FACULTY OF ENGINEERING AND TECHNOLOGY

Geothermal Energy

•Geothermal energy is heat derived within the sub-surface of the earth. Water and/or steam carry the geothermal energy to the Earth's surface. Depending on its characteristics, geothermal energy can be used for heating and cooling purposes or be harnessed to generate clean electricity.

•A renewable energy source because the water is replenished by rainfall and the heat is continuously produced inside the earth.

•Geothermal energy is generated in the earth's core about 4000 miles below the surface.

•Temperature hotter than the earth's surface are continuously produced inside the surface by slow decay of radiactive particles, a process that happens in all rocks.

•It is contained in the rocks and fluids beneath the earth's crust and can be found as far down to the earth's hot molten rock, magma.

•To produce power from geothermal energy, wells are dug a mile deep into underground reservoirs to access the steam and hot water there, which can then be used to drive turbines connected to electricity generators. There are three types of geothermal power plants; dry steam, flash and binary.

•It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot **water** and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

Role of Thermodynamics

The production of electricity from a geothermal source is about producing work from heat.

Electricity production from heat will never be successful unless appropriate respect is paid to the second law of thermodynamics.

The type of energy conversion system used to produce electrical power from a geothermal resource depends on the type and quality (temperature) of the resource.

Geothermal power is generated by using steam or a secondary hydrocarbon vapor to turn a turbine-generator set to produce electrons.

Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. The geothermal energy of the Earth's crust originates from the original formation of the planet and from radioactive decay of materials.

Geothermal energy can be used for heating and cooling purposes or be harnessed to generate clean electricity.

Magneto hydrodynamics (MHD)

•**Magneto hydrodynamics** (**MHD)**; also magneto-fluid dynamics or hydromagnetics) is the study of the magnetic properties and behavior of electrically conducting fluids. The word "**magneto hydrodynamics**" is derived from magneto- meaning magnetic field, hydro- meaning water, and dynamics meaning movement.

•The fundamental concept behind MHD is that magnetic fields can induce currents in a moving conductive fluid, which in turn polarizes the fluid and reciprocally changes the magnetic field itself. The set of equations that describe MHD are a combination of the Navier–Stokes equations of fluid dynamics and Maxwell's equations of electromagnetism. These differential equations must be solved simultaneously, either analytically or numerically.

•The efficiency of conductive substances should be increased to increase the operational efficiency of a power generating device.

•The required efficiency can be achieved when a gas is heated to become plasma/fluid or adding other ionizable substances like the salts of alkali metals.

• To design and implement an MHD generator, several issues like economics, efficiency, contaminated hypo ducts are considered.

Principle of working of MHD Power plant

•The principal of MHD power generation is very simple and is based on Faraday's law of electromagnetic induction, which states that when a conductor and a magnetic field moves relative to each other, then voltage is induced in the conductor, which results in flow of current across the terminals.

•A magneto hydrodynamic (MHD) generator is a device that generates power directly by interacting with a rapidly moving stream of fluid, usually ionized gases/plasma.

•MHD devices transform heat or kinetic energy into electrical energy. The typical setup of an MHD generator is that both turbine and electric power generator coalesce into a single unit and has no moving parts, thus, eliminating vibrations and noise, limiting wear and tear.

•MHDs have the highest thermodynamic efficiency as it operates at higher temperatures than mechanical turbines.

•MHD generator is commonly referred to as a fluid dynamo, which is compared to a mechanical dynamo – a metal conductor when passed through a magnetic field generates a current in a conductor.

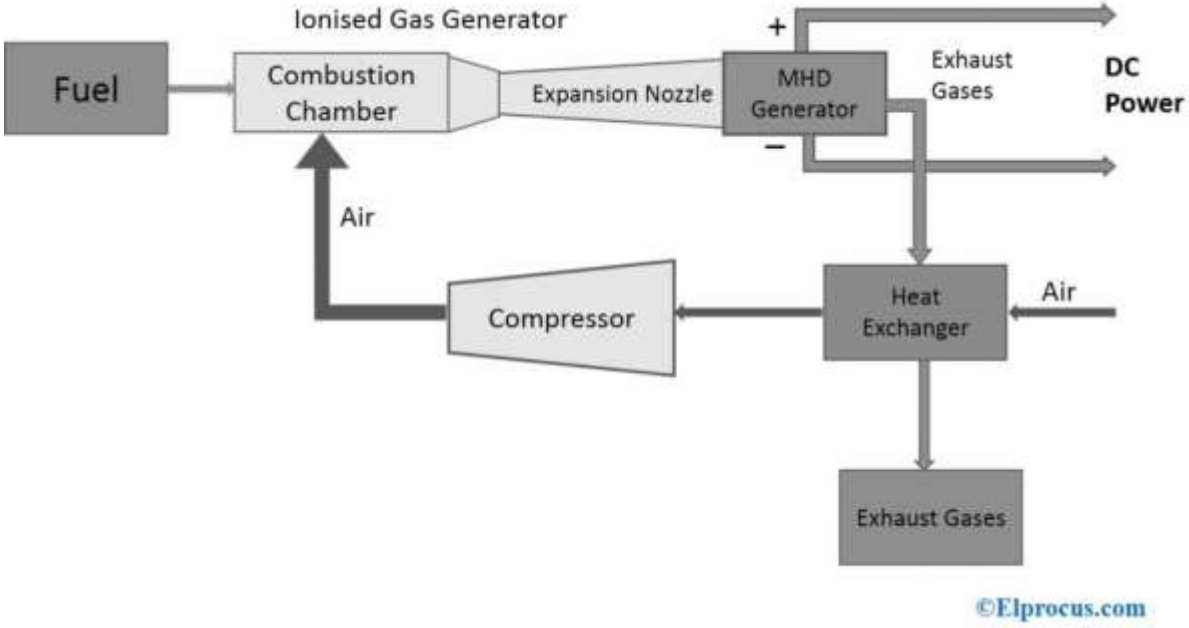
•However, in the MHD generator, conducting fluid is used instead of a metal conductor. As the conducting fluid (conductor) moves through the magnetic field, it produces an electrical field perpendicular to the magnetic field. This process of electric power generation through MHD is based on the principle of Faraday's law of electromagnetic induction.

When the conducting fluid flows through a magnetic field, a voltage is generated across its fluid and it is perpendicular to both the fluid flow and the magnetic field as per Fleming's Right Hand Rule.

MHD Generator Working

•The MHD generator requires a gas source of high temperature, which can be either a coolant of a nuclear reactor or can be high-temperature combustion gases produced from coal.

•As the gas and fuel pass through the expansion nozzle, it decreases the pressure of the gas and increases the speed of fluid/plasma through the MHD duct, and increasing the overall efficiency of the power output. The exhaust heat produced from the fluid through the duct is the DC power. It used to run the compressor to boost the fuel combustion rate.



Advantages, Disadvantages and Applications

Advantages

•The advantages of the MHD generator include the following.

•MHD generators convert heat or thermal energy directly into electrical energy

•It has no moving parts, so mechanical losses would be minimal

•Highly efficient Has higher operational efficiency more than conventional generators, therefore, the overall cost of an MHD plant is less compared to conventional steam plants

•Operational and maintenance costs are less

•It works on any type of fuel and has better fuel utilization

Disadvantages

The disadvantages of the MHD generator include the following.

•Aids in the high amount of losses that include fluid friction and heat transfer losses

•Needs large magnets, leading to higher costs in implementing MHD generators

•High operating temperatures in the range of 200°K to 2400°K will corrode the components sooner

Applications of MHD Generator

•The applications are

•MHD generators are used for driving submarines, aircraft, hypersonic wind tunnel experiments, defense applications, and so on.

•They are used as an uninterrupted power supply system and as power plants in industries

•They can be used to generate electric power for domestic applications