PROSPECTS FOR USING THERMAL WATER IN KALBAJAR DISTRICT AND OTHER REGIONS (AZERBAIJAN) AS AN ALTERNATIVE ENERGY

Islam Tagiyev, Mehriban Ismailova, Vagif Karimov, Jafar Sharifov
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Azerbaijan State University of Oil and Industry
islamtagiyev258@gmail.com

Abstract

One of the essential problems of the present time in the field of natural sciences is saving energy resources and substitution of hydrocarbon energy with solar, wind, and geothermical types of energy. The Republic of Azerbaijan is rich with renewable sources including thermal water deposits being situated in a number of regions of the Greater and Lesser Caucasus, Apsheron peninsula, Talysh, as well as in the bounds of the Kura and Pre-Caspian-Guba depression. The article is based on the analysis of published materials, data from geological prospecting and scientific research work carried out in different time, as well as results of geochemical analyses of water sample. This article discusses issues about utilizing thermal water as an alternative energy. As alternative energy, thermal water of Kalbajar district has been investigated insufficiently for obvious reasons. Nowadays, not deep and low debit wells having bored in due course for balneological goals do not permit to consider thermal water in Kalbajar district as noteworthy sourses of alternative energy.

Keywords: Kalbajar region, thermal water, alternative energy, geological prospecting work, debit of sourses and wells

The material for preparing the given article was the results of analysis of geological prospecting work conducted previously, printed publications, and data from scientific research work carried out in recent years.

In connection with uninterrupted growth of worldwide energy consumption, international organizations on the level UN are raising the issue of sharply reduction of using traditional hydrocarbon resources (oil, gas, and coal) over the next 20-25 years. In this regard, nowadays specialists and scientists focus on prospecting new sources of energy. We consider side by side with wind and solar energy, within the conditions in Azerbaijan, thermal water known in a number of regions of the Greater and Lesser Caucasus, Apsheron Peninsula, Talysh, as well as within the Kura and Pre-Caspian-Guba depression possesses a great significance. The deposits of this water has been revealed by a number of wells drilled for oil and gas, as well as directly for thermal water [2, 3].

Over the past 30-40 years, scientific and experimental investigations relating to solving the problems in using not traditional energy of solar, wind, and thermal water have been realized in the republic. The quality of thermal energy accumulation and high thermal energy capacity counts for to be much significant energy source.

Moreover, in the years of 1964-1970, 17 wells were drilled in the Talysh zone under the one of the author's leadership and high temperature water was obtained from each well on the basis of which 10 greenhouses were constructed for cultivating early vegetables in the winter months by

the geologists jointly with agricultural entrepreneurs; and possibility of obtaining two and three harvest during the year was practically proved.

The thermal water in Massally, Lankaran, and Astara districts of Talysh-Lankaran zone are confined to the regional tectonic fault crossing the entire mountainous Talysh. Here, termal water with the temperature of 50°C with the debit up to 40 l/sec was exposed from the wells with the depth till 500 meter. The water is mineralized (18-29 g/l) having sodium chloride composition. The total debit from sources and wells of Talysh is amounted to 24,000 m^3/day.

The thermal water with hydrocarbonate-calcium-sodium composition with mineralization of 08-1,9 g/l and with the temperature of 50-90^0 C, and with the total debit up to 13,000 m^3/day was exposed from the specially drilled wells with the depth of 3,000 m in the Pre-Caspian-Guba zone (the southeastern slope of the Greater Caucasus) [2].

On Apsheron Peninsula, the thermal water has been found in the wells with the various depth. So, in the eastern part of Hovsan village, the water temperature in the drilled wells reaches up to 100^{0}C. In Bibi-Heybat, right next to Baku, the well is gushing chloride-hydrocarbonate-sodium water with mineralization of 16,5 g/l and with the temperature of 71^0 C, and with the debit of 450 m^3/day.

The Kura depression is a single complicatedly constructed artesian basin with complex distribution of temperature and water composition. The thermal water was discovered from 200 till 4,500 m, which were confined to the deposits of Apsheron, Akchakyl layers, productive thick layers, Maikop suite, and Cretaceous. The thermal water was revealed by a number of wells drilled for oil and gas in Babazanan, Neftchala, Khilly, aand Mishovdag fields. That water is enriched with iodine and bromine [5].

İn 1969, in the well number 3 in Jarly area (Kurdamir district) thermal water with the debit of 20,000 m^3/day and with the temperature of 100^{0}C was discovered in the Upper Cretaceous deposits. İn Kurdamir district, thermal water with the debit of 10,000 m^3/day with the temperature of 80^{0}C was revealed fron another well on the suface of the earth (Table 1, 2).

On the basis of conducting prospecting work it was determined that the southwestern side of the Kura depression possesses sufficient resreves of thermal water. That water can be used comprehensively and profitably for the purposes of heat supply for industrial and residential establishments, for obtaining chemical rare elements, thermic-greenhouse keeping, as well as for balneological goals. [6].

Table 1: *Forecast resources of thermal water in Azerbaijan*

Geothermal regions	Water temperature, ^{0}C	Forecast resources, m^3/day
Mountainous-folded zone of the Greater Caucasus	50-90	2000
Gusar foothill lowlands	40-97	22000
Apsheron peninsula	40-90	20000
Nakhchivan AR	40-53	3000
Talysh mountainous-folded zone	40-64	15000

Total area of the Lesser Caucasus is approximately 20,000 km^2. It occupies the southwestern slope of the Murovdag range of mountain, considerable part of Nagorno-Garabagh, as well as Shahdag ridge and it stretches from the Aras river in the south-east through Hakari and Tartar basins till the lake Sevan and further to the north-west. The north-eastern border of the lake Sevan in Garabagh zone is formed from massive and lasting Murovdag thrust fault getting the fault character in the east and is traced along south-western wing of Aghdam anticlinorium almost till the Aras River.

Table 2: *The main parameters of geothermal indices of thermal water in Azerbaijan*

Geothermal regions	Number of oil and gas bearing structures	T ^{0}C in the depth 3000m	Heat flux magnitude mW/m^3	Factors affecting the magnitude of the heat flux
Pre-Caspian - Guba	15	90	50	The area is characterized by low 30 mW/m^3 HF, to the southeast value of HF reaches 50 mW/m^3, which is associated with the fragmentation of deep faults
Apsheron	23	74	90	Relatively increased HF is associated with the influence of N-W directions of deep tectonic faults
Ganja	8	99	50	The thermal background is mainly formed due to the conductive, as well as the superposition of the convective component of HF
Yevlakh - Aghjabadi	8	75	50	The thermal background is mainly formed due to the conductive component of the HF
Shamakhy - Gobustan	6	80	99	High HF is due to the fragmentation of the basement by transverse and longitudinal faults

Kalbajar district is located within the Lesser Caucasus in the valley of the Tartar river at an altitude of 1,800-3,800 meters above sea level. In terms of area, the district is the largest administrative-territorial unit of Azerbaijan. The area of the district is 6,420 km^2 that is 7.5% of the total area of Azerbaijan (Figure 1.).

At the present time, a number of draft for infrastructure are being introduced contributing to the reestablishment of economy in liberated regions including Kalbajar district. The territory of the district is rich in vast amount of valuable minerals including mineral and thermal waters.

In the liberated regions, many-sided work is being conducted to reestablish them, the modern types of city building will be applied considering the concepts of "smart" residential complex and modern management models. One of the most important problems of the modern requirements of science, technique and technology is to reduce to minimum and replace hydrocarbon energy with alternative one – solar, wind, geothermal and other types of energy [7, 8].

The advantage of thermal water is that it has opportunity to gain heat, energy, and its reserves are being uninterruptedly renewed, as well as they are worthy for obtaining medicinal properties and for possibility of obtaining valuable chemical products.

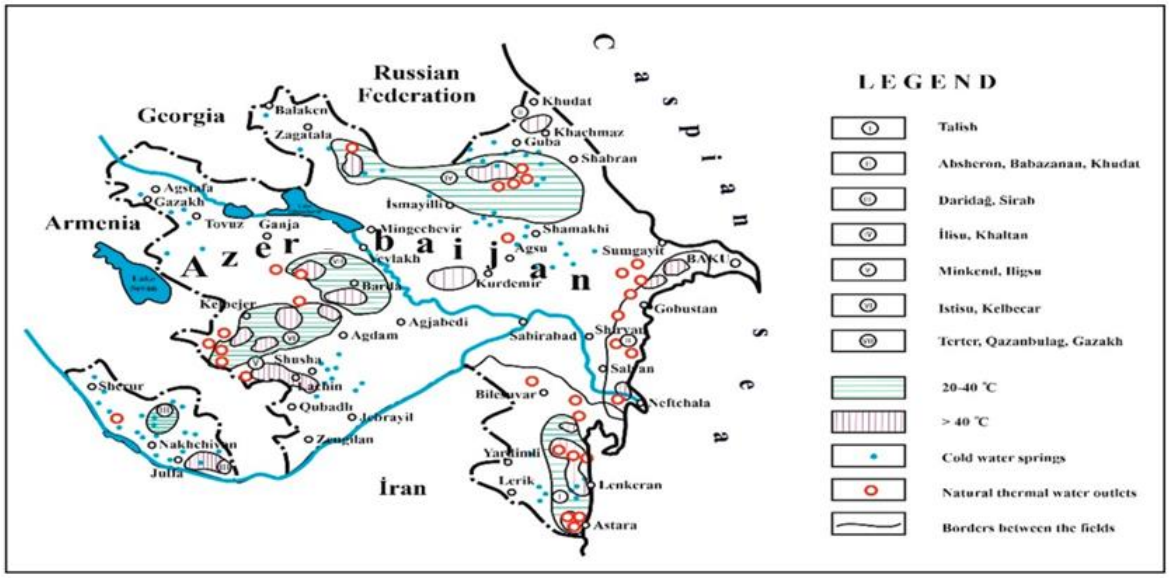

Figure 1: *Map of thermal water of Azerbaijan*

According to the conditions of occurrence, the thermal water of investigating area is related to fracture and fractured-veiny type of deep circulation and is cropped out on the day surface as the ascending sources.

Within the limits of this mountainous system, the belted location of separate complexes can be observed perfectly reflecting in the chemical composition of mineral and thermal water confined to the micro and macrotectonic disturbance and contacts with separate layers in the folded areas. Here, the igneous rocks of intrusive and effusive magmatism were widely developed stratifying with carbonate, sandstone, and clay formations.

The thermal water is manifested in the places of obvious and possible hidden tectonic faults, magmatic hotbeds of Paleogen-Neogene age and active volcanic manifestations of the Pliocene and Anthropogen [2].

Within the territory the Kalbajar superimposed trough, basin water with the highest temperature was developed related to magmatic activity during the period of manifestation and extinction of recent volcanism. Evidently, existing magmatic chambers in the depths up to now feed underground water with heat and enrich with carbon dioxide, and with several other ingredients (Table 3). Hydrogeological properties of the thermal water deposits in Kalbajar district is given below [4, 6].

Summing up, geothermal conditions in the regions considered above are changed under the total influence of many factors effecting on the heat flux density. The revealed anomaly of geothermic regime can be explained by the lithological properties of rocks, tectonic phenomena, and volcanism of the Quaternary period.

CONCLUSIONS

1. In the Kalbajar zone, prospecting and exploration work was conducted 40-50 years ago, exclusively for the development of health resort complexes. Nowadays, exploitation of the drilled sallow wells (up to 700 m) is used for obtaining an alternative energy (80^0C). Analysis of hydrogeological, geological, and tectonic materials shows that the thermal water with the temperature of 100^0C can be obtained from the wells of 1,000-1,500 meters.

2. In the investigated region, anomalous thermal regime is characterized over more than 40 km along the river Istisu valley. The geothermic step in the south slopes (the resort Istisu and

Bagyrsag area) is decreased up to 2-5 m and less, and for the entire resort region it is close to 18 m/ °C.

Table 3: *Hydrogeological properties of the thermal water deposit in the Kalbajar region*

Deposit names	Water-mixing rocks	Chemical composition					Water temperature, ^{0}C	pH	Water debit, l/day	Approved reserves
		Water points	Gas composition	Mineralization, g/l	Formula of ionic composition	Specific compo-nents mg/l				
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Upper Istisu	Volcanogenic strata, limestones and chalk sandstones	Source	CO_2	4,1-5,8	$\frac{HCO_3 51 Cl 32}{Na 91 Ca 9}$	Ba, Cu, Cr	54	6,7	200 thousand	825
Upper Istisu	Volcanic strata, (limestones) Cretaceous	well 700 m	CO_2	4,4-7,6	$\frac{HCO_3 50 Cl 39}{Na 90 Ca 8}$	Ba, F, Cr	71	6,7	3 million	-
Lower Istisu	Quaternary lavas, dacite-andesites	Source	CO_2	4,6-6,9	$\frac{HCO_3 69 Cl 24}{Na 88 Ca 10}$	Pb, Mn, Cu	39,5	6,8	800 thousand	180
Lower Istisu	Fissure Limestones, Marls, Sandstones	well	CO_2	3,2-7,4	$\frac{HCO_3 70 Cl 23}{Na 89 Ca 11}$	--	67	7,1	20 thousand	-
Bagyrsag	Cracks. Granite-diorite intrusions of the Santonian Stage	well 250 m	CO_2	4,1-5,8	$\frac{HCO_3 69 Cl 29}{Na 91 Ca 8}$	Sr, Zn, Ni	64	6,5	2 million	-
Geshtek	Limestones, chalk sandstones	well 700 m	CO_2	4,1-6,1	$\frac{HCO_3 72 SO_4 18}{Na 88 Ca 11}$	Pb, Ni, Cu	51	7,1	50 thousand	-

3. In the tectonic fractured areas, increasing the temperature with the release of carbon dioxide components is sometimes traced. As it was shown by drilling operations, the temperature of thermal water in Bagyrsag area increases rapidly, and at the depth of 100 m it reaches 80^{0}C.

4. Anthropogenic greenhouse gas emissions have had noticeable influence on the global climate change, CO_2 that is formed from the combustion of hydrocarbon fuel, methane (CH_4) forming as a result of various processes basically during the decomposition of biomasses, and several other gases not decomposing in the environment during hundreds of years.

5. Analysis of materials from thermal water deposits have determined that Azerbaijan possesses extremely favorable natural conditions for developing reestablishment of energy sources. Within the limits of the Kura depression, the thermal water up to 100^0C was discovered from the wells with the depth up to 3,000-3,500 m drilled for oil and gas. In the north-eastern part of the Greater Caucasus, the thermal water with the temperature of 80^0C was disclosed from the exploration wells specially drilled for obtaining thermal water.

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