GEOTHERMAL RESOURCES OF THE REPUBLIC OF DAGESTAN: PRESENT STATUS AND FUTURE POTENTIAL

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Abstract

The most powerful natural thermal water resources of the Caspian region are located in the Republic of Dagestan. Thermal waters are used here widely for heating and hot water supply. This region has, however, been depressed for the last period and development of geothermal program was practically stopped, and at present it is required the full modernization of obsolete technologies. Opened JSC "Geotermneftegas" is the only economical subject in Russia, having more than 10 licenses on the right of geothermal heat-carriers production. The other structures either have been disintegrated or use foreign credits. The company is also an owner of the licenses for geological exploration and production of hydrocarbons in the Caspian shelf, the forecasted resources of which are 340 million tons of oil and 540 billion m^3 of gas and gas-condensate.

Production of such volume of raw materials will lead to losses of biological resources of the sea, where 90% of world sturgeon reserves of total cost about US$ 5 billion are concentrated. Taking all this into account, in the paper the main attention is paid to elaboration of preventive compensational measures, in particular, creation of energy-biological complexes (EBC) on geothermal waters for reproduction and restoration of the resources of sturgeons – representatives of relict ichthyofauna.

The conception of integrated geothermal systems, realized when developing the described EBC, is directed to solution of the main for the Republic problems: creation of new work- places, keeping of Russian population in the territory of their constant residence, improvement of the quality of life and health of the population, protection of a unique nature of the region.

This project will support economics of Dagestan, adding the stability to the policy of the reforms. Realization of the project will supply the population with high quality food (fish, fish-products, poultry and vegetables). Application of complex technologies will give the opportunity to use thermal water for electric power production and balneology. In the paper the brief description is given of the situation with power in the Republic of Daghestan.

It is shown that development of systems of geothermal water supply and of energy-biological complex has prospects. The most interesting financial results and schematic solutions realized for elaboration of the business-plan of investment project "Creation of energy-biological complex on the basis of explored geothermal resources of the Northern Dagestan" are presented.

Key words: *geothermal sources, hydrocarbon and biological resources of the Caspian shelf, oil and gas production, sturgeons cultivation, compensation of damage; valuable food growing in energy-biological complexes.*

1. Introduction

The Republic of Dagestan (RD) is situated at the northeast slope of the Central Caucasian Range. It borders on five foreign States and occupies key economical and geographical position in the South of Russia. In the East the territory of Daghestan is washed by the Caspian Sea. Mountains occupy more than 50 % of the area and the lowland – to 44 %. Dagestan is the largest on the size of territory (50,3 thousand sq km) and a population republic of Russia.

However features of social-economical development of the Republic last years at sharp deficiency of own fuel resources (≈ 100% of solid fuel and up to 60% of natural gas are imported) had resulted in lowering of living standard in comparison with all-Russian one. So, average salary in Dagestan is 2,7 times lower than in Russia as a whole, and unemployment is 1,8 times higher.

Difficulties of economic situation and large demographic loading are at the bottom of social tension in the region and of the low standard of life of a population. In addition the decrease of production and consumption of the most valuable food: meat, milk, eggs, fish, is quite appreciable. In 2001 only 27 kg of meat per head was produced that 2,6 times less than physiological norm. Last years this tendency has even more amplified, that is proved by correspond statistics (see Table 1).

Table 1. Production of basic food per head in the Republic of Dagestan

Name of products	Years						Living mini-mum	Medi-cal norm	Per-cent of provis ion
	Mean annual numbers of population, thous. of people								
	1986-1990	1996	1997	1998	1999	2000			
	2000	2073,2	2094,2	2120,1	2142,7	2159,1			
Grain, kg	264	148	132	94	124	108	1000	1000	10,8
Flour, kg	62	35	20	11,5	16	5	187	137	3,7
Meat, kg	67	51	55	55	46	49	36	70	70
Milk, kg	192	122	125	125	125	125	196	360	34,7
Potatoes, kg	43	75	51	48	58	48	100	97	49,5
Vegetables, kg	125	61	58	120	180	143	97	165	86,7
Fruit, kg	207	107	92	43	43	48	19	80	60
Fish, kg	18	10	8	7	10	7	11	18	38,9
Eggs, pieces	131	70	90	102	105	113	180	243	46,5

The power situation in the Republic is unfavourable for the development of agriculture. The clearest example of this are the enterprises located in Northern Dagestan that have an almost 100% focus on consumption of natural gas. Under this condition any interruptions in energy supply of the enterprises, which have a purpose of achievement of immediate profitableness, are resulted in serious consequences. So, ceasing of gas delivery in December 1997 for three days in poultry farm “Oktjabrsky” was resulted in material damage at a rate of 56 million dollars.

Dagestan possesses different kinds of energy resources. Oil, natural gas, hydroelectric power, geothermal power, solar energy, wind power are main of them. Practically all of electric power of the Republic is produced by hydroelectric power stations (by central heating plants less than 3 %). Resources of oil and natural gas of Dagestan are significant, but require considerable financial credits, which the Republic has not, to increase their production.

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

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

In future Dagestan 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).

Dagestan is consider by right a geothermal province of the Russia and the pioneer in development of deep underground heat in the USSR, it has unique reserves of non-polluting and renewable energy, which being fully used, may be 50% in fuel-energy balance of the country.

Capacities of the Company "Geotermneftegas" permit to carry out in wide industrial scale all works connected with geological exploration, production and realization of geothermal water in territory of the Republic of Dagestan: drilling of exploratory and development wells, construction of areas of production and transportation of geothermal heat-carriers, building of energy-biological complexes. What about resources of geothermal water, they amount 2,2 million cubic m/day, that on heat equivalent (60 million GJ) is fully comparable with volumes of fuel-power resources (3,2 mln tn), annually consumed in the Republic.

At present in Dagestan 17 fields of salt and heat power waters have been explored and more than 120 wells have been drilled, 53km heat pipelines and 7 heating and pumping stations have been built.

There are not geothermal power plants in Dagestan, therefore obtained thermal water are using mainly for heat supply and particularly for mineral water bottling and balneology. Nowadays the capacity of geothermal heat supply systems is 32,2 MWt and object of the same capacity are suggested to building in Makhachkala and Kizljar towns. In 2002 the Company "Geotermneftegas" produced 613.000 GJ of thermal power. It enabled more than 100.000 consumers in towns of Kizljar, Makhachkala, Izberbash to be provided with heat and hot water. Hot water supply of sanatoria and recreation zones in territory of Dagestan also is carried out by means of thermal water heat. Geothermal heat sources are quite competitive and significantly cheaper than traditional heat-carriers. The average cost 1 Gkal of geothermal heat now is $ 4,7, that 35-50 % cheaper than heat obtained from gas boilers.

However it is necessary to note, that with transition to market economics and suspension of prospecting works financing from the federal budget the first serious difficulties had appeared in maintenance of functioning of already created geothermal complex. Increase of natural gas delivery to the Republic from the main pipelines has intensified this situation. Thus, contrary to expectations, the sharp rise in prices of gas and traditional energy carriers has not stimulated adequate increase of demand for geothermal energy; instead the falling-off in production has taken place.

Scale of this falling-off may be illustrated in the following figures: if in 1988 geothermal water production on the Board "Dagburgeotermija" reached 11,3 mln.m^3, in 2002 it has made 3,6 mln.m^3, i.e. recession has made more 60%.

The present-day situation in this sphere is characterized by absence of increment of geothermal water reserves, low demand for geothermal heat produce and, as a sequence, by increase of numbers of idle wells and fields, especially in regions, remote from large populated areas. So, experience of preceding years has shown that the geothermal brunch without the State support cannot play significant part in energy balance of the Republic.

The most extensive explored geothermal resources with temperatures 40-107 ^{0}C and mineralization range 1.5 - 27 g/l are concentrated in the northern region of Dagestan. Since 1960s till present, ten fields have been discovered here, 64 wells have been drilled and prepared for exploitation. Some of them are used already for heating of Kizlyar town and a number of villages in this region. Concerning other wells, they are far from large settlement, which does not allow exploiting them for district heating. For this reason these wells are put in dead storage.

In this connection we have made analysis of the standing idle explored deposits of the northern region of Dagestan to determine the most prospective of them for creation of the first energy-biological complex (EBC) on their basis. It is established that the Rechninsky field is an ideal for demonstration of an opportunity of wide complex utilization of geothermal water in agriculture. This field is located in the territory of "Oktyabrsky" poultry state farm and is 7 km distant from Kizlyar town along good asphalt road. The geographic coordinates of the deposit center are following: latitude 43^0 51' north, longitude 46^0 43' east, absolute height from -5 to -7 m. The deposit territory is placed in the waterless zone of semidesert and characterized by continental climate. Summer is dry and hot with maximum temperature in July up to +40 ^{0}C. Winter is moderately cold with the lowest temperature till -20 ^{0}C. Duration of heating cycle is 155 days. Control atmospheric temperature for heating system is -17 ^{0}C. Duration of solar radiance is not less than 2000 hours per year. Annual precipitation is 300 mm. northeast and southwest winds prevail here. Rechninsky deposit is 13 km distant from the railway station Kizlyar and 150 km distant from the capital of the republic. There are six wells prepared in readiness for exploitation, which have been yielded powerful inflows of thermo-mineral waters from chokhrak, akchaghyl and apsheron deposits as a result of tests. Discharges of wells mount to 3 000 cb m/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. It is necessary to finish the detail exploration of the field with calculation of commercial reserves. These operations are executed simultaneously with deposit exploitation under condition approximated to operating ones.

After analysis of experience of EBC creation at nuclear power plants in Russia and other countries (USA, Germany, France) we have made a conclusion that the use of thermal mineral water allows to increase significantly the profitableness and reliability of the Complex and expand the operation range of heat potential of geothermal water. Actually by their 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 stuff such as vegetables, poultry and fish, chlorella and other by-products (see Table 2). Low mineralization of water and absence of phenol in it are favourable to this purpose. Moreover the problem of emergent release of used water along the bed of the river Gorodskoy Bank and numerous irrigation canals (Kislyar - Caspian, Novoterechnyi and other), which are practically waterless in winter, is solved. Existence of settlements in radius of 1-5 km from designed complex is additional advantages of chosen deposit. There is trained personal to operate the EBC in these settlements. Neighbourhood of Kizlyar allows the delivering of the grown production to consumers. In case of need there is real possibility to obtain additional considerable amount of thermal water by new drilling.

In connection with transition to the market relations it is formed an idea that at present the advantage in organization of geothermal production must be revised in favour of agriculture. It is caused, first of all, by local character of underground heat utilization, what dictates to develop on their basis fast circulating and fast payable productions, placing of which near thermal water intake are economically expediently. Taking into account, that now any new building may be done only by means of credits it is necessary to choose such a direction of geothermal water utilization and such forms of organizational structures, which would be a guarantee to investor of the maximal profit reception. This condition is of great significance because it opens possibilities for private business in sphere of geothermal production.

Table 2. Comparative parameters of fresh water quality for fish breeding

№ pp	Substance	MPC		Geothermal water quality parameters				
		fresh water	fish breeding	Rechninskaja № 4т	Kordonovka № 4т	Thernair №105	Isberbash № 239	Karaman № 1-к
1	Depth of drilling, m			1720	1106	1240	1555	2000
2	Aquifer			Continental d.	Apsheron	Karagan,1 s.	Tshokrak, "B"	Aktshagyl
3	Flow rate of well, m^3/day			620	2500	1440	700	260
4	Head on wellhead, MPa.			0,04	0,6	0,2	0,3	0,5
Generalized parameters								
5	Temperature, ^{0} C	7-11	20-28	45	40	48	45	40
6	Colour	< 30	< 30	Colorless	Yellowish	Colorless	Colorless	Colorless
7	Transparence, sm	30	30	Transparent	Transparent	Transpare nt	Transparent	Transpare nt
8	Smell, grade	No > 2	No > 2	Oil	Without smell	Without smell	Without smell	Oil
9	Taste and smack, grade	No > 2	No > 2	Salt	Fresh	Fresh	Fresh	Salt
10	pH	6-9	6-8	6,78	8,4	7,43	7,24	8,6
11	Mineralization total, g/l	1-1,5	10-18	23,5	2,5	5,0	1.4	8,3
12	Alkalinity, mg-eqv/l	2	2	3,5	19	10,8	8,1	8,1
13	Hardness total, mg-eqv/l	7-10	8-12	40,7	0,98	2,6	6,0	3,77
14	Oxidisability, mg O_2/l	5	5-20	9,9	60,8	2,3	1,04	30,4
15	Oil products total, mg/l	0,1	0,05	Not deter.	Not deter.	Not deter.	Not deter.	Not deter.
Inorganic substances								
16	Sulfates (SO_4^{2-}), mg/l	500	100	18,7	22,2	1455,9	411,5	70,8
17	Chlorides (Cl^-), mg/l	350	300	14111,7	524,4	1165,5	102,4	4560
18	Phosphates, mg P_2O_5/l	0,2	0,2	0,02	Not found	0,05	0,01	Not deter.
19	Lead (Pb^{2+}), mg/l	0,03	0,1	Not found	0,007	Not found	0,009	Not found
20	Zinc (Zn^{2+}), mg/l	5,0	0,05	0,065	0,622	0,059	0,015	0,015
21	Nitrogen ammonal, mg/l	0,5	0,5	19,44	1,5	0,55	2,33	Not deter.
22	Nitrogen nitrital	0,02	0,02	Not found	Not found	Not found	Not found	0,02
23	Nitrogen nitratal	9,1	9,1	Not found	Not found	Not found	Not found	1
24	Iron (Fe), mg/l	1,0	0,05	20,2	76,6	0,9	5,2	1,7
25	Calcium (Ca^{2+}), mg/l		180-610	518,6	8,1	31,2	66,8	27,7
26	Magnesium, mg/l	50	50	181	7	13,4	33	29
27	Copper, mg/l	1,0	0,005	0,034	0,1	0,004	0,003	0,005
28	Manganese (Mn), mg/l	0,5	0,05	Not found	1,8	0,06	0,21	0,069
29	Selenium (Se^{6+}), mg/l	0,01	0,0016	Not found	Not found	Not found	Not found	Not found
30	Strontium (Sr^{2+}), mg/l	7	10	3,4	2,5	1,6	1,6	4,7
31	Mercury (Hg^{2+}), mg/l	0,0005	0,0005	Not found	Not found	Not found	Not found	Not found
32	Arsenic (As^{3+}; As^{5+}), mg/l	0,05	0,05	0,1	0,01		0,008	0,16
33	Fluorine (F), mg/l	0,05	0,05	1,2	1	0,5	1	1
34	Chromium (Cr^{6+}), mg/l	0,05	0,02	Not found	Not found	Not found	Not found	Not found
35	Nitrates (NO_3), mg/l	45	40	Not found	10	Not found	Not found	1
Gases								
36	Oxygen (O_2), mg/l	No < 4	No < 6	Not found	Not found	Not found	Not found	Not found
37	Carbon dioxide (CO_2), mg/l	To 10	To 10	96	Not found	150	200	Not deter.
38	Hydrogen sulfide (H_2S), mg/l	0,003	Absence	Not found	Not found	Not found	Not found	Not found
39	Methane (CH_4), mg/l	2	Absence	264		Not found	33	
40	Chlorine free, mg/l	0,5	Absence	Not found	Not deter.	Not found	Not found	Absence
41	Nitrogen free, mg/l	0,085		Not deter.	Not deter.	Not found	Not deter.	Absence
42	Nitrogen dissolved, % volume			38,7	1,15	52,9	66,1	Absence
43	Mixture of spontaneous gas			CH_4+N_2	Not deter.	N_2 -97%	Not deter.	CH_4 -97%
44	Mixture of dissolved gas			$N_2+CH_4+CO_2$	$CH_4+CO_2+N_2$	N_2+CO_2	$N_2+CO_2+CH_4$	CH_4+CO_2
45	Gas saturation, ml/l			7,08	13,05	Not deter.	5,4	14,44
Organic substances								
46	Bitumen neutral			1,5	1,5	2,3	0,8	1,4
47	Bitumen air-blown			1,4	5	2,9	1	4,2
48	Humus			6	57,5	3,1	2,8	32,9
49	Phenols, mg/l	0,001	0,001	Not found	Not found	Not found	Not found	Not found
50	Aromatic hydrocarbons, mg/l	0,5	0,5	Not found	0,425	Not found	1,1	Not found
51	Volatile acids, mg/l	4	4	Not found	Not found	Not found	Not found	Not found
52	Naphtenic, mg/l	1	1	Not found	Not found	Not found	Not found	Not found

In the last years a significant work has been done for substantiation of this new direction in geothermal and adaptation of existing technologies of energy-biological complexes to conditions of geothermal fields. Results of this work have found the most complete realization in the business-plan of investment project, elaborated by JSC “Geotermneftegas”. It includes the autonomic geothermal power plant (GPP) with capacity 0,7 MWt, fish-ponds and pools (35 hectares) for growing 25 mln specimens of sturgeon fry, 1150 tn of marketable sturgeons and 1500 tn of chlorella and spirulina; green-houses and heated ground under polyethylene film (5,3 hectares)) for growing 5040 tn of early vegetables, poultry-house for 54 thous. of broilers and unit for production of dried yeast (20 tn). Thus surpluses of fallowing gas are used on manufacture of non-polluting liquid fuel- dimethyl ether (see fig.1).

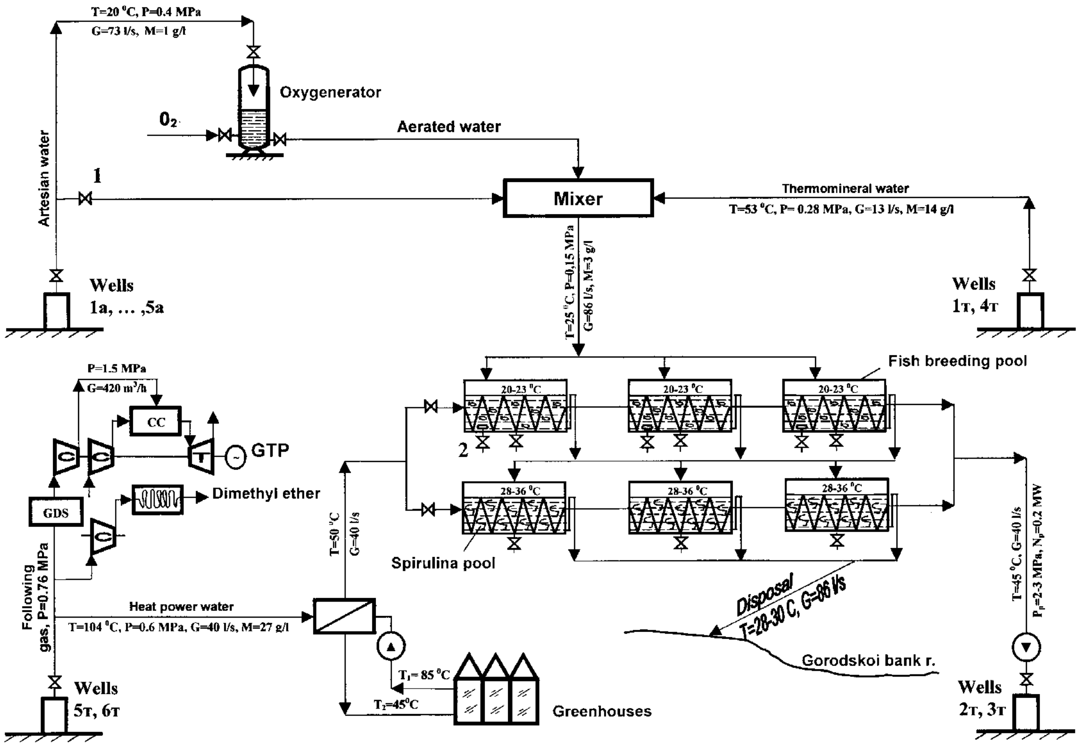

Fig.1. Diagram of Rechninsky energy-biological complex: 1 – crosspiece; 2 – emergent delivery of oxygen

One can see that orientation to maximal use of heat and water resources of geothermal field and chemical energy of associated gas and also inculcation of intensive biotechnologies are the features, which will permit to raise commercial profit significantly by producing the valuable food.

In addition, possibilities of building and operation of the EBC, working on geothermal water are essentially higher, than when using waste waters of electric power stations, which contain different organic pollutions, causing anomalies of fish development. In difference from the last circumstance geothermal waters are sterile, have increased operational reliability, high temperature potential, and constant temperature and flow rate and also free heads, sufficient for transportation to significant distances without pumping. They are also excellent culture medium for production of vitamin fodder, baking yeast, micro-greens chlorella and spirulina.

The possibility of round-year operation of the geothermal EBC without use of commercial heat in winter is very important its advantage in comparison with EBC at nuclear electric power stations. As the experience of fish breeding in warm water shows (the Kostroma, Tver and Tula regions, Republic of Udmurtiya), this method provides sufficiently intensive growth about all of sturgeon juveniles, permits to reduce a period of maturing of spawners by two times, to provide their yearly spawning and to obtain marketable produce already in the second year of cultivation. Productivity of fish-ponds and pools, heated with thermal water is increased by the order and mass of two-year old specimens of sturgeon reaches 2-3 kg and more (see Fig.2).

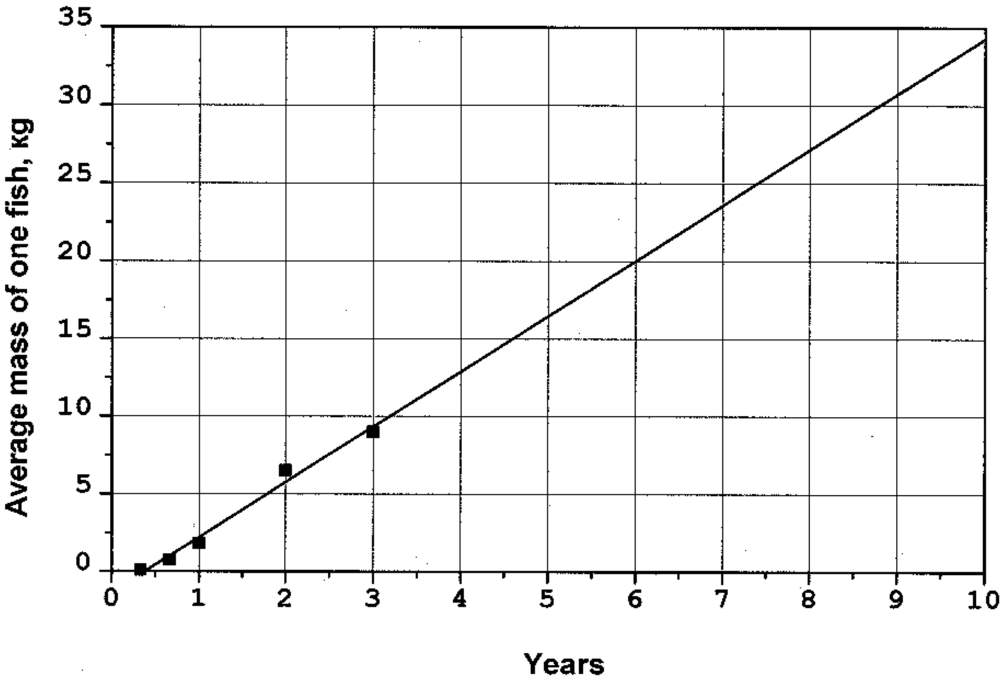

Fig. 2. Dynamics of marketable sturgeon growth in fishponds and pools, heating with geothermal water with control of thermal mode.

The working project of the first turn of the construction foresees creation of complete hatchery with using of opened and closed pools and stationary fish-ponds, filling with warm mineral water (36-38^{0}C). Growing of sturgeon takes two years, bringing fish to standard marketable mass of 2 kg, which is suitable for use as a food. It is contemplated that the second turn can realize more prospective long-term rotation with the purpose to obtain the commercial caviar at the end of production cycle. It considerably raises the efficiency of the EBC, i.e. demand for caviar is practically unlimited and it's 10 higher in prices than meat of fish.

Unit for growing of chlorella and spirulina represents opened round pools with the depth 0,5 m and area 0,1 hectares, total number 200.

In such units during the vegetation period from 15 of May till 15 of September from one hectare of aquatic surface one can obtain 800-1000 m^3 of suspension with density 20 mln sells/ml that, evaluated in dried substance of chlorella, makes 5-7 tons. As culture medium for intensification of their growth the geothermal water from well №6T, drilled in chockrac aquifer and from fish breeding unit of the EBC is used. Thermal water from this well is characterized as silicate boric chloride-sodium, neutral reaction with mineralization 18 g/l, temperature 104^{0}C, pH 6,9, it contains CO_2 0,47 g/l and wide scale of macro- and microelements, required for effective cultivation of aquatic plants in artificial conditions. After filling in pools with water, they are sawed with a culture of chlorella, counting 340-350 g of micro-greens on 1 hectare (proceeding from dry weight). Gathering began, when the density of green biomass reaches 5 cm^3/1. This produces approximately 1 g/l of dried biomass. Further suspension, taking from pools, is subjected to filtration, centrifuging, sedimentation, drying and milling.

Dried biomass milled to condition of marketable produce and packed in sacks – for dispatch to consumers.

Output of biomass, grown on geothermal water is two times as much and – by biochemical indices – as good as biomass, obtained, on known culture mediums (Tamija, Zarruck and soon). High productivity of chlorella in geothermal water is due to presence in it easy assimilated salts, microelements, CO_2 and optimal pH of the medium Besides which insufficient changing of temperature and chemical mixture of water do not influence intensity of growth of the cells in suspension. At the same time availability in the water of elements of the construction from copper and other heavy metals, rubber and soon negatively influences the growing of chlorella cells.

One can note that in process of growing cells of chlorella refreshes geothermal water and also clean them from some harmful admixtures, phenols among them (see fig.3).

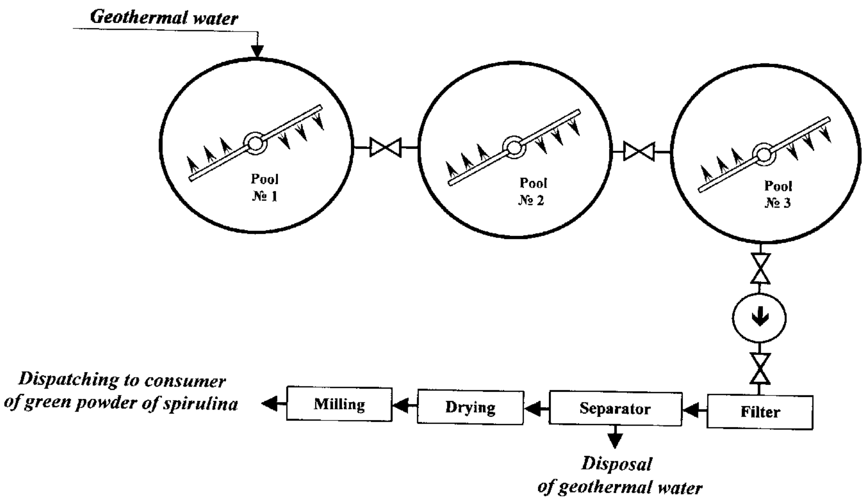

Fig.3. Diagram of cleaning of geothermal water from phenols with output of dried mass of spirulina.

Cost of vitamin-mineral additions, obtained from dried biomass of chlorella now is \$330/kg. For some information, cost of preparations from spirulina reaches US\$100/ kg and for raw material of chlorella - US\$30, that testifies to existence of high demand for this produce.

Summary volume of investments, required for realization of the project is estimated \$16 mln, including buildings and constructions - US\$11,43 mln.

The total prime cost of finished production of the EBC is US\$12,86 mln, including: expenses for salary US\$2,0 mln (15,55%), material expenses - US\$6,16 mln (47,9%), amortization - US\$1,141 mln (8,87%), taxes and other obligatory payments US\$3,559 mln (27,68).

Given in Table 3 technical-economical parameters testify to high level of economical efficiency of the project: profitableness of the capital - 12,5%, profitableness to the cost - 304%, net present value (NPV) - US\$35 mln, internal rate of return (JRR) - 27%, profitability index (PI) - 3,2, payback period (PP) - 3 years from output of the first production and 6 years from start of financing. Income of the enterprise for design period 4,5 times exceeds exploitation costs, i. e. the EBC is highly paying production.

Realization of the project will make additionally 500 new work places and will provide revenues to the budget of the Kizlyar district US$3,3 mln annually, i.e. the EBC is a socially significant investment project.

At present it is the unique geothermal project, which has been passed the competitive selection and the State examination in the Ministry of Building, the Ministry of Agriculture, the Ministry of Natural resources and the Ministry of Economics of Republic of Dagestan.

2. Conclusions

1. On the basis of studying the technologies of energy-biological complexes at thermal and nuclear electric power stations a new conception has been formulated and substantiated on development of geothermal resources of explored fields, which permits to force the solution of the problem of sturgeons reproduction and damage compensation, caused for biological resources of the Caspian Sea as result of development hydrocarbon resources in licensing shelf blocks.

2. Use of geothermal water in energy-biological complexes allows creating the continuous production process of sturgeon youth and marketable sturgeon growing. Simultaneously sterilization of water is provided, risks of production and power consumption are reduced, that permits to shorten by 1,5-2 times the process of growing and maturing of spawners in comparison with natural conditions. Regulated conditions of growing allow accelerating the process of production of other types of delicacy - balyk, reproduction and food black caviar.

Table 3: Parameters of efficiency of energy-biological complex

Parameters	Unit	Total	including on years									
			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1. Volume of loan capital*, including:	***$ thous.***	***16000***	***5030***	***6520***	***4450***	-	-	-	-	-	-	-
- investments in fixed capital	"	11430	3430	5720	2280	-	-	-	-	-	-	-
- investments in circulating capital	"	4570	1600	800	800	1370	-	-	-	-	-	-
2. The cost of production:	"	***12860***	-	-	-	***1370***	***1520***	***1588***	***1676***	***1727***	***1863***	***3116***
- planting material, raw material, fodder, completing, fuel and power	"	6160	-	-	-	670	720	780	852	895	990	1253
- expenditure for salary	"	2000	-	-	-	248	292	292	292	292	292	292
- depreciation charges	"	1141	-	-	-	163	163	163	163	163	163	163
- taxes and other payments	"	3559	-	-	-	289	345	353	369	377	418	1408
3. Liquidation cost	***$ thous.***	10289	-	-	-	-	-	-	-	-	-	10289
4. Production volume in natural expression	***tons***	***11575***	-	-	-	*1300*	*1360*	*1580*	*1600*	*1650*	*1700*	*2385*
- sturgeon youth (120 g)	***thous. pieces***	**25000**	-	-	-	2500	2500	4000	4000	4000	4000	4000
- meat of sturgeon	***tons***	**1150**	-	-	-	90	325	450	645	825	1000	1150
- black caviar unpressed	"	**60**	-	-	-	-	-	-	-	-	-	60
- balyk of cartilaginous fish	"	**575**	-	-	-	-	-	-	-	-	-	575
- spirulina and chlorella	"	**1500**	-	-	-	80	140	180	200	250	300	350
- early vegetables	"	**5040**	-	-	-	720	720	720	720	720	720	720
- other products (poultry, yeast, organic fertilizer)	"	**1400**	-	-	-	200	200	200	200	200	200	200
5. The total receipts from produce realization	***$ thous.***	***128200***	-	-	-	***9500***	***11300***	***16250***	***16850***	***18350***	***19850***	***36100***
- sturgeon youth	"	62500	-	-	-	6250	6250	10000	10000	10000	10000	10000
- black caviar unpressed	"	9000	-	-	-	-	-	-	-	-	-	9000
- balyk of sturgeons	"	5750	-	-	-	-	-	-	-	-	-	5750
- spirulina and chlorella	"	45000	-	-	-	2400	4200	5400	6000	7500	9000	10500
- early vegetables	"	5040	-	-	-	720	720	720	720	720	720	720
- other products	"	910	-	-	-	130	130	130	130	130	130	130
6. Receipts from realization of produce	***$ thous.***	***106834***	-	-	-	***7916***	***9417***	***13542***	***14042***	***15292***	***16542***	***30083***
7. Financial result	"	***105633***	-	-	-	***6546***	***7897***	***11954***	***12366***	***13565***	***14679***	***38626***
8. Repayment of received investments	"	***23600***	***1600***	***800***	***800***	***800***	***800***	***800***	***4800***	***4600***	***4400***	***4200***
9. Net present value (NPV)	***$ thous.***	*35049*	*-5030*	*-6331*	*-4201*	*3926*	*4684*	*7089*	*4578*	*5279*	*5889*	*19166*
10. Taxes and payments in budget, total:	"	***23285***	-	-	-	***2095***	***2328***	***2562***	***2795***	***3027***	***3260***	***7218***
11. Profitability index ***(IP) accounting discount***	***o/s***	***3,2***										
12. Internal rate of return ***(IRR)***	***%***	***27***										
13. Profitability of investments	***%***	***125***										

*** Calculated without taking into account of early expenditures of the Company on drilling and field construction (US$28 mln.)**
**** By average rate of exchange of the dollar 32 rouble/US$**