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Ibraheem M.A. Naser, Lecturer (Technical Institute, Mosul, Iraq)

Techniques of applicability geothermal of hot springs water in heating

The present study investigates about the possibility of applying geothermal of hot spring water in heating, which locates in Hammam-Alalil region on the distance 30 km from Nineveh province in Iraq as heating system for domestic using, which considers one of the alternative energy, environmentally friend. Through studying physical, chemical, ecological and geological properties. The study shows by measuring temperature ,that the water classification was hot water by limiting the range of temperature 60-80 °c,the electrical conductivity Ec 5100 µSm/ cm ,total dissolved solid TDS 3800 mg/L,CO_3^{-2} 0.1 mg/L, HCO_3^{-1} 180 mg/L, PO_4^{-2} 0.038 mg/L, Ca^{+2} 84 mg/L, Mg^{+2} 283 mg/L, Na^{+1} 88 mg/L, K^{+1} 0.1 mg/L .These components indicate that hot spring water consider of mineral and gypsum waters by the reason of high concentration of sulfates and TDS .the conclusion appears that hotness of this water suitable to establishment technology system to use hot spring water in heating.

***Keywords**: Geothermal, Hot springs water, Heating, Alternative energy, Techniques.*

Техническое применение источников геотермальной горячей воды в системах отопления

Исследование посвящено изучению применения в системах отопления геотермальной горячей родниковой воды, которая находится в области Хаммам-Алил на расстоянии 30 км от провинции Ниневия в Ираке. Родниковая вода используется в качестве системы отопления для бытовых нужд, которая считается одним из альтернативных источников энергии, не загрязняющии окружающую среду. Это подтверждает исследование физических, химических, экологических и геологических свойств этой воды. Исследование показало, что температура горячей воды 60-80 ° С., электропроводность Ec 5100 µSm/см, общее количество растворимых твердых TDS 3800 мг/л, CO_3^{-2} 0,1 мг/л, HCO_3^{-1} 180 мг/л, PO_4^{-2} 0038 мг/л, Ca^{+2} 84 мг/л, Mg^{+2} 283 мг/л, Na^{+1} 88 мг/л, K^{+1} 0,1 мг/л. Вода продолжительно сохраняет тепло из-за высокой концентрации в ней сульфатов и TDS и применима для создания технологической системы отопления в холодное время года.

***Ключевые слова**: геотермальная, горячая родниковая вода, отопление, альтернативная энергетика, технический.*

Технічне застосування геотермальної джерельної гарячої води в системах опалення

Дослідження присвячене вивченню застосування в системах опалення геотермальної гарячої джерельної води, яка знаходиться в області Хаммам-Алил на відстані 30 км. від провінції Ніневія в Іраку. Джерельна вода використовується в системі опалення для побутових потреб і є одним із альтернативних джерел енергії, що не шкодять довкіллю. Це підтверджує вивчення фізичних, хімічних, екологічних та геологічних властивостей цієї води. Дослідження показло, що температура гарячої води становить 60-80° С., електропровідність Ec 5100 мкСм/см, загальна кількість розчинних твердих TDS (загальна кількість розчинних твердих фракцій) 3800 мг/л, CO_3^{-2} 0,1 мг/л, HCO_3^{-1} 180 мг/л, PO_4^{-2} 0038 мг/л, Ca^{+2} 84 мг/л, Mg^{+2} 283 мг/л, Na^{+1} 88 мг / л, K^{+1} 0,1 мг/л. Вода довго зберігає тепло завдяки високій концентрації в ній сульфатів і TDS і придатна для створення технологічної системи опалення в холодну пору року.

***Ключові слова**: геотермальна, гаряча джерельна вода, опалення, альтернативна енергетика, технічний.*

Hot springs were fountains of boil waters and hot steams, which runs out of interior to exterior ground. These springs being in volcano regions, the stones under ground in deep layers will be very hot, that provides ground waters runs out through cracks of earth surface. In many countries applying hot springs waters in central heating of domistics, agricultural greenhouse heating and generate electrical energy, such as Iceland, New zealand, Georgia and...etc. To day, when demand for energy is increasing with more development technologies it is important to think about energy sources in special renewable energy sourses, which were an essential alternative to current widely utilized fossil fuels. Wind power, solar energy, hydro power, tidal power, biomass power and geothermal energy are considered as renewable sources, the problems with using traditional energy sources (coal, gas, oil) is their limited amount and greenhouse gas emission. Using renewable sources helps to decrease the increasing demand for primary energy sources and to reduce greenhouse gas emission from energy generation and consumption. Also reduce dependence on imported fossil fuels, particulary oil and gas. The optimal use of thermal springs is largely depended upon its physical and chemical characteristics [1]. This study focuses on the thermal and chemical, physical features of thermal springs located in the northern part of Iraq, Ninevah province (Hammam - Alalil region), and water samples were collected from hot spring for analysis physical and chemical parameters. The temperature at source vary from 60-80°C on the surface of springs water. The springs are associated with faults and impermeable dykes and are assumed to be meteoric origion the mineral composition of the

thermal waters reflects to geological formations found at the depth of origion. None of the hot springs water are fit for human consumption since the contain unacceptability high levels of mineral anions and cat ions. Ninevah province be locate in northern of Iraq between longitude 44°10' - 41°15' and latitude 37°00' - 34°50'. Occupy area about 2003 km². In direction of environment, characterize climate of Iraq in semi-arid kind, continental, there are great variation in temperatures of daily, yearly. Average of rainfall differ in the region from location to other, also characterize sun rays abundance which reaches to earth surface may be distinguishing the four seasons, the summer season characterize with high temperatures, which increase off 45°C in June, July months, winter season characterize be low temperatures to zero some times, yet autumn and spring seasons characterize with moderation of temperatures. The great amount of rains be fall in winter ranged between 1/2-1/3 from all rain water of falling and remaining rain water distribute to autumn and spring seasons, reach falling rain water in years 1996-2000 with amount 128.90, 130 mm/y, reach falling rain water for 44 years between 1941 – 1985 y, with amount 338.8 mm/y as ratio. This depletion affected in finally on the quantity and quality of ground water from its among springs water in significant form in region. The springs water production to be less in great form, the quality could be bad by the result of high salinity and sulfur. The reason of the components according to geological nature of region, which to be formed from rotation of thick layers of gypsum, rock salt and clay stone. These stones be plays important role in limiting the quality and quantity of ground water, it was wealthy in salts and effective in water storage, also characterize of high dissolution ability. Yet the reason of high sulfur concentration in these springs return to geological nature of region to existence of sulfate rocks ($CaSO_4$) calcium sulfates, gypsum ($CaSO_4$, $2H_2O$) calcium carbonate and magnesium carbonate. The importance of these springs in using direction, its water not competence in agricultural field for irrigation, not suitable for drinking because of high temperature and bad quality, by the reason of high dissolved solid (anions, cations) which gives to water bitter taste, bad-smelling [2]. Include this study to knowing some physical, chemical properties of hot spring waters in Ninevah province, and possibility of its application techniques in heating.

Methods and materials

Took samples from spring locations which contains hot waters in average 5 liters , location Hammam-Alalil area. Analysis the sample in laboratory by the following method of analysis in book "Standard methods for the examination of water and waste water", to knowing following characteristics:

1. Physical properties

1.1 Heat (°C)

1.2 Electrical conductivity (Ec):

Limited by using the system conductivity mater model MC Mark V, unit microsiemens/cm (μSm/cm)

1.3 Total dissolved solid (TDS):

Measured (TDS) by weighted method, that evaporation knowledge volume of the sample and then drying the residue is an oven drying, under temperature (105°C) for a period one hour, then weighted the samples with sensitive balance of type meter, and unit mg/ L.

2. Chemical properties

2.1 Acidity (pH):

pH was measured by using pH-meter Philips-PW 9421.

2.2 Total hardness (TH):

Was measured by titration method against (Na_2EDTA) (Ethylene Diamine Tetra Acetic Sodium) and using solution of the buffer of the ammonia (Erichrome black) and unit mg/L.

2.3 Calcium hardness ($Ca^{+2}H$):

Was measured by analysis method against solution (Na_2EDTA) and using the buffer (murexide indicator) and unit mg/L.

2.4 Magnesium hardness ($Mg^{+2}H$):

Was measured by calculation method by minuc the calcium hardness from total hardness and unit mg/L.

$$Mg.H=T.H - Ca.H$$

2.5 Sodium ion (Na^{+1}) and potassium (K^{+1}):

The extent of these elements by means of a photometric spectrometer (Digital Flame Analysis Gallen Kampy) flame, and the unit mg/L.

2.6 Carbonates (CO_3^{-2}) and bicarbonates (HCO_3^{-1}):

Measured by titration method against solution sulfatic acid (H_2SO_4) molarity (0,02) by using phenolaphtalin indicator and yellow methyle, the unit mg/L.

2.7 Sulfate (SO_4^{-2}):

Measured in a way burning the weightly sediments, which called gravimetric method with ignition of residue and unit mg/L.

2.8 Phosphate (PO_4^{-2}):

Measured by the method of stannous chloride calorimetric with using the system PYE UNICAM – speectrometer SP8-100 UVIVIS and the unit mg/L [3].

Results and discussion

The present study investigates the techniques of applicability geothermal hot springs water in heating, which the hotness was as average 60-80°C in the surface of spring sited in Ninevah Governate, Hammam-Alalil region. It aims at determining the types of this hot water through the study of their physical, chemical, environmental and geological characteristics, the chief aim is to determining the validity of this types of hot ground water for heating purposes. To this end hot springs water were chosen sample from springs was selected. With regards to temperature. The study shows through tests, the spring water hotness is possible for using in heating and others application by the reason of high temperature in the surface which was more in deep layer, as geothermal energy, through heating pump erection in depth which fit for this aim and pumps the hot water from its source to heating insulator tanks then its distributing in special pipes to domestics as in figure 1, the table 1, shows some physical, chemical characteristics, where the temperature was 42-50°C, electric conductivity Ec 5100 Mcm/ cm, total dissolved solid TDS 3800 mg/ L, acidic number PH 5.8, sulfate $SO4^{-2}$ 2345 mg/L, $CO3^{-2}$, $HCO3^{-1}$ O.1 mg/L, 180 mg/L/, $PO4^{-2}$ 0.038 mg /L , Mg^{+2}, Na, K 283,88,0.1 mg/L.In geological properties considers gypsum water by the reason of high sulfate, characterize this water by more dissolved minerals according to geological nature of the earth layer component, where these hot springs be spread in the region of Hammam- Alalil, that considers more heating water in Iraq, these results be advocate with [4], which the hotness belong to leak surface water from Tigris river to more depth which cause to highest its temperature this advocate with [5], or ground water being through its penetration on dissolving and analysis minerals such as gypsum, anhydride, and dolomite rockes, where dissolving facilitate to occur the chemical reaction with heating incentive (Exothermic reaction) which doing to rising temperature of waters in these distant deepnesses, or that, the reason of temperature rising in these springs water is

Table 1. ***Physical, chemical analysis of hot springs water in region of study***

Physical analysis									
Temp°C			Ec μ Sm/cm			T D S mg/ L			
60-80			5100			3800			
Chemical analysis									
PH	TDS mg/L	SO_4^{-2} mg/L	CO_3^{-2} mg/L	HCO_3^{-1} mg/L	PO_4^{-2} mg/L	Mg^{+2} mg/L	Ca^{+2} mg/L	Na^{+1} mg/L	K^{+1} mg/L
5.8	3800	2345	0.1	180	0.038	283	84	88	0.1

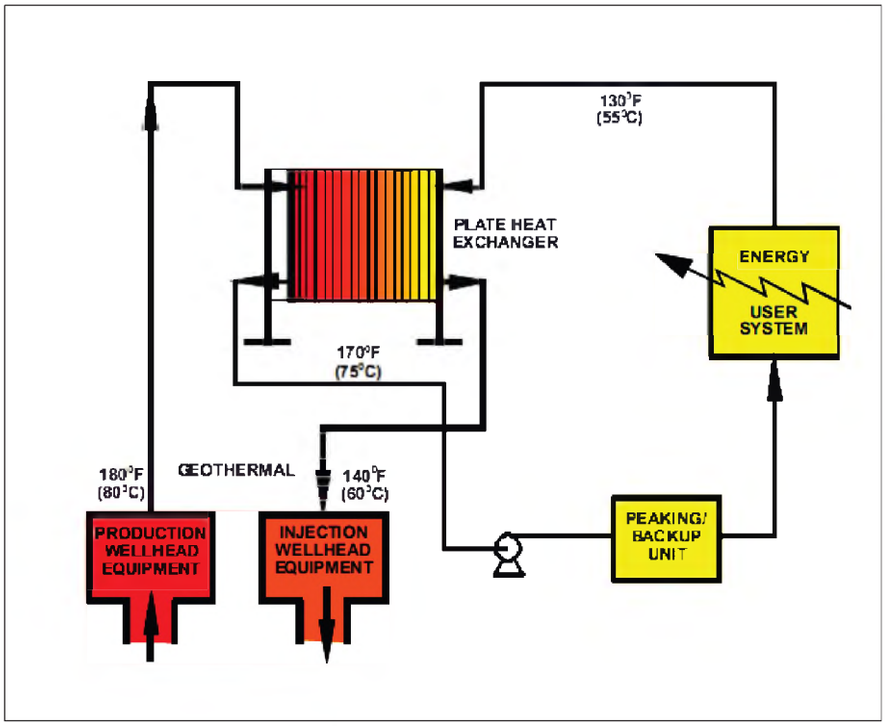

Figure 1. Typical Direct Use Geothermal Heating System Configuration

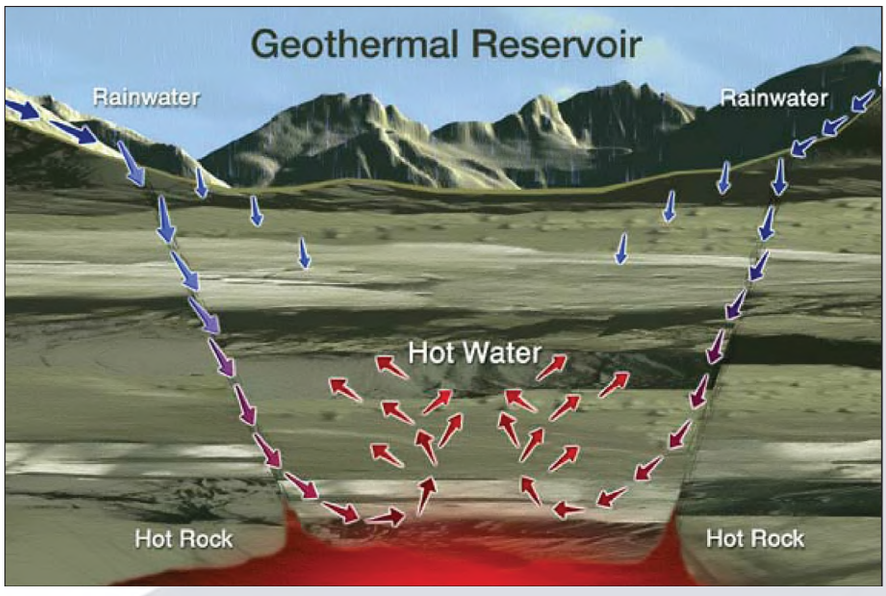

Figure 2. The Formation of a Geothermal Reservoir

belong to reaction rushing waters in direct of earth surface through surface of fault plane with gases be causing to rising water temperature in these springs which locate in the region of study [6], or the rising of water temperature belong to be locate these springs among volcano region which its stones characterize in deepness as a fire stones on very high temperature such as in the figure 2, which being waters in boiling stage, of what to make these waters to rush through cracks to the earth surface, this is more likely view. Therefor, that possible to benefit from this renewable alternative power in heating which is sustainable energy and safe for environment [7,8].

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