SEPARATION OF IODINE FROM IODINE-CONTAINING UNDERGROUND HYDROTHERMAL WATER

Abstract

The study presents generalized experimental data obtained by us in many years of research. It has been revealed that the studied groundwater in terms of iodine content of the Surkhandarya region, Kruk (Kashkadarya artesian basin) and their reserves fully meets the industrial requirements for extraction of iodine.

Аннотация

В статье полученные и обобщены нами многолетние экспериментальные данные выявили, что изученные подземные воды по содержанию йода месторождения Сурхандарьинской области, Крук (Кашкадарьинского артезианского бассейна) и их запасов вполне можно использовать для промышленного извлечения йода.

Annotatsiya

Maqolada Surxondaryo viloyatida joylashgan konlar, Kruk (Qashqadaryodagi artezian havzasi) konining yer osti suvlaridagi yod miqdorini oʻrganish boʻyicha bizning koʻp yillik tajribalarimizdan olingan va umumlashtirilgan natijalar yoritilgan, ularning zahirasidan sanoat miqyosida yod ajratib olish uchun foydalanish mumkin.

Iodine is a valuable chemical element and plays an important role both in the life of living organisms and in various branches of the national economy. In particular, iodine occupies a special place in the regulation of the metabolism of humans, animals and birds. Iodine is used in the food, pharmaceutical industry, and veterinary. As a catalyst, iodine is used in chemical production to produce some particularly pure materials, special glasses, fuels, artificial rubbers. Iodine has also found wide application in semiconductor production, like other halogens. Iodine forms numerous iodine compounds, which are part of some dyes [1-5].

Iodine is of particular importance for Uzbekistan. The Republic of Uzbekistan is remote from sea coasts, from sources of iodine. In addition, the very high ambient temperature of the Central Asian region contributes to the evaporation of even the iodine contained in the soils. Therefore, vegetation and live food iodine enters the human body in insufficient quantities, which leads to a large number of different diseases and especially endemic goiter.

At present, over one billion six hundred million people suffer from iodine deficiency endemic goiter [1]. To date, a certain part of the population of Bukhara, Samarkand, Ferghana, Andijan, Namangan, Surkhandarya regions and the Karakalpak Republic suffers from endemic goiter. Moreover, there is a constant increase in the incidence of people. In particular, more than 195,000 people from the population of the Surkhandarya region suffer from iodine deficiency endemic goiter. Consequently, for the Republic of Uzbekistan at present it is necessary to produce a sufficient amount of iodine and its compounds for medical needs, for iodizing salt and for other purposes [2].

In the Republic of Uzbekistan, the acute shortage of iodine is primarily reflected in the production activities of Uzfarmkhimzavod and Uzzoovetsnab. The annual requirement of these two organizations in the crystalline iodine of grade "A" GOST 4159-79 is 10 tons, in potassium iodide "A" - 2.2 tons, in 5% iodine tincture - 10 tons [3]. The cost of 1 ton of iodine (depending on the purity of the product) is from 85 thousand to 100 thousand US dollars [4]. At the same time, the Republic of Uzbekistan is quite rich in iodine reserves, it is found in hydrothermal associated petroleum waters. Iodine-containing groundwater is located mainly in the Fergana, Bukhara-Karshi artesian basins and on the Ustyurt plateau.

In the Surkhandarya artesian basin, 6 deposits of strong hydrogen sulfide iodine-containing waters have been identified and investigated, the formation of which is also associated with oil deposits and oil-bearing rocks: Uchkyzyl, Haudag, Kakayty, Lialmicor, Jayranhana and Old

Termez [5,6]. In these underground, saline waters, there is a sufficient amount of iodine and its compounds for industrial extraction.

Quantitative determination of iodine content in hydrothermal groundwater. The development of groundwater for iodine production in the Surkhandarya basin is possible at the expense of associated oil and hydrothermal waters. These waters during the development of oil wells are extracted to the surface together with oil. Studies of the hydrogeological series "Uzbekhydrogeology" in previous years revealed the presence of iodine in exploited oil fields, in associated waters in which iodine content is of practical interest for its extraction. These deposits are Kokaity, Haudag, Lialmicor, Uchkyzyl, etc. According to the calculation of operational reserves, these waters can be an industrial source for extracting iodine.

The results of complex physical and chemical studies carried out by us on the study of the composition of the hydrothermal waters of the Surkhandarya Depression are given in Table 1. The analysis of the obtained data for the year showed the absence of any regularity in the changes in the time of mineralization, the concentrations of macro- and microcomponents, and their distribution, with fluctuations in the greater or lesser side.

The most indicative average values of concentrations of components in associated waters, developed oil fields, are the results obtained from the head (central) reservoirs.

The results of physical and chemical analyzes were obtained in 2014-2016. As can be seen from Table 1, there is a change in the iodine content in the associated waters in different periods of the year. The content of iodine in the associated waters of the oil fields of Kokaita, Lialmicor and Haudag increases in the warm season, and in fall, winter and spring periods it decreases. This may be due to the rise in water temperature in the spring and summer periods of the year.

Table 1

Composition of associated and reservoir waters of oil deposits of the Surkhandarya basin

Analysis data	pH	Iodine, mg/L	Mineralization, g/L
1	2	3	4
Kokayty (central water collector)			
20.02.2016	7,2	12,57	123,61
24.04. 2016	7,3	16,94	124,70
20.06. 2016	7,4	18,03	142,30
22.08. 2016	7,2	20,60	145,25
20.10. 2016	7,4	17,41	136,22
24.12. 2016	7,3	14,87	136,55
Lialmicor (central water supply)			
25.06. 2016	7,3	4,6	59,6
24.12. 2016	7,2	4,4	59,32
Haudag (central water collector)			
20.02. 2016	7,1	18,46	174,10
24.04. 2016	7,0	19,75	181,20
22.06. 2016	7,0	20,60	183,00
24.08. 2016	7,2	20,80	196,27
20.10. 2016	7,0	18,40	178,60
Well "Kattakum-2" in the area of Haudag			
1	2	3	4

18.02. 2016	6,6	21,32	219,41
20.04. 2016	6,2	21,31	219,85
24.06. 2016	6,4	21,33	219,30
24.08. 2016	6,2	21,34	219,28
25.10. 2016	6,2	21,32	219,81
20.12. 2016	6,3	21,33	219,72
Well in Uchkyzyl Square			
20.06. 2016	5,1	20,60	298,39
24.12. 2016	5,0	20,50	300,98

Due to the direct location of associated oil fields of the Haudag and Uchkizyl fields in the underground basins, iodine content changes are not observed in them.

Well "Kattakum-2", as exploration, drilled in 1979. The initial water production in 1979 was 432 m^3/day (5L/s), the water temperature in the mouth was 76°C. The flow rate of water measured when water was injected into oil reservoirs was 23.04.96. Was 414.72m^3/day (4.8L/s), and the water temperature was 72°C.

By the amount of mineralization of water from the well on the Uchkyzyl area are derived from the deposits of the Turonian - Upper Cretaceous. From the mouth of the well, water is poured at a rate of 2.5L/s. The depth of the well is 1,050.5 m. The mineralization is 273 - 298 g/L and the iodine content is 15-20 mg/L.

We also conducted a study of some wellbore waters of various deposits. Data on the sampling point of the water under study, mineralization, pH of the medium and iodine content are given in Table 4. It can be seen that the total mineralization of water varies over a wide range and ranges from 45.1 g/L to 300.82 g/L. The highest salinity is characteristic for water taken from the wells of the 1.2 Haudag field and well 37 of the Uchkyzyl deposit. The smallest mineralization of the water sample is recorded in well 17 and in self-ejection wells. The pH of the medium of the investigated waters is mainly weakly acidic.

The concentration of iodine in the studied waters also varies widely. The highest concentration of iodine is characteristic for the Haudag field (Kattakum-2) and the Uchkyzyl deposit (well 37). The lowest iodine content observed for samples in well 1 and well 49.

Table 2 shows the combined technical and economic characteristics of the iodine-containing groundwater in the Surkhandarya region. As can be seen from the data in Tables 1, 2, 3, for the associated extraction of iodine from oil wells, the most promising in terms of iodine content and reserves is the Kattakum-2 well of the Haudag field. The long-term experimental data obtained by us revealed that the studied groundwater in terms of iodine content and their reserves can be used for industrial extraction of iodine.

Table 2

Data on mineralization, pH of medium and iodine content in the investigated waters

№	Place of sampling	**Mineralization, g/L**	**pH**	The average content of iodine**, mg/L**

	The Kokaidi field			
1.	**Well 38**	**142,9**	**6,7**	**16,4**
2.	**Well 37**	**132,8**	**6,6**	**15,2**
3.	**Well 17**	**125,4**	**6,5**	**17,4**
	The Haudag field			
4.	**Well 49**	**162,4**	**7,0**	**12,1**
5.	"Kattakum", well -2	**220,0**	**5,7**	**21,3**
6.	"Kattakum", well -1	**240,6**	**5,2**	**11,7**
	The Uchkyzyl field			
7.	Self-ejection well	**45,0**	**6,8**	**11,2**
8.	**Well 37**	**300,8**	**5,0**	**20,6**

Table 3

Technical and economic characteristics of iodine-containing groundwater Surkhandarya artesian basin

№	Field	Temperature, °C	Operating Reserves, m^3/day	Annual extraction of iodine, in tons
1.	Haudag	72-76	420	2,2
2.	(Kattakum Well -2) Haudag (associated waters)	27	64,4	0,26
3.	Uchkyzyl (Well 37)	40	216,0	1,2
4.	Kokaidi (associated waters)	39	785,4	3,2
5.	Lialmicor (associated waters)	25	201,2	0,78

It is of interest to study the form of iodine in groundwater. Knowledge of the form of finding iodine allows developing and applying affordable cheap technological methods of extraction of iodine from saline groundwater.

Calculation of possible extraction of iodine from waste (associated) waters of the exploited oil field of **Kruk (Kashkadarya artesian basin).**

At present, the volume of waste water, after separation of the fluid from oil, is 2000 m^3/day. There is a tendency to increase the volume of waste waters and increase the watering of the field.

It follows that the technological plant for extracting iodine will be provided with raw water [7].

According to oil companies, it is planned to extract oil at the Kruk field until 2035, which indicates a stable increase in the volume of associated water from year to year.

When processing 2000 m^3/day of associated waters and with a content of 30 mg/L iodine and 80% recovery, 48 kg of crystalline iodine per day can be obtained. When organizing work 365 days a year, you can get 17.5 tons/year, and if you work 260 days a year, you can get 12.5 tons/year of iodine. From 2000 m^3/day and 36 mg/L iodine at 80% recovery can be obtained 57.6 kg/day, and for 365 days * 57.6 = 21 tons/year with 260 working days per year * 57.6 = 15 tons/year.

Calculations were carried out under the condition of organizing three-shift work (i.e. 24 hours a day). When creating a process unit (or several units) for iodine production, it is necessary to calculate the possibility of using the entire volume of waste water (i.e. 2000 m^3/day).

Hence the volume of the pool (the evaporator of the storage tank) should be calculated at least 2000 m^3/day.

Thus, the conducted assessment of the forecast resources and operational reserves of industrial iodine waters is the scientific justification of the hydromineral resource base for the cost-effective extraction of iodine.

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