Geothermal Energy:-An Effective Means of Renewable Energy Source

Vishal Ikshvaku[1], Shamasher Sharma[2], Vipin Maurya[3], Ajay Saroj[4]

[1,2,3,4]Student, Mechanical Engineering Department, Rajarshi Rananjay Sinh Institute of Management & Technology Amethi, 227405 UP, India

---

Abstract - *Geothermal energy is the earth's natural heat available inside the earth. This thermal energy contained in the rock and fluid that filled up fractures and pores in the earth's crust can profitably be used for various purpose. Among the various and renewable energy source, Geothermal energy is known as to be one of the clean energy without smoke and also without environmental hazards. Geothermal energy is used extensively for electric power generation and direct utilisation. The energy saving from electric power generation, direct use and ground source heat pumps among almost nine million tonnes of equivalent fuel oil per year and reduces air pollution by almost eight millions tonnes of carbon annually***.**

Keywords:-Geothermal Power Residential, Geothermal Heating & cooling, Geothermal Cost Calculater.

1. INTRODUCTION

Geothermal energy is heat energy which is stored in the earth. Thermal energy is that particular energy which determines the temperature of matter. This energy can be used for the various purposes. Heat from the earth or the Geothermal – Geo (Earth) + Thermal (Heat)- energy can be accessed by drilling water or steam well in a process similar to drilling for oil. The earth is made up of layer or parts like a hardboiled egg. It has three layers like core, mantle & crust. At the centre is a solid core of iron around that is outer core, made of iron and rock so hot the rock is melted and liquid rock is called magma. The middle layer is a mixture of rock and magma called the mantle. The shell of the Earth- with the ocean and mountain called crust. Geothermal resource range from shallow ground to hot water and rock several miles below earth surface and even further down to extremely hot molten rock of magma. In some places magma comes closer to the earth surface. This geothermal energy originate from the original formation of planet from radioactive decay of minerals from volcanic activity and from solar energy absorbed at surface. It has been used for bathing since Paleolithic times and for space heating since ancient Roman time but is now better known for generating electricity. Worldwide, about 10718 megawatt(MW) of Geothermal power is online in 24 country among which top ten countries are following-

1. United States (3591MW)
2. Philippines (1868MW)
3. Indonesia (1809MW)
4. Turkey (1100MW)
5. New Zealand (980 MW)
6. Mexico (951 MW)
7. Italy (944 MW)
8. Iceland (710 MW)
9. Kenya (676 MW)
10. Japan (542 MW)

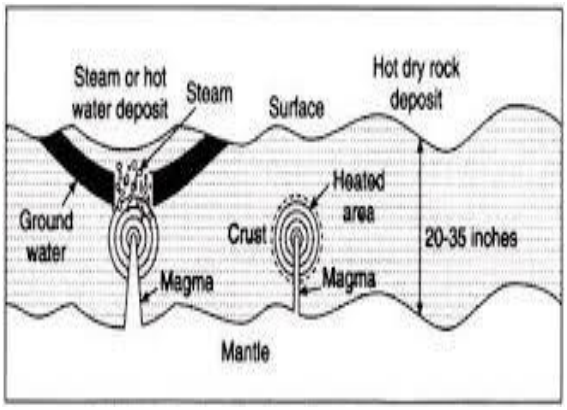

Figure1-formation of Geothermal energy reservoir

India has reasonably good potential for Geothermal; geothermal provinces can produce approximately 10600 MW of power.

2. Geothermal Energy

Geothermal energy is made up of heat from the earth. Underneath the earth's releatively thin crust, temperature range from 1000-4000^{0}c and in some areas pressure exceed 20000 psi. Geothermal energy is most likely generated from radioactive, thorium, potassium and uranium dispersed evenly through the earth's interior which produce heat as part of decaying process. The geothermal gradient is not the only tool used to measure the accessibility of geothermal energy. The permeability of rocks, which determines the rate of flowing heat to the surface, is considered to be another important measure in the availability of geothermal energy.

Geothermal energy has a major advantage compared to wind and solar energy in that it is available 24 hours a day through the year. According to Ngô and Natowitz (2009), the Estimated CO2 emissions produced by geothermal resources is 55 g/kWh when utilizing data from a survey of 73% of the geothermal power plants.

Figure shows the installed capacity and produce energy .

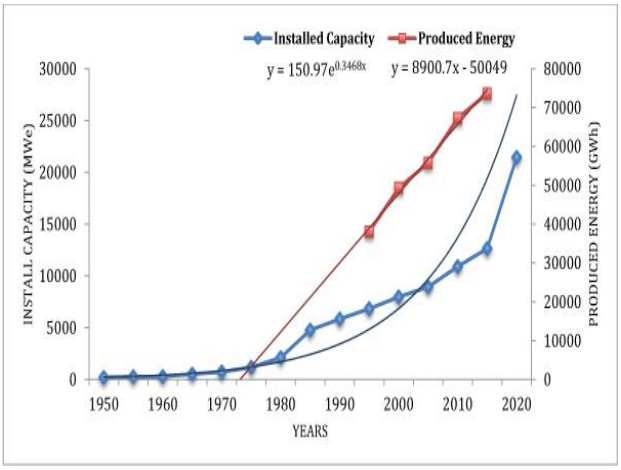

Figure-2

3. Geothermal Power plants Technology

Like all conventional thermal power plants, uses a heat source to expand the liquid to vapour. To convert Geothermal energy into electrical energy heat must be extracted first to change into useable form. More deep wells can be drilled into underground reservoir to tap steam and very hot water that drives turbines that drive electricity generators.

After the thermal energy has been used to turn the turbine, spent steam is condensed back to a liquid and injected into the ground where it is reused in thermal system, prolonging the lifetime of a Geothermal plants.

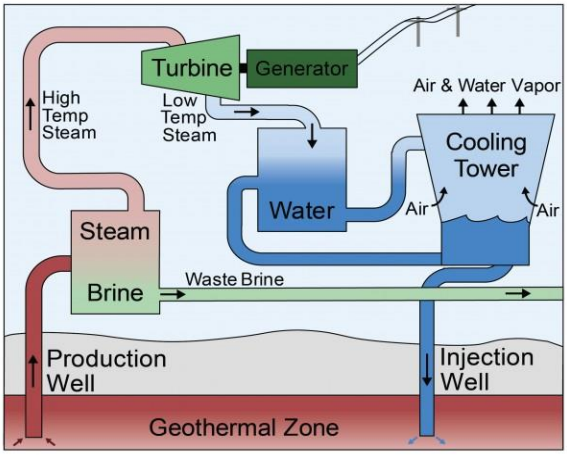

Fig.(3) Electricity generation scheme using Geothermal energy

There are basically four type of Geothermal power plant which are operating today. The elaboration of these power plant is as below-

Flashed steam plant

The extremely hot water from drill hole when leaving from the deep reservoir high pressure vapour is released. This force of vapour is used to rotate turbines. The first geothermal power plant was built in 1904 in Tuscany, Italy, where natural steam erupted from the earth. Flash power plant typically required resource temperature in the range of 177 -260 ^{0}C.

Dry steam plant

Usually geysers are the main source of dry steam. Dry steam reservoirs use the water in the earth's crust, which is heated by the mantle and released through vents in the form of steam. The dry steam power plant is suitable where the geothermal steam is not mixed with water. Production wells are drilled down to the aquifer and the superheated, pressurised steam (180°-350°C) is brought to the surface at high speeds, and passed through a steam turbine to generate electricity. In simple power plants, the low pressure steam output from the turbine is vented to the atmosphere, but more commonly, the steam is passed through a condenser to convert it to water

Hybrid power plant

some Geothermal fields boiling water as well as steam which are used as power generation. In this system of power generation, the flash and binary system combined to make use of steam and hot water.

A ground breaking renewable only hybrid is Newada's still water power plant' the first triple hybrid facility in the world, combining geothermal, photovoltice and solar thermal power generation. How ever, world wide trend for natural gas to replace diesel and, with the decline in the cost of batteries, to employ batteries to store surplus power for later use.

Binary power plant

In this power plant, the geothermal water passed through a heat exchanger where its heat is transferred to a secondary liquid, namely isobutene, isopentane or ammonia water mixture present in an adjacent, separate pipe. Due to this double liquid heat exchanger system, it is called binary power plant.

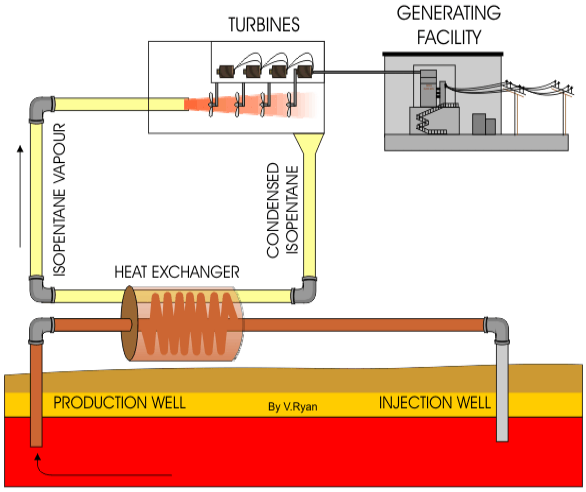

fig. (4) Binary power plant

4. Scope of geothermal energy in India:

In India, exploration of geothermal fields started in 1970.The Geological survey of india (GSI) has identified 350 geothermal location in India.The most promising of these is in puga valley of Laddakh.The estimated potential for geothermal energy in India is about 10000 MW.

These are 7 major geothermal provinces in India

1. The Himalaya

2. Sohana

3.Westcoast

4. Cambay

5. Son-Narmada-Tapi(Sonata)

6. Godavari

7. Mahanadi

These are four major types of geothermal energy source,

1. Hydrothermal

2. Geopressurised brines

3. Hot dry rocks

4. Magma

Promising geothermal sites for the development of geothermal energy India

Table 1: Current project in India Source : NGRI

Geothermal Field	Estimated(min.) reservoir Temp.(Approx)	Status
Puga geothermal field	240^{0}C at 2000m	From geochemical & deep geophysical studies(MT)
Tattapani Sarguja (Chhattisgarh)	120-150^{0}C At 500m & 200 Cat 2000m	Magnetotellur-ic survey done by NGRI
Tapoban Chamoli (Uttarakhand)	100^{0}C at 430m	Magnetotellur-ic survey done by NGRI
Cambay Garden (Gujrat)	160^{0}C at 1900m (From oil exploration borehole)	Steam discharge was estimated 3000 cu-meter/day with high temperature gradient
Badrinath Chamoli (Uttrakhand)	150^{0}C estimated	Magnetotellur-ic survey done by NGRI
Surajkund Hazaribagh (Jharkhand)	110^{0}C	Heat rate 128.6mW/m^2
Manikaran Kullu (HP)	100^{0}C	Heat rate 130mW/m^2
Kasol Kullu (HP)	110^{0}C	Magnetotellur-ic survey done by NGRI

5. Conclusions

Since estimated total amount of geothermal energy that could be used is significantly bigger than the total quantity of energy resources based on oil, coal and natural gas all together, geothermal energy should be having more significant impact. Especially since it's cheap, renewable energy resource that is also ecologically acceptable. But since geothermal energy isn't easily available on all areas, at least areas where this energy is easy available should be exploited (edges of tectonic plates) because this could soften the pressure on fossil fuels helping Earth to recover from dangerous greenhouse gases.

India is yet to produce the electric power from geothermal energy except for nominal 5 KW binary power plants at manikaran that was operational for very short time. India has high scope in utilizing its geothermal resources. India's ministry of non-renewable energy and other geo research centres may pay their attentions towards these renewable resources of clean energy. There is enormous scope for developing the capabilities in geothermal cooling of buildings by modifying existing technologies to suit Indian conditions. Geothermal power can become a valuable source of energy if properly harnessed. Continued energy shortages have created added interest in geothermal energy for both power generation and direct

applications. The technology is expensive and it is necessary that for real breakthrough the cost to be reduced substantially. Environmental problems associated geothermal development is physical disturbance of site, noise, brine disposal and ground water contamination by geothermal fluids and air pollution especially by hydrogen sulphide. Manageable problems relate to serious social, economic and institutional impacts that generally accompany large scale geothermal source energy development.

6. REFERENCES

[1]R R Shah, Bala dutt "Geothermal Energy:An Alternative Source of Energy" IJERA, Vol. 4, Issue 4(Version 5), April 2014.

[2] Umesh Rathore "Energy Management" Non conventional Energy Source-Geothermal Energy

PP 84-92

[3]The status and future of geothermal electric power by NREL.

[4]https://en.wikipedia.org/wiki/Geothermal_energy.

[5]Sukanta Roy and Harsh Gupta "Geothermal Energy" An overview Akshay Urja MNRE April 2012.

[6]http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095849133

AUTHORS

1.Shamasher Sharma perspiring the B. tech in mechanical engineering from Mechanical Engineering Department, Rajarshi Rananjay Sinh Institute of Management & Technology ,Amethi. Currently, He is a student of final year (B.tech).

2.Vipin Maurya perspiring the B. tech in mechanical engineering from Mechanical Engineering Department, Rajarshi Rananjay Sinh Institute of Management & Technology ,Amethi. Currently, He is a student of final year (B.tech).

3. Ajay Saroj perspiring the B. tech in mechanical engineering from Mechanical Engineering Department, Rajarshi Rananjay Sinh Institute of Management & Technology ,Amethi. Currently, He is a student of final year (B.tech).

4. Vishal Ikshvaku perspiring the B. tech in mechanical engineering from Mechanical Engineering Department, Rajarshi Rananjay Sinh Institute of Management & Technology ,Amethi. Currently, He is a student of final year (B.tech).