advantages of geothermal power plants

Advantages of Geothermal Power Plants

Geothermal power plants are used for production of electricity from geothermal energy. The traditional thermal power plants need fuel for generating electricity while geothermal powre plants don't need fuel. Here are some of the advantages of generating electricity from geothermal energy. Advantages of using Geothermal Energy for Producing Power

Geothermal energy is the energy stored below the earth's crust. Due to heat below the earth's crust water gets heated and also sometimes gets converted into steam. This hot water and steam can be used for generating electricity. Here are the advantages of using geothermal energy for producing electricity: 1) No fuel is required: The thermal and nuclear power plants use fossil and nuclear fuels respectively to heat water and generate steam for production of electricity.

The geothermal power plants use the readily available hot water from the geothermal reservoir so no fuel is required. 2) Clean source of power: The fuels used in conventional thermal power plants produce lots of toxic gases and particulate matter polluting the surrounding atmosphere. Electricity can be produced from geothermal reservoir without creating any air-pollution. 3) Less area is required: The land required for the geothermal power plant per megawatt of power produced is much lesser than that required for the other types of power plants. 4) Unhindered production of power: The energy from geothermal reservoir is available 24 hours a day and all the days of the year without any breakage or change during varying seasons, natural disaster and political turmoil. Thus geothermal energy is the reliable source for producing electricity continuously without any hindrance.

Parts of a Geothermal Power Plant

Geothermal Vents

The geothermal vent is the first component of a geothermal plant. A geothermal vent is a deep well drilled into the Earth that the power plant uses to tap into the Earth's heat. A geothermal plant may have twogoalsfor its vent; most current geothermal plants draw superheated, pressurized water upward; these are called flash steam plants. Geothermal plants may also simply dig far enough underground, as many as three kilometers, to reach a point where the Earth is warm enough to boil water, these are called dry steam vents. Steam Generator

Another key component of a geothermal plant is the steam production unit, which can take multiple forms. In a flash steam vent, superheated pressurized water is drawn from its place underground to low-pressure tanks. The pressure of the Earth kept the water in liquid form despite its high temperature, and by removing that pressure the hot water instantly turns to steam, hence the term flash steam. In a dry steam plant, the plant technicians pump water to the bottom of the vent where the Earth's heat boils the water and turns it into steam.

Turbine

Regardless of the plant type, both flash steam and dry steam plants pump the steam from the geothermal vent to a large turbine. The steam passes this turbine, turning it in the process. This turbine is attached to an electric generator, and as the turbine turns the generator turns the mechanical energy into electric energy, thus converting the heat from the Earth into usable electricity.

Condenser

After the steam passes through the turbine, it continues to a condenser chamber. This chamber condenses the steam back into liquid water by cooling it. The excess heat lost as the steam turns to liquid water may be used for other applications, such as heating or greenhouse farming. The cooled liquid water is then typically pumped back into the ground to either restart the boiling process for dry steam or to replenish the natural heated aquifer for flash steam plants.

Disadvantages of Geothermal Energy

Geothermal energy is a key contender for future electricity production in various countries across the globe. This however, doesn't mean that geothermal energy comes without its disadvantages, many of which are explained below.

The Disadvantages Availability

The availability of geothermal energy that is capable of feeding geothermal power stations is limited. This intense energy source is often only available in countries where geothermal activity is at its peak, mainly tectonic/volcanic regions such as Iceland. Significant Investment Required - A significant investment is often required prior to building a geothermal power station. Geological surveys have to be undertaken to ensure the location is suitable for geothermal electricity production before any potential installation work can go ahead. It's often costly to transport any required materials to remote locations where there is sufficient geothermal activity.

Harmful Gas Potential - Geothermal power stations have the potential to release harmful gases into the air. Toxic gases exist deep beneath the ground in various regions and can sometimes be released via the infrastructure used by geothermal power stations. Most modern geothermal power plants have systems and procedures in places to deal with these harmful gases. Localised Supply - As geothermal is trapped beneath our feet, we cannot extract, store and transport this energy source to other countries as we do with fossil fuels such as oil, coal and gas. Geothermal energy has to be used at source to generate electricity, thus providing a supply of electricity for the electrical grid system of only the source country.

The Steam Can Stop - Geothermal power stations have the potential to cool the rocks beneath them buried deep under the ground. If the rocks are cooled via too much water flowing into the well, they will no longer be able to produce the steam required to turn a generator, thus rendering a site useless and resulting in significant losses for any company making use of geothermal energy at that location. Visual Pollution - Geothermal power stations, as with many other power station designs can be unsightly and provide visual pollution. Networks of pipe systems have to be utilised for production purposes and many people are opposed to the sight of these. -

Advantages of Geothermal Energy Geothermal energy is widely considered as a key contender for future electricity production in various corners of the earth. Countries including Iceland, the USA and New Zealand already make use of this renewable energy source to provide electricity on a significant scale. There are many advantages relating to the use of geothermal energy and these are described below. The Advantages

Environmentally Friendly - Geothermal energy is a renewable energy source that's highly environmentally friendly. Little disruption is made to theenvironmentas a result of the various processes that are used to harness this energy source in order to provide electricity. Few chemicals and pollutants feature in geothermal electricity production. Highly Efficient - Geothermal energy is highly efficient and can be used to provide electricity in select areas or even to provide heating for our homes and business on a much wider scale via the use of ground source heat pumps.

Cost Effective - As geothermal power stations are relatively small and less complex than large fossil fuel alternatives, they are highly cost effective, especially when they are placed in areas of high geological/tectonic activity where magma is closer to the earth's crust when compared with other locations. Job Creation - The introduction of geothermal energy systems on both an industrial and domestic scale has helped to boost jobs in many different countries. This is a key advantage for areas that may have already been experiencing job shortages. Land Value - Another advantage of geothermal energy and tied into the cost effectiveness of this energy source is land value.

Geothermal power stations are often placed in areas of high geological activity where land values may be low due to obvious reasons. This helps to provide cost savings for energy companies that wish to make use of geothermal activity. Almost Infinite - Although geothermal activity in a particular area is actually finite, this is likely to be available for anywhere between 5, 000 and 1, 000, 000 years. This huge time scale means geothermal energy is almost infinite and will be able to long live out many fossil fuel alternatives. Always On - As long as geothermal activity is present in a particular region, this energy source will always be on and will be fairly constant.

This means that unlike solar, wind, wave and tidal alternatives, geothermal energy can provide continuous electricity production whatever the weather. Very Quiet - Another significant advantage of geothermal energy is how quiet it can be. Geothermal energy is the electric car of power stations and is likely to provide little noise pollution to nearby residents. -

Geothermal Power Plant

A geothermal power plant uses its geothermal activity to generate power. This type of natural energy production is extremely environmentally friendly and used in many geothermal hot spots around the globe. To harness the energy, deep holes are drilled into the earth (much like when drilling for oil) until a significant geothermal hot spot is found. When the heat source has been discovered, a pipe is attached deep down inside the hole which allows hot steam from deep within the earths crust to rise up to the surface. The pressurized steam is then channeled into a turbine which begins to turn under the large force of the steam. This turbine is linked to the generator and so the generator also begins to turn, generating electricity.

We then pump cold water down a new pipe which is heated by the earth and then sent back up the first pipe to repeat the process. The main problems with geothermal energy is that firstly, you must not pump too much cold water into the earth, as this could could cool the rocks too much, resulting in your geothermal heat source cooling down. secondly, geothermal power plants must be careful of escaping gases from deep within the earth. We suggest if you would like to learn more on this topic, you take a look at our advantages of geothermal energy, and our disadvantages of geothermal energy articles.

A very good way of thinking about geothermal energy is remembering that all our continents lie on molten rock deep within the earth, this rock produces tremendous levels of heat that we are able to extract, just think of your nation lying on a bed of fire. Geothermal power is one of the most renewable energy sources that exists on our planet today, the earth will contain this heat for our lifetime. If this heat disappears, our planet will become too cold to survive on.

You can purchase small scale geothermal equipment for your home yet this works in a different manner to geothermal power stations. The power stations extract the heat directly from deep within the earth, whereas home geothermal hot water equipment absorbs heat over a lengthy period of time from a few meters beneath your feet.

Main parts of the plant are

1. Coal conveyor 2. Stoker 3. Pulverizer 4. Boiler 5. Coal ash 6. Air preheater 7. Electrostatic precipitator 8. Smoke stack 9. Turbine 10. Condenser 11. Transformers 12. Cooling towers 13. Generator 14. High - votge power lines

Basic Operation : A thermal power plant basically works onRankine cycle. Coal conveyor : This is a belt type of arrangement. With this coal is transported from coal storage place in power plant to the place near by boiler. Stoker : The coal which is brought near by boiler has to put in boiler furnance for combustion. This stoker is a mechanical device for feeding coal to a furnace.

Pulverizer : The coal is put in the boiler after pulverization. For this pulverizer is used. A pulverizer is a device for grinding coal for combustion in a furnace in a power plant.

Types of Pulverizers

Ball and Tube Mill

Ball mill is a pulverizer that consists of a horizontal rotating cylinder, up to three diameters in length, containing a charge of tumbling or cascading steel balls, pebbles, or rods. Tube mill is a revolving cylinder of up to five diameters in length used for fine pulverization of ore, rock, and other such materials; the material, mixed with water, is fed into the chamber from one end, and passes out the other end as slime. Ring and Ball

This type consists of two rings separated by a series of large balls. The lower ring rotates, while the upper ring presses down on the balls via a set of spring and adjuster assemblies. Coal is introduced into the center or side of the pulverizer (depending on the design) and is ground as the lower ring rotates causing the balls to orbit between the upper and lower rings. The coal is carried out of the mill by the flow of air moving through it. The size of the coal particals released from the grinding section of the mill is determined by a classifer separator. These mills are typically produced by B&W (Babcock and Wilcox).

Boiler : Now that pulverized coal is put in boiler furnance. Boiler is an enclosed vessel in which water is heated and circulated until the water is turned in to steam at the required pressure.

Coal is burned inside the combustion chamber of boiler. The products of combustion are nothing but gases. These gases which are at high temperature vaporize the water inside the boiler to steam. Some times this steam is further heated in a superheateras higher the steam pressure and temperature the greater efficiency the engine will have in converting the heat in steam in to mechanical work. This steam at high pressure and tempeture is used directly as a heating medium, or as the working fluid in a prime mover to convert thermal energy to mechanical work, which in turn may be converted to electrical energy. Although other fluids are sometimes used for these purposes, water is by far the most common because of its economy and suitable thermodynamic characteristics.

Classification of Boilers

Bolilers are classified as

Fire tube boilers : In fire tube boilers hot gases are passed through the tubes and water surrounds these tubes. These are simple, compact and rugged in construction. Depending on whether the tubes are vertical or horizontal these are further classified as vertical and horizontal tube boilers. In this since the water volume is more, circulation will be poor. So they can't meet quickly the changes in steam demand. High pressures of steam are not possible, maximum pressure that can be attained is about 17. 5kg/sq cm. Due to large quantity of water in the drain it requires more time for steam raising. The steam attained is generally wet, economical for low pressures. The outut of the boiler is also limited.

Water tube boilers : In these boilers water is inside the tubes and hot gases are outside the tubes. They consists of drums and tubes. .

They may contain any number of drums (you can see 2 drums in fig). Feed water enters the boiler to one drum (here it is drum below the boiler). This water circulates through the tubes connected external to drums. Hot gases which surrounds these tubes wil convert the water in tubes in to steam. This steam is passed through tubes and collected at the top of the drum since it is of light weight. So the drums store steam and water (upper drum). The entire steam is collected in one drum and it is taken out from there (see in laout fig).

As the movement of water in the water tubes is high, so rate of heat transfer also becomes high resulting in greater efficiency. They produce high pressure , easily accessible and can respond quickly to changes in steam demand. These are also classified as vertical, horizontal and inclined tube depending on the arrangement of the tubes. These are of less weight and less liable to explosion. Large heating surfaces can be obtained by use of large number of tubes. We can attain pressure as high as 125 kg/sq cm and temperatures from 315 to 575 centigrade.

Superheater : Most of the modern boliers are having superheater and reheater arrangement. Superheater is a component of a steam-generating unit in which steam, after it has left the boiler drum, is heated above its saturation temperature. The amount of superheat added to the steam is influenced by the location, arrangement, and amount of superheater surface installed, as well as the rating of the boiler. The superheater may consist of one or more stages of tube banks arranged to effectively transfer heat from the products of combustion. Superheaters are classified as convection , radiant or combination of these.

Reheater : Some of the heat of superheated steam is used to rotate the turbine where it loses some of its energy. Reheater is also steam boiler component in which heat is added to this intermediate-pressure steam, which has given up some of its energy in expansion through the high-pressure turbine. The steam after reheating is used to rotate the second steam turbine (see Layout fig) where the heat is converted to mechanical energy. This mechanical energy is used to run the alternator, which is coupled to turbine , there by generating elecrical energy.

Condenser : Steam after rotating staem turbine comes to condenser. Condenser refers here to the shell and tube heat exchanger (or surface condenser) installed at the outlet of every steam turbine in Thermal power stations of utility companies generally. These condensers are heat exchangers which convert steam from its gaseous to its liquid state, also known as phase transition. In so doing, the latent heat of steam is given out inside the condenser. Where water is in short supply an air cooled condenser is often used. An air cooled condenser is however significantly more expensive and cannot achieve as low a steam turbine backpressure (and therefore less efficient) as a surface condenser.

The purpose is to condense the outlet (or exhaust) steam from steam turbine to obtain maximum efficiency and also to get the condensed steam in the form of pure water, otherwise known as condensate, back to steam generator or (boiler) as boiler feed water.

Why it is required ?

The steam turbine itself is a device to convert the heat in steam to mechanical power. The difference between the heat of steam per unit weight at the inlet to turbine and the heat of steam per unit weight at the outlet to turbine represents the heat given out (or heat drop) in the steam turbine which is converted to mechanical power. The heat drop per unit weight of steam is also measured by the word enthalpy drop. Therefore the more the conversion of heat per pound (or kilogram) of steam to mechanical power in the turbine, the better is its performance or otherwise known as efficiency.

By condensing the exhaust steam of turbine, the exhaust pressure is brought down below atmospheric pressure from above atmospheric pressure, increasing the steam pressure drop between inlet and exhaust of steam turbine. This further reduction in exhaust pressure gives out more heat per unit weight of steam input to the steam turbine, for conversion to mechanical power. Most of the heat liberated due to condensing, i. e., latent heat of steam, is carried away by the cooling medium. (water inside tubes in a surface condenser, or droplets in a spray condenser (Heller system) or air around tubes in an air-cooled condenser).

Condensers are classified as (i) Jet condensers or contact condensers (ii) Surface condensers. In jet condensers the steam to be condensed mixes with the cooling water and the temperature of the condensate and the cooling water is same when leaving the condenser; and the condensate can't be recovered for use as feed water to the boiler; heat transfer is by direct conduction.

In surface condensers there is no direct contact between the steam to be condensed and the circulating cooling water. There is a wall interposed between them through heat must be convectively transferred. The temperature of the condensate may be higher than the temperature of the cooling water at outlet and the condnsate is recovered as feed water to the boiler. Both the cooling water and the condensate are separetely with drawn. Because of this advantage surface condensers are used in thermal power plants. Final output of condenser is water at low temperature is passed to high pressure feed water heater, it is heated and again passed as feed water to the boiler. Since we are passing water at high temperature as feed water the temperature inside the boiler does not dcrease and boiler efficincy also maintained.

Cooling Towers : The condensate (water) formed in the condeser after condensation is initially at high temperature. This hot water is passed to cooling towers. It is a tower- or building-like device in which atmospheric air (the heat receiver) circulates in direct or indirect contact with warmer water (the heat source) and the water is thereby cooled (see illustration). A cooling tower may serve as the heat sink in a conventional thermodynamic process, such as refrigeration or steam power generation, and when it is convenient or desirable to make final heat rejection to atmospheric air. Water, acting as the heat-transfer fluid, gives up heat to atmospheric air, and thus cooled, is recirculated through the system, affording economical operation of the process.

Two basic types of cooling towers are commonly used. One transfers the heat from warmer water to cooler air mainly by an evaporation heat-transfer process and is known as theevaporative or wet cooling tower.

Evaporative cooling towers are classified according to the means employed for producing air circulation through them: atmospheric, natural draft, and mechanical draft. The other transfers the heat from warmer water to cooler air by a sensible heat-transfer process and is known as the nonevaporative or dry cooling tower.

Nonevaporative cooling towers are classified as air-cooled condensers and as air-cooled heat exchangers, and are further classified by the means used for producing air circulation through them. These two basic types are sometimes combined, with the two cooling processes generally used in parallel or separately, and are then known as wet-dry cooling towers.

Evaluation of cooling tower performance is based on cooling of a specified quantity of water through a given range and to a specified temperature approach to the wet-bulb or dry-bulb temperature for which the tower is designed. Because exact design conditions are rarely experienced in operation, estimated performance curves are frequently prepared for a specific installation, and provide a means for comparing the measured performance with design conditions.

Economiser : Flue gases coming out of the boiler carry lot of heat. Function of economiser is to recover some of the heat from the heat carried away in the flue gases up the chimney and utilize for heating the feed water to the boiler. It is placed in the passage of flue gases in between the exit from the boiler and the entry to the chimney. The use of economiser results in saving in coal consumption , increase in steaming rate and high boiler efficiency but needs extra investment and increase in maintenance costs and floor area required for the plant. This is used in all modern plants. In this a large number of small diameter thin walled tubes are placed between two headers. Feed water enters the tube through one header and leaves through the other. The flue gases flow out side the tubes usually in counter flow.

Air preheater : The remaining heat of flue gases is utilised by air preheater. It is a device used in steam boilers to transfer heat from the flue gases to the combustion air before the air enters the furnace. Also known as air heater; air-heating system. It is not shown in the lay out. But it is kept at a place near by where the air enters in to the boiler. The purpose of the air preheater is to recover the heat from the flue gas from the boiler to improve boiler efficiency by burning warm air which increases combustion efficiency, and reducing useful heat lost from the flue.

As a consequence, the gases are also sent to the chimney or stack at a lower temperature, allowing simplified design of the ducting and stack. It also allows control over the temperature of gases leaving the stack (to meet emissions regulations, for example). After extracting heat flue gases are passed to elctrostatic precipitator. Electrostatic precipitator : It is a device which removes dust or other finely divided particles from flue gases by charging the particles inductively with an electric field, then attracting them to highly charged collector plates. Also known as precipitator. The process depends on two steps.

In the first step the suspension passes through an electric discharge (corona discharge) area where ionization of the gas occurs. The ions produced collide with the suspended particles and confer on them an electric charge. The charged particles drift toward an electrode of opposite sign and are deposited on the electrode where their electric charge is neutralized. The phenomenon would be more correctly designated as electrodeposition from the gas phase. The use of electrostatic precipitators has become common in numerous industrial applications.

Among the advantages of the electrostatic precipitator are its ability to handle large volumes of gas, at elevated temperatures if necessary, with a reasonably small pressure drop, and the removal of particles in the micrometer range. Some of the usual applications are: (1) removal of dirt from flue gases in steam plants; (2) cleaning of air to remove fungi and bacteria in establishments producing antibiotics and other drugs, and in operating rooms; (3) cleaning of air in ventilation and air conditioning systems; (4) removal of oil mists in machine shops and acid mists in chemical process plants; (5) cleaning of blast furnace gases; (6) recovery of valuable materials such as oxides of copper, lead, and tin; and (7) separation of rutile from zirconium sand. Smoke stack : A chimney is a system for venting hot flue gasesor smoke from a boiler, stove, furnace or fireplace to the outsideatmosphere.

They are typically almost vertical to ensure that the hot gases flow smoothly, drawing air into the combustion through the chimney effect (also known as the stack effect). The space inside a chimney is called a flue. Chimneys may be found in buildings, steam locomotives and ships. In the US, the termsmokestack (colloquially, stack) is also used when referring to locomotive chimneys. The term funnel is generally used for ship chimneys and sometimes used to refer to locomotive chimneys.

Chimneys are tall to increase their draw of air for combustion and to disperse pollutants in the flue gases over a greater area so as to reduce the pollutant concentrations in compliance with regulatory or other limits. Generator : An alternator is an electromechanical device that converts mechanical energy to alternating current electrical energy. Most alternators use a rotating magnetic field. Different geometries - such as a linear alternator for use with stirling engines - are also occasionally used. In principle, any AC generator can be called an alternator, but usually the word refers to small rotating machines driven by automotive and other internal combustion engines.

Transformers : It is a device that transfers electric energy from one alternating-current circuit to one or more other circuits, either increasing (stepping up) or reducing (stepping down) the voltage. Uses for transformers include reducing the line voltage to operate low-voltage devices (doorbells or toy electric trains) and raising the voltage from electric generators so that electric power can be transmitted over long distances. Transformers act through electromagnetic induction; current in the primary coil induces current in the secondary coil. The secondary voltage is calculated by multiplying the primary voltage by the ratio of the number of turns in the secondary coil to that in the primary. To see the complete operation of the plant in flash player Click here