ISSN 2393-8471

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 6, Issue 2, pp: (1-3), Month: October 2019 – March 2020, Available at: www.paperpublications.org

Performance study of PEMFC and DMFC

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Abstract: **Fuel cell technology is an emerging technology as they are going to replace fossil fuels to generate the power. As the fossil fuels are non renewable energy sources, the industries are looking for renewable energy sources to protect the environment by reducing the use of fossil fuels. There are various types of fuel cell depending on the catalyst we use to initiate the electrochemical reaction to generate electricity. Hydrogen plays a vital role in producing electrons which results in electrical energy. This paper discusses about Proton Exchange Membrane Fuel Cell and Direct Methanol Fuel Cell. With reference to some journal this paper also provides the information about performance of the two fuel cells with some characteristics which affect the current density from the fuel cells.**

Keywords: **Fuel cell, hydrogen, methanol, electricity.**

I. INTRODUCTION

Fuel cell is also like a battery which produces electricity from electrochemical reaction. Fuel cell converts chemical potential energy into electrical energy and produces water and heat as by products. In fuel cell chemical reaction takes place between hydrogen and oxygen. Hydrogen is considered as a fuel oxidation of hydrogen results in water and electrons. These electrons pass through external circuit as an electrical current. In fuel cell two electrodes forming electrical circuits are separated by a liquid or solid electrolyte that carries electrically charged particles. A catalyst is often used to speed up the reaction at the electrodes. There are different types of fuel cells abased on type of electrolyte used.

The various types of fuel cells are Proton Exchange Membrane Fuel Cell (PEMFC), Direct Methanol Fuel Cell (DMFC), Solid Oxide Fuel Cell, Alkaline Fuel Cell, Phosphoric Fuel Cell, Molten Carbonate Fuel Cell and Solid Fuel Cell.

II. PROTON EXCHANGE MEMBRANE FUEL CELL

Proton exchange membrane fuel cell uses water based, acidic polymer membrane as electrolyte with platinum based electrodes. PEMFC operates at relatively low temperature. It can improve the electrical output to meet dynamic power requirements. Hydrogen is processed at the anode where electrons are separated from protons on the surface of platinum based catalyst. The protons pass through the membrane to cathode while electrons pass through the external circuits to produce electricity. The protons combine with oxygen and form water which is expelled.

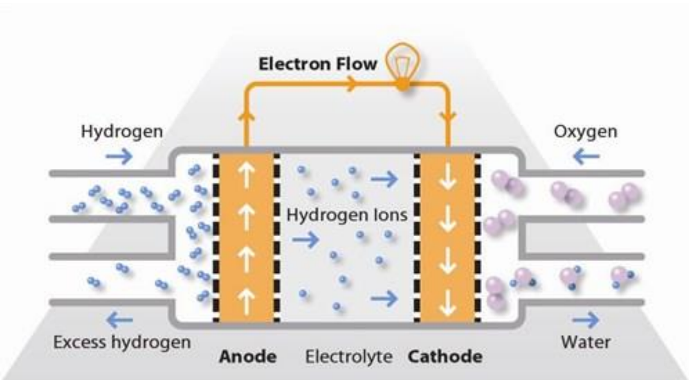

Fig. 1. Proton Exchange Fuel Cell

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Direct Methanol Fuel Cell is similar to PEMFC but method is used as a fuel. From the methanol the hydrogen is extracted with the help of platinum ruthenium catalyst. So, no separate hydrogen supply is required. Hence the name is given based on methanol. DMFC is more compatible as compared to PEM Fuel. Because it is simple to provide methanol to the fuel cell device as it is a fuel. But in case of PEM fuel cell, as hydrogen is a gas as separate provision should be provided in the form of cylinders as it can be stored in. Hydrogen gas is difficult to handle as it is hazardous. Another advantage of DMFC is that small quantity of methanol is enough to produce required electricity. Hence, it is used to make small compact devices like power banks.

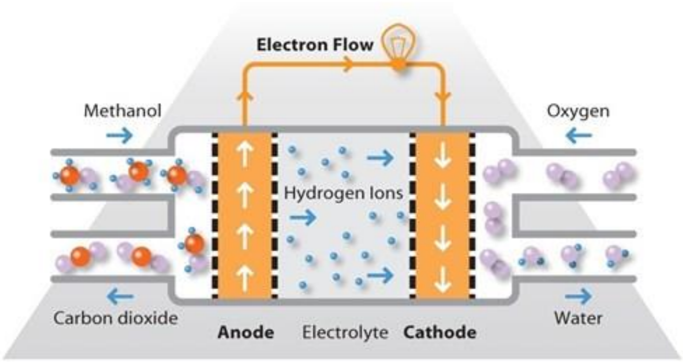

Fig. 2. Direct Methanol Fuel Cell

III. PERFORMANCE EFFECTS OF PEM FUEL CELL

Current density is the current demand per area of the cell in a PEMFC system. Due to activation reactions the voltage suddenly drops and slowly decreases due to ohmic losses. When compare the power and current density, the increases with increase in current density. The performance of PEM fuel cell depends on characteristics of membrane. In thermodynamic behaviour of fuel cell, the voltage delivers increases with increase in temperature.

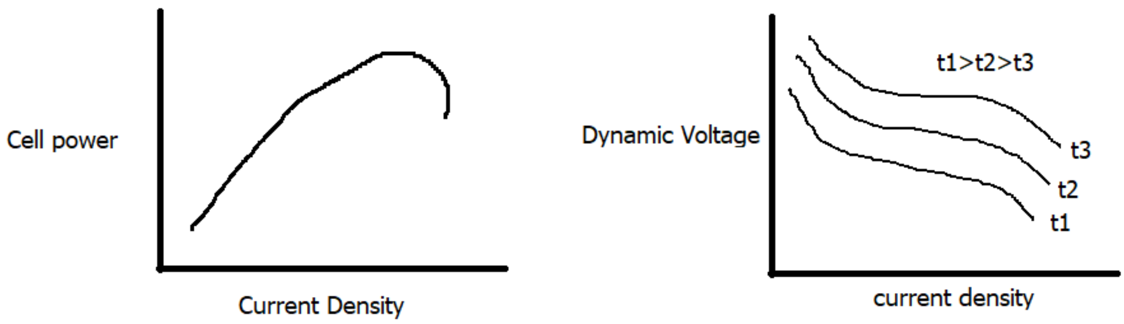

Fig. 3. Performance of PEM fuel with cell power, current density and dynamic voltage

IV. PERFORMANCE EFFECTS OF DIRECT METHANOL FUEL CELL

Direct methanol fuel cell is operated in between the temperatures of 10^0C and 80^0C. In DMFC, the oxygen can be supplied in two ways as directly from air and providing pure oxygen from cylinders. The performance of DMFC increases as increase in temperature. Then we compare performance with air and oxygen (pure), the pure oxygen supply improves power density three times of during air supply. This is due to reduction in activation loss and concentration loss by oxygen supply. Maximum power density of DMFC can be obtained with pure oxygen and at a temperature of 80^0C. Further increase in temperature causes reduction in performance of DMFC. The performance of DMFC also depends on concentration of methanol. The methanol concentration should be in optimum, range. The higher concentration of methanol causes decrease in the performance of the DMFC. This high concentration of methanol avoids the catalyst to react with anode. When you compare this condition with air and oxygen, the decrement is less in using oxygen other than air. This is because high amount of oxygen is enough to react with high amount of methanol.

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V. CONCLUSION

The better performance can be obtained with high temperature and pressure. However, the oversupply of input pressure and temperature will damage membrane of PEM fuel cell. In DMFC also the performance is increased with increase in temperature and mixed result with increase in methanol concentration. This study can be further extended by considering the characteristics of membrane using a catalyst in the fuel cell.

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