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Eco Friendly Power Generation using Geo-Thermal Energy in thermocouple

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ABSTRACT

Geothermal energy can be used for power generation using thermocouple. In this technology the emission of greenhouse gases has been minimized to zero as compared to 5-7% in geothermal energy by drilling method. The chances of occurring earthquake in thermocouple are limited as compared to drilling method. The results indicate that the temperature ranges from 80-90 ^{0}C during the experiment performed under the laboratory condition. It is equal to the approximation recordings from the geo-thermal natural springs. Down fall observed in-between the noon time for the output voltage this is due to rise in the surrounding temperature cause the effects on the performance of the heat sink used. During the noon the mean temperature of the surrounding increase to 40-50 ^{0}C, hence mean temperature difference between the source and sink decrease which further causing decrease in the output voltage.

Introduction

The threat of global warming has made it increasingly imperative that energy sources be developed that do not emit carbon dioxide or other greenhouse gases. Globally, emissions of CO2 are growing, and faster now than any time in the last 20 years[1]. The mounting evidence is incontrovertible that global warming will have significant effects on the Earth in the future, both environmental and financial; the only question that remains to be seen is just how large the cost will be. It has been argued that the costs of efforts to reduce greenhouse gas emissions will simply be too large and that the future is still too uncertain to invest in making changes that may ultimately be unnecessary. However a serious flaw exists in this argument. Once it is established with certainty that global warming is causing serious harm to our planet and its inhabitants, it will not only be too late to alter the situation, but the damage will have lasting consequences for a timescale comparable to modern human history. The only way to find out the result of the experiment is to actually do the experiment itself. Once done, it cannot be undone.

Geo Thermal Approach (Hot springs)

Geothermal energy originates from the original formation of the planet (20%) and from radioactive decay of minerals (80%). The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface.

At the core of the Earth, thermal energy is created by radioactive decay and temperatures may reach over 9,000^{0}C.[2] Heat conducts from the core to surrounding cooler rock. The high temperature and pressure cause some rock to melt, creating magma convection upward since it is lighter than the solid rock. The magma heats rock and water in the crust, sometimes up to 700^{0}C. Worldwide, about 10,715 megawatts (MW) of geothermal power is online in 24 countries. An additional 28 gigawatts of direct geothermal heating capacity is installed for space heating, spas, industrial processes, desalination and agricultural applications.[3]

Geothermal power is cost effective, reliable, sustainable, and environmentally friendly, but has historically been limited to areas near tectonic plate boundaries. Recent technological advances have dramatically expanded the range and size of viable resources, especially for applications such as home heating, opening a potential for widespread exploitation. Geothermal wells release greenhouse gases trapped deep within the earth.

The use of geothermal energy sources in the form of hot springshas the disadvantage ofavailability only at limited places. Even Earth's geothermal resources are theoretically more than adequate to supply humanity's energy needs, but only a very small fraction may be profitably exploited. Drilling and exploration for deep resources is very expensive. Forecasts for the future of geothermal power depend on assumptions about technology, energy prices, subsidies, and interest rates.

A case study of a coal plantupdated with scrubbers and other emissions control technologies emits 24 times morecarbon dioxide, 10,837 times more sulphur dioxide, and 3,865 times more nitrous oxidesper megawatt hour than a geothermal steam plant.[4]

Environmental impact of the Present Methods

Fluids drawn from the deep earth carry a mixture of gases, notably carbon dioxide (CO_2), hydrogen sulphide (H_2S), methane (CH_4), and ammonia (NH_3). These pollutants contribute to global warming, acid rain, and noxious smells if released. Existing geothermal electric plants emit an average of 400 kg of CO_2 per megawatt-hour (MW·h) of electricity, a small fraction of the emission intensity of conventional fossil fuel plants[5]. Plants that experience high levels of acids and volatile chemicals are usually equipped with emission-control systems to reduce the exhaust. Geothermal plants could theoretically inject these gases back into the earth, as a form of carbon capture and storage.

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In addition to dissolved gases, hot water from geothermal sources may hold in solution trace amounts of toxic chemicals, such as mercury, arsenic, boron, antimony, and salt[6]. These chemicals come out of solution as the water cools, and can cause environmental damage if released. The modern practice of injecting geothermal fluids back into the Earth to stimulate production has the side benefit of reducing this environmental risk.

New geo thermal approach (Hot springs)

Hot springs having temperature ranges from 90-100^{0}C, near the temperature of the boiling water. Bottom side of the experimental set up is shown in fig. 1. Direct connection of hot side of thermocouple is harmful, even protection from the excess of humidity is necessity. Hence a protection layer of solid polythene mounted across the thermocouple with tape has been provided. Hot side is attached to a hollow container' closed to bottom side. Hefley dipped inside the boiling water (hence protected from the direct connect of hot water). Other side has been attached to the heat sink. Heat will transfer in phase initially heat is taken from hot water by the aluminium container and then it will transfer to the hot junction of the thermocouple; further heat will be lost from the cold junction by heat sink attached to it. Fraction of heat will be converted to the electric energy. In configuring as whole it was just the reversible order of the part of the source collecting energy from the solar radiation. Bottom side is source and upper side is sink.

Heat Sink

A heat sink has been designed to increase the surface area in contact with the cooling medium surrounding it, such as the air. Air velocity, choice of material, fin (or other protrusion) design and surface treatment are some of the factors which affect the thermal performance of a heat sink. A heat sink is an object that transfers thermal energy from a higher temperature to a lower temperature fluid medium. The fluid medium is frequently air, but can also be water or in the case of heat exchangers, refrigerants and oil. If the fluid medium is water, the 'heat sink' is frequently called a cold plate.

Commercial extruded aluminium heat sinks have a thermal resistance (heat sink to ambient air) ranging from 0.4 °C/W for a large sink meant for TO3 devices, up to as high as 85 °C/W for a clip-on heat sink for a TO92 small plastic case. The famous, popular, historic and notable 2N3055 power transistor in a TO3 case has an internal thermal resistance from junction to case of 1.52 °C/W. The contact between the device case and heat sink may have a thermal resistance between 0.5 up to 1.7 °C/W, depending on the case size, and use of grease or insulating mica washer.[7]

The most common heat sink materials are aluminium alloys.[8] Aluminium alloy 1050A has one of the higher thermal conductivity values at 229 W/m•K but is mechanically soft. Aluminium alloys 6061 and 6063 are commonly used, with thermal conductivity values of 166 and 201 W/m•K, respectively.[9] The values depend on the temper of the alloy.Copper has around twice the conductivity of aluminium and faster heat dissipation, but is three times as dense and, depending on the market, around four to six times more expensive than aluminium. Aluminium can be extruded, but copper cannot. Copper heat sinks are machined and skived. Another method of manufacture is to solder the fins into the heat sink base [8].

Efficiency

Fin efficiency is one of the parameters which make a higher thermal conductivity material important. A fin of a heat sink may be considered to be a flat plate with heat flowing in one end and being dissipated into the surrounding fluid as it travels to the other. As heat flows through the fin, the combination of the thermal resistance of the heat sink impeding the flow and the heat lost due to convection, the temperature of the fin and, therefore, the heat transfer to the fluid, will decrease from the base to the end of the fin. Fin efficiency is defined as the actual heat transferred by the fin, divided by the heat transfer was the fin to be isothermal (hypothetically the fin having infinite thermal conductivity). Equations 1and 2 are applicable for straight fins [9].

$$\eta_f = \frac{\tanh(mL_c)}{mL_c} \qquad \ldots\ldots\ldots\ldots\ldots(1)$$

$$mL_c = \sqrt{\frac{2h_f}{kt_f}}L_f \qquad \ldots\ldots\ldots\ldots\ldots(2)$$

where

hf is the convection coefficient of the fin

Air: 10 to 100 W/(m2K)

Water: 500 to 10,000 W/(m2K)

k is the thermal conductivity of the fin material

Aluminium: 120 to 240 W/(m•K)

Lf is the fin height (m)

tf is the fin thickness (m)

Heat sing is a cylindrical body with one (bottom) side is open, when placed in its axis. Thermocouple's rectangular shape is fixed with cylindrical source's upper circular shape. Fixing is carried out in a way that the circular area of the cylindrical source must be greater than the rectangular Ares of the thermocouple. Configuration should be in the shape shown in fig. 1. The output temperature will be taken in front of time laps of equal laps.

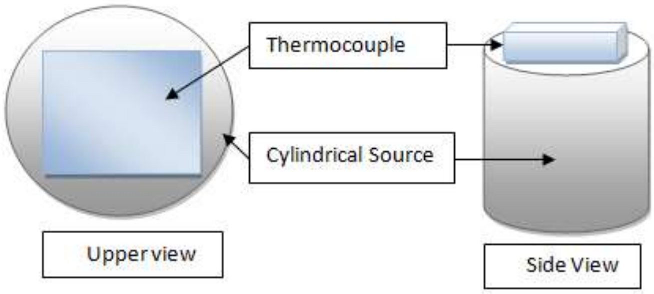

Fig 1 Provision for placing the thermocouple on source

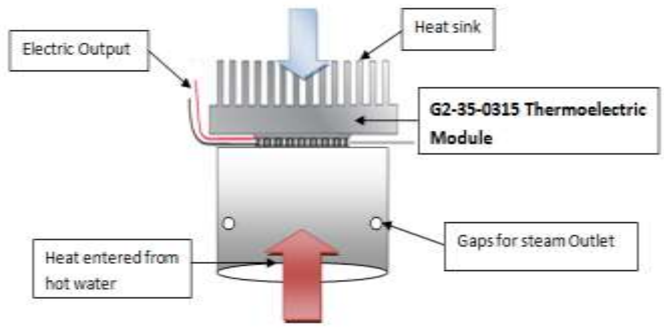

Fig 2 Main part of thermoelectric generation from geo thermal

Since the temperature of the hot spring lies in 80-90^{0}C, hence excess of steam is generated there. Under the source part it produced the pressure and even goes through of circulation inside the source part. This condition avoided with using the simple idea of making hole in axis perpendicular to the cylindrical axis. Steam generated leaved the source through these holes. Since the density of the hot water is low it flows over the cold water hence these helped in flow of hot water through the source.

Thermoelctric power genration from geo-thermal energy

Output voltage and current

Fig 3 and Fig 4 show the output voltage and output current of the electricity generated using geo- thermal energies. However Geo-thermal energy is available for the 24hours. Reading evaluated here are approximate continues and graph indicates their continuity for night. Temperature ranges from 80-90 ^{0}C during the experiment performed under the laboratory condition. It is equal to the approximation recordings from the geo-thermal natural springs.

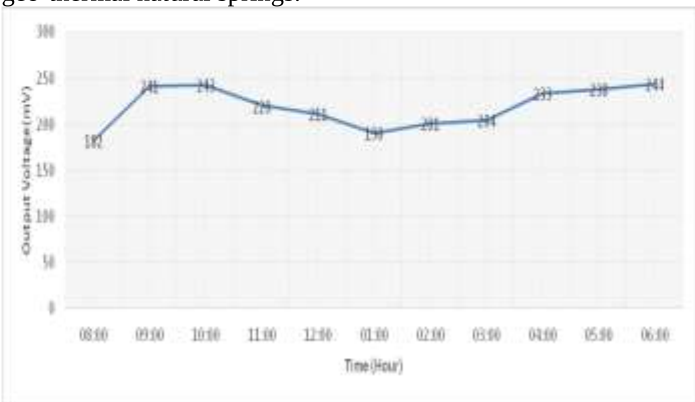

Fig 3. The output voltage of the electricity generated using geo- thermal energy

Down fall observed in-between the noon time for the output voltage is due to rise in the surrounding temperature cause the effects on the performance of the heat sink used. Its working based on the heat released to the surrounding. During the noon the mean temperature of the surrounding increase to 40-50^{0}C, hence mean temperature difference between the source and sink decrease which further causing decrease in the output voltage. Same pattern observed in the output current indicated the further improvement in sink part of the geothermal. Dataisrecorded under the consideration of the full sun shine day after regular interval of time along with the different sets of variables

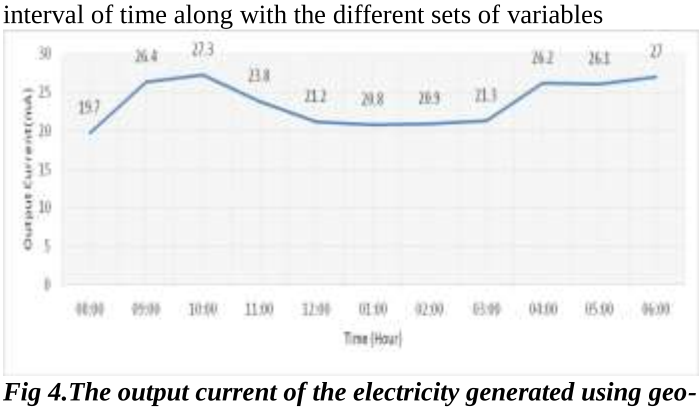

Fig 4.The output current of the electricity generated using geo-thermal energy

Economical Comparison with traditional methods

Costs of a geothermal plant are heavily weighted toward early expenses, rather than fuel to keep them running. Well drilling and pipeline construction occur first, followed by resource analysis of the drilling information. Power plant construction is usually completed concurrent with final field development. The initial cost for the field and power plant is around \$3000 to \$5000/kWe for a small (<1Mwe) power plant. Operating and maintenance costs range from \$0.01 to \$0.03 per kWh.[10]

Whereas using a **G2-56-0375 Thermoelectric Module** having 14 W power output[11] on natural geysers with initial cost for field and power plant is around \$7000-\$8000 per installed kW. However it is about 1.5 to 5.2 times more costly but a small one for eco friendly and clean and harmless geo thermal power production.

Discussion

Identifying a heat sink for the cold side of an air-to-air system must target a temperature drop for this side of system (i.e., the difference between the temperatures of the heat sink and the air circulating through it). On the load side of the system, the wattage is confined to active and passive loadsthat what is passing through the sink; thermoelectric power dissipation is not an issue here. With far fewer watts to handle, the heat sink on the cold side of the system tends to be significantly smaller than the one on the hot side.

There are certain 'rules of thumb' which should be observed in dealing with heat sinks in thermoelectric designs. When it is important to squeeze out as much cooling performance as possible, in order to minimize the temperature drops across sinks; good targets would be about a 10°C rise on the hot side with around half that on the cold side. This means, however, using heat sinks and fans which are more thermally conductive (i.e., less resistive) and that translates into more fin area, more aluminum (or copper), and greater cost.

In some extreme cases, exotic heat sink designs may be chosen to take thermal resistance to an absolute minimum. When cost is of critical concern, however, it may well mean compromises in the thermal performance of the heat sinks; this leads to higher temperature drops across the sinks and a loss of cooling capacity. In the end, component choices will come down to cost/benefit analysis and every user's needs be different.

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