Working Model of Magneto Hydrodynamics System

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Abstract— Magneto Hydrodynamics is a technique through which electrically conductive flue gases are passed through a magnetic field and as a result electricity can be generated. The preliminary requirement for working of MHD is electrically conducting fluids. So we replace the conventional flue gases produced by burning of coal by naturally available salty ocean water. To demonstrate this phenomenon, we conduct an experiment in which salt water is stored in a vessel. It is passed through the MHD generator located above with the help of pump as an experimental set up. Practically, ocean wave energy can be utilised to generate the pump power so that ocean salt water can be made to pass through the MHD generator at the requisite velocity needed. The MHD generator is a vertically held cuboid which contains taper on both ends designed using CAD software Creo Parametric 2.0, PTC. Two permanent magnets are arranged just outside the cuboidal generator's two opposite faces to produce the necessary magnetic field. As salt water passes through the generator, by MHD principles, electricity is generated and extracted with the help of two copper plates assembled mutually perpendicular to flow and the magnetic field inside the generator. The water then flows back to the stored vessel after passing through the generator. In this way, pollution free and easily available ocean water can be utilized to produce energy with negligible maintenance since it has no rotating part.

Key words: Hydrodynamics System, CAD

I. INTRODUCTION

In the today's world Renewable Energy sources are playing a very important role because it is reliable, plentiful & very cheap if once technology and infrastructure are developed well. Renewable energy resources like Solar Energy, Wind Energy, Geothermal Energy, and Hydroelectric Energy are emerging as important resources.

Power Generation has been a constantly developing field in which there is a constant need of more efficiency with less pollution. Electricity production accounts for more than one-third of global warming emissions with majority generated by coal fired power plant. Coal fired powerplant are also very expensive in terms of maintenance and raw materials used.

As we all have studied this statement that says "Earth contains of 97% of sea water and 3% of pure drinking water", if this sea water is used for producing something useful than it would be a very beneficial resource. So We as Engineers are trying to utilize this sea water to solve the problems of world of lack of electricity.

We are using a technique of Magneto Hydrodynamics system to utilize this sea water to generate electricity. We have designed an Experimental Model which would use salt water and produce electricity

II. CONCEPT OF MAGNETO HYDRODYNAMIC SYSTEM.

When an electric conductor moves across a magnetic field, a voltage is induced in it which produces an electric current. This is the principle of the conventional electric generator where the conductors are of copper plates. In MHD generator, the solid conductors are replaced by a gaseous conductor (an ionized gas). If such a gas is passed at a high velocity through a powerful magnetic field, a current is generated and can be extracted by placing electrodes in suitable position i.e. perpendicular to flow of steam.

III. WORKING PRINCIPLE

The principle as shown in Fig. 1 can be explained as follows: "An electric conductor moving through a magnetic field experiences a retarding force as well as an induced electric field and current."

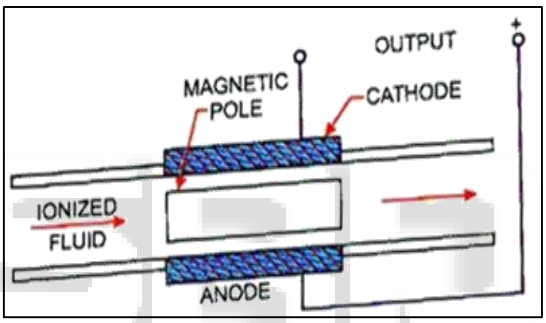

Fig. 1: Basic of magneto hydrodynamics.

IV. CONCEPT

In the concept Fig. 2, we have placed a cuboidal generator vertically with the help of support. The cuboidal generator has 0.15 m tapered drafts on both sides so as to reduce the losses occurring due to sudden enlargement. The wall at both the ends of tapered section contains hole of 0.015 m diameter for water inlet and outlet.

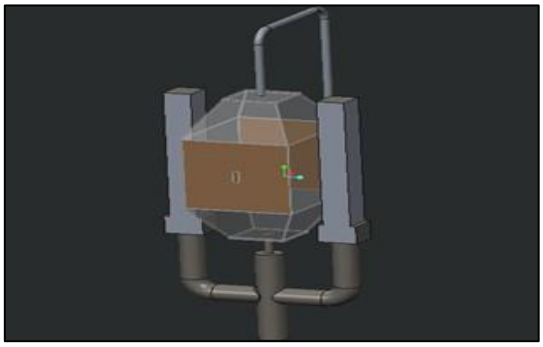

Fig. 2: Concept Design

There are magnets with magnet field intensity 0.6 Tesla on both the sides of cuboidal generator. There are copper plates of 0.200 mX0.170 m on the wall perpendicular to both magnetic field and flow of sea water to collect the ions produced due to dissociation phenomenon. A domestic pump of 2900 rpm is used to provide the requisite velocity of 18.5 m/s.

In this way D.C current would be produced that would be picked up using brushes from copper plates through a slot provided in the design.

V. CALCULATIONS

We calculated the requisite velocity V, needed with the help of available data such as discharge Q, of the pump and area A, of the outlet. We used the formula (1.1) for calculations.

$$Q=A\times V \qquad (1.1)$$

We calculated the produced potential difference using the formula (1.2) which is based on the principles of MHD. The produced potential difference Ve, is dependent on strength of magnetic field B, the velocity U, of flowing fluid and the distance d, between the electrodes. Here $\sin\theta$ is the component which represents the angle factor between the flow of fluid and the magnetic field.

$$Ve = B\times U\times D\times \sin\theta \qquad (1.2)$$

From the above equation it is evident that the produced voltage can be varied by changing the three different parameters.

In our present experiment, we made the flow vertical so that the flow of fluid is constantly perpendicular to the magnetic field and as a result the angle factor is 1.

For the first experiment, we have kept a magnetic field of intensity 0.6 Tesla while keeping a constant flow with velocity 18.63 m/s. The electrodes were kept 0.24 m apart.

As a result, we found the potential difference of 2.6784 V which is greater than 1.23 V which is the electrolysis voltage.

Corresponding to the formula, we have varied the three parameters so that the voltages produced can be known. The voltage produced is represented on graphs.

In the first case, we have varied the magnetic field intensity B and kept the rest two parameters as constant and plotted the graph as shown in Fig.3 of magnetic field intensity v/s voltage.

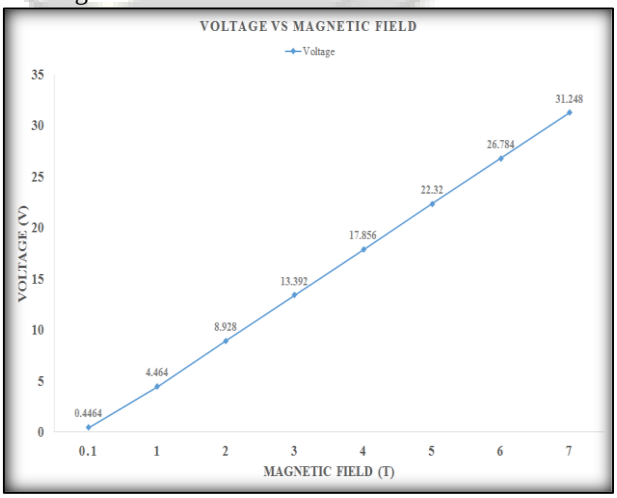

Fig. 3: Graph of magnetic field v/s voltage

In the second case we have varied the velocity of flow of fluid and kept the rest two parameters as constant and plotted the graph as shown in Fig.4 of velocity v/s voltage.

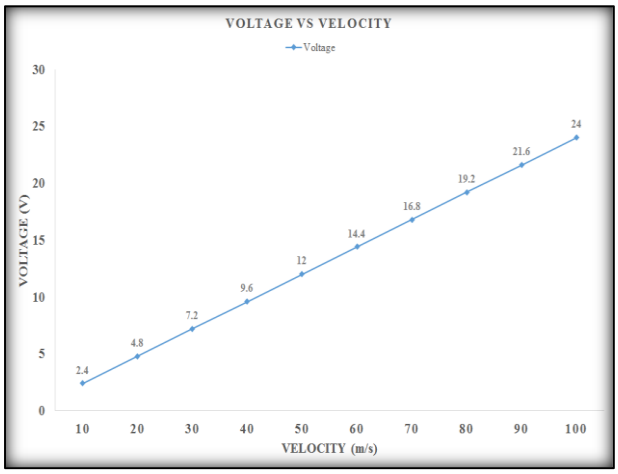

Fig. 4: Graph of velocity v/s voltage

In the third case we have varied the distance between electrodes and kept the rest two parameters as constant and plotted the graph as shown in Fig.5 of distance v/s voltage.

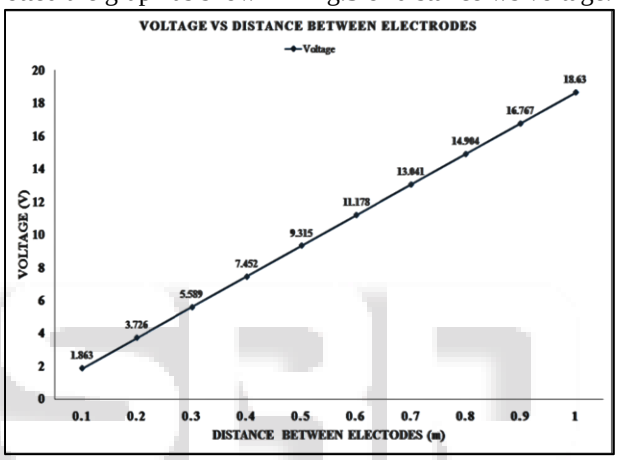

Fig. 5: Graph of Distance between electrodes v/s voltage

VI. SUMMARY

Our results can be summarized as

1) The cuboidal-type seawater MHD generator with a 0.6 T permanent magnet was constructed and tested.
2) The electromotive force increased linearly with increasing average flow velocity and magnetic field. The experimental values were smaller than the theoretical values and computed values.

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