

The state and prospects of geothermal energy development in Uzbekistan

Bakhtiyar Ismailov^{1}, Aziz Ibragimov¹, Timur Gafurov¹, Talad Mumindjanov¹, and Rakhim Tursunmetov¹*

¹SE “Institute HYDROENGEO”, Laboratory “Hydromineral resources”, Tashkent, Uzbekistan

Abstract. The article considers topical issues of the state of resources and prospects of use of geothermal energy taking into account foreign experience in the republic as one of the types of renewable energy source, connected, first of all, with depleted fossil fuel reserves and dependence on imports (mainly oil and gas imports). Uzbekistan has huge resources and reserves of geothermal resources, the projected resources of which at accessible depths (up to 5-6 km) are 4-6 times higher than those of hydrocarbons. The high economic efficiency of geothermal resources is determined by their thermal potential, which can be achieved by developing integrated schemes for each geothermal field. All this makes it possible to consider geothermal waters of the republic as the basis of development of geothermal energy in the republic.

1 Introduction

In recent years, renewable energy (solar, small river, petrothermal and geothermal) has received increasing attention from developed countries as an indicator of a nation's level of development. Thermal or geothermal water is an important renewable energy resource. Because of economic, political, social and environmental challenges, many countries around the world are faced with the need to promote renewable energy, including geothermal energy [1-2].

Uzbekistan has huge resources and reserves of geothermal, that is, accumulated in groundwater, and petrothermal (accumulated in rocks). Potential geothermal energy resources are divided into hydrothermal and petrothermal resources: the former are heat carriers such as groundwater, steam and vapour mixtures; the latter are geothermal energy contained in rocks [3].

In the territory of Uzbekistan, the projected geothermal resources at accessible depths (up to 5-6 km) are 4-6 times greater than the hydrocarbon resources, the main consumers, which in the near and distant future will undoubtedly have heat and hot supplies and, to a much lesser extent, electricity generation [4].

The current demand for geothermal energy as a renewable energy is primarily due to depletion of fossil fuel reserves and dependence of most developed countries on its imports

* Corresponding author: timur-02151980@mail.ru

(mainly oil and gas imports) as well as the significant negative impact of traditional energy on the environment.

2 Materials and research methods

The article used materials of previously conducted geological exploration and hydrogeological works (archival and stock materials) on geothermal waters in the republic.

Research methods included the following:

- Collection, systematization and analysis of previously conducted studies and published literature on the formation and distribution of geothermal waters in the territory of the republic.
- Study of foreign experience in the use of geothermal waters, as well as their implementation of geological exploration to identify natural heat carrier resources that can be used for thermal energy purposes and to select the most suitable options for the conditions of the republic.

On the basis of the collection, systematization and analysis of previously conducted studies and published literature on the formation and regularity of distribution of these waters, promising areas were identified (about 30) to arrange further exploration works and substantiated the possibilities of their complex development.

Geothermal energy in some countries (USA, Iceland, Italy, Germany, Hungary, Australia, New Zealand, Philippines, Indonesia, Russia, Kazakhstan, etc.) has become a very tangible source of heat and electricity. In recent years, projects have been successfully implemented in the USA (six new stations with a total capacity of 181 MW), Indonesia (137), Turkey (47), Italy (40). The European leaders in geothermal thermal power generation are Italy (636), Hungary (614.3) and France (345 MW). In 2021, there were 3,692 MW of geothermal power in the United States, growing at a rate of 3% per year. In 2022, the US, Indonesia, the Philippines, Turkey, New Zealand and Mexico accounted for 74% of the world's installed geothermal power. The combined electric and thermal power plant in Neshavellir (Iceland) has been operating successfully since September 1998 and has proven to be highly efficient in the use of geothermal sources. The rated capacity of the station is now: 60 MW of electrical and 200 MW of thermal power [5, 6, 7].

Among the countries that have achieved good results in the use of low (35-70°C) and medium potential (70-100°C) geothermal waters is France, where the main object of exploitation is the Dogger age reservoir (Middle Jurassic) in the Paris artesian basin, and the geothermal potential in Australia is best viewed as a continuum of high-enthalpy, deep-laying resources (3,000-5,000 m) suitable for large-scale commercial electricity generation (geothermal engineering systems, TGS and hot sediment aquifers, HSA) to low enthalpy, shallow resources suitable for small applications in low enthalpy aquifers (LEA) (direct use in heating and industrial processes) geothermal heat pumps (GSHP) and thermal energy storage in aquifers (ATES) [1, 8].

In addition, during the preparation of the article, the compilations of the United Nations Framework Classification for Resources (UNFC) were examined, providing examples of 14 projects received from Australia, Germany, Hungary, Iceland, the Netherlands, New Zealand, the Philippines and the Russian Federation, which demonstrate the application of the United Nations Framework Classification of Resources to geothermal energy resources [9].

Projects 6, 9, 10 deserved the most attention. As the Hungarian project (Central Heating in Hodmezjevár) is closer to our conditions (depth of the basin 800-2000m, water temperature 60-90 °C, used for heating and balneological purposes), Italian projects (Kanawase District DH Geothermal System, Milan) is very intriguing in its design, as the project concerns the connection of a heat pump unit using the thermal energy of

groundwater (90°C) to the district heating system, a project (Heat Pumping Plant with Vertical Ground Heat Exchanger, located in one of the office buildings of Pisa) operating in both heating mode (45°C) and cooling (7°C), which as innovative, deserves attention for introduction in our conditions.

3 Results

The Republic of Uzbekistan, together with the regions of the Russian Federation such as the Far East (Kamchatka and the Kuril Islands), Pre-Orthodox and West Siberian, are rightly among the most promising regions for the high-thermal waters of the great social-siberian region economic importance.

Geothermal waters identified on the territory of the republic can be used mainly for the production of thermal energy, as water of curative value, and on a large area of the Bukharo-Karshinsky artesian basin - as a raw material for the production of rare elements (iodine, bromine and others). All this makes it possible to consider the republic's geothermal waters as a complex mineral resource, which is especially important when developing low-potential geothermal waters [10].

In order to substantiate the expediency of involvement in the prospective fuel and energy balance of the deep heat of the earth, the staff of the Institute "HYDROENGEO" (1977-79y) made an assessment of the projected resources of thermal waters of Uzbekistan on the basis of the following indicators: Depth of the well, temperature at the bottom of the aquifer, mineralization of the water, water permeability of the rocks and static levels from the ground. The available data on sediment water abundance were approximate, so the estimated reserves are very approximate: for the Alb-Senomani and Senon-Paleocene aquifer complex of the Bukhara artesian basin, the projected resources are - 42.0 and 10.4 thousand. m³/day, and thermal resources - about 555 thousand. Gcal/year; on the Senoman and Turoon-Senon aquifer complex of the Aral Sea basin forecast resources - 11.3 and 5.7 thousand. m³/day, and thermal resources 143 and 53 thousand Gcal/year., the Senon Aquifer Complex of the Mingbulak Artesian Basin has a projected resource of 1.0 thousand. m³/day, and thermal resources of about 10 thousand. Gcal/year [11].

Conducted studies have revealed that the geothermal energy of mineral waters of the sanatorium "Altaryk" in the Fergana region, released from the subsoil of the earth, in the form of hot water (high thermal water 37-42°C) can be used not only for balneological purposes and for hot water and heat supply, as well as for power generation or simultaneously for all three purposes, its practical inexhaustibility, complete independence from environmental conditions, time of day and year is the main advantage of this facility [2].

At present, in the republic only on Altynsaik field (wells 1-re, 2-re, 1-r, 2-r, 2-p and 5-p, depth 135-300 m, Paleozoic deposits) in Navoi region, where low mineralized (1,6-1,9 g/l), high thermal (68-70°C) water sulfide-fatnosodium composition is used for balneotherapy, as well as for heating, hot water supply of buildings and structures, and greenhouse facilities sanatorium "Altynsai" and "Mother and Child".

4 Discussion

In the world practice, there are a number of technologies for the integrated development of medium and low-potential geothermal resources using thermal and water-resource potential for various purposes, the study and implementation of their in the branches of the economy, is relevant for today. Geothermal resources are the most important source of development of energy, rare metal and chemical industries, spa and agro-industrial complexes. For

example, geothermal energy, extracted in Dagestan for more than 40 years (in the cities of Makhachkala, Kizlyar, Izerbash) has the greatest potential for involvement in the fuel and energy balance. Development of new systems for integrated use of geothermal energy for heat supply and cold-water supply for human settlements, as well as of rare earth metal recovery technology [12-15].

Foreign experience with thermal water shows that the more diversified and technologically advanced all the useful properties of water are used, the higher its economic efficiency. It should be noted that, at present, most thermomineral water deposits in the Republic are not being exploited at the required level. Often, after consumption as a therapeutic and therapeutic drink, thermomineral water is discharged with a temperature high enough to be used in the economic sectors.

In order to ensure high economic efficiency of these waters it is necessary to make maximum use of the thermal and mineral potential, which can be achieved in the development of technological schemes for each thermal mineral water deposit. Below is a recommended diagram of the possible use of thermomineral waters.

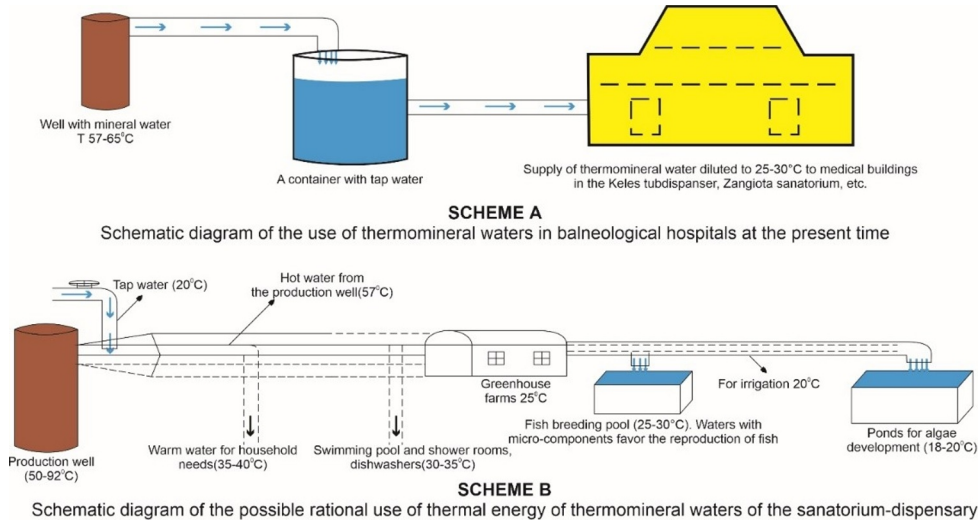


Fig 1. Diagram scheme of possible use of thermomineral waters.

5 Conclusion

At present, the State is paying special attention to strengthening the implementation of renewable energy sources in various sectors of the economy, in particular:

- The President of the Republic of Uzbekistan adopted a decision on intensifying the creation of renewable energy sources on 26 May 2017. PP-3012 "On the program of measures for the further development of renewable energy, improving energy efficiency in the economic and social sectors for 2017-2021".
- In the field of aquaculture development, the President of the Republic of Uzbekistan adopted a resolution from 01.05.2017 PP-2939 "On measures to improve the management system of the fish industry", which defines the main tasks and activities of the association "Uzbekbaliqsanoat" to develop aquaculture and increase fish production.
- In the field of creating modern greenhouse and greenhouse facilities in the regions of the republic, a decree of the President of the Republic of Uzbekistan dated 10.07.2018 "On measures to create a free economic zone "Bukhoro-agro" was adopted.

- In the field of the use of geothermal waters in health tourism, the Cabinet of Ministers adopted Resolution No. 41 dated January 25, 2022 "On additional measures to turn the Aral Sea region into a zone of environmental innovations and technologies".

In view of the above, it can be concluded that the use of geothermal waters in the Republic at present and in the future will be decided in the following areas:

- Development of recommendations for the utilization of the thermal energy potential of groundwater, taking into account the distance of the thermal power source from industrial sites and settlements. The chemical composition of groundwater is important in the assessment of the thermal energy potential, because the use of groundwater with a high temperature at the outlet (over 80-100°C), but with mineralization from 30 to 50 g/l and above can create technical problems, clogging of heat-conducting pipes.
- The possibility of using thermal water to generate energy by using small (up to 50 kW/h) power plants, which requires carrying out patent studies on the experience of the creation of such plants, technological schemes of their creation, as well as water chemistry requirements.
- Further develop aquaculture and increase fish production, including through intensive fishing.
- To develop proposals for the development of medical and recreational tourism in the Aral Sea region on the basis of identified geothermal water sources and the effective use of its potential, which will make the region a leading economic sector and increase investment attractiveness, Attract more local and foreign tourists, create new jobs and raise incomes and livelihoods in the region.

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