ENERGY-BIOLOGICAL COMPLEXES OF GEOTHERMAL FIELDS

Aliyev R.M.[1],
Badavov G.B.[2], Palamarchuk V.S.[3]

[1] JSC Geotermneftegaz, Shamilya 55A, Makhachkala, Russia, 367030, geoterm@dinet.ru
[2] Institute for Geothermal Problems, Shamilya 39 A, Makhachkala, Russia, 367030, geoterm@dinet.ru
[3] Administration of the Kizlyar city, Sovetskaya street, 17, Kizlyar, Russia

The brief description is given of the situation with power in the Republic of Daghestan. The prospects are proved of creation of energy-biological complexes on the basis of explored conservated fields of Northern Daghestan, using geothermal waters for extended production of valuable food products: commodity sturgeons, early vegetables, poultry, macro seaweeds, yeast. The most interesting financial results and schematic decisions realized for elaboration of the business-plan of investition project " Creation of energy-biological complex on the basis of explored geothermal resources of Northern Daghestan" is presented.

Key words: geothermal fields, wells, gas turbine plant, heat exchanger, unit for sturgeons growing.

Large scale, possibility of complex utilization and production by modern technical means are the peculiarity of geothermal energy.

In global aspect resources of geothermal energy at available for development depths (up to 5 km) are sufficient for work of all thermal electric power stations of the world during 100 thous. years. In utilitarian aspect reserves of thermal water all over the CIS are more than 20 mln. m^3/day (the lowest estimation) for work of geothermal circulating systems and 1 Gj of obtained heat is 1,5-2,5 more cheap than produced by thermal power stations and boiler-houses.

Taking into account aforesaid and significant explored resources, geothermal power engineering may be considered the priority direction of Russian economy.

Although now the main directions of thermal energy utilization are formed, that is: electric power production, industrial and municipal heat and water supply, balneology, green-houses, valuable microelements extraction-the real sphere of possible application of geothermal water is more wide. To confirm it we represent the diagram of complex utilization of geothermal water in different technological processes (Fig. 1).

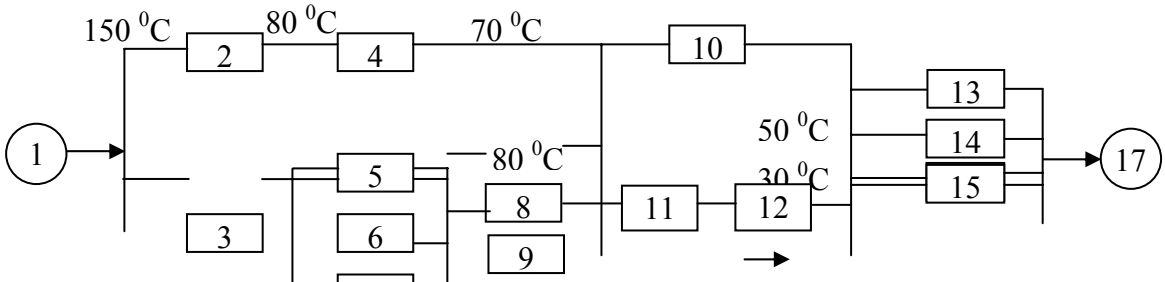

Fig. 1. Basic integrated diagram of geothermal water utilization:
1 - producing well; 2 - electric power production; 3 - refrigeration; 4 - central

heating and (or) hot water supply; 5 - industrial processes; 6 - sawmills; 7 - foodstuffs production; 8 - green-houses; 9 - grain drying; 10 - dehydration; 11 - fodder production; 12 - heat pump; 13 - soil heating and (or) irrigation; 14 - fish breeding; 15 - chemical production; 16 - balneology and bathing; 17 - injection well.

In our opinion, just this factor in future will become leading when developing the resources of isolated and distant fields, since it will permit to improve essentially the economy of geothermal production.

It is necessary to note that now many practical questions, connected with creation of geothermal circulating systems, prevention of corrosion and saline depositions, injection back of used geothermal water, are solved already.

The Republic of Daghestan is situated at the Northwest slope of the Central Caucasian Range and occupies the south most part of Russian Federation. In the East the Daghestan territory is washed by the Caspian Sea. Mountains occupy more than 50 % of Daghestan territory. Daghestan is the biggest of its territory (50,3 thous. km^2) and population (2,18 mln peoples) republic of Northern Caucasus.

Continental and temperate warm climate of Daghestan is conducive to develop the plant growing and to cultivate different warm-liking crops.

Daghestan possesses of different kinds of power resources. Oil, natural gas, hydroelectric power, geothermal power, solar energy, wind power are main of them. Practically all-electric power of the republic is produced by hydroelectric power stations (by central heating and power plants less than 3%). Daghestan resources of oil and natural gas are negligible and considerable financial support is required to increase their production (for example, oil reserves are 340 mln. t., gas reserves - 540 mlrd. m^3).

Daghestan exports all obtained oil and part of electric power, produced by hydroelectric power stations. In 2000 the export of power resources from Daghestan was about 25 % of their total production.

Since oil and electric power as a fuel do not take part in energy balance, this leads to necessity to import significant quantity of energy resources, such as oil products, natural gas, cool and firewood. In 1994 their quote in total consumption was 41 %, and in 2000 - 50 %. It demands to use all available local energy resources.

In future Daghestan intends to reduce gradually the oil export and import of oil products. Besides, there is a possibility to increase significantly the quote of applied in housing natural gas, electric power and renewable energy sources (RES).

Greatest explored geothermal resources in temperature range from 40^0 C to 107^0 C and mineralization range from 1.5 g/l to 27 g/l are concentrated in Northern region of Daghestan. Starting since 1960 year till present, ten fields have been discovered here, 64 wells have been drilled and prepared in readness for exploitation. Some of them are used already for heating of Kizlyar city and a number of villages in this region. Concerning other wells, they are far from large a habitation that does not allow exploiting them for district heating. For this reason these wells are put in dead storage.

We made analysis of the standing idle explored deposits of Northern region of Daghestan to determine the most prospective of them for creation of the first energy-biological complex (EBC) on its base. It is established the Rechninsky deposit is most interesting than all other. This field is located on the territory of Oktyabrsky poultry state farm and is 7 km distant from Kizlyar city along good covered with asphalt road. Rechninsky deposit is 13 km distant from Kizlyar railway station and 150 km distant from republic capital. There are prepared in readiness for exploitation 6 wells, which have been yielded powerful inflows of thermal mineral waters from chockrak, akchaghyl and apsheron deposits as a result of tests.

Discharges of wells mount to 3 000 cbm/day at gauge pressure 0,9 - 1,0 MPa and mouth temperature 40-105^0 C. The possibility of full injection back all utilized geothermal heat carrier at comparatively not high (till 2-3 MPa) discharge pressures is proved also by development works.

After analysis of experience of EBC creation at atomic power plants in Russia and other countries (USA, Germany, France) we believe the utilization of thermal mineral water for EBC allows to increase significantly the profitableness and reliability of the complex functioning and expand the operation range of heat potential of geothermal water. Actually by theirs temperature and quality described waters are the most suitable for utilization in the hot water heating and ventilation and hot water supply systems of green-houses, hotbeds, poultry farms and fish ponds, i.e. for growing under artificial conditions worth food products such as vegetables, poultry and fish, chlorella and other byproducts also. Low mineralization of water and absence of phenol in it are favorable to this. Moreover the problem of emergency release of used waters along the Gorodskoy Bank river bed and numerous canals (Kizlyar - Caspian, Novoterechnyi and other), which are practically waterless in winter, is solved.

The existence of settlements which are 1-5 km radial distant from designed complex is additional advantages of choused deposits. There is trained personal to operate the EBC in these settlements. Neighborhood of Kizlyar city allows delivering the grown production to consumers. If necessary there is real possibility to obtain additional considerable amounts of thermal waters by new drilling.

The deposit territory is placed in the waterless zone of semi desert and characterized by continental climate. Summer is dry and hot here with maximum temperature in July up to +40 C. Winter is moderately cold with the lowest temperature till -20 C. Duration of heating cycle is 155 days. Control atmospheric temperature for heating system is -17 C. Duration of solar radiance is not less than 2 000 hours per year. Annual precipitation is 300 mm. Northeast and southwest winds prevail here.

Designed EBC (see Fig. 2) consists of the autonomous GPP (geothermal power plant) with capacity 0,7 MW, the green-house (area 3 hectare), seasonal heated soil under polyethylene film (area 2.3 hectare), poultry house (for 54 thous. poultries), and ponds for breeding of sturgeons, chlorella and spirulina, (total area 30 hectare).

At present in the field the preparing works are carried out for realization of the first turn of the EBC construction, consisting of two production units: the unit of sturgeons breeding and the unit for spirulina growing. For water supply of these units free from phenols apsheron geothermal waters will be mainly used. Thus, as it can be seen from Fig.2, phenol containing thermal waters after utilization in farm-heaters will be directed to the system of under-water and wall heating of fish- and aquatic plant pools with the purpose of saving of standard thermal water consumption. But these waters – chockrac, phenol containing, and apsheron, standard, – never mix one another. To the selected building site the water supply and sewerage lines have been brought, there are wells for thermal water output, the part of equipment has been bought, the business-plan has been prepared, which has been coordinated with the Administration of the Kizlyar district. Completion of all works is expected to 2005. Analogous production capacities are planned for building also in the Karaman area, Thernair, Isberbash, Tarumovka and Kalinov geothermal fields. Low cost price of own heat and electrical energy and the availability of demand for EBC production provide high economical efficiency of realization of such projects practically in any point of Northern Daghestan. What about the unit for purification from phenols, it is meant exclusively for supernumerary situations, which may be occur, for example, when short-term acid processing the bottom-hole zone of injection wells. In Daghestan the re-injection of geothermal water has been using already in the Kizlyar and Isberbash fields for many years. The possibility of re-injection in

Rechninski field had been studied on the stage of prospecting works and therefore it is doubtless.

The gross yield of marketable products for principal kind of EBC structures and units was defined on the basis of possessed agriculture recycles and productivity. On the whole the designed EBC must yields in a year up to 7 thous. Hundred-weights of tomatoes and cucumbers, 85 tons of poultry meat, 24 tons of balyk and not less 6 tons of caviar.

A summary investment required for suggested of the first turned of building of Rechninsky EBC is estimated equal to 900 thous. dollars: buildings and constructions - 469,6, raw and materials stock - 106,6, power consumption - 507,7, wages - 115,6, depreciation of equipment - 149,7, taxes and other payments - 41,2.

Expected profit obtained already in the first year of normal exploitation is going to be about 20 thous. dollars ignoring profit from the sale of chlorella.

Comparing to known kinds of similar plants, which use in cold season large amount of commercial heat, the geothermal waters allow to support optimal temperature conditions in the units of EBC all the year round. Besides ones are fine nutritious medium to growing the valuable vitamin fodder.

The new conception of commercial development of geothermal resources of conserved proven fields is a basis of elaborated by joint-stock Company "Geotermneftegas" business-plan "Creation of energy-biological complex (EBC) on the basis of explored geothermal reserves of the Northern Daghestan". It is included as an immediate one in the Federal Aim Program of social and economical development of the Republic of Daghestan, which is confirmed by Resolution of Government of the Russian Federation of 12-th of August 1998, N 931.

Creation of the Rechninsky EBC will permit to draw in district economy not used earlier geothermal resources, give additional 72 new working places and secure significant tax revenues.

So, revenues of all levels in 2004 will account 0,88 mln $, including: in federal budget - 0,48 mln $, in republic budget - 0,23 mln $, in local budget - 0,17 mln $.

For business-plan there are positive decisions of expert-analytical Counsel at Chairmen of the RD Government, State non-departmental experts at Ministry of Building and Architecture of RD, State Ecological Commission of experts at Ministry of Environment and Natural Resources Protection of RD.

Expected financial results of the project: profitableness of the capital – 127 %, profitableness to cost – 304 %, net present value (NPV) - 1,143 mln $, internal rate of return (IRR) - 65 %, profitability index (PI) - 3,2, payback period (PP) - two years from commissioning of edifices, 3 years from beginning of financing.

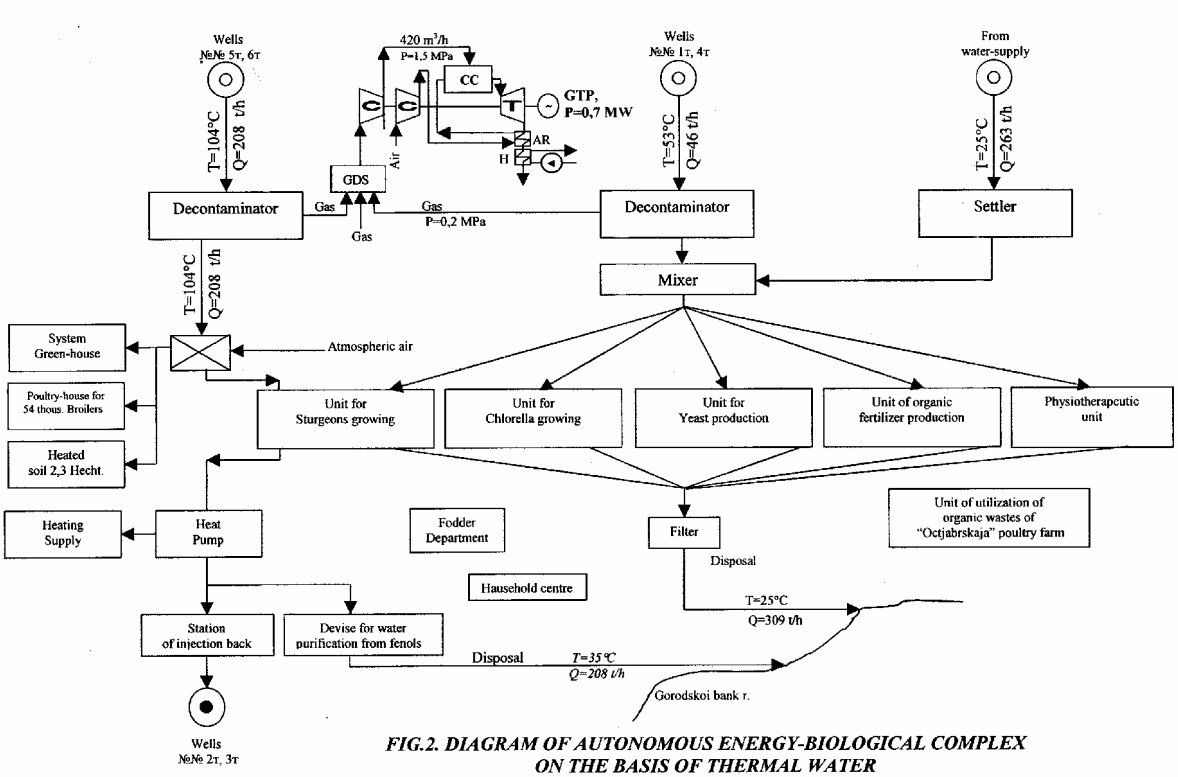

FIG.2. DIAGRAM OF AUTONOMOUS ENERGY-BIOLOGICAL COMPLEX ON THE BASIS OF THERMAL WATER