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Pem Fuel Cell – Attractive Source Of Energy

Sanjeev Doijode
JNTU research scholar, Hyderabad,
Department of Mechanical Engineering,REC Bhalki

B.P. Yadav
Principal, Basavkalyan Engineering College Basavkalyan

B Sudheer Premkumar
Prof, Department of Mechanical Engineering,
JNTU, Hyderabad

Abstract:

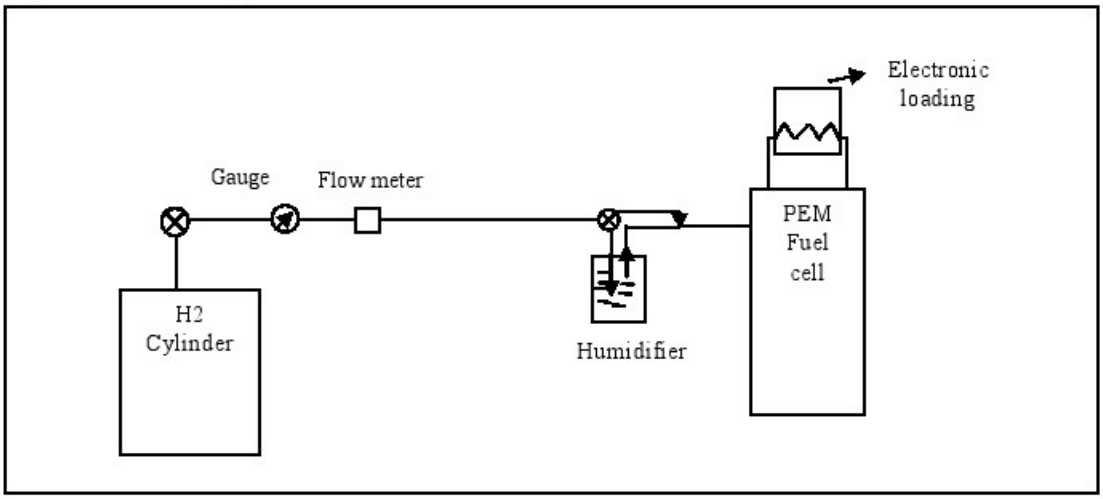
Hydrogen represents an alternative source of energy carrier to the oil based economy. Fuel cells are electrochemical devices and can be efficient for converting nearly 80 % of chemical energy of the fuel into electricity in contrast to the thermal power plant which gives around 40%. In structure fuel cells are similar to batteries except that in batteries the chemical energy is stored and need to be recharged while in the fuel cell fuel is constantly fed to the cell so that consistent generation of electricity is ensured. Fuel cell can be constructed in moduler form and hence fuel cell power plant can be erected.

The present paper deals with the study and performance of PEM FUEL cell with hydrogen fuel. The testing unit comprises a hydrogen gas cylinder , press regulator flow meter and a self breathing PEM fuel cell. The electronic loading device is attached with the system for loading. The fuel cell is tested with different quantity of flow and corresponding observation of power output, voltage and current etc. are to be noted and analyzed.

Introduction

The proton exchange membrane fuel cell is a device which converts chemical energy of fuel and oxidant into electrical energy and heat energy without classical combustion. The PEM fuel cell work with polymer electrolyte in the form of thin permeable sheet (Naffion membrane). This membrane is small and light and it works at room temperature To speed the reaction a platinum catalyst is used on both sides of membrane. Next to catalyst anode and cathode (GDL-gas diffusion layer) of about 235-427 micrometer is provided on both side. The total assembly is known as MEA i.e.Membrane electrode assembly. The MEA is provided with flow field pattern on either side. The hydrogen is supplied from anode side and oxygen is supplied on cathode side. Hydrogen atoms are ionised at the anode and the positively charged proton diffuse through one side of the porous membrane and migrate towards the cathode. The electron pass from the anode to the cathode through an exterior circuit and provide electrical power along the way. At the cathode the electron, hydrogen proton and oxygen from the air combine to form water. The heat energy also produces during the process.

Experimental Setup



Chemical Reaction

- Reaction are as follows:-
- Anode Reactions: $2H_2 \Rightarrow 4H^+ + 4e^-$
- Cathode Reactions: $O_2 + 4H^+ + 4e^- \Rightarrow 2\ H_2O$
- Overall Cell Reactions: $2H_2 + O_2 \Rightarrow 2\ H_2O$ + Heat + Electricity

The experimental test rig consists of self breathing rig PEM fuel cell as shown in the figure. The hydrogen fuel will be supplied towards the anode side. A hydrogen cylinder with a pressure regulator (2 in no.) will govern the supply of hydrogen to the PEM fuel cell .For 12 w fuelcell the inlet pressure of hydrogen is maintained between 0.4 to 0.5 bar. In the path of hydrogen flow a flow meter is installed to know the quantity of hydrogen being supplied to PEM fuel cell. The flowmeter is of rotameter type having the graduation from 25ml to 275 ml /min in a step of 25 ml.

The fuel cell will be tested in different ways. In this test the fuel i.e. hydrogen is constantly supplied to PEM fuel cell from anode side .Since, the PEM fuel cell is self breathing hence it is not necessary to measure oxygen quantity. It takes as per its requirement .Due to this PEM fuel cell produces maximum power output.

Later the PEM fuel cell is loaded electronically with rheostat and ammeter by changing the resistance from 10 ohm to 200 ohm, Accordingly the variation in the voltage and power output is recorded. It may be also tested with variation in fuel ie in a step of 25ml/min to 275ml/min and output is recorded. The observation table is shown below and accordingly graphs are plotted.

Constant pressure – 0.4 to 0.5 bar, Flow rate 275 ml/min , Variable load

Sl. No.	Resistance Ohm	Voltage Volts
1	10	4.4
2	20	5.5
3	30	6.2
4	40	6.6
5	50	6.9
6	60	7
7	70	7.2
8	80	7.3
9	90	7.4
10	100	7.45
11	110	7.5
12	120	7.5
13	130	7.6
14	140	7.65
15	150	7.7
16	160	7.7
17	170	7.7
18	180	7.7
19	190	7.7
20	200	7.75

Table 1

Sl.No.	Watts	voltage
1	0	9
2	1.5	8
3	2	7
4	3	6
5	4	5
6	6	4
7	7	3
8	8	2
9	9	1
10	10	0.2

Table 2

Result And Discussion

With the increase in the resistance the value of voltage increases whereas the power output increases with the decrease in voltage. It is also observed that increasing the resistance above 200 ohm fuel cell does not respond. Now a day's Fuel cells have wide range of application due to its eco friendly characteristics and zero pollution.

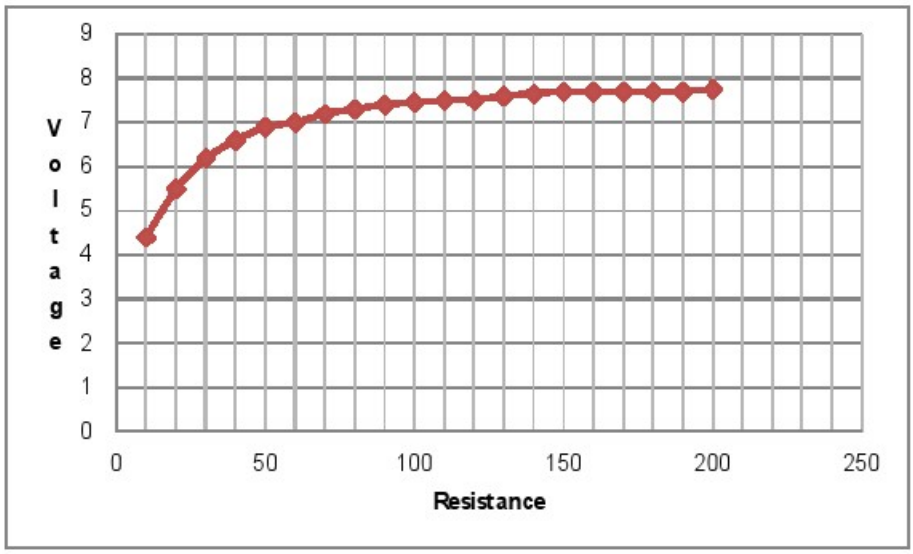


Figure: 2

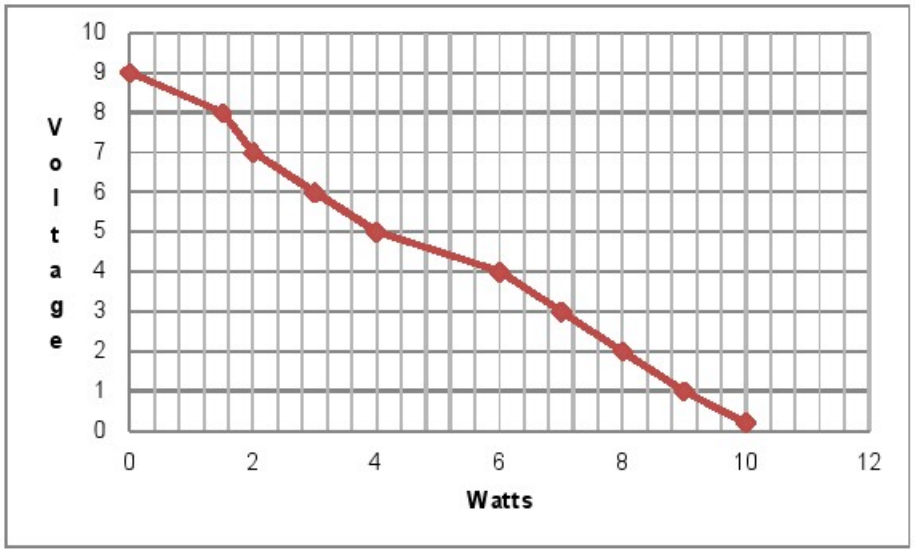


Figure: 3

Conclusion

The energy is the crucial input for the development of nation. Due to rapid consumption of fossil fuels and petroleum products, it is necessary to go with alternate source of energy. The PEM fuel cell in all is the best option and is eco-friendly with almost zero pollution .In future it will be proved as power source for automotive and power sector. It is the most promising alternative to the present day crisis.

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