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Satbayev University

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ
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T. Ustabaev, M. Mirdadayev*, N. Balgabaev, I. Kudaibergenova, B. Amanbayeva

Kazakh Scientific Research Institute of Water Economy, Taraz, Kazakhstan.
E-mail: mirdadaev@mail.ru

RESEARCH OF THE GEOLOGICAL CONDITIONS OF THE PASTURE TERRITORIES OF THE ZHAMBYL REGION FOR THE PURPOSE OF DESALINATION MINERALIZED GROUNDWATER

Abstract. In the article, eaking into account the geological conditions of the pasture areas of the Zhambyl region, as well as the high mineralization and low yield of underground water sources located here, the economic use of groundwater is possible only with the provision of the desalination process with scientifically based methods.

The article considers the geological conditions of the distant pasture areas of the Zhambyl region and the possibility of water supply for distant pasture livestock breeding using mineralized groundwater by desalination.

The analysis of the geological and hydrogeological conditions of the territory under consideration carried out, brief characteristics of the main groundwater deposits in the Zhambyl region are given, the levels of groundwater occurrence are established, methods for improving the technology of brine utilization after desalination are given in order to reduce their volume and obtain commercial salts. Laboratory tests of the reverse osmosis module with the ESPA1-400 device carried out.

Based on the studies obtained, recommendations will be developed for the operation of desalination plants and the use of recycled brines, which will take into account the geological and hydrogeological characteristics of the Zhambyl region. Also, the results of the research will be tested on an area of 50 thousand hectares of remote pastures with a difficult water supply due to increased mineralization of groundwater.

Key words: Geological conditions, hydrogeological characteristics, desalination, reverse osmosis, brine, disposal.

Т.Ш. Устабаев, М.С. Мирдадаев*, Н.Н. Балгабаев, И.Р. Құдайбергенова, Б.Ш. Аманбаева

Қазақ су шаруашылығы ғылыми-зерттеу институты, ЖШС,
Тараз, Қазақстан.
E-mail: mirdadaev@mail.ru

ЖАМБЫЛ ОБЛЫСЫНЫҢ ЖЕР АСТЫ СУЛАРЫН ТҰЩЫЛАНДЫРУ МАҚСАТЫНДА ЖАЙЫЛЫМДЫ ЖЕРЛЕРДІҢ ГЕОЛОГИЯЛЫҚ ЖАҒДАЙЫН ЗЕРТТЕУ

Аннотация. Жамбыл облысының шалғай аудандарының геологиялық жағдайын, сондай-ақ осында орналасқан жер асты су көздерінің жоғары минералдануын және төмен шығымдылығын ескере отырып, жер асты суларын тұщыландыру процесін ғылыми негізделген әдістермен қамтамасыз ету қажет.

Мақалада Жамбыл облысының шалғайдағы жайылымдық аймақтарының геологиялық жағдайы және минералданған жер асты суларын тұщыландыру арқылы алыстағы жайылымдық мал шаруашылығын сумен қамтамасыз ету мүмкіндіктері қарастырылған. Қарастырылып отырған аумақтың геологиялық және гидрогеологиялық жағдайларына талдау жүргізілді, Жамбыл облысындағы жер асты суларының негізгі кен орындарының қысқаша сипаттамасы келтірілді, жер асты суларының пайда болу деңгейлері белгіленді, тұзсыздандырылғаннан кейін тұзды пайдалану технологиясын жетілдіру әдістері анықталды. ESPA1-400 құрылғысымен кері осмос модулінің зертханалық сынақтары жүргізілді. Режимдік параметрлер арасындағы байланысты: қысым мен минералдану, өткізгіштік пен концентраттың арақатынасы, күрделі салымдар мен тұзсыздандырылған су құнының нақты көрсеткіштерінің мәндері сипаттайтын бірқатар тәуелділіктер құрылды.

Тұзды қайта пайдалану элементтерімен тұзсыздандырудың технологиялық схемасы ұсынылған, Жамбыл облысындағы жайылымдарды суару үшін пайдаланылатын жер асты минералданған сулардың аналогтары бойынша кері осмос элементтерін сынау үшін зертханалық мәліметтер келтірілген. Алынған зерттеулер негізінде Жамбыл облысының геологиялық және гидрогеологиялық ерекшеліктерін ескере отырып, тұщыландыру қондырғыларын пайдалану және қайта өңделген тұзды ерітінділерді пайдалану бойынша ұсыныстар әзірленетін болады. Сондай-ақ, зерттеу нәтижелері жер асты суларының минералдануының жоғарылауына байланысты сумен қамтамасыз етілуі қиын 50 мың гектар шалғай жайылымдарда сынақтан өткізілетін болады.

Түйін сөздер: гидрогеологиялық сипаттамалары, тұзсыздандыру, кері осмос, тұзды ерітінді, қайта пайдйлану.

Т.Ш. Устабаев, М.С. Мирдадаев*, Н.Н. Балгабаев, И.Р. Кудайбергенова, Б.Ш. Аманбаева

Казахский научно-исследовательский институт водного хозяйства,
Тараз, Казахстан.
E-mail: mirdadaev@mail.ru

ИССЛЕДОВАНИЕ ГЕОЛОГИЧЕСКИХ УСЛОВИЙ ОТГОННЫХ ТЕРРИТОРИЙ ЖАМБЫЛСКОЙ ОБЛАСТИ В ЦЕЛЯХ ОПРЕСНЕНИЯ МИНЕРАЛИЗОВАННЫХ ПОДЗЕМНЫХ ВОД

Аннотация. Учитывая геологические условия отгонных территорий Жамбылской области, а также высокую минерализацию и малодебитность находящихся здесь подземных источников воды, хозяйственное использование подземных вод возможно лишь с обеспечением процесса опреснения научно-обоснованными методами.

В статье рассмотрены геологические условия отгонных территорий Жамбылской области и возможности водообеспечения отгонного животноводства с использованием минерализованных подземных вод путем их опреснения.

Проведен анализ геологических и гидрогеологических условий рассматриваемой территории, приводятся краткие характеристики основных месторождений подземных вод в Жамбылской области, установлены уровни залегания подземных вод, приведены методы совершенствования технологии утилизации рассолов после опреснения с целью сокращения их объемов и получения товарных солей. Проведены лабораторные испытания обратноосмотического модуля с аппаратом ESPA1-400. Построен ряд зависимостей, характеризующих взаимосвязь параметров режима: давление и минерализация, соотношение пермеата и концентрата, величины удельных показателей по капитальным вложениям и себестоимости опресненной воды.

Представлена технологическая схема опреснения с элементами утилизации рассолов, приведены лабораторные данные испытания обратноосмотических элементов на аналогах подземных минерализованных вод, используемых для обводнения пастбищ в Жамбылской области.

На основе полученных исследований были разработаны рекомендации по эксплуатации опреснительных установок и использованию

утилизированных рассолов, которые будут учитывать геологические и гидрогеологические характеристики Жамбылской области. Также результаты исследований были апробированы на площади 50 тыс. га отгонных пастбищ, имеющих сложную водообеспеченность из-за повышенной минерализации подземных вод.

Ключевые слова: геологические условия, гидрогеологические характеристики, опреснение, обратный осмос, рассол, утилизация.

Introduction. A significant problem is now becoming the problem of obtaining potable fresh water. The shortage of fresh water acutely felt in 40 countries located in arid regions of the globe and occupying about 60% of the entire land surface. World water consumption at the beginning of the 21st century reached 120-150•109m3 per year. The growing world shortage of fresh water can be compensated by desalination of saline (salt content more than 10 g/l) and brackish (2-10 g/l) oceanic, sea and ground waters, the reserves of which make up about 98% of all water on the globe (Geologıa USSR, 1921).

Some regions of Central Asia, including Kazakhstan, possessing the largest mineral resources, do not have sources of fresh water. At the same time, a number of regions of Kazakhstan have large reserves of groundwater with a total mineralization of 1.0 to 35 g/l, which, due to the high content of salts dissolved in water, not used for water supply needs. These water resources can become a source of water supply only if they are further desalination (Geologıa USSR, 1921).

However, when desalination of mineralized waters, brines of maximum concentration obtained, which discharged into natural reservoirs, ravines, which greatly harms the environment. In rare cases, brines diverted to evaporation sites, where the obtained salt of a multicomponent composition utilized. At the same time, in Kazakhstan there is a shortage of edible table salt, that meets the standards. In many regions and districts, low quality self-planting salt is used. Such salt has a high content of insoluble impurities (granite, marble, etc.), and in most cases, it contains salts of calcium, magnesium, iron, copper, lead in quantities exceeding the maximum permissible concentrations.

In this regard, there is a need to substantiate the technological foundations of desalination of mineralized waters with a multi-purpose direction, i.e. the process of obtaining water of drinking quality, with the provision of utilization of the released brine and, on its basis, the release of table salt and some types of fertilizers from it. The solution of two problems, such as - desalination of mineralized groundwater, obtaining various salts from discharged brines in one technological scheme, is an important task.

Research Materials and methods. In the Republic of Kazakhstan, 118.2

million m^3 of water or less than 1% of the used water resources used for pasture irrigation. Of this volume 50 % watered from surface and 50% from groundwater.

According to preliminary data, more than 40 % of the water used for irrigation of remote pastures has a mineralization of more than 4 g/l, and needs to desalinate. The analysis shows that with the desalination of 40 million m^3 of mineralized water for the needs of distant pastures, it is possible to obtain annually about 160 thousand m^3 of brines that require technological solutions to prevent pollution of pasture ecosystems (Zhaparkulova, et all, 2021).

The objects of our research were located in the Moiynkum district of the Zhambyl region, the farm “Urker”, which has an area of pastureland of more than 10 thousand hectares in private ownership and more than 15 thousand hectares of state reserve land leased from the forestry enterprise. When conducting field studies, an assessment was made of the use of water intake facilities, samples taken from water sources. The results of the mineralization of the studied water were obtained because of chemical analyzes of water samples in the chemical laboratory of LLP “KazSRIWE” (Veselov et all, 2004).

The total area occupied by the Zhambyl region is 155.5 thousand km2, or 15.5 million hectares, half of which occupied by pastures. In the southern part of the region, there are high mountain pastures (watersheds of Karatau, Kirghiz Alatau, Shu-Ili Mountains) with juicy nutritious herbs. According to the seasonality of use, they can be divided into:

- winter pastures (4265.8 thousand ha) occupying the sands of Moiynkum, the lower reaches of the Shu, Talas and Kurgata rivers, most of the Anarchai mountains, as well as the southern slopes of Karatau, the Shu-Ili mountains and the Kyrgyz Alatau;
- summer pastures - dzhailau (857.6 thousand ha), capturing the upper slopes and watersheds of the Kyrgyz Alatau, Karatau and Shu-Ili mountains;
- autumn-spring (2199.2 thousand ha), which are confined to the foothills and potentially includes the entire territory of Betpak-Dala.

A feature of the location of pastures in the Zhambyl region is the relatively close proximity of arrays that used at different times of the year. The advantage of these pastures is the possibility of use for different types of livestock. On alpine and subalpine meadows, higher steep mountain slopes, it is advisable to graze sheep, goats and horses in summer. Cattle can be grazed in the intermountain valleys in the lower part of the ridges and river floodplains. Covering the entire central and northern part of the region, sands, dry low mountains and salt marshes used for grazing sheep, goats, horses and camels (Svittsov, 2006).

Livestock in private ownership (peasants and farms) is currently concentrated near settlements and one flock is, at best, about 300-500 sheep and a small number of cattle and horses. Seasonal pastures are not used due to the absence and (or) deterioration of fresh water sources, and grazing is carried out around villages with a maximum removal radius of up to 5 km (Geologıa USSR, 1921).

The productivity of pastures around the villages has fallen sharply, edible plant species are disappearing, gradually being replaced by weeds and poisonous ones (adraspan, wormwood, itsigek, etc.). Pastures intensively degraded in areas inhabited by the rural population. Lack of fodder hinders the growth of the animal population, forcing farmers to keep only as many animals as they can provide with fodder. Pasture areas practically do not have an owner, there is no association of livestock breeders (in the image and likeness of “land users” and “water users”), and there are no legal and legal bases in the pasture animal husbandry industry (Methodological instructions “Calculation of the economic efficiency of research and development work in the field of melioration and water management, 2001).

The solution to the problem of lack of fodder and increase in livestock is the restoration of watering facilities and watering points on distant pastures, as well as the cleaning and repair of water supply sources, the restoration of their debit, and the construction of new facilities. This will make it possible to use remote areas, and, with sufficient debits of water supply sources, to create irrigated areas to create insurance stocks of fodder and increase fodder intensity.

The main sources for water supply and irrigation of pasture areas in the Zhambyl region are groundwater, the largest reserves of which are concentrated in the foothills of the Karatau, Kyrgyz Alatau, and Shu-Ili mountains. The northern and northwestern parts of the region are relatively poor in sources for irrigation and water supply, have increased mineralization of groundwater and insignificant debits (0.1-1.5 l/s).

Groundwater deposits explored in the Zhambyl region belong to four main types: groundwater deposits in river valleys, deposits in alluvial fans of foothill plumes, deposits in artesian basins, deposits in structures limited in area and fissured and fissured-karst rocks. In total, there are 25 deposits in the Zhambyl region for all of the above types (Scientific substantiation of the pasture watering system based on GIS technologies for the intensification of distant pastures, 2017). The total secular and long-term groundwater reserves (groundwater and artesian) are 727 billion m^3. The volume of annually renewable water is 70 m^3/s, operational - 155 m^3/s.

The following are brief characteristics of the main groundwater deposits in the Zhambyl region:

- The Furmanov field is located 25 km south of the village of Moyinkum. The depth of the groundwater level is from 3 to 14 m, flow rates are 11-20 l/s, hydrocarbonate-sulfate, sodium in chemical composition, mineralization is 0.3-0.7 g/l. Near the village of Moiynkum, mineralization reaches up to 3 g/l.

- Chu-Novotroitsk groundwater deposit is located in the Shuisky district, the depth of the groundwater level is 1-5 m, well flow rates are 1.7-69 l/s, salinity is 0.6-0.8 g/l. According to the chemical composition, they belong to hydrocarbonate-sulfate, sodium-calcium.

- The Kokterek groundwater deposit is located in the northeastern part of the Moiynkum sandy massif, the depth of the groundwater level is 30-130 m, well flow rates are from 6 to 70 l/s, salinity is from 1.2 to 3.6 g/l. According to the chemical composition, they are classified as -sulfate and hydrocarbonate-sulfate. The groundwater level is set at 3.2-9 m (Mooers et all, 2009.).

Developments in brackish water desalination using new desalination technologies can increase the productivity of transhumance; however, so far, desalination of mineralized waters is the most energy-intensive industry (Natali, 2016). The current state of development of the national economy requires the rational use of energy resources. In this regard, the most optimal method of desalination is considered to be mineralized water is reverse osmosis (Elimelech et all, 2011).

The degree of water desalination and the productivity of the reverse osmosis membrane for desalinated water depend on various factors, primarily on the total salinity of the source water, as well as the salt composition of the desalinated water, pressure and temperature Voutchkov, 2018). The degree of water desalination by dissolved inorganic salts is 85-98%. So, when desalination of salt water from a well containing 0.5% of dissolved salts, at a pressure of 50 atmospheres during the day, it is possible to obtain approximately 700 liters, fresh water with 1m^2 membrane (McCutcheon, 2019).

Summarizing the data of literary sources, it can be noted that further improvement of methods for desalination of mineralized waters should aimed at the development and creation of resource-saving methods (Werber, 2016).

During the tests, the main task was to select and establish the optimal desalination regime for the initial underground-mineralized water of a certain type, the testing of the installations carried out in the laboratory of agricultural water supply of KazSRIWE on reverse osmosis modules with an ESPA1-400 apparatus using LVR high pressure pumps (Membr et all, 2020). According to the test experience, the operating mode was selected by gradually changing the pressure on the apparatus and changing the ratio of permeate and concentrate volumes (%), determining the parameters for changing the mode (flow rate, pressure, salt removal) over time (Orlov, 2007). At the same time, failures of individual units and the technological scheme as a completely registered, if they occurred. The duration of operation at each stage of the mode change carried out for 50 hours of continuous operation.

The studies carried out on waters with a salinity of 2.6 g/l and 4.1 g/l, (Table 1-2) which are similar in physical and chemical composition at the water intake facilities of the Urker pilot sites in the Zhambyl region.

Table 1 - Physical and chemical composition of source water

TT°C	pH	Total hardness, mg-eq/l	Ca++ мг/л	Mg++ мг/л	Na+ мг/л	Cl- мг/л	SO--4 мг/л	NO-3 мг/л	HCO-3 мг/л	∑мин в-вмг/л
16	7,4	22,4	368	86	369	180	1315	-	317	2 635

Result and discussion. In the conditions of distant pasture. (Technological regulations of a mobile desalination plant for the efficient use of water resources of distant pastures in Taraz 2021). which are used only in the summer, and all equipment for servicing the watering point is transported for storage to the base for wintering, and the use of technology will not be rational (Rustem et all, 2021).

Therefore, despite the higher specific indicators, according to our considerations, the most acceptable option is the use of a mobile reverse osmosis unit. In this case, the volume of drinking water for the shepherd's brigades desalinated by alternately bypassing water points and desalination at a mobile desalination plant (Dytnersky, 1978).

The technology under consideration intended for the complex treatment of mineralized surface, underground and collector-drainage mineralized waters, with the production of water of the required quality and saturated salt brines.

Table 2 - Indicators of the test mode of the reverse osmosis module

Mineralization of source waters, $C_{исх,.}$ г/л	Working time, hour.	Operating pressure, P mPa			Consumption Q, l/h		Mineralization, C, g/l	
		at the entrance	permeate outlet	at the outlet of the brine	Permeate	brine	permeate	brine
2,635	10	0,2	0,18	0,19	60	60	0,15	5,12
	20		0,18	0,19	60	60	0,15	5,12
	30		0,175	0,18	60	60	0,15	5,12
	40		0,18	0,19	60	60	0,15	5,12
	50		0,18	0,182	60	60	0,15	5,12
2,635	10	0,4	0,36	0,38	72	48	0,20	5,07
	20		0,36	0,38	72	48	0,20	5,07
	30		0,36	0,38	72	48	0,20	5,07
	40		0,36	0,38	72	48	0,20	5,07
	50		0,36	0,38	72	48	0,20	5,07
2,635	10	0,6	0,45	0,54	84	36	0,30	4,97
	20		0,45	0,54	84	36	0,30	4,97
	30		0,45	0,54	84	36	0,30	4,97
	40		0,45	0,54	84	36	0,30	4,97
	50		0,45	0,54	84	36	0,30	4,97

2,635	10	0,8	0,50	0,72	96	24	0,45	4,82
	20		0,50	0,72	96	24	0,45	4,82
	30		0,50	0,72	96	24	0,45	4,82
	40		0,50	0,72	96	24	0,45	4,82
	50		0,50	0,72	96	24	0,45	4,82
2,635	10	1,0	0,60	0,85	108	12	0,6	4,67
	20		0,60	0,85	108	12	0,6	4,67
	30		0,60	0,85	108	12	0,6	4,67
	40		0,60	0,85	108	12	0,6	4,67
	50		0,60	0,85	108	12	0,6	4,67

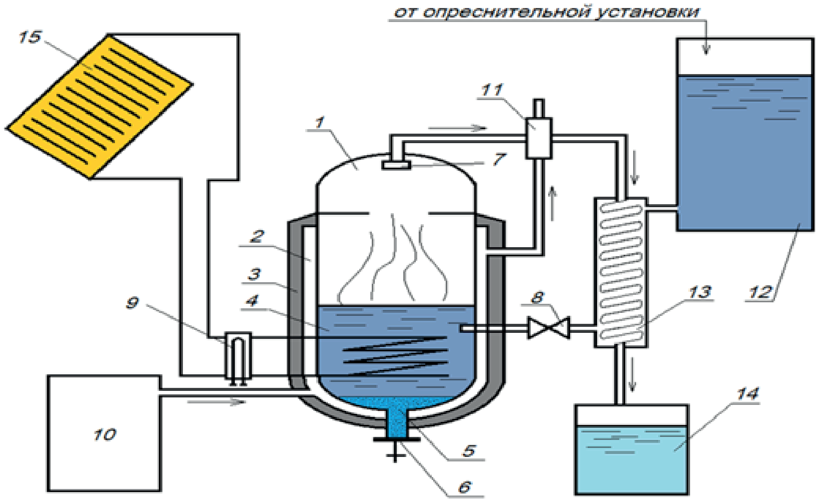
The physical and chemical composition of desalinated water obtained at various pressures (P) on a reverse osmosis apparatus, at the established permeate and brine flow rates, shown in Table 3.

Table 3 - Physical and chemical composition of desalinated water

P, mPa	pH	General hardness, mg-eqv/l	Ca^{++} мg/l	Mg^{++} мg/l	Na^{+} мг/л	Cl^{-} мг/л	SO^{--}_{4} мг/л	NO^{-}_{3} мг/л	HCO^{-}_{3} мг/л
1	2	3	4	5	6	7	8	9	10
0,2	7,3	7,2	21,08	0,07	0,080	-	128,85	-	-
0,4	7,3	7,3	25,21	0,09	0,08	-	174,62	-	-
0,6	7,3	7,5	34,30	0,2	0,12	-	265,4	-	-
0,8	7,3	7,7	51,25	0,35	0,35	6,0	284,1	-	-
1,0	7,0	8,0	81,50	0,51	0,92	7,10	510,09	-	-

Tests of the reverse osmosis apparatus on natural underground waters of sulfate-chloride-sodium and sulfate-carbonate-sodium type showed a fairly reliable and stable desalination regime when changing the flow head and the ratio of permeate and concentrate volumes at different concentration ratios of the source water (Irfan, et all, 2020).

With this arrangement of equipment, drinking-quality water enters a clean water tank, brine into another tank. Drinking water drained into a tank (container) of clean water (Wang et all, 2017). The brine fed into a vacuum evaporator where the brine evaporated and a distillate and precipitated salts obtained (Fig. 1).



1. Vacuum evaporator
2. Exhaust jacket
3. Insulation
4. Initial brine
5. Salt sediment
6. Hatch for unloading sediment
7. Drop catcher
8. Initial brine dispenser
9. TEN.
10. Electric generator
11. Ejector (Venturi tube)
12. Storage tank
initial brine
13. Capacitor
14. Distillate
15. Sunny водонагреватель.

Figure 1 - Vacuum evaporator of brine after water desalination

The working principle of vacuum brine evaporator after water desalination (Fig. 1) is as follows: The initial brine comes from the desalination plant into the storage tank (12) with a volume of 200 liters. From the accumulator tank through the condenser (13) (where it is partially heated) it enters through the dispenser (8) into the evaporation chamber of the vacuum evaporator (1). In the evaporation chamber, it is heated by a solar water heater (15), electret (11) and exhaust gases (2), from an electric generator (10) the brine is heated to 400C-700C.

The resulting steam is sucked off by an ejector (11) powered by the exhaust gases of an el. generator, by creating a vacuum in the evaporation chamber. The steam enters the condenser (13) where it is cooled by the initial brine. After passing through the condenser (13), it is converted into distillate and drained into the storage tank (14). After evaporation, a precipitate of salts is formed in the dry residue (5) and is unloaded through the receiving hatch (6).

The application of the proposed technological scheme will make it possible to provide shepherd brigades on summer remote pastures with high-quality drinking water and to utilize the brines obtained during desalination without polluting the environment.

The number of drinking points serviced by the plant depends on the condition of the roads, the distance between the drinking points (travel time), and the operating time to obtain drinking water (productive time), which depends on the amount of salinity of the source water and the volume required for each point. To serve several watering points with one desalination plant, which includes technological elements for brine utilization, a scheme has been developed for the layout of equipment on a tractor trailer with a carrying capacity of up to 3 tons.

The unit being developed can also be used in organizing mass trans- portation of animals along cattle routes to seasonal summer distant pastures, such as the sands of Moiynkum, Betpak-Dala, Sary-Arka, and in other arid zones of Kazakhstan.

To date, in world practice, there are numerous methods and ways of desalination of mineralized waters. These include methods and technologies for electrodialysis desalination and preparation of brines in electrodialyzer concentrators for disposal. The electrodialysis method of desalination on charge-selective sodium and chlorine membranes is widely used, which makes it possible to obtain a concentrate (brine) containing predominantly singly charged ions (NaCl) and desalinated water enriched with doubly charged ions (CaSO4, MgSO4.

A significant problem of humanity is currently becoming the problem of obtaining potable fresh water. The shortage of fresh water acutely felt in 40 countries located in the arid regions of the globe and occupying about 60% of the entire land surface. The growing world shortage of fresh water can be compensated by desalination of saline (salt content over 10 g/l) and brackish (2-10 g/l) oceanic, sea and ground waters, the reserves of which make up 98% of all water on the globe.

Some regions of Central Asia, having the largest mineral resources, do not have sources of fresh water. At the same time, a number of regions of Kazakhstan have large reserves of groundwater with a total mineralization of 1.0 to 35 g/l, which not used for water supply needs due to the high content of salts dissolved in water. These water resources can become a source of water supply only if they further desalinated.

An important task in the complex processing of mineralized waters is the utilization and partial use of brines obtained a result of their desalination. The chemical composition of the resulting brines is different, which determined by the content of chemical components in the source water. It is possible to obtain salts and fertilizers from accompanying impurities, which, like table salt, will sold to consumers. Therefore, the work has an economic, environmental and social impact.

Conclusion. Technical and economic comparisons have shown that for the conditions of pasture village water supply (insignificant daily volumes of water consumption) and the salinity of the source water of 3-10%, it is advisable to use reverse osmosis installations, because their performance is higher in all respects than that of electrodialysis.

Laboratory tests of the reverse osmosis module with the ESPA1-400 device carried out. A number of dependences characterizing the relationship between the regime parameters has built: pressure and mineralization, the ratio of permeate and concentrate the values of specific indicators for capital investments and the cost of desalinated water.

It has been established that with an increase in the salinity of the source water from 3.5 to 7 g/l and a corresponding increase in pressure, the mineralization of the permeate is within acceptable limits (up to 1 g/l), and the volume of desalinated water decreases over time by 2-5% (limit value 15%).

It was found that reducing the discharge of concentrate to 10% of the total volume of water supplied does not lead to a decrease in the quality of permeate, but allows to reduce the discharge of concentrate for disposal.

A technological scheme of a mobile desalination plant for use in summer distant pastures, including a brine disposal unit, is proposed.

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Information about authors:

Ustabayev Timur – Master of ecology, Researcher, Department "Melioration, Ecology and Water Supply", Taraz, Kazakhstan; *timoha_85_85@mail.ru*, http://orcid.org/0000-0001-6467-369:

Mirdadayev Mirobit – Candidate of Technical Sciences, Head of the Department "Melioration, Ecology and Water Supply", Taraz, Kazakhstan; mirdadaev@mail.ru, http://orcid.org/0000-0002-7371-5846;

Balgabayev Nurlan – Doctor of Agricultural Sciences, Professor, General Director of the Kazakh Scientific Research Institute of Water Economy, iwre@bk.ru, http://orcid.org/0000-0003-1645-6283;

Kudaibergenova Indira – Master of Agricultural Sciences, Scientific Secretary Kazakh Scientific Research Institute of Water Economy, indira.luna@mail.ru, http://orcid.org/0000-0001-9353-6231;

Amanbayeva Balzhan – PhD, Researcher, Department "Melioration, Ecology and Water Supply",Taraz, Kazakhstan; amanbaeva88@mail.ru, http://orcid.org/0000-0001-5000-2555.

REFERENCES:

Elimelech M., Phillip W.A7 (2011) The future of sea water desalination: energy, technology, and the environment, Science. 333:712–717, *https://doi.org/10.1126/science.1200488* (in Eng).

Geologıa USSR. (1921). M., T40 Iýjnyı Kazahstan. 534 p (in Russ).

Irfan M., Wang Y., Xu T7 (2020) Novel electrodialysis membranes with hydrophobic alkyl spacers and zwitterion structure enable high monovalent/divalent cation selectivity, Chem. Eng. J. 383, 123171, https://doi.org/10.1016/j.cej.2019.123171 (in Eng).

McCutcheon J.R. (2019) Avoiding the hype in developing commercially viable desalination technologies, Joule. 3:1168–1171 (in Eng).

Membr J. Sci. (2020) 118072, *https://doi.org/10.1016/j.memsci.2020.118072* (in Eng).

Methodological instructions "Calculation of the economic efficiency of research and development work in the field of melioration and water management, (2001) RGKP" KazSRIWE ". – Taraz (in Russ).

Mooers Howard, Kanivetsky Roman and others. (2009) Geological Controls on Water Resource Variability in Minnesota, USA. November. DOI: 10.1038/npre.2009.3957.1 (in Eng).

Orlov N.S. (2007) Industrial application of membrane processes, Moscow, RKhTU after named DI. Mendeleeva, 114-115 (in Russ).

Rustem Ergali, Yestaev Kuat, Abdimomynova Manshuk, Abduvalova Ainur, Tassybayev Altynbek (2021) Study of new designs of spillway channels with artificial roughness//ISSN 2303-4521. Periodicals of Engineering and Natural Sciences Original Research. Vol. 9, No. 4, September: 117-133 (in Eng).

Scientific substantiation of the pasture watering system based on GIS technologies for the intensification of distant pastures (2017) Final report on the research work of KazSRIWE.- No. GR0115RK02478.- Inv. No. 0217RK00226. - Taraz, 155 p (in Russ).

Svittsov A.A. (2006) Introduction to membrane technologies, Moscow, De Liprint, p. 208-209 (in Russ).

Technological regulations of a mobile desalination plant for the efficient use of water resources of distant pastures in Taraz 2021. (in Russ).

Veselov V.V., Sydykov Zh.S. (2004) Gidrogeologya of Kazakhstan. - Almaty, - 484 p (in Russ).

Voutchkov N. (2018) Energy use for membrane seawater desalination – Current status and trends, Desalination, https://doi.org/10.1016/j.desal.2017.10.033 (in Eng).Wang Q., Gao X., Zhang Y., He Z., Ji Z., Wang X., Gao C., (2017) Hybrid RED/ED system:simultaneous osmotic energy recovery and desalination of high-salinity wastewater, Desalination. 405: 59–67, https://doi.org/10.1016/j. desal.2016.12.005 (in Eng).

Werber J.R., Osuji C.O., Elimelech M. (2016) Materials for next-generation desalination and water purification membranes, Nat. Rev. Mater. 1, https://doi.org/10.1038/natrevmats.2016.18 (in Eng).

Zhaparkulova E.D., Amanbayeva B.Sh., Dzaisambekova R.A., Mirdadayev M.S., Mosiej J. (2021) Geological structure of soils and methods of water resources management of the Asa River//News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. Vol. 4, № 448:131-138. https://doi.org /10.32014/2021.2515-170X.91 (Online), ISSN 2224-5278 (Print) (in Eng).

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