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Mineral Waters of Republic of Tajikistan

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ABSTRACT

The republic of Tajikistan resides in the highland and occupies an area of 143.000 km. Within the limits of Tajikistan there are the mountain high lands of Pamir and Northern and Southern Tyan - Shyan with heights of 5000-6000 or more meters.

Between the high lands there are many mountain caves, which occupy the valleys of the largest rivers Amu - Darya and Syr - Darya in Central Asia with numerous inflows.

1. INTRODUCTION

The territory of Tajikistan is part of the Tyan - Shyan Djungar - Pamirian hydro-geological folded area within the system of intermountain artesian pools.

Classification of Tajikistan water mineralization content (in gr/dm³):

very fresh waters is less than 0,1

fresh - from 0,1 up to 1,0 (among them 0,1-0,3; 0,3-0,5; 0,5-0,1)

salty - 0,1-35,0 (light salted 1-3; medium salted 3-5; salty 5-10; over salted 10-35);

bracken - more than 35 (among them 35-75; 75-150; 150-200, etc.)

The chemical composition of the water of Tajikistan is varied, but the basic types are:

carbonated (hydro carbonated, calcium, sodium); sulfate and chloride (chloride calcium).

The republic is subdivided by geological structures and hydro-geological conditions. The divisions are: North-Tajik, Central-Tajik, Northeast, Southwest and Southeast.

NORTH-TAJIK

Within the region, Mesozoic-Cenozoic and Paleozoic develop cracking-earth, cracking-lode, pore-primordial and pore - cracking; in hollows (quaternary deposit) - pore-primordial on valleys of the rivers and the pile-dwellings.

Water-carrier horizons are classified as without self outpouring and self outpouring. In unusual circumstances springs are permanent but typically seasonal with the production rate from 0,1-0,5 up to 1-5 l/s, it is rare up to 10 l/s or more.

Quaternary deposit underground waters are opened at depths from 15,5 up to 100 m or more. The production rate raises to 20 l/s. Waters contain hydro carbonated-sulfate calcium - magnesium and sulfate sodium-calcium with a mineralization 0,5-0,8 up to 7,5 g/dm3.

2. The Northeast region occupies the Western part of the Fergana artesian pool and is limited to deep breaks from Northern and Southern Tyan - Shyan.

The following types of waters are developed in the region:

I. The pore primordial of the quaternary deposit is 500 m or more. The depth of deposits are from 0,5-3,0 m (is flooded the part of the bottom of the river Syr-Darya) to 10-30 m, and on inter-cone watersheds up to 80-90 m. Waters without self outpouring and self outpouring have the production rate of 0,1-0,5 up to 15 l/s or more. Mineralization goes up to 1g/dm3, as hydro carbonated-sulfate calcium-magnesium.

CENTRAL - TAJIK

The underground water's Mesozoic-Cenozoic deposits are used as water supplies for settlements and irrigation. Springs have a production rate from 0,1-0,2 l/s to 10-20 l/s, and are often outputs of the group character.

The structure of the water is hydro carbonated-sulfate calcium-sodium with a mineralization up to 1 g/dm3 and only on occasions up to 1,2-1,3 g/dm3, leaving springs from the Jurassic period carboniferous thickness - up to 2 g/dm3 and the structure of the water is sulfate-chloride calcium.

Waters of Paleozoic deposit and intrusion formations have a wide development and leave as descending and weak rising single and group springs with the production rate from 0,5-1,5 l/s till 5-10 l/s.

The springs from tectonic zones, sometimes have expenses 20-25 l/s and even up to 40-50 l/s. The structure of hydro carbonated -sulfate calcium-chloride (magnesium) waters with a mineralization are 0,2-0,3 g/dm3, and waters dated for Silurian sandstones -up to 1 g/dm3.

Mineral water output coincides with Silurian deposits (sources Anzob and Khoja-Sang-Khok) which creates numerous jets from zones of small breaks surrounding the Main Hissar's deep break. The production rate of the separate jets are 0,01-0,03 l/s. Parts where it is capped by chinks, natural outputs have run low. The production rate of the chinks (with a self outpouring) are 0,2-0,3 l/s, the temperature of the water is 6-80 C, a mineralization (Anzob) is of 1,5 g/dm3 and (Khoja-Sang-Khok) is 1,97 -2 g/dm3 , the dissolved gas carbonic acid is (1,7-2,5 g/l). It also contains silicon acidity - 8 mg/l ; radon - 1,9 unit. Mahe, trivalent iron - 0,5 mg. The structure of the water is hydro carbonated calcium – sodium - magnesium. It is seen as an intensive travertine.

The Khoja – Sang - Khok source of waters is used for bottling of a table water "Anzob".

Cracking-lode waters of the intrusive complex have a mineral water output, that coincide with young breaks, surrounding numerous ancient deep deposit breaks.

Mineral waters have high-temperatures and (26-750C) nitric terms with miscellaneous chemical compound and a mineralization (0,4-1 up to 2,5 g/dm3).

Well-known sources Yavroz (a valley of the river Kafirnigan); Khoja – Obi - Garm (a valley of the river Varzob) and Obi – Garm (a valley of the river Obi - Garm) are commonly utilized. Mineral waters Yavroz are connected with Yos break. Water is released by a chink at the depth of 128 - 275 m. The chink itself gives vent to the production rate 0,6-0,9 l/s. The mineralization of the water changes from 0,3 g/dm3 (in spring) up to 3,1 g/dm3 (in winter). There are components from silicon acidity - 7,3 - 28 mg/l, bromine up to 10 mg/l, radon of – 5 - 8 units Mahe.

The dissolved gas is nitrogen, with trace amounts of hydrogen sulfate. The water is used by the balneary "Yavroz".

MINERAL SOURCES OF OBI – GARM are connected to breaks, in surrounding Vahsh a deep break that is shipped under quaternary deposit (capacity in the center of a hollow up to 300 m).

Mineral water is capped by chinks at the depth of 100-200 m. A total production rate at the self-outpouring up to 60-65 l/s. Temperature on the self- outpouring is 42-530C. A structured of sulfate-chloride, sodium-calcium with a mineralization of 0,9 g/dm3. Water contains silicon acid (25,7-31,4 mg /l) and the dissolved gas - nitrogen.

The waters are being utilized by the Obi - Garn health resort.

MINERAL WATERS OF HOJA – OBI -GARM are in the regional zone of the Gushary (Hoja-Obigarmian) thrust, which is complicated because it has broken breeds (granitoids) that have formed into shallow blocks. Water flows from cracks and spreads on a slope. Where water outputs "it boils" due to the difference of temperatures and forms high-temperature steam (96-980 C) which is used in the steam emanatory.

The water temperature on the self outpouring is from 60-680 C up to 82-960 C, the mineralization is 0,4 g/dm3. The presence of radon in the water is 5-40 units Mahe, silicate is -140 mg / l, hydrogen sulfate – is 3 of mg / l, fluorine – is 20 of mg / l, the free dissolved gas - nitrogen As the temperature lowers the mineral contents of the components also decrease. The structure of water is hydro carbonate (35 %), - chloride (33 %), sulfate (32 %), sodium (70 %).

The health resort Hoja - Oby - Garm exists because of the abundance of mineral water.

Special attention to Chilu – Chor - Chashma (a central part of the Beshkent valley),is deserved because it has numerous jets in cracked (gaping cracks) lime stones with a total production rate of about 1500 l/s.

Fresh water is (0,3-0,4 g/dm3). Formation of underground water, with partial unloading - like the spring of Chilu – Chor - Chashma, occurs due to a superficial water river of Kafirnigan, which circulates on a tectonic break in paleogen lime stones. Spring water is valuable to the waterless valley and is used for economic drinking water supplying settlements, as irrigation, a watering place, and flooding.

WATERS OF THE JURASSIC DEPOSITS

Jurassic deposits are widespread.

Springs are usually(70 %) grouped with the production rate from 2-3 l/s to 10-20 l/s. A mineralization is 0,1-0,3 g/dm3. The water contains hydro carbonate-sulfate calcium and isn't used. Output of mineral water is connected to Jurassic breeds: the pool river Aksu, sources Kazil-Rabat, Khan - Yuli, Shainak with production rate separate jets up to 1 l/s and total production rate is 5 l/s. Fresh waters azotic-carbonic, warm (up to 400C), it is strong aerated.

The salted carbonic warm and hot (30-400C up to 650C) - source Djartigumbez (a valley of the river Istik) is used by the local population for baths. The structure of the water is hydro carbonate sodium and has a mineralization of 1,70C. The production rate is about 10 l/s (has about 70 jets). There is a deposit of travertine on the left board, but there is no output of water.

The local population uses it for baths.

WATERS OF PRE CAMBRIAN METAMORPHIZATION INTRUSIVE FORMATIONS

Pre Cambrian metamorphic widths are distributed in the Northern and in the Central zones of Pamir by narrow strips. They compose almost all of Southwest Pamir and are submitted by strongly cracked gneisses, magmatics and crystal slates with interlayer and lenses of marble which are broken by numerous intrusive formations from which the largest are granitoids of the Pamir-Shugnanian complex.

Underground waters have universal distribution and unload as springs with the production rates 1-3 l/s, are dated to washed off loops or taken out of a deposit of the pile-dwellings and to the cones carrying out the draining of these types.

The structure of the water is hydro-carbonate sulfate calcium-magnesium (sodium) with a mineralization of 0,1-0,3 g/dm3.

A number of mineral sources are dated with Pre Cambrian breeds on the Southwest Pamir, are more likely to occur in the zones of tectonic breaks.

On features of chemical and gas structure, temperature of the following groups are allocated:

1. **Salted carbonic** comes from very hot sources Lyangar (a valley of the river Pamir) and Garm-Chashma (a valley of the river Garm-Chashma) are dated to a sub latitude break in widths of gneisses and marble. There are plenty of griffons, where the total of the production rates are more than 6 l/s. Waters are hydro-carbonate-chloride, sodium-calcium with a mineralization of 3,4 g/dm3 with silicate - 150 mg / dm3. The temperature of the water is 620C. A balneary of Garm – Chashma come from this source.

Lyangar has water containing hydro-carbonate-chloride, and a sodium structure with a mineralization of 2,3 g/dm3. The production rates is -0,2 l/s, a temperature is 450C. It is used by local population for medical purposes.

2. Water sources Darshai, Shirgin, Avdj (a valley of the rivers Pjandzh, Pamir), Hoz - Guni (a valley of the river

Garm- Chashma) have salted carbonic hot and warm waters.

Source Shirgin. The temperature is 350C. The production rates is -3,5-4 l/s, mineralization is 1,22 g/dm3. The structure of water is hydro-carbonate-sulfate calcium-sodium-magnesium. Has no absorption and is used by the local population.

Source Darshai. The temperature is 380C, the production rates is 8 l/s, mineralization is 2,6 g/dm3. The structure of the water is hydro-carbonate-chloride sodium-calcium. There is no absorption and it is used by local population.

Source Avdj. The temperature is 32-35 0C, the production rates are -1,5 l/s, mineralization is 2,0 g/dm3. The structure of the water is hydro-carbonate-chloride sodium-calcium. There is no absorption and it is used by the local population.

3. Iniv, Vrang, Borshor, Junt and Churj are salted carbonic sodium sources. Water seeps from cracks in breeds of Pre-Cambrian. The temperature of water is 13-200C, the production rates is 0,5-2 l/s, the mineralization is 1,5-2,5 g/dm3. The structure of the water is hydro-carbonate sulfate calcium-sodium-magnesium. There is no absorption and it is used by the local population.

A spontaneous gas -carbonic is also present in all described groups of mineral waters silicate - 46-74 mg / dm3.

The output of mineral sources Djilandi, Yashilkul, Tokuzbulak, Garm - Chashma on Gunta, Sulu-Tagarcati are dated to the intrusive formations, mainly with the granitoid Pamiro-Shugnanian complex, etc.

Production rates of the sources are 2-4 l/s (separate griffon) The temperature of water is from 53 0C (Djilandi) up to 770 C (Tokuzbulak). The spontaneous gas is nitrogen. The water is composed of sulfate-hydro carbonate sodium with a mineralization up to 0,5 g/dm3 and have silicate 30-50 mg / dm0.

None of the sources have a measurable absorption rate. The local population uses it for balneological purposes, except for some outputs of source Djilandi, where above the outputs are small houses and pools. The deposits of Djilandi are explored and measured.

There are also more mineral sources in valleys of the rivers Vanch, Gunt, Pyandj and it's inflows.

In the neogen deposit of Northern periphery of Dushanbe's pool lie self -outpouring thermal slightly hydrogen sulfate midmineralized (3 - 12 g/l) waters of sulfate-chloride sodium structure aerated by nitrogen. They are used for medical purposes by a balneary Shaambari, and also used as table and medical waters under the name « Shaambari №1». Shaambari, despite their significant stocks, are used insufficiently and do not satisfy the needs of the population.

Waters of such type are opened by chinks in the valleys of the rivers Hanaka and Luchob. They are distinguished as having favorable climatic conditions and can provide for the expansion of health resorts and sanatoriums. From 750 m3 / revealed part of water, in quantity of 250 m3 / day, can be used for table water (chink № 60 - hingou-tavildarinsky horizon), the other part - 500 m3 / day will be a reserve for their external applications after additional preheating (chink № 6, 82, 84 - boldjuanski horizon). For additional resources of such waters in a case of an emergency it is necessary to bore the special chinks in accordance with their technical equipment.

The best places to open the waters: on the Northern board of the pool is- between the cities Dushanbe and Vahdat, on the Southern board area are Sardarov (Northwest slope storage Rangon). The incoming water will find balneological applications to the ambulance station in the regional centers Rohati and Sardarov.

Self - outpouring, warm and hot, high expenditure, strong hydrogensulphite medium-and high-mineralized waters such as Sochi - Matsesta, a different chemical compound, aerated by nitrogen and methane are circulated in the deposits of paleogene. These waters are not used yet, but have balneological value. On the basis of these waters there can be created the long time balneological resort in the picturesque valley of Luchob in 4 - 5 kms to Northwest from Dushanbe. Only one chink (№ 81) gives every day 700 m3 of strong hydrogensulphite water, which will provide for a large health resort on 1500 - 2000 places with a structure of treatment like the well-known health resort of Sochi - Matsesta. The construction of a health resort in the Tajik republic will relieve workers not only in Tajikistan, but also the other areas of Central Asian republics of far and expensive trips on a resort of Sochi - Matsesta.

A similiar resort could be opened on the Southern board of pool near the center of Sardarov and Vahdat. It's a water of paleogene complex, opened on Luchob structure, can simultaneously be considered as hydro mineral industrial raw material - for extraction from these strong sulfate waters of native sulfur. Water expenditures of only one chink will provide the daily reception from 0,3 up to 0,6 t. pure sulfur that in one year makes above 100 – 200 t.

The self outpouring, warm and hot iodine - bromine - boric hydrogensulphite are highly mineralized chloride - sodium and chloride, sodium - calcium waters, aerated by methane, less often nitrogen (extreme east part of pool) lie in thick deposits.The mineralization of water grows from the East to the West, and the quantitative maintenance of biologically active components increases. These waters are not used yet, but there is a balneological value in the diluted type. There are favorable conditions for using these waters in the valley of river Luchob, where they lie at an accessible depth (1200 - 1500 м). One chink (№ 81) can produce about 700 m3/ a day, bracken iodine - bromine - boric - water. It can provide for 600 - 700 baths under condition that the water is diluted. These waters can be an additional reserve for a potential balneological resort in the valley of Luchob.

There are self outpouring high expenditure hot bromine and bore containing hydrogensulphite high mineralized waters chloride - sodium structure, aerated by methane in the deposits of high denseness in the Chalk period. There are more full investigated waters in the East part of Dushanbe pool (Andigen chink № 92, 100) in the deposits of the low thickness in the Chalk period. These waters are recommended by us for balneological use (bath) without additional heating and can provide for the needs of a big resort. Only from one chink (№ 92) water gives vent a day 500 m3 hot (45 – 500C). This water can also be used for industrial heating purposes in Vahdat for heating hotbeds and hothouses for the cultivation of citrus. Similar waters could be opened near the Northern suburb of Dushanbe and in area of the region center Sardar, accessible depth (1300-1400 м).

Low expenditure, warm and hot lie on the bromine and bore vent containing hydrogensulphite high mineralized chloride - sodium or chloride sodium - calcium waters, aerated by methane in the deposits of Jurassic age. It is possible that the mineralization of the waters will grow from the boards of the pool to it's center and from the East by the West up to the concentration of strong brines. The water is not used at this time but an opening of a high expenditure of water will create balneological interest, and may be an industrial heating value. The most favorable areas for a conclusion of Jurassic waters on a surface are areas of Andigen and Luchob anticlines crimps, where Jurassic breeds lie at a depth of 1000 and, probably, 1700 m.

In Paleozoic breeds the bases can be opened cracking hot, and it is possible that when superheated, high expenditure waters of different structure will be formed. The most probable place for an opening is an area Fajzabad (Andigen folds and to the East from it), Northern suburb of city Dushanbe (Luchob folds) and area Karateginskogo of a ledge (a prospective underground shaft). Before a program of deep drilling on the ast site (Karateginski a ledge) geophysical works should be carried out with the purpose of defineing the depth deposit of the Paleozoic base. Cracking waters of the Paleozoic base will have broad applications: а) medical waters as a basis for balneological sanatoria and hospitals; б) as a source of thermal energy for central heating; в) as economic waters (depending on a mineralization) - for creation douches, baths and laundries.

As a result of studying the hydro-geological conditions of Gissar valley, we aspired to show what a great thermal mineral water resource the artesian pool of Dushanbe is. This remarkable gift of nature in the picturesque Gissar valley is a treasure to the Tajik republic. It could become in due course a valley of health resorts. Further investigation by deep drilling are needed not only on anticlines, but, primarily in local synclinal crimps for potentially wide economic and balneological use.

CONCLUSION

In the territory of the Republic of Tajikistan more than 200 mineral sources were detected. They differ on a physicochemical composition and geographic situation. In the northern zone of Tajikistan (Sogd area) the mineral sources are placed, basically, on plains and in foothills, in central and southern zones-in valleys, foothills and middle mountains, in Gorno - Badakhshan autonomous region-in Alpine mountains.

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