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Scientific Study of Cooling of Hydrotherm Extracted from the Source when Heating Buildings with Renewable Hydrotherm in the District of Guzor

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Abstract
This article presents the method of heating buildings from hydrotherms available in the territory of Uzbekistan, as well as the calculation methodology and calculation results of the hydrothermal temperature drop extracted from the source.

Keywords: Renewable energy, geothermal energy, biosphere, energy efficient foundation, Earth's core, Earth's crust, hydrothermal district heating system.

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Introduction

Particular importance is attached to the increasing use of renewable energy and the production of highly efficient constructive and technological solutions to construction practices in the world, at the same time as a constant increase in energy consumption and a decrease in hydrocarbon reserves. Currently, the development of alternative energy networks that use renewable energy sources is recommended geothermal energy, wind energy, solar energy, river flows and runoff energy. In this regard, geothermal renewable energy sources, in addition to the economic effect, occupy an important place in the Prevention of further pollution of the biosphere. This is becoming more and more relevant in the context of the deterioration of the environmental situation. Today, geothermal energy is developed and economically efficient. Also, at present, energy-efficient foundation projects for "double" purposes are widely used in foreign construction practice. In addition to performing the basic function of transferring the load that falls from the building to the floor, an energy-efficient foundation also acts as a thermal insulation layer in a certain sense for the Hydrotherm used. Geothermal energy is thermal energy that has been released from the inner zones of the Earth for hundreds of millions of years. According to geological and Geophysical Research, the temperature in the Earth's core reaches 3000-6000 °C and gradually decreases from the center of the planet towards its surface. The eruption of thousands of volcanoes, the movement of blocks of Earth's crust, earthquakes are a signal to the existence of strong internal energy of the Earth. According to scientists, the thermal area of the planet is due to radioactive decay inside it, as well as the release of nuclear matter due to gravity.

The consumer will notice their variability during the seasons and days of the year during the use of solar, wind and even water energy. An important advantage of using geothermal energy is that it provides relatively stable production and heat or electricity [3].

Increasing the energy efficiency of buildings using geothermal energy in our republic has not yet been widely applied to construction practices. In our opinion, this is due to the lack of experimental data necessary for the use of geothermal energy and the development of energy-efficient foundation technologies.

The in-depth study of all issues related to the distribution of hydrotherms on the territory of the Republic of Uzbekistan and the conditions of their formation and the interaction of various types of energy-efficient foundation structures with grunt mass is not only of practical interest, but also of important theoretical, scientific importance, since the determination of general hydrogeothermal norms

In the decree of the president of the Republic of Uzbekistan on September 9, 2022 “on the introduction of energy-saving technologies and additional measures for the development of small-capacity renewable energy sources”PF-220 [1], including the introduction of mechanisms for state support for the widespread use of renewable energy sources, the president of the Republic of Uzbekistan on August 22, 2019, the decision”on the implementation of energy-saving technologies and operational measures for the development of renewable energy sources " [2], as well as the implementation of tasks set out in other regulatory legal acts related to this activity, this article serves to some extent.

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Main Part

As you know, the marginal temperature of the heat carrier or heat-giving surface should not exceed 95°C for residential buildings, according to the normative document 10 of building codes and regulations of Uzbekistan ҚМҚ 2.04.05-97* "heating, ventilation and conduction". Hydrotherms around 90°C were therefore studied to heat the building. As a result of scientific research, with the support of the Institute of Geology and exploration of oil and gas fields of the Republic of Uzbekistan, the presence of hydrotherms in the Bukhara-Khiva oil shale region of the Republic of Uzbekistan is determined in Table 1.

Table 1. Hydrogeological data in Bukhara-Khiva oil shale

№	Area and deposits	The well №	Test range, m	Hydrothermic density , kg/l	Hydrothermal pressure , 1/10 MPa	Temperature , ^{0}C
1.	Ilim	3	2987-3003	1,06	319,99	114
2.	Noviy Guzar	1	3192-3284	1,075	346,57	113
3.	Chilgumbaz	1	3041-3035	1,04	583,15	113
4.	Kamashi	8	3320-3312	1,07	571,92	124
5.	Yangi Qaratepa	7	3572-3569	1,06	485,00	116
6.	Mangit	3	3596-3590	1,065	471,30	121,5
7.	Vost.Ayzovot	1	3660-3550	1,06	351,62	120
8.	Chatыrtepa	1	3523-3510	1,059	375,13	128
9.	Djambulak	2	3760-3748	1,14	513,13	115
10.	Buzaxur	3	3486-3478	1,065	389,16	126
11.	Quruqsay	2	3157-3340	1,06	459,73	110
12.	Mavlyankuduk	1	3522-3504	1,075	357,58	123
13.	Oxir	1	3182-3166	1,07	576,12	116

A hydrothermal central heating system described in Figure 1 is proposed for the study.

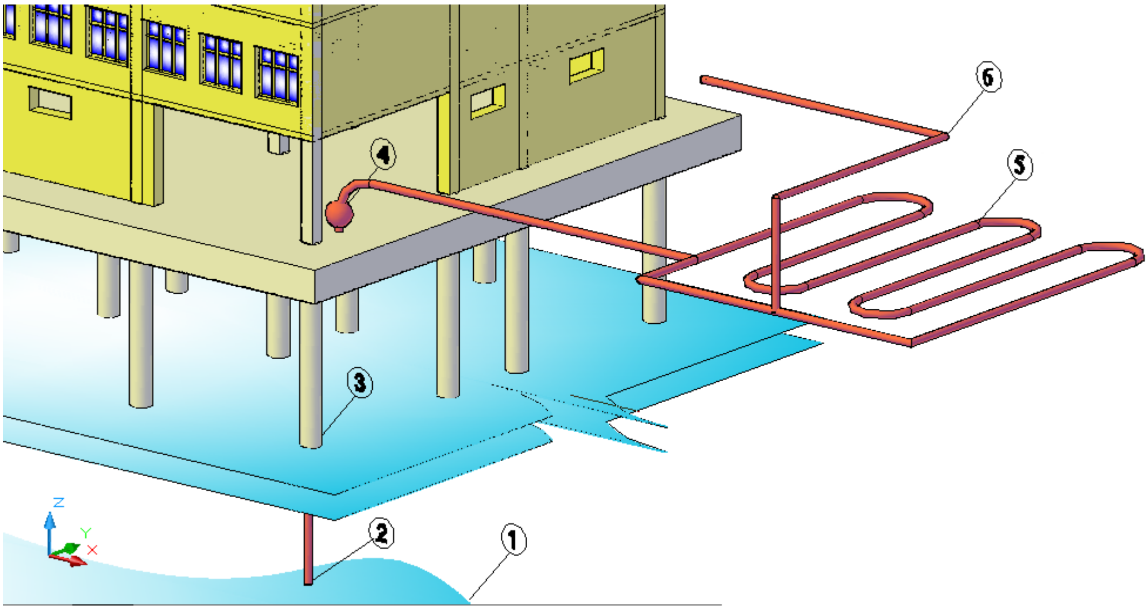

Figure 1. Energy efficient building scheme. 1-Hydrotherm; 2-Hydrotherm tow pipe; 3 - energy-efficient pile foundation; 4-water pump; 5-automatic cooling collector; 6-hot water supply to the building.

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Let's take a look at the steps of the account book for the Ilim mine. As the Hydrotherm rises to the Earth's surface, there is a decrease in the temperature of the Hydrotherm. In practice, it is found that as the Earth descends from the surface to the ground, the temperature rises from an average of 3°C every 100 meters [5-6]. The implementation of the results of this observation in the work of calculations increases the degree of accuracy of the result. Therefore, we calculate the change in the water temperature in the system for every 100 meters. This process is determined based on the formula for the change in the temperature of the fluid flowing in the Pipe **(1).**

$$\tau_{end} = t_{a.t} + (\tau_{i.t} - t_{a.t}) * e^{-\left(\frac{(1+\beta)*L}{C_r*G*\sum R}\right)} \qquad (1)$$

In calculations, the water density and heat capacity are obtained from Table 2:

Table 2 Table for determining water density and heat capacity

t, °C	100	101	102	103	104	105	106	107	108	109	110
C_p, J/(kg⁰C)	4194	4195	4196	4197	4198	4199	4200	4201	4202	4203	4204
ρ, kg/m³	958,05	957,33	956,6	955,87	955,13	954,39	953,65	952,9	952,14	951,38	950,62

t, ⁰C	111	112	113	114	115	116	117	118	119	120
C_p, J/(kg⁰C)	4205	4206	4207	4209	4210	4211	4212	4214	4215	4216
ρ, kg/m³	949,85	949,08	948,31	947,53	946,74	945,95	945,16	944,37	943,57	942,76
t, °C	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**
C_p, J/(kg⁰C)	4217	4219	4220	4222	4223	4225	4226	4228	4229	4231
ρ, kg/m³	941,95	941,14	940,32	939,5	938,67	937,84	937,01	936,17	935,33	934,48

The depth of the **Ilim** geothermal mine is about 3000 meters. To increase the accuracy of the calculation results, we divide the total height into 30 pieces with a height of 100 meters. The temperature on Earth is defined as follows:
The change in water temperature in the system is calculated for the first 100 meters as follows:

$t_{a.t}$ - ambient temperature in the geothermal mine, 112,50⁰C;
$\tau_{i.t.}$-the initial temperature of the water leaving the geothermal mine is on average 114⁰C;
L-pipe length-100 m;
C_r-heat capacity of water 4209 J/(kg⁰C);
ρ-water density based on Table 4.2-947,53 kg/m³;
$V_{v.c.w}$-volumetric consumption of Water SE 2500-60-11-1 for pump 2500 m³/h or 0,6944 m³/sec;
$\lambda_{t.i}$ - thermal conductivity coefficient of used glass cotton and Basalt Fiber thermal insulating material-0.07 W/m⁰C;

$\lambda_{p.f}$-thermal conductivity coefficient of pile foundation-2,04 W/m^{0}C;
D_p-pipe diameter-600 mm= 0,6 m;
$D_{p.f.}$ - pile foundation diameter - 800 mm= 0,8 m;
δ_{in}-insulating material thickness-6 cm=0,06 m;
$\delta_{p.f}$ -insulating material thickness-1,1 m;
According to the above data, the resistance of a thermal insulating material to heat transfer **(2):**

$$R_{t.i} = \frac{1}{2*\pi*\lambda_{t.i}} * ln\left(\frac{D_p+2*\delta_{t.i}}{D_p}\right) = \frac{1}{2*3,14159*0,05} * ln\left(\frac{0,6+2*0,06}{0,6}\right) = 0,5803\ m^2\ {}^0C/W; \quad (2)$$

Mass water consumption (3):

$$G = \rho * V_{v.c.w} = 947,53 * 0,6944 = 657,96 \text{ kg/sek} \quad (3)$$

Water temperature at the end of the pipe

$$\tau_{end} = t_{a.t} + (\tau_{i.t} - t_{a.t}) * e^{-\left(\frac{(1+\beta)*L}{C_r*G*\sum R}\right)} =$$

$$=112,1 + (114 - 112,1) * e^{-\left(\frac{(1+0,2)*100}{4209*657,96*0,5803}\right)} = 114^0C$$

When calculating the change in water temperature for the second 100 meters, the final temperature of the previous 100 meters is assumed for the initial temperature Ʈdast value and recalculated in the above sequence. In the last 100 meters will be released to the Earth's surface [7-8]. In this case, the sum of the heat-insulating material and the resistance of the pile foundation to heat transfer is assumed for ∑R. Heat transfer resistance of the pile foundation (4):

$$R_{p.f} = \frac{1}{2*\pi*\lambda_{p.f}} * ln\left(\frac{D_{p.f} + 2*\delta_{p.f}}{D_p}\right) =$$

$$= \frac{1}{2*3,14159*2,04} * ln\left(\frac{0,8+2*1.1}{0,8}\right) = 0,1031\ m^2\ {}^0S/W; \quad (4)$$

The cooling of the water in the later mines was thus calculated and the results are given in Table 3. As can be seen from the table, the temperature of hydrotherming in the proposed system rises to the Earth's surface almost unchanged, i.e.τ_{end}=113,9°C.

3- table The results of calculations for the Ilim geothermal field are summarized in the table below:

The number of the settlement point	Distance from the well to the counting point	t_{at}- ambient temperature	$\tau_{i.t.}$- the temperature of the water leaving the geothermal mine is	L- quvur uzunligi	c_r- heat capacity of water	ρ- water density	$V_{v.c.w}$- volumetric water consumption	$\lambda_{t.i}/\lambda_{p.f}$- thermal conductivity coefficient of insulation/foundation material	$D_p/D_{p.f}$- inner diameter of pipe / Foundation	$\delta_{t.i}/\delta_{p.f}$- insulation material / pipe wall thickness	G- mass water consumption	$R_{t.i}/R_{p.f}$- insulation material / pipe resistance to heat transfer	τ_{end}- temperature at the end of the pipe
№	m	^0C	^0C	m	$J/(kg^0C)$	kg/m^3	m^3/sek	Vt/m^0C	m	m	kg/sek	$m^2 * {}^0C /Vt$	^0C
1	100	112,1	114,000	100	4209,00	947,53	0,6944	0,05	0,6	0,06	657,96	0,5803	114,000
2	200	108,3	114,000	100	4209,00	947,53	0,6944	0,05	0,6	0,06	657,96	0,5803	113,999
3	300	104,5	113,999	100	4209,00	947,53	0,6944	0,05	0,6	0,06	657,97	0,5803	113,999
4	400	100,7	113,999	100	4209,00	947,53	0,6944	0,05	0,6	0,06	657,97	0,5803	113,998
5	500	96,9	113,998	100	4209,00	947,53	0,6944	0,05	0,6	0,06	657,97	0,5803	113,996
6	600	93,1	113,996	100	4208,99	947,53	0,6944	0,05	0,6	0,06	657,97	0,5803	113,995
7	700	89,3	113,995	100	4208,99	947,53	0,6944	0,05	0,6	0,06	657,97	0,5803	113,993
8	800	85,5	113,993	100	4208,99	947,54	0,6944	0,05	0,6	0,06	657,97	0,5803	113,991
9	900	81,7	113,991	100	4208,98	947,54	0,6944	0,05	0,6	0,06	657,97	0,5803	113,989
10	1000	77,9	113,989	100	4208,98	947,54	0,6944	0,05	0,6	0,06	657,97	0,5803	113,986
11	1100	74,1	113,986	100	4208,97	947,54	0,6944	0,05	0,6	0,06	657,97	0,5803	113,983
12	1200	70,3	113,983	100	4208,97	947,54	0,6944	0,05	0,6	0,06	657,97	0,5803	113,980
13	1300	66,5	113,980	100	4208,96	947,55	0,6944	0,05	0,6	0,06	657,98	0,5803	113,976
14	1400	62,7	113,976	100	4208,95	947,55	0,6944	0,05	0,6	0,06	657,98	0,5803	113,972
15	1500	58,9	113,972	100	4208,94	947,55	0,6944	0,05	0,6	0,06	657,98	0,5803	113,968
16	1600	55,1	113,968	100	4208,94	947,55	0,6944	0,05	0,6	0,06	657,98	0,5803	113,964
17	1700	51,3	113,964	100	4208,93	947,56	0,6944	0,05	0,6	0,06	657,98	0,5803	113,959
18	1800	47,5	113,959	100	4208,92	947,56	0,6944	0,05	0,6	0,06	657,99	0,5803	113,954
19	1900	43,7	113,954	100	4208,91	947,57	0,6944	0,05	0,6	0,06	657,99	0,5803	113,949
20	2000	39,9	113,949	100	4208,90	947,57	0,6944	0,05	0,6	0,06	657,99	0,5803	113,943
21	2100	36,1	113,943	100	4208,89	947,57	0,6944	0,05	0,6	0,06	658,00	0,5803	113,937
22	2200	32,3	113,937	100	4208,87	947,58	0,6944	0,05	0,6	0,06	658,00	0,5803	113,931
23	2300	28,5	113,931	100	4208,86	947,58	0,6944	0,05	0,6	0,06	658,00	0,5803	113,925
24	2400	24,7	113,925	100	4208,85	947,59	0,6944	0,05	0,6	0,06	658,01	0,5803	113,918
25	2500	20,9	113,918	100	4208,84	947,59	0,6944	0,05	0,6	0,06	658,01	0,5803	113,911
26	2600	17,1	113,911	100	4208,82	947,60	0,6944	0,05	0,6	0,06	658,01	0,5803	113,904
27	2700	13,3	113,904	100	4208,81	947,60	0,6944	0,05	0,6	0,06	658,02	0,5803	113,897
28	2800	9,5	113,897	100	4208,79	947,61	0,6944	0,05	0,6	0,06	658,02	0,5803	113,889
29	2900	5,7	113,889	100	4208,78	947,62	0,6944	0,05	0,6	0,06	658,03	0,5803	113,881
30	3000	1,9	113,881	100	4208,76	947,62	0,6944	0,05 2,04	0,6 0,8	0,06 1,1	658,03	0,5803 0,1031	113,874

Conclusion / recommendations

As we take from the world, geothermal znergy is now being used effectively in most countries. But the use of this energy in Uzbekistan is at a much lower level. Comparing the temperature depth (around 3 km) used in the paper to the Earth's radius (an average of 6,371 km), it can be concluded that geothermal energy can be used in a wide range. The identified methods of extracting hydrotherms to the Earth's surface now provide a wide path for the use of geothermal energy in Uzbekistan. Where hydrotherms are not available, the petrothermal method of using geothermal energy is used. In this method, closed contour systems are organized. Today's modern technologies of geothermal boreholes are considered to be fully capable of digging this closed contour [9]. Based on the calculations presented in the article, the temperature of the circulating water using the SE 2500-60-11-1 pump is 113.9°c, rising to the Earth's surface almost unchanged. As noted above, considering that the marginal temperature of the surface, which gives heat mainly to building codes and regulations of Uzbekistan ҚМҚ 2.04.05-97*, is 95°C for residential buildings, 113,9°C refers to the latitude of yanayam, the possibility of heating buildings from hydrotherms.

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УЗБЕКИСТАН И РАСЧЕТ ПАДЕНИЯ ТЕМПЕРАТУРЫ ВОДЫ ПРИ ВЫНЕСЕНИИ ИСТОЧНИКА НА ПОВЕРХНОСТЬ." Collection of scientific papers «SCIENTIA» April 7, 2023; Pisa, Italia (2023): 185-191.

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