International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 7, Issue 2, February 2018, ISSN: 2278 -7798

Improvised Hydrogen Fuel Cell to Generate Cooking Gas

Mr. Jason ElroyMartis
Asst.Professor
NMAM Institute of Technology,Nitte

Abstract -The use of LPG as a cooking fuel for domestic purposes is an old approach and produces carbon dioxide which is a pollutant. A promising solution is the use of Hydrogen as a cooking fuel.Using KOH as an electrolyte, we produce hydrogen by passing current through water and passing it again through the dryer to remove moisture. Since there is no carbon emission in this approach, it is more suitable and eco-friendly.

I. INTRODUCTION

With the declining amount of LPG available for usage and its effect on the environment, the use of hydrogen gas as a cooking fuel turns to be a smart approach. This can be an eco-friendly and efficient approach as there is no carbon content released during the process and also the cost involved is also comparatively less.The components used include a fuel cell, dryer, gas pipe, a gas injector, a gas collecting chamber and a burner rim. When current is passed through the fuel cell which contains water and KOH as an electrolyte, hydrogen is released. It is then sent to the dryer through the gas pipe, in order to ensure that it is moisture free. Later on, the moisture free hydrogen is injected to the gas collecting chamber through the gas injector. The burner rim has minute holes to ensure only sufficient amount of gas is exposed to fire and thus hydrogen can be used as the cooking fuel.

II. UTC Cell and Working

A. Working of the Hydrogen Fuel Cell

The fuel cell consists of anode and cathode separated by an electrolyte between them.Oxygen is supplied into the cathode and hydrogen into the anode. Hydrogen and oxygen will want to join but this is prevented by the electrolyte. This will cause splitting of hydrogen into proton and electron. The proton passes through the electrolyte and the electron is forced to go in a different path around it. This will generate electric current before it re-combines with the proton to give hydrogen which will then combine with oxygen through a catalyst, creating a water molecule. There are different types of fuel cells which work on this principle, each uses a different the electrolyte (alkaline, phosphoric acid molten carbonate, solid oxide and solid polymer or proton exchange membrane).Operates are at different temperature ranges and is suitable for different applications within stationary, or transport.

B.Fuel Cell CHP and Working

Since Grove's experiments, the technology has been developed intermittently stepping back the Hydrocarbon Economy.The fuel cells were used in a real practical environment. UTC Power,who make alkaline fuel cells for NASA, produced the first phosphoric acid fuel cells in 1991 for commercial purpose.The UTC Power Pure Cell four hundred Fuel Cell CHP is a packaged machine combining the gas processor (or reformer), gasoline cellular stack and electricity conditioner. The fuel cell stack contains 32 sub-stacks of 8 fuel cells so the gasoline mobile CHP definitely contains 256 gas cells. Heat is recovered at every sub-stack and aggregated to provide the gas mobile package heat output.

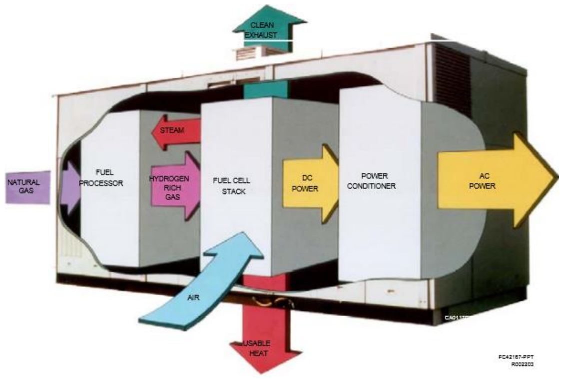


Fig1 :Operation of UTC Power Pure Cell 400

As an instance, the UTC gasoline cell uses phosphoric acid as the electrolyte, natural fuel chemically reformed into hydrogen fuel through steam reforming and oxygen extracted without delay from outside air. Fuel cells additionally operate on 5renewable gases including syngas from waste, biogas, waste fuel from sewage remedy, or different biogases. Renewable gases are rich in hydrogen and can be provided with dual fuel alternatives (renewable fuel and herbal fuel) to make certain continuity of supply at complete strength and to take gasoline cells generate strength through an electro-chemical response there's no combustion and no noxious emissions. Therefore, no flue is needed, the most effective emissions being water.

C. Quadgeneration Systems

The easy exhaust of a gas mobile is pure water which can be captured, condensed and utilised as potable or non-potable water. The water from a gas cell is H_2O or 100 percent natural water and astronauts definitely drink the water from on board fuel cells in space.

III. HYDROGEN AS A COOKING FUEL

The hydrogen fuel cell gives out hydrogen when electric current is passed into it. But this hydrogen cannot be directly used as it contains moisture.Inorder to remove the moisture, it is sent into dryer.The dryer ensures that the hydrogen gas is completely moisture free. The full cell is connected to the dryer through a gas pipe.Even though the hydrogen gas is now moisture free we cannot directly use it as a cooking fuel as the amount of hydrogen exposed to fire is very critical. Inorder to ensure that only sufficient amount of hydrogen gas is exposed to fire, it is passed to the gas collecting chamber through gas injector. The burner rim used has minute holes and this will ensure that only sufficient amount of hydrogen is exposed thus making hydrogen an efficient fuel to be used for cooking.

IV.EXPERIMENTAL RESULTS AND CONCLUSION

Form of water product	Temp °C	ΔG kJ/mole-1	Max. EMF	Efficiency limit
Liquid	25	-237.2	1.23V	83%
Liquid	80	-228.2	1.18 V	80%
Gas	100	-225.3	1.17 V	79%
Gas	200	-220.4	1.14 V	77%
Gas	400	-210.3	1.09 V	74%
Gas	600	199.6	1.04 V	70%
Gas	800	-188.6	0.98 V	66%
Gas	1000	-177.4	0.92 V	62%

Table 1: Output efficiency values of Hydrogen Fuel Cell

As it can be seen in the above tabular column, the experimental results show an increased output of hydrogen(in ml) with the increase in the output electrode voltage.

Equations Involved in the Fuel cell:

The electrical power and energy output are easily calculated from the well-known formulas:

Power = VI and Energy = VIt (1)

For the burning of hydrogen:

$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O \text{ (steam)}$$

$$\Delta H = -241.83\ kJ/mole$$

Whereas if the product water is condensed back to liquid, the reaction is:

$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O \text{ (liquid)}$$

$$\Delta H = -285.84\ kJ/mole$$

The difference between those two values for ΔH (forty four.01 kJ/mole) is the molar enthalpy of vaporization of water. The higher figure is called the higher heating price (HHV), and the lower, quite logically, the lower heating fee (LHV). Any statement of performance should say whether or not it pertains to the higher or lower heating fee. If this statistics is not given, the LHV has possibly been used, when you consider that this may supply a higher efficiency parent.

We can now see that there may be a restriction to the performance, if we define it as in Eq. 1. The maximum electric electricity available is equal to the alternate in Gibbs unfastened power, so:

$$Maximum\ efficiency\ possible = \frac{\Delta G}{\Delta H} \times 100\%$$

THE EFFECT OF PRESSURE AND GAS CONCENTRATION

The values for the changes within the Gibbs unfastened strength given in Tables II and III all situation natural hydrogen and oxygen, at fashionable pressure, one hundred kPa. However, in addition to changing with temperature, as shown in those tables, the Gibbs electricity modifications with pressure and attention.

A complete treatment of those troubles is past a ebook together with this, and it is able to without difficulty be located some other place. Suffice to say that the connection is given by a completely critical gas cell equation derived from the paintings of Nernst. It may be expressed in many specific forms, depending on what issue is to be analyzed. For example, if the change of device stress is the problem, then the Nernst equation takes the form:

$$\Delta V = \frac{RT}{4F}\ln\left(\frac{P_2}{P_1}\right)$$

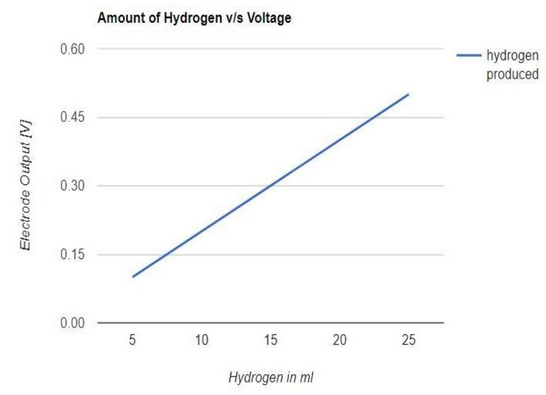
Where ΔV is the voltage boom if the strain adjustments from P 1 to P 2 . Other causes of voltage exchange are a reduction in voltage because of the usage of air instead of natural oxygen. The use of hydrogen fuel that is combined with carbon dioxide, as is acquired from the 'reforming' of fuels consisting of petrol, methanol or methane, additionally causes a small reduction in voltage.

For excessive temperature gasoline cells the Nernst equation predicts very well the voltage modifications. However, with decrease temperature cells, together with are utilized in electric cars, the modifications are almost constantly extensively more than the Nernst equation predicts. This is because the 'activation voltage drop' cited inside the ultimate section is also quite strongly tormented by problems inclusive of gasoline awareness and strain. This is specially the case on the air cathode.

The voltage increase resulting from a doubling of the system pressure would be:

$$\Delta V = \frac{8.314\times(273+80)}{4\times 96485}\ln(2) = 0.0053V \textit{ per cell}$$

However, in practice the voltage increase could usually be about zero.04 V, almost ten instances as much. Even so, we ought to observe that the increase remains not large, and that there may be massive strength value in strolling the device at higher strain. Indeed, it's miles proven elsewhere that the electricity won from a better voltage could be very not going to be extra than the power loss in pumping the air to better strain.



The amount of hydrogen gas produced is directly proportional to the voltage of the output electrode. Based on this principle we can develop a comparatively better solution to the problem of cooking gases at homes.

REFERENCES

1. **Appleby, A. John.***Fuel Cell Handbook.* New York : Van Reinhold Co., 1989.

2. **Breeze, Paul.***Power Generation Technologies: Evaluating the Cost of Electricity.* London : Financial Times Energy, 1998.

3. **Hacker, Barton C. and James M. Grimwood.***On the Shoulders of Titans: a history of Project Gemini.* Washington, DC : NASA, 1977.

4. **Ostwald, Wilhelm, Translated by N. P. Date.***Electrochemistry: History and Theory.* New Delhi : Amerind for the Smithsonian Institution and the National Science Foundation, 1980.

5. **Young, George J.***ed. Fuel Cells.* New York : Reinhold Publishing Corp., 1959 and 1961, respectively. V1 - 1959, V2 - 1961.

6. *"Note on the Development of Voltaic Electricity by Atmospheric Oxidation of Combustible Gasses and other Substances".* **Alder Wright, Charles R. and C. Thompson.** 1889, London : Proceedings of the Royal Society of London, Vol. 46.

7. **Appleby, A. John.***"The Electrochemical Engine for Vehicles".* s.l. : Scientific American, July 1999. P 74.

8. **Wendel, Charles H.***The Allis-Chalmers Story.* Sarasota, Florida : Crestline Publishing Co., 1988.