NUMERICAL INVESTIGATION ON EFFECT OF BIPOLAR PLATE IN PEMFC

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Abstract**—** The PEMFC(Proton Exchange Membrane Fuel Cell) power out and performance is mainly based on the few parameters like temperature, pressure, mass flow rate and the channel where the fluid flows through. Here Design parameters of the flow field channels are changed so that efficiency or the performance of the fuel cell can be improved. This work numerically investigated how serpentine flow-fields with different channel cross section areas affect performance and species distributions in stationary conditions.

Flow direction to performance and its distribution was also taken This revealed that for stationary condition, narrower channel with wider rib spacing gives higher performance.

Keywords: Proton Exchange Membrane Fuel Cell, Bipolar Plate, Serpentine Model, Channel Width/rib

I.INTRODUCTION

In proton exchange membrane fuel cell, we just took the bipolar plate which is its key component. Comparing the existing design patterns it is planned to come up with the more efficient design pattern and iterating it with the various design parameters by analyzing it with the Ansys Fluent software. Hence with the help of polarity graph the change in the power output can be obtained.

The main component of a hydrogen vehicle is the fuel cell because the fuel acts the component which produces the power and makes the vehicle to run. The Fuel cell's key component is bipolar plate. We mainly focused on redesigning this bipolar plate design pattern and analyzing this CFD software called Ansys Fluent so that we able to confirm that this new design can be more efficient than the existing design patterns

II.EXISTING SYSTEM

There are various flow field patterns that are existing in today but among all these designs we came to know that only a one flow field shows good performance and power output. In this I have mentioned a few types flow field design pattern.

1. pin-type flow field,
2. series-equivalent flow field,
3. serpentine flow field,
4. composed flow fields,
5. interdigitated stream field,
6. Flow field plans delivered utilizing metal sheets

The best flow field pattern among this is serpentine
This we came to know after researching many literature reviews and papers.

III. DESIGN AND ANALYSIS

Catalyst layer: The catalyst layer acts as a seal between the graphite plate and the GDL. It should be placed on both sides, like the anode and cathode. Two catalyst layers collected in the center of the graphite plate and GDL.

Gas distribution layer: GDL is centered on the graphite plate and film. Scattered coal paper as a material. The GDL model follows the impulse layer and has a similar thicknes-s. A 1mm panel was demonstrated. Film, pulse layer, and GDL have similar display and display methods. In this review, a single channel cut segment was obtained, with 1.2 mm vertical and 2.4 mm planar components, with different GDL (gas diffusion layer), cathode, anode pulse, etc. between the two channels.
There are layers and the membrane.

Layer: The membrane is filled as an electrolysis of PEMFC. It should be placed between the anode and cathode. The layer was platinum with carbon particles.

Channels:
Two channels were taken one is used for the inlet and the channel which is down is used for the outlet. These channels are the one which is designed and the analyzed for better performance and efficiency.

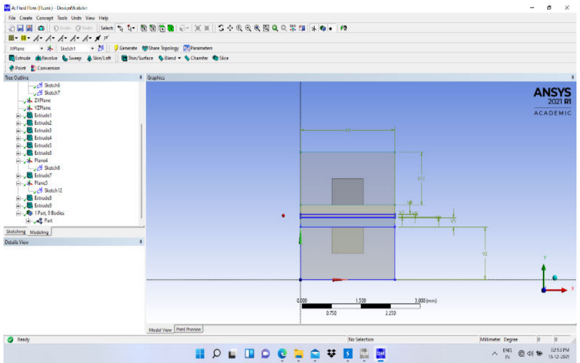

Figure.1

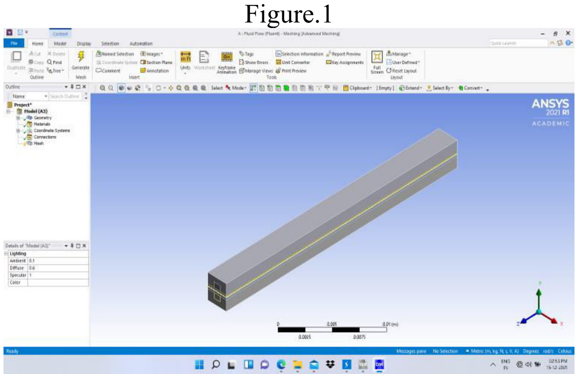

Figure.2

The PEMFCs in this (Fig 2) involved two flow field pattern. There were three estimations considered in this survey for analyzing the impact of channel/rib width.

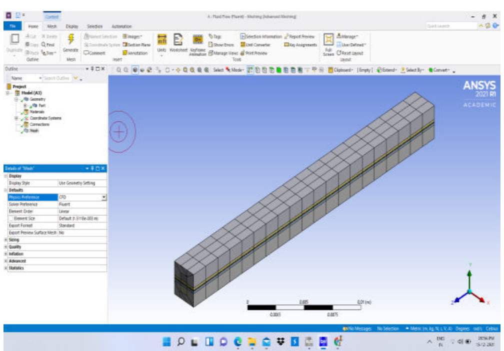

Figure.3

In the above figure it is shown meshing of the single flow field is done. Here meshing is done with different layers like GDL(Gas Diffusion Layer),Catalyst layers like Anode and cathode layers and the membrane in the center.

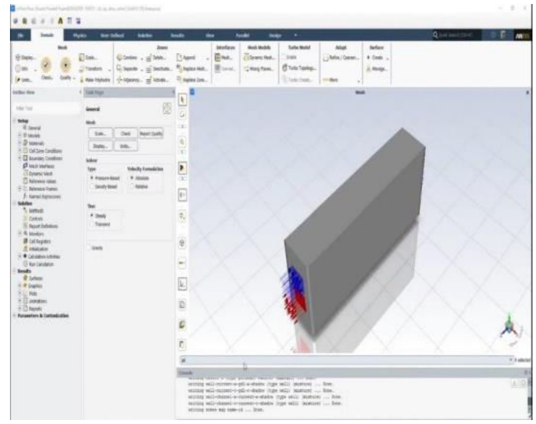

Figure.4

The fluid sent through the above channel is mentioned in blue is inlet and the below channel is where the fluid comes out is outlet which is indicated in red color.

IV.BOUNDARY CONDITIONS:

;•Inlet boundary conditions:

$\vec{U}$ inlet = $\vec{U}$in,

$$Y|_{inlet} = Y_{H_2O,in}, \; Y_{inlet} = Y_{O_2,in}, \; Y_{inlet} = Y_{H_2,in}.$$

•Outlet boundary conditions:

P |outlet = Pout , v|outlet = w|outlet = 0

• Wall boundary conditions.

With this assumption of laminar flow in the single channel has no-slip boundary condition when used at the wall.

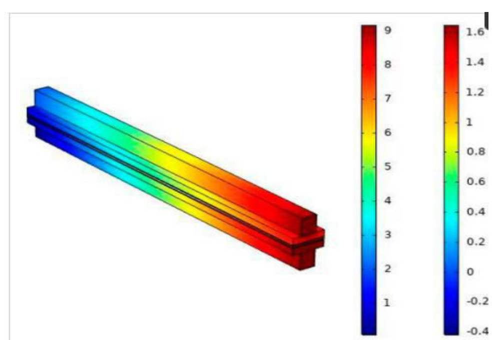

Figure.5

This (Fig 5) is the analyzed image of the single flow field pattern when the fluid is sent through the single channel.

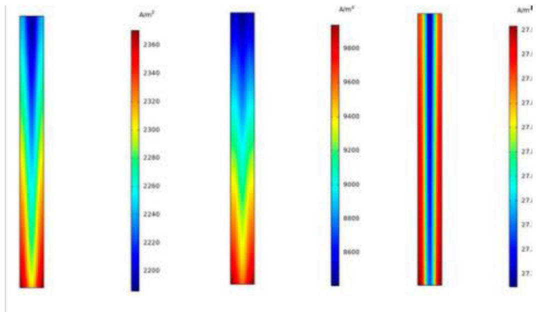

Figure.6

V. RESULTS AND DISCUSSION

During the time of analysis, we used a certain parameter which is mentioned below. The parameters such as Temperature, pressure and Mass flow rate are the parameters which we have taken and slight changes has been done in the values side so that during the time of analysis we could see some changes or the improvement in the power output part of view.

Table:1

S.No	Parameters	Values	
1	Temperature	337 K	
2	Pressure	2 bar	
3	Mass flow rate	Anode	4.33×10^{-7} kg/s
		Cathode	3.33×10^{-6} kg/s

Here the we have changed temperature parameter and checked with different iterations so we can see change in the power density considerably.

Table.2

Temperature (K)	Current density (A/cm²)	Power density (W/cm²)
317	2.45	1.53
327	2.34	1.58
337	2.62	1.42
347	2.56	1.54
357	2.79	1.32

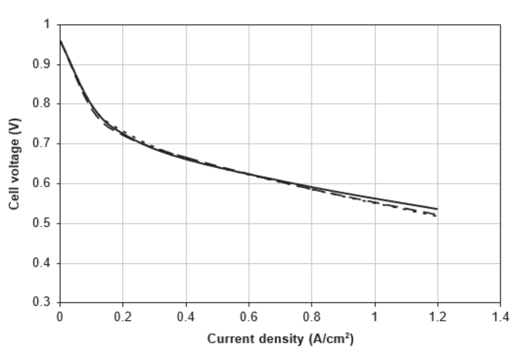

Figure.8

The graph shown here is the current density with respect to the cell voltage. This graph is obtained by changing various parameters mentioned like the temperature, pressure and the mass flow rate.

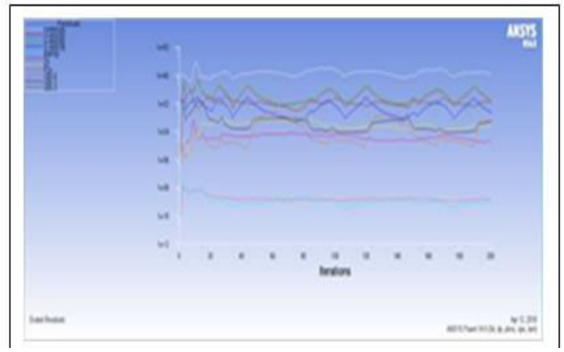

Figure.9 Fuel cell iteration

The fuel cell iteration graph mentioned above is the obtained by various changes in the parameters.

VI. CONCLUSION

In this project we have done a designed a bipolar designed and we have analyzed this new design with various parameters. Many iterations are done with various design parameters and came to conclusion that these new design is much more effective and can give good result in terms of performance and power output.

Analyzing with different channel dimensions to get efficient output changing flow-field configuration, including channel path length, width, or height to distribute the gas more evenly, is one method of minimizing these stresses.

VII. REFERENCES

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