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Renewable Resources

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ABSTRACT

The electricity requirements of the world including India are increasing at alarming rate and the power demand has been running ahead of supply. It is also now widely recognized that the fossil fuels (i.e., coal, petroleum and natural gas) and other conventional resources, presently being used for generation of electrical energy, may not be either sufficient or suitable to keep pace with ever increasing demand of the electrical energy of the world. Also generation of electrical power by cold based steam power plant or nuclear power plants causes pollution, which is likely to be more acute in future due to large generating capacity on one side and greater awareness of the people in this respect. The recent severe energy crisis has forced the world to develop new and alternative methods of power generation, which could not be adopted so far due to various reasons. The magneto-hydro-dynamic (MHD) power generation is one of the examples of a new unique method of power generation. The other non-conventional methods of power generation may be such as solar cells, fuel cells, thermo-electric generator, thermionic converter, solar power generation, wind power generation, geo-thermal energy generation, tidal power generation etc. This paper elucidates about Different Energy sources, why we are going for non-conventional energy sources, Different non-conventional energy sources & comparison between them, about fuel cells and their applications.

Keywords: Magneto-Hydro-Dynamic (MHD) Power Generation, Solar Power Generation, Wind Power Generation, Geo-Thermal Energy Generation, Tidal Power Generation.

INTRODUCTION

Why we are going for renewable resources?

Basically, the energy sources are two types; they are conventional energy sources like coal, petroleum, natural gas etc. & non-conventional energy sources like solar cells, fuel cells, thermo-electric generator, thermionic converter, solar power generation, wind power generation, geo-thermal energy generation, tidal power generation ETC.

A magneto- hydrodynamic generator (MHD generator) is a magneto-hydrodynamic device that transforms thermal energy and kinetic energy into electricity. MHD generators are different from traditional electric generators in that they operate at high temperatures without moving parts. MHD was developed because the hot exhaust gas of an MHD generator can heat the boilers of a steam power plant, increasing overall efficiency. MHD was developed as a topping cycle to increase the efficiency of electric generation, especially when burning coal or natural gas. MHD dynamos are the complement of MHD propulsors, which have been applied to pump liquid metals and in several experimental ship engines.

An MHD generator, like a conventional generator, relies on moving a conductor through a magnetic field to generate electric current. The MHD generator uses hot conductive plasma as the moving conductor. The mechanical dynamo, in contrast, uses the motion of mechanical devices to accomplish this. MHD generators are technically practical for fossil fuels, but have been overtaken by other, less expensive technologies, such as combined cycles in which a gas turbine's or molten carbonate fuel cell's exhaust heats steam to power a steam turbine.

Natural MHD dynamos are an active area of research in plasma physics and are of great interest to the geophysics and astrophysics communities, since the magnetic fields of the earth and sun are produced by these natural dynamos.

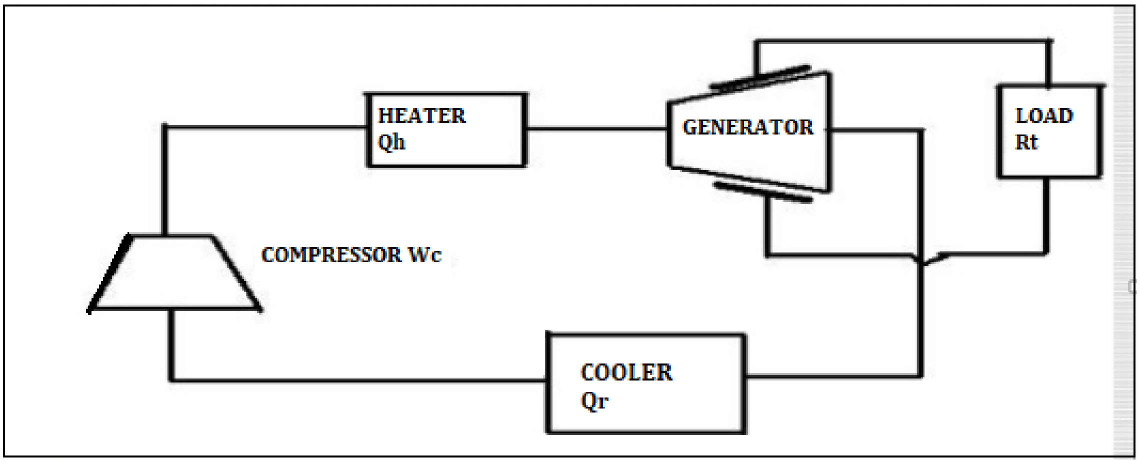
Fast depletion of conventional energy sources made us to look after alternate energy sources.

METHODOLOGY

1. MHD generator consist of a Combustion chamber and generator chamber,
2. The fluid conductor is passed into the combustion chamber where they are ionized at very high temperature.
3. There is a nozzle through which the ionized gas passé into the generator chamber.
4. The generator chamber consists of powerful magnet and a number of oppositely located electrode pair is inserted in the channel to conduct the electrical current generated to an external load.
5. Both combustion chamber and generator chamber are surrounded by a heat resistance material and water cooler.
6. The gaseous (fluid) conductor is passed into the combustion chamber through inlet.

Table 1:

Sr. No.	Method	Efficiency	
		Present	Future
1.	MHD Power Generation	Around 50%	Up to 60%
2.	Thermo-electric power generation	Around 3%	Up to 13%
3.	Thermionic converters	Around 15%	Up to 40%
4.	Photo-voltaic or solar cells	Around 15%	______
5.	Fuel cell technologies	Around 50%	Up to 60%
6.	Solar Power Generation	Around 30%	Up to 50%
7.	Wind Power Generation	Around 30%	______
8.	Geo-thermal Power Generation	Around 15%	______ _



7. By using a fuel like oil (or) natural gas (or) coal, the fluid conductor is heated to a plasma state and hence it is ionized.
8. The temperature in the combustion chamber is around 2000°K to 2400°K.
9. The heat generated in the combustion chamber removes the outermost electrons in the fluid conductor.
10. Therefore, the gas particle acquires the charge
11. The charged gas particles with high velocity enter into the generator chamber via nozzle.
12. The positive and negative charge moves to corresponding electrodes (anode and Cathode) and constitute the current.
13. In generator chamber, based principles of Faraday's law, the high velocity ionized conducting gas particles experience the magnetic field at right angles to their motion of direction and hence the potential (current) is produced.
14. The direction of current (Potential) is perpendicular to both the direction of moving gas particle and to the magnetic field.

CONCLUSION

Faraday generator

The Faraday generator is named after the man who first looked for the effect in the Thames River. A simple Faraday generator would consist of a wedge-shaped pipe or tube of some non-conductive material. When an electrically conductive fluid flows through the tube, in the presence of a significant perpendicular magnetic field, a voltage is induced in the field, which can be drawn off as electrical power by placing the electrodes on the sides at 90 degree angles to the magnetic field.

There are limitations on the density and type of field used. The amount of power that can be extracted is proportional to the cross sectional area of the tube and the speed of the conductive flow. The conductive substance is also cooled and slowed by this process. MHD generators typically reduce the temperature of the conductive substance from plasma temperatures to just over 1000 °C.

The main practical problem of a Faraday generator is that differential voltages and currents in the fluid short through the electrodes on the sides of the duct. The most powerful waste is from the Hall Effect current. This makes the Faraday duct very inefficient. Most further refinements of MHD generators have tried to solve this problem. The optimal magnetic field on duct-shaped MHD generators is a sort of saddle shape. To get this field, a large generator requires an extremely powerful magnet. Many research groups have tried to adapt superconducting magnets to this purpose, with varying success.

Hall generator:

The most common solution is to use the Hall Effect to create a current that flows with the fluid. The normal scheme is to place arrays of short, vertical electrodes on the sides of the duct. The first and last electrodes in the duct power the load. Each other electrode is shorted to an electrode on the opposite side of the duct. These shorts of the Faraday current induce a powerful magnetic field within the fluid, but in a chord of a circle at right angles to the Faraday current. This secondary, induced field makes current flow in a rainbow shape between the first and last electrodes.

Losses are less than a Faraday generator, and voltages are higher because there is less shorting of the final induced current. However, this design has problems because the speed of the material flow requires the middle electrodes to be offset to "catch" the Faraday currents. As the load varies, the fluid flow speed varies, misaligning the Faraday current with its intended electrodes, and making the generator's efficiency very sensitive to its load.

Disc generator:
The third and, currently, the most efficient design is the Hall effect disc generator. This design currently holds the efficiency and energy density records for MHD generation. A disc generator has fluid flowing between the center of a disc, and a duct wrapped around the edge. The magnetic excitation field is made by a pair of circular Helmholtz coils above and below the disk. The Faraday currents flow in a perfect dead short around the periphery of the disk. The Hall effect currents flow between ring electrodes near the center and ring electrodes near the periphery.

Another significant advantage of this design is that the magnet is more efficient. First, it has simple parallel field lines. Second, because the fluid is processed in a disk, the magnet can be closer to the fluid, and magnetic field strengths increase as the 7th power of distance. Finally, the generator is compact for its power, so the magnet is also smaller. The resulting magnet uses a much smaller percentage of the generated power.

ADVANTAGES

1. The conversion efficiency of MHD system can be around 50% much higher compared to the most efficient steam plants.
2. Large amount of power is generated
3. It has no moving parts so reliable
4. It has been estimated that overall operational costs in plant would be about20% less than conventional steam plants.
5. It is possible to use MHD for peak power generation and emergency service.

Conflicts of interest: The authors stated that no conflicts of interest.

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