

Abstract

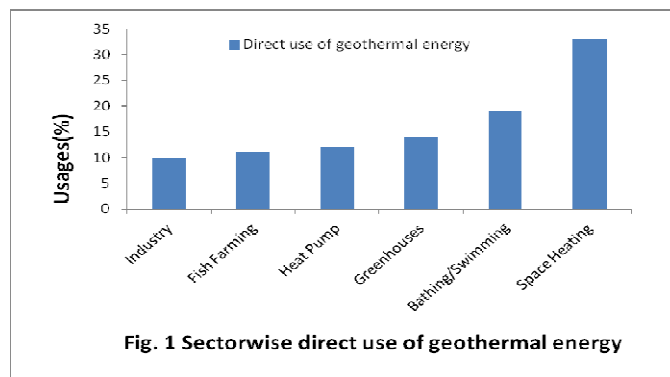
Geothermal energy can be used for generating electricity or can be used for direct applications. The present work is to compare the energy efficiency of two methods of geothermal energy utilization. The comparison of the two methods shows that energy efficiency is more in the case of direct use of geothermal energy. The geothermal energy utilization in case of direct use is more than in case of electricity generation by an amount 18 GWt and 252 GWt for India and world respectively.

Keywords: Geothermal energy, heating load, geothermal electricity, sustainable energy.

Introduction

Geothermal energy is a renewable form of energy. It can be used for producing electricity or for direct application. Electricity can be produced from the geothermal energy in two ways depending on the amount of geothermal energy available and its temperature. Large amount of high temperature geothermal water or steam available can be used in steam power plants. Other way called binary fluid technology can be used for low to average temperatures geothermal fluid. In this method two fluids are used, the secondary fluid must have low boiling point and also have high vapour pressure. Usually the secondary working fluid is isobutane or isopentane. The binary fluid power generation method works on the conventional Rankine cycle. Usually electric power generation is limited to about 150°C fluid temperatures, but with the binary fluids lower temperatures of the order of 100°C can be used for power generation [3]. In certain cases temperature as low as 85°C can be used for power generation [2].

The direct applications of geothermal energy are many. The space heating is main use of direct utilization of geothermal energy in the world (33%) [3, 1]. The distribution of direct uses of geothermal energy is shown in Fig. 1 [1]. The perfect inlet temperature to homes for space



heating is around 80°C [3]. In the year 2004 around 270 PJ of geothermal energy was utilized for the purpose of direct heating [4]. In space heating Iceland is the leader, around 85% of the houses in Iceland are heated by means of geothermal energy [6]. Direct utilization of geothermal energy has several advantages in comparison to electricity generation. Like a lot higher energy efficiency of the order of 50 - 70% as compared to 5 - 20% for geothermal electricity generation plants, the time of development is very less and very less money investment is required. Also direct application can utilize both low and high temperature geothermal energy resources. However direct utilization is much more site specific, as steam or hot water is seldom transported over lengthy distances from the geothermal energy site. [3]. Geothermal heating unit is designed based on the knowledge of heat transfer, geology of the place and availability of land [5]. Estimated geothermal energy

potential in India is of the order of 40 GWt and that of the world is 560 GWt.

The present work is to compare the geothermal electricity generation with direct application. The various other parameters like efficiency of direct application and electricity generation was taken from the literature available, geothermal energy potential in terms of direct use & electricity generation and savings in terms of energy was computed.

Materials and Methods

The electricity can be produced from the geothermal fluid in the following ways: -

Dry steam power plant

In this the plant uses geothermal fluids that are mainly steam. The steam directly goes to a turbine that runs a generator which produces electricity. The direct steam saves the cost of conventional fossil fuels to run the turbine. It also saves the cost of transportation and storage of the fossil fuels. The schematic sketch of dry steam power plant is shown in Fig. 2.

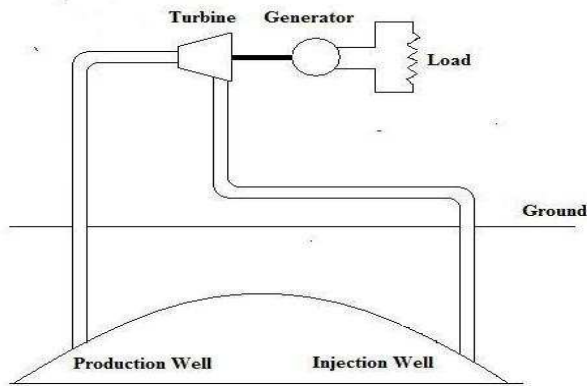


Fig. 2 Schematic sketch of a dry steam power plant

Flash steam power plant

Geothermal fluid (water/steam) above 180°C is pushed up to the surface by boiling. This hot water/steam on reaching the surface enters a separating chamber and is separated into liquid and steam. The steam obtained is used to run a steam turbines and the liquid is utilized as a source of heat to power a binary cycle. The schematic sketch of flash steam power plant is shown in Fig. 3.

Binary system power plant

Heat from geothermal water is transferred to a secondary fluid which has lower boiling point as compared to water. The working fluid transforms to vapours and is used to run the turbine to generate electricity. The schematic sketch of binary system power plant is shown in Fig. 4.

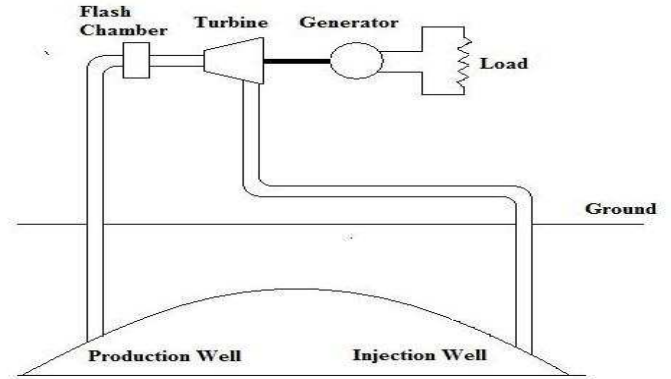


Fig. 3 Schematic sketch of a flash steam power plant

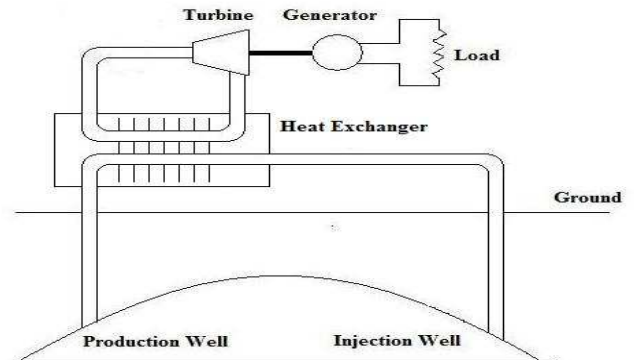


Fig.4 Schematic sketch of a binary cycle power plant

Space Heating

In space heating, the inside of buildings and houses are kept warm by the use of geothermal energy. The schematic sketch of geothermal space heating is shown in Fig. 5.

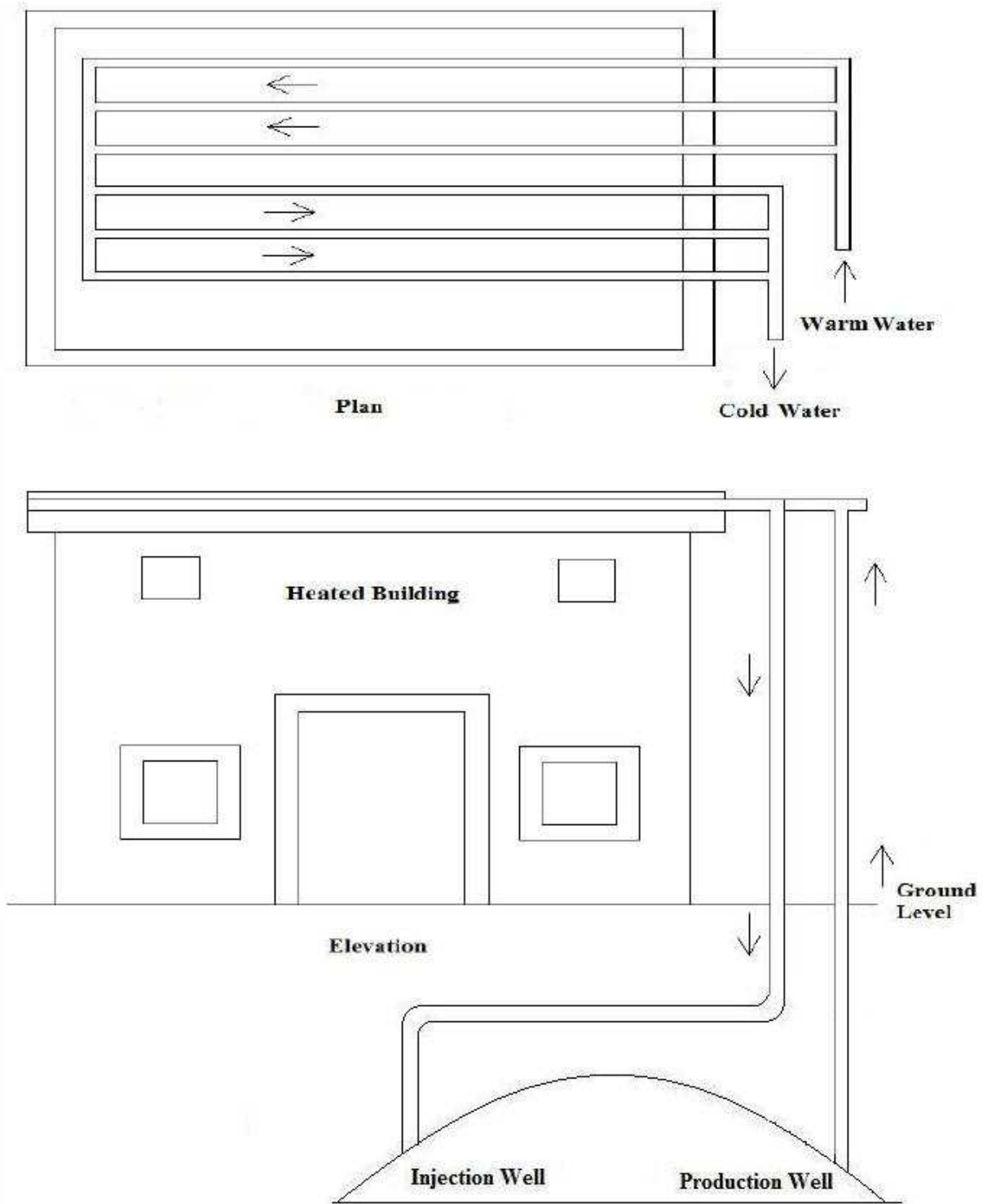
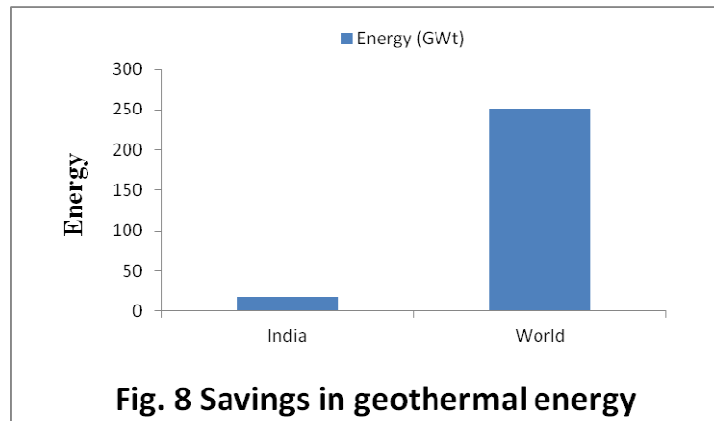
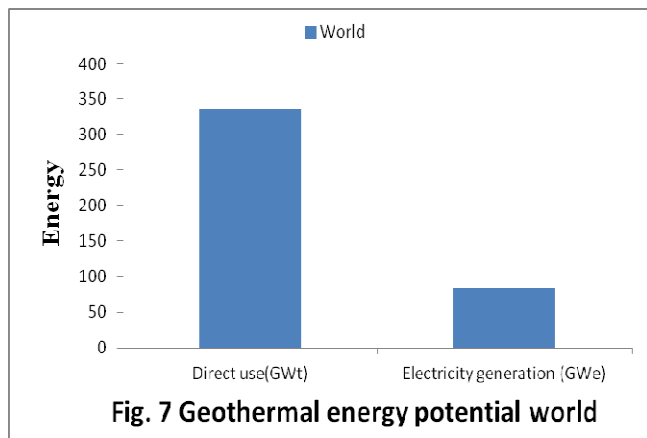
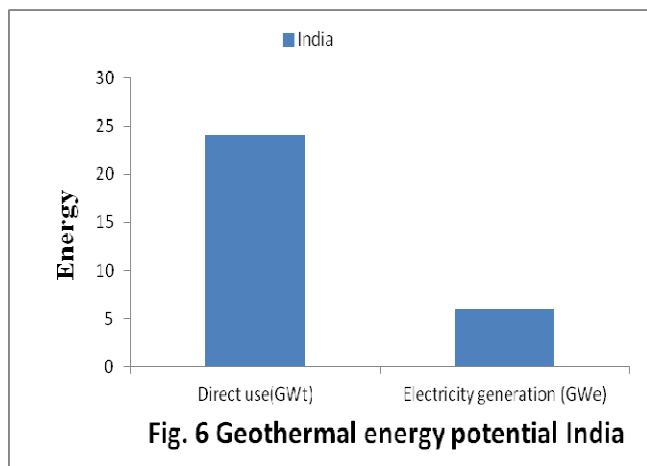


Fig.5 Schematic sketch of geothermal space heating

Results and Discussion

The potential of geothermal energy for direct use and electricity generation is shown in Fig. 6 and Fig. 7 for India and the world respectively. The potential is much more in case of direct use as compared to electricity generation this is due to the fact that efficiency of conversion of geothermal heat into electricity is very less as compared to that of direct use efficiency.

The amount by which the conversion is more in case of direct use as compared to electricity generation is 18 GWt and 252 GWt for India and world respectively (Fig. 8).



Conclusions

The potential of geothermal energy for direct use and electricity generation is much more in case of direct use as compared to electricity generation. It is better to use geothermal energy directly as compared to generating electricity from it. The utilization of geothermal energy is more in case of direct use as compared to electricity generation by an amount 18 GWt and 252 GWt for India and world respectively.

References

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