A GAS BASED GEOTHERMAL POWER PLANT

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ABSTRCT

Geothermal Energy is the form of energy which is stored inside the earth in form of heat & exists in the form of steam, hot water & molten rocks & releases in the form of geysers, hot springs & volcanic eruptions. This natural source of heat is utilized to produce electric power by running a steam power plant. But if a close cycle gas turbine plant is run by this heat more output can achieve.

Keywords: Geothermal energy, close cycle gas based plant & inter cooling.

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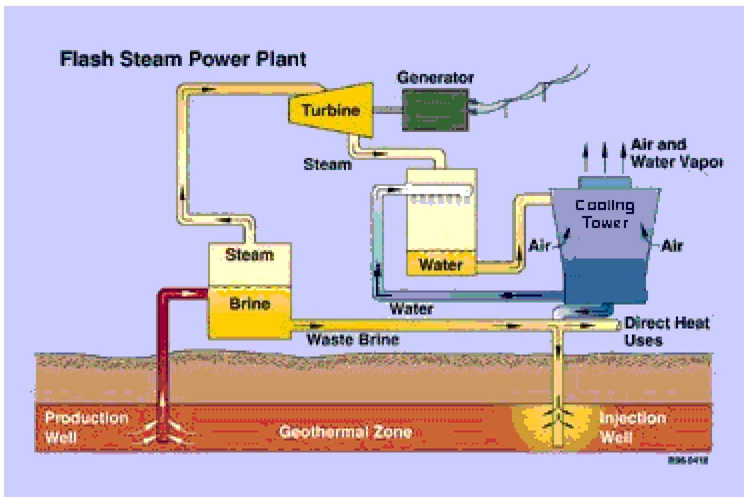
INTRODUCTION

Global warming gases() have a property to absorb heat quickly. If Co_2 or a mixture of Co_2 & CH_4 can use as working fluid of plant. Still today steam based plants are using to producing power from this heat but these type of plant has a bulky construction with various parts. On the other hand water takes more time to convert into steam & heat absorbing capacity of steam is less than Co_2 (because steam is less responsible for global warming than carbon dioxide). So a close cycle gas based plant can be used to produce electricity.

ABOUT TODAYS GEOTHEMAL PLANTS



1. Cavity (Production well):- A cavity is form inside the earth which is fill with water. Water is pore with the help of injection well. Water takes the heat from magma & changes the phase into steam. The super heated steam is then expand isentropically into turbine & produce shaft power.
2. Turbine:- turbine is the part where thermal energy convert into mechanical energy & produce rotation in turbine shaft.
3. Generator:- Generator is machine where an armature is rotate inside a magnetic field & produce e.m.f due to change in linked flux.
4. Condenser (cooling tower):- It is a part where the steam & water mixture condense & convert into water. The cooling medium is atmospheric air.
5. Pump:- two circulating pump is use to run the working fluid throughout the entire cycle.

ASSIGNED GAS BASED PLANT

Assigned gas based plants has compressor, gas turbine, heating chamber, cooler or condenser & close cycle i.e operating fluid will circulate repeatedly.

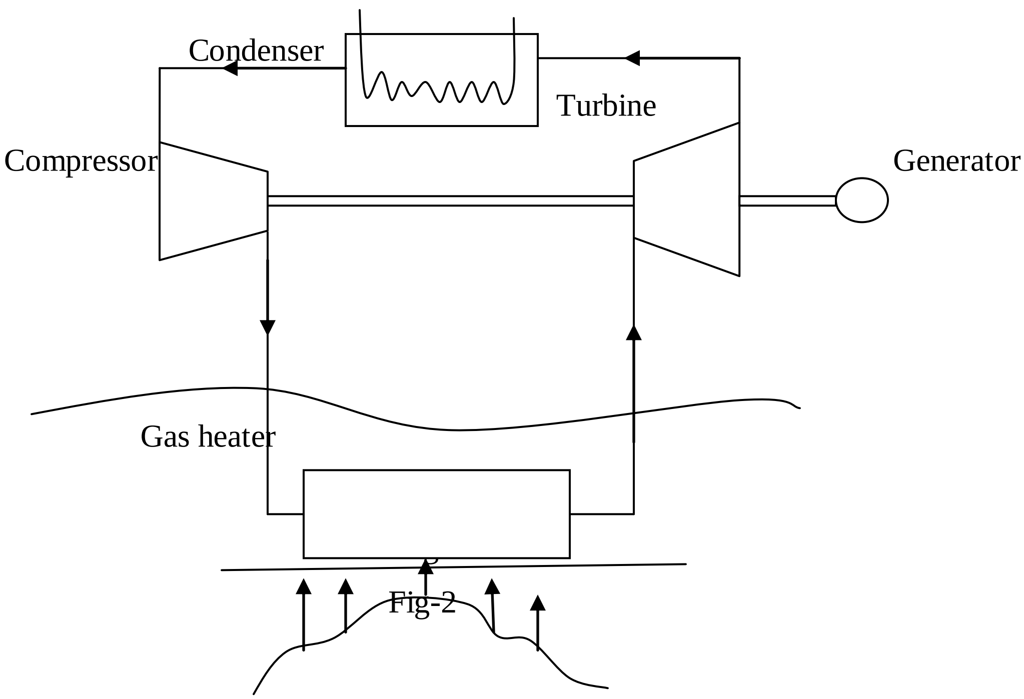


Fig-2

Fig-2 represents flow diagram of normal geothermal gas based power plant. The part compressor directly takes power from turbine so net output will decrease. Working fluid is in gaseous phase throughout the cycle & absorbs heat from hot magma. In this plant pumps are not use because gas will circulate due to density variation & compressor pressure.

COMPARISON BETWEEN GAS & STEAM PLANTS

Efficiency (thermal) & net work of a steam plant is more than gas plant if maximum cycle temperature (turbine inlet temperature) & initial cycle temperature is same for Ranking & Brayton power cycle. But for different maximum cycle temperature this is not valid. In case of gas based plant gas mixture(Co_2 & CH_4) can trap more heat than water so max cycle temperature will be higher. If turbine inlet temperature increases efficiency of plant also increase.

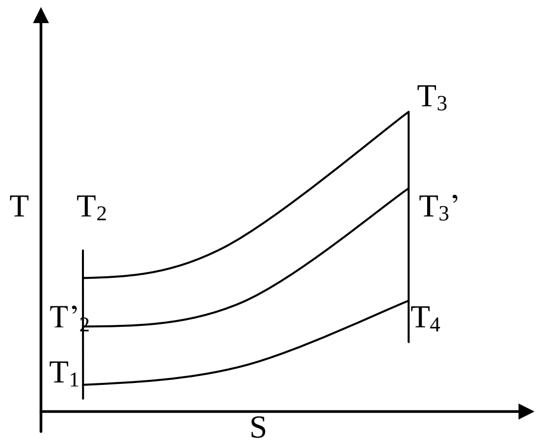


Fig-

In given T-S (Temperature- Entropy) diagram 1-2'-3'-4 represents steam based cycle & 1-2-3-4 represents gas based cycle.

1-2= compression process in compressor. For per unit mass of gas enthalpy after compression= $C_p(T_2-T_1)$

1-2'= Pumping process of condensed water. Basically enthalpy does not increase in remarkable amount after pumping. Here, enthalpy after pumping= $C_p(T'_2-T_1)$

But in real practice $(T_2-T_1)>>(T'_2-T_1)$

During the heating process Co_2 can absorbs more heat than water/ steam. So $T_3>T'_3$. So maximum cycle temperature is more in case of gas based plant than steam based plant.

3-4= expansion in gas turbine. Work output from gas turbine= $C_p(T_3-T_4)$.

3'-4= expansion in steam turbine. Work output from steam turbine= $C_p(T'_3-T_4)$.

So, work output from gas based plant> steam based plant.

Now, net work of steam based plant=Turbine work- pump work.

$$=C_p[(T'_3-T_4)-(T'_2-T_1)]$$

Net work of gas based plant= $C_p[(T_3-T_4)-(T_2-T_1)]$.

So, net work in gas based plant> steam based plant. We can produce more electricity from GAS BASED.

REDUCTION OF COMPRESSOR EFFORT

The net work of a gas based plant can reduce by reducing compressor effort. Inter cooling of working fluid is a process to reduce compressor efforts.

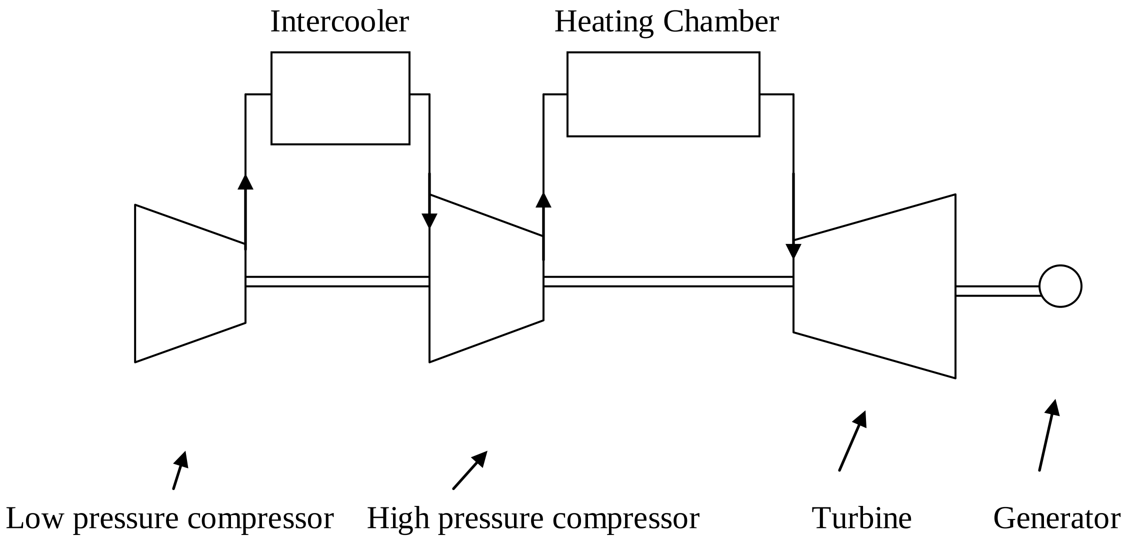
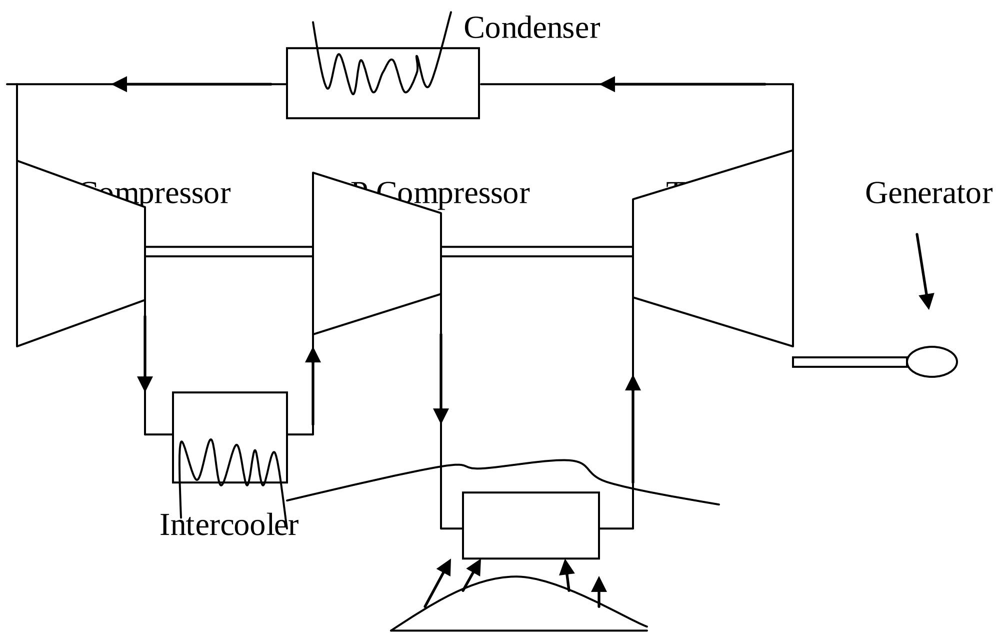


Fig-

Fig- represents the flow diagram for gas based plant with inter cooling arrangement in between high & low pressure turbine.



Heater

Hot Magma

Fig- shows a geothermal gas based close cycle power plants with inter cooling arrangement. Heat is receiving by Co_2 gas from hot magma & expands inside turbine to produce shaft power.

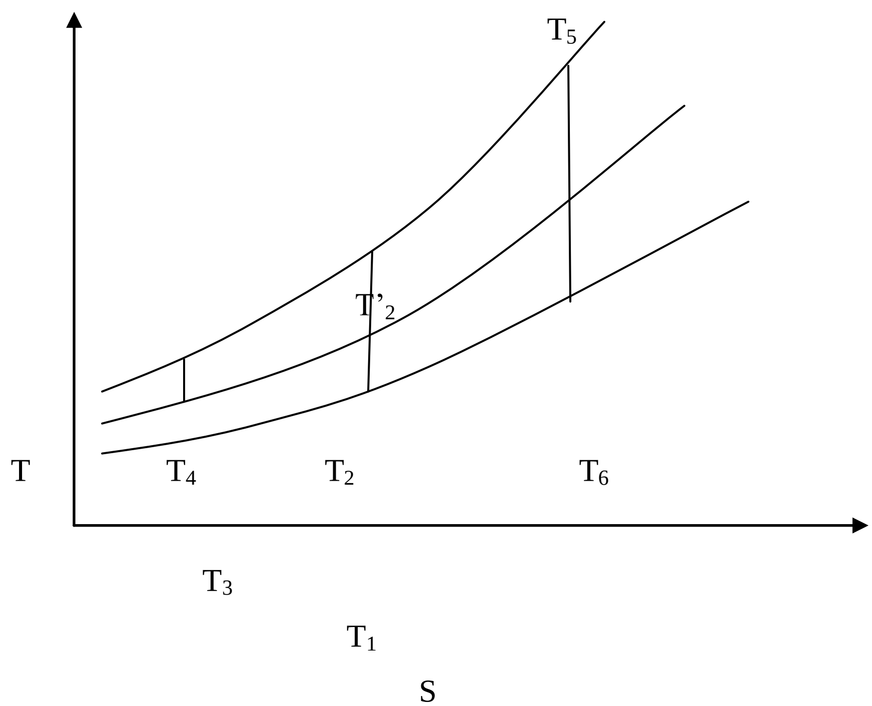


Fig-

Fig- shows T-S diagram of thermodynamic cycle with inter cooling. T_1-T'_2-T_5-T_6 is the cycle without inter cooling arrangement. T_1-T_2-T_3-T_4-T_5-T_6 is the cycle with inter cooling arrangement.

Work required to run the compressor without inter cooling$(W_C) = C_P(T'_2 - T_1)$

$$= C_P[(T_2 - T_1) + (T'_2 - T_2)]$$

$T_2 - T_3 =$ Temperature decrease due to inter cooling.

Work required to run compressor with inter cooling$(W_{Ci}) = C_P[(T_2 - T_1) + (T_4 - T_3)]$

Here, $W_C > W_{Ci}$ because$(T'_2 - T_2) > (T_4 - T_3)$.

So, net work & plant efficiency of the plant will increase after using inter cooling for same turbine output.

CONCLUSION

Electrical energy is mainly produce from thermal & nuclear power plants. Amount of hydro power also decreasing day by day. Now renewable sources also use to power generation due future fuel scarcities. Geothermal energy is a large source of energy. Using this heat for power generation is very important for future energy cry. In present century all geothermal plants are steam based plant but it is observed that close cycle gas based plant can produce more power than steam based plant.

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