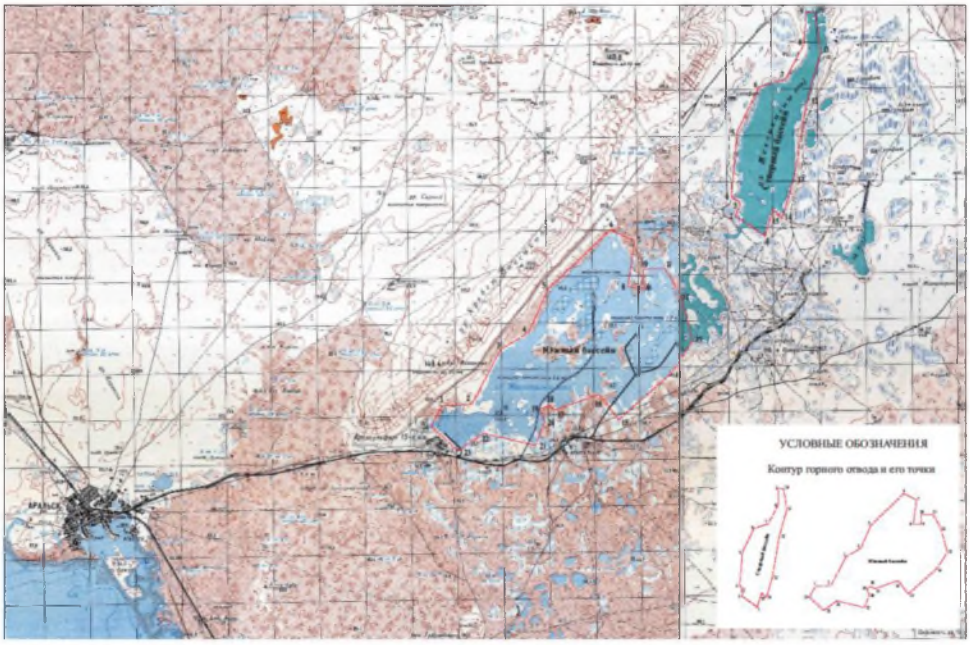
Introduction. One of the main riches of the Republic of Kazakhstan is the mineral resource base. Assessment of natural resources, their reserves, extraction and rational use is becoming an important task for the development and economic growth of our state. It should be noted that the rational use of natural resources, including the mineral resource base, implies the most complete extraction of all valuable components with the least change in the resource potential and the state of the environment (Luneva E. V., 2017). Kazakhstan has a developed mineral resource base, while the Republic ranks sixth in the world in terms of mineral reserves. According to international experts, the value of the proven balance reserves of the main types of minerals is 10 trillion us dollars. According to E. G. Karibayev (2014) the Republic of Kazakhstan has significant forecast resources of oil – 17 billion tons, iron – 148 billion tons, manganese – 4.7 billion tons and chromite ores – about 3 billion tons, copper – 182 million tons, lead – 108 million

tons, zinc 220 million tons, bauxite – 1.2 billion tons, tungsten – 4.8 million tons, molybdenum – 6.2 million tons, gold – 15 thousand tons, nickel – 4.8 million tons, titanium – 291 million tons, tin – 1.7 million tons, uranium – 600 thousand tons and coal 90 billion tons. Attracting investment in the development of the mineral resource base of Kazakhstan contributed to the republic's entry into the top ten countries both in terms of mineral reserves and the development of new deposits.

In the future, the forecast reserves of minerals, which can include deposits of various salts, are of great importance. The Aral sea and the system of lakes located around it represent a mineral resource base of various salt-containing raw materials, ranging from various types of salts to types of brine, silt and, importantly, waste after processing of the initial salts. Of particular interest is the Dzhaksy-Klych salt lake, which has become a salt deposit as a result of drying up. Despite the long history of studying lake systems and the Aral sea itself, a number of established parameters of the chemical, mineralogical and microbiological composition of the Dzhaksy-Klych Deposit require additional research. This need is dictated by the search for rational use of the entire potential of the mineral resource base.

In this regard, the purpose of the research was to study the state of salt-containing raw materials to determine the prospects for rational use of mineral resources of the Dzhaksy-Klych Deposit.

Objects and methods of research. The object of the study was the Dzhaksy-Klych Deposit, located in the North-Eastern Aral sea region, northeast of the Sary-Chaganak Bay of the Aral sea, 15-20 km from the railway station and occupies the Dzhaksy-Klych hollow (figure). In addition, the research uses salt-containing raw materials of the deposit: halite, sulfate, magnesium, mixed salts, brine, silt**.**



Map location of the deposits Dzhaksy -Klych

The area of the Northern basin with islands is 19,21km^2, without islands – 18,97 km^2. The area of the Southern basin is more than 35 km^2 (without islands). The area of the deposit belongs to the zone of deserts and semi-deserts, where the average annual precipitation is 126-182 mm, falling in dry years to 64-70 mm.

Exploration work was carried out by "Onyx-R" LLP on the order of "Araltuz" JSC. In 2017-2019, an exploration network of 300x400m (Northern basin) and 400x400m (Southern basin) was used for field exploration, with maximum overlap with the workings of the predecessors. The field was studied to a depth of by drilling wells. The drilling depth is determined by the peculiarities of the geological structure and was 0.3-6.1 m. Exploration drilling volumes totaled 392 wells (847.5 m), including 252 wells (494.5 m) in the Southern basin and 140 wells (352.5 m) in the Northern basin. The core yield from exploration wells was 100%.

Drilling was carried out by UKB-12/25 "Pombur" and "Strong Hydro 21PU" drilling rigs using the core method with graphite crowns without flushing. The drilling diameter of ordinary wells is 93mm. The representativeness of the main core testing for exploration wells with a drilling diameter of 93mm is controlled by sampling core samples from control wells with a larger diameter of 151mm.

The volumetric weight was determined from the surface by excavating the salt pillars by clogging a pipe with a diameter of 219mm with an internal diameter of 201mm, a length of 400mm and a massive square head. A total of 126 volume mass determinations were made during the exploration period, including 72 determinations in the Southern basin and 54 in the Northern basin.

Methods of differential thermal analysis and differential scanning calorimetry were used to study the chemical, mineral, and mineralogical compositions of salt-containing raw materials. The analyses were carried out at the A. Mickiewicz state University of Poznan (Poland).

Microbiological examination was carried out according to the methods accepted in Microbiology with isolation of microorganisms on the nutrient media with a content of 1.0% NaCL: heterotrophs –on MPA, enterobacteria –on Endo-Ploskirev medium, micromycetes-on Chapek medium.

Statistical processing. Experiments were carried out five times in repetition, calculate the standard deviation at 0.95> P> 0.80. Statistical processing was performed using the statistical software package Microsoft Excel on a PC «Pentium-IV». By the number of measurements and in general diagnostic group determined the arithmetic mean (Schabenberger O. and Pierce F.J., 2002). In some cases, statistical processing of results to represent averaged data does not show the entire range of primary data obtained, so the data series is shown in the "from" and "to" variants.

Research results. The Dzhaksy-Klych Deposit is confined to modern lake deposits. All salt lakes of the Deposit are divided into three main types according to their regime, composition of salt deposits and genesis features: mirabilite, tenardite and halite. The Southern and Northern basins of the Dzhaksy-Klych Deposit are considered to be halite lakes. The salt deposit has a plast-like shape and is surrounded by a silt "pillow"on all sides. The top layer is always represented by halite. The halite layer is mainly underlain by a sulfate layer: astrakhanite, mirabilite, tenardite, and less often others, which is underlain by a layer of silt below. The bed of salt deposits is dark brown clay, less often- clay sands. Measurements and calculations showed that the volume weight of halite is 1.28±0.10 t/m^3. Averaged data on the component composition of the Northern/Southern basins are as follows, %: NaCI - 92.23/92.27; Ca -0.46/0.74; Mg - 0.64/0.40; SO_4 -2.4/2.4. mineralogical characteristics of the halite formation are presented, %: halite – 90-96, epsomite -1.2-2.6, mirabilite -0.2-1.9, gypsum-0.2-1.4.

Using differential thermal analysis and differential scanning calorimetry, it was found that the initial salt-containing raw materials of the Dzhaksy-Klych Deposit contain NaCl , Na_2CO_3, $CaSO_4 \times 2H_20$, Na_2SO_4, Na_2SiO_4. Some samples contain minerals of a more complex structure such as astrakhanite ($Na_2Mg(SO_4)_2 \times 4H_2O$). Some salt samples are a mixture of halite (NaCl), astrahanite, magnesium sulfate hexahydride ($MgSO_4 \times 6H_2O$), gypsum ($CaSO_4 \times 2H_2O$), and sodium sulfate (Na_2SO_4), presumably in the form of mirabilite ($Na_2SO_4 \times 4H_2O$).

Microbiological examination showed the presence of mobile halophilic heterotrophic rod-shaped and coccoid bacteria in samples of halite salts taken from depths of 0-10 cm. The largest number of bacteria (103 CFU/g) was found in samples taken along the coastline, and a pattern was observed for reducing the number of bacteria to 10-10^2 CFU/g as the distance from the coast to 10-12 m.

Of interest are the waste products of table salt production from this deposit, which contain 65.5% chlorides (NaCl), 24.5% sulfates ($CaSO_4 \times 2H_20$ and Na_2SO_4), 6.5% sodium carbonates (Na_2CO_3), and 3.5% sodium silicates (Na_2SiO_4).

In addition, the deposit has a large reserve of bottom silty mud, which by origin and chemical composition belongs to the continental silt-sulfide type, which includes sand, clay, iron sulfurous compounds, colloidal substances of mineral and organic origin. The amount of water varies between 37.5±3.5%. The ionic composition of the mud liquid phase solution is: sodium – from 1.99 to 18.12%; sulfate - ion from 25.7 to 44.23%.; calcium - from 1.11 to 2.16%.; magnesium – from 3.89 to 4.24%.; potassium – from 0.78 to 1.11%.; carbonate-ion– from 0.22 to 0.57%.; chlorine– from 1.89 to 3.11%. In addition, it contains a large number of trace elements.

The average thickness of the sulphate reservoir in the Southern basin is 0.87±0.05 m, and in the Northern basin 0.91±0.06 m. The mineralogical composition is represented by,%: halite (from 0.7 to 70),

astrakhanite (from 10 to 50), epsomite (from 1 to 30), kizerite(from 0.9 to 30), mirabilite (from 0.2 to 30), tenardite (from 0.3 to 65) and gypsum (from 0.2 to 10). The ionic composition is represented by chlorides, sulfates, bicarbonates, potassium, sodium, magnesium and calcium with a predominance in the Southern/In the Northern basin, sulfate ions 36.58/37.21 %; chloride ions -20.95/19.09%; sodium - 19.38/18.49%. In the mineral composition of a sulfate formation consisting of $Ca(HCO_3)_2$, KCl, NaCl, $MgCl_2$, $CaSO_4$, $MgSO_4$, K_2SO_4, Na_2SO_4 dominate, respectively, Southern/Northern basins - NaCl (34.19/30.89 %), $MgSO_4$ (25.28/25.49%); Na_2SO_4 (19.35/18.8%). Of particular interest is brine, a concentrated salt solution that permeates salt deposits. Brine density: 1.15-1.40 g/cm^3 at temperatures from +7^{0}C to -16^{0}C. Hydrogen indicator (pH) – of 6.79 and 7.33. The salinity of the brine – 299,29-428,18 g/dm^3. To study the amount of brine evaporation, two evaporators for brine and fresh water were installed in each of the pools (Northern and Southern). Measurements and calculations showed that in the Northern basin , the volume of brine evaporation per day is 3.343 l/m^2, in the Southern basin - 4.020 l/m^2, while the annual volume of brine evaporation in the basins is, mln.m^3: Northern basin – 20.26; Southern basin - 53.41 (table).

Chemical composition of intercrystal brine of the Dzhaksy-Klych Deposit

№	Components	Content					
		Southern basin			Northern basin		
		from	to	average	from	to	average
Ions, mg/dm^3							
1	Na^+	57000	81250	54446	49500	79700	61176
2	K^+	668	8830	6695	2680	13060	49500
3	Ca^{2+}	<2	<2	<2	<2	<2	<2
4	Mg^{2+}	23104	52288	42020	11552	51072	37088
5	CO_2^{2-}	<8	<8	<8	<8	<8	<8
6	HCO_3^-	439	1025	787	275	1495	859,8
7	Cl^-	163102	207423	184598	161329	187922	172897
8	SO_4^{2-}	3787	80097	37613	13994	67914	45208

The mineral composition of both types of brine differs only in the magnesium component and is represented by the following characteristics of intercrystal/surface brine in the Southern basin, %: KCl - 1.28/0.8; NaCl - 13.92/18.61; $MgCl_2$ - 12.3/7.48; $MgSO_4$ - 5.26/2.99. In the Northern basin,%: KCl - 1.49/0.99; NaCl - 15.51/18.97; $MgCl_2$ - 10.85/6.97; $MgSO_4$ - 4.65/3.0. The absence of $Ca(HCO_3)_2$, K_2SO_4, Na_2SO_4, and $CaSO_4$ in all samples. In the brine selected from the halite formation from a depth of 0.3 m, bacterial microflora was observed, represented by small halophilic coccoid and rod-shaped mobile bacteria.

Halite reserves were calculated for the Northern basin in categories B+C_1 – 17520. 87 thousand tons (NaCl-92.19%), for the Southern basin these indicators are higher – 30239. 75 thousand tons (NaCl-92.26%). In the Northern basin, the bottom layer halite reserves are classified as off – balance sheet in categories C_1-3 687.17 thousand tons (NaCl-83.44%). Established reserves for brine: for the Northern basin in categories C_1 – 11,822,0 thousand m3 with a NaCl content of 15.51% and for the southern basin in categories C_1 - 21,899,1 thousand m^3 with a NaCl content of 13.92%. Stocks taken as off-balance - it supplies the mixed sulfate salts - the Northern pool C_1 – 17 520.87 thousand tons, for the Southern pool C_1 – 39567.88 thousand tons. Revealed that the reserves of halite resume number: for the Northern basin – 343.4±30.3 thousand tons per year, for the Southern basin - 393.59±35.3 thousand tons per year.

Discussion. Currently, only halite salt is widely used, while "Araltuz" JSC produces a wide range of products of more than 39 names that meet regulatory requirements (SanPiN 2.3.2.560-96 (4.01.047-97), ST RK GOST R 51574-2003, Iskakov T. U. et al., 2020). However, rational use of the mineral resource base of the Dzhaksy-Klych Deposit implies expanding the range of possibilities for using salt-containing raw materials in addition to obtaining an assortment of sodium chloride products. A promising direction

for the development of the mineral resource base is the production of soda based on sodium and magnesium sulfates, chloride and mixed salts (Yuan F., et al., 2020). Unfortunately, such a resource as salt-containing raw materials: salt, silt, brine is not used by any of the Kazakh companies that produce cosmetology products. Despite the well-known antiseptic and bleaching properties of salt, saturation of the skin with minerals, macro and microelements, acceleration of regeneration of damaged integuments and stimulation of the autonomic nervous system, this component is undeservedly overlooked (Panova O., 2012). The use of salts and mud from the Dead sea, lakes in France and Gabon for cosmetic purposes is known (Portugal-Cohen, M. et al., 2009, Eba, F et al., 2010), studies have been conducted related to the use of Dead sea mineral water to protect the skin from air-polluting ingredients (Portugal-Cohen, M., et al.,2017). Laboratory experiments have shown that the salts, brine, and clay of lake Dzhaksy-Klych have a detrimental effect on hydrobiont organisms, including pathogenic microflora (Issayeva et al., 2018). According to the results of microbiological studies conducted on various salt-containing sources, the microflora is characterized by a wide variety of halophilic forms of viruses(Emerson J. B. et al., 2013), bacteria (Jioang H. et al., 2007; Lee and Lee, 2014, Kemp B. L. et al., 2018), micromycetes and protozoa (Haner G. and Rogerson A., 2005).

Despite the revealed heterotrophic microflora in salt-containing raw materials, according to numerous studies (Litshfield, 2011; Canfora L. et al, 2017). Research is continuing on the effect of salt-containing raw materials on various parameters of age-related skin. The interfacial distribution of boric acid between aqueous solutions and modified cellulose was studied (Sarsenov et al., 2018). For rational use of the entire potential of the mineral resource base, it is necessary to take into account the plant resources of the region. Currently, 342 species of vascular plants belonging to 43 families and 170 genera have been registered in the Aralkum desert in Kazakhstan. The leading families are: Chenopodiaceae (83 species), Asteraceae (45), Brassicaceae (32), Fabaceae (22), Roaceae (19), Boraginaceae (13), Suregaseae (5), Ariaceae (5). Among the life forms, annuals (41.5%), herbaceous perennials (31.9%) and shrubs (16.7%) predominate. Studies by L. A. Dimeeva and I. Pankratova (2011) showed that the flora of the Aral sea coast includes 414 species belonging to 43 families and 192 genera. We have compiled a summary of the flora of medicinal plants of the Aral sea region, represented by 56 plant species of which 25% belong to the families Asteraceae, Poaceae 32%, Amaranthaceae 22%, Tamaricaceae 21%. The complete composition of phenolic compounds of a number of medicinal plants, including a list of about 200 compounds, was studied. More than 10 prototypes of cosmetic products have been developed, including bath salts, scrubs, masks, soaps, etc., and their effect on the condition of different skin types has been studied. The preliminary results show the prospects of using domestic salt-containing and plant raw materials and the need for further research in the rational use of the entire potential of the mineral resource base of the Dzhaksy-Klych Deposit and the surrounding area. The combination of plant and salt resources will allow you to develop a wide range of cosmetic products for baths, lotions and rinses. The obtained information provides a basis for predicting the prospects for the use of salt-containing and plant resources in Spa and balneological treatment and the creation of cosmetology production for the innovative and industrial development of the Aral sea region.

Conclusion. As a result of geological exploration studies, it was revealed that the halite layer in the Northern and southern basins of the field is underlain by a sulfate layer: astrakhanite, mirabilite, tenardite, and less often others, which is underlain by a layer of silt below. The bed of salt deposits is dark brown clay, less often- clay sands. Mineralogical characteristics of the halite formation are represented by halite, epsomite, mirabilite, and gypsum. Waste from the production of table salt contains 65.5% chlorides, 24.5% sulfates, 6.5% sodium carbonates, 3.5% sodium silicates, which can be used for pharmaceutical and medical purposes. The Deposit has a large reserve of bottom silty mud, which by origin and chemical composition belongs to the mainland silt-sulfide type and is applicable for Spa and balneological use. The Dzhaksy-Klych Deposit has significant reserves of sulfate salts, intercrystal and surface brine. The analysis of the state of the mineral resource base of the Dzhaksy-Klych Deposit showed a wide range of possibilities for using salt-containing raw materials. A promising direction for the development of the mineral resource base is the production of soda based on sodium chloride, as well as the production of a commercial product based on sodium sulfate and magnesium chloride. Microbiological examination showed the presence of non-pathogenic forms of halophilic bacteria in the salt-containing raw materials, which indicates safety for use in pharmaceutical and medical practice.

In the Aral sea region, there are all prerequisites for the development of the cosmetology industry, where a wide range of cosmetology products can be produced on the basis of salt-containing and local plant raw materials, which will not only make rational use of the mineral resource base of the Dzhaksy-Klych Deposit, but will also help reduce social tension in the region by creating additional jobs.

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АРАЛ ӨҢІРІНДЕГІ ЖАҚСЫ ҚЫЛЫШ КЕН ОРНЫНЫҢ МИНЕРАЛДЫ ШИКІЗАТ РЕСУРСТАРЫН ҰТЫМДЫ ПАЙДАЛАНУ ПЕРСПЕКТИВАЛАРЫ

Аннотация. Минералды шикізат ресурстарын ұтымды пайдалану Қазақстанның дамуы мен экономикалық өсуі үшін маңызды міндетке айналуда. Зерттеудің мақсаты – Арал өңіріндегі тұзды галит көлі – Жақсы қылыш кен орнының минералды шикізат ресурстарын ұтымды пайдалану перспективаларын анықтау үшін құрамында тұзы бар шикізаттың жай-күйін зерттеу. Геологиялық барлау зерттеулері кен орнының қабатты болып келетінін көрсетті, онда галит қабаты сульфат қабатының: астраханит, мирабилит, тұнба қабатында орналасқан тенардит, қара қоңыр саз, сирек сазды құм тұзды шөгінділердің астында жатады. Минералогиялық тұрғыдан галит қабаты, %: галит 90-96, эпсомит 1,2-2,6, мирабилит 0,2-1,9, гипс 0,2-1,4. Ас тұзын өндіру нәтижесінде құрамында 65,5% хлорид, 24,5% сульфат, 6,5% натрий карбонаттары, 3,5% натрий силикаттары бар қалдықтар пайда болады, оларды фармацевтикалық және медициналық мақсаттарда пайдалануға болады. Төменгі сазды балшық шығу тегі мен химиялық құрамы бойынша материктік тұнба – сульфид түріне жатады және оны курорттық-бальнеологиялық емдеу үшін қолданады. Кен орнындағы сульфат тұзының қоры едәуір кездеседі, бұл ретте Оңтүстік бассейні бойынша сульфат қабатының орташа қуаты 0,87 м, ал Солтүстік бассейн бойынша 0,91 м құрайды. Натрий мен магнийдің хлоридті-сульфатты тұзы бар кристаларалық және беттік рапс ерекше қызығушылық тудырады. Жақсы қылыш кен орнының минералды шикізат ресурстарының жай-күйін талдау құрамында тұзы бар шикізатты пайдалану мүмкіндігінің ауқымын кеңейту үшін алғышарттарды анықтады. Минералды шикізат базасын дамытудың перспективалы бағыты – натрий хлориді негізінде сода өндіру, сондай-ақ натрий сульфаты мен магний хлориді негізінде тауарлық өнім алу. Микробиологиялық тексеру құрамында тұзы бар шикізатта галофильді бактериялардың патогенді емес түрлерінің кездесетінін айқындады әрі бұл фармацевтикалық және медициналық практикада қолданудың қауіпсіздігін білдіреді. Арал өңірінде косметологиялық саланы дамыту үшін барлық негіз бар, онда құрамында тұзды және жергілікті өсімдік шикізатының үйлесімі негізінде косметологиялық және фармацевтикалық өнімдердің ассортиментін өндіруге болады.

Түйін сөздер: Жақсы қылыш кен орны, құрамында тұзы бар шикізат, галит тұзы, сульфат тұзы, рапа, минералды шикізат ресурстары.

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ПЕРСПЕКТИВЫ РАЦИОНАЛЬНОГО ИСПОЛЬЗОВАНИЯ МИНЕРАЛЬНО-СЫРЬЕВЫХ РЕСУРСОВ МЕСТОРОЖДЕНИЯ ДЖАКСЫ-КЛЫЧ, АРАЛЬСКИЙ РЕГИОН

Рациональное использование минерально-сырьевых ресурсов становится важной задачей для развития и экономического роста Казахстана. Целью исследования было изучение состояния солесодержащего сырья для определения перспектив рационального использования минерально-сырьевых ресурсов месторождения Джаксы-Клыч, одного из соленых галитовых озер Аральского региона. Геологоразведочные исследования показали, что месторождение сложено послойно, где пласт галита подстилается сульфатным пластом: астраханитом, мирабилитом, тенардитом, расположенном на слое ила, ложем соляных отложений являются тёмно-коричневые глины, реже – глинистые пески. Минералогически галитовый пласт представлен, %: галитом – 90-96, эпсомитом – 1,2-2,6, мирабилитом – 0,2-1,9, гипсом-0,2-1,4. В результате производства поваренной соли образуются отходы, содержащие 65,5% хлоридов, 24,5% сульфатов, 6,5% карбонатов натрия, 3,5% силикатов натрия, которые возможно использовать в фармацевтических и медицинских целях. Донная илистая грязь по происхождению и химическому составу относится к материковому илово-сульфидному типу и может быть использована для курортно-бальнеологического лечения. Запасы сульфатных солей на месторождении значительны, при этом средняя мощность сульфатного пласта по Южному бассейну составляет 0,87м, а по Северному бассейну – 0,91м. Особый интерес представляет межкристальная и поверхностная рапа, содержащая хлоридно-сульфатные соли натрия и магния. Анализ состояния минерально-сырьевых ресурсов месторождения Джаксы-Клыч выявил предпосылки для расширения диапазона возможностей использования солесодержащего сырья. Перспективным направлением развития минерально-сырьевой базы является производство соды на основе хлорида натрия, а также получение товарного продукта на основе сульфата натрия и хлорида магния. Микробиологическое обследование показало наличие в солесодержащем сырье непатогенных форм галофильных бактерий, что указывает на безопасность для применения в фармацевтической и медицинской практике. В Приаральском регионе имеются все основания для развития косметологической отрасли, где на основе сочетания солесодержащего и местного растительного сырья можно производить широкий ассортимент косметологической и фармацевтической продукции.

Ключевые слова: месторождение Джаксы-Клыч, солесодержащее сырье, галитная соль, сульфатная соль, рапа, минерально-сырьевые ресурсы.

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