Design and Figment of brine fueled automobile

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Abstract: **This paper introduces a renewable source to decrease the demand of fuels for automobile. Brine is one of the renewable sources which can make a great difference for the automobile in gaining energy. Brine is also called as salt water or sea water which consists of adequate oxygen, hydrogen and amounts of salt like Sodium chloride. Hydrogen plays a vital role among those particles. When the brine has been used as a fuel, it cannot burn easily. So it is stressed under electrolysis process to gain hydrogen. Resulting hydrogen gives maximum power to the automobile reacting with oxygen in a fuel cell. This study is an attempt to use theoretical methods and fuel cell techniques and to analyze the performance of an automobile. Electric motor plays a major role since it has been used to give the thrusting movement for the automobile by using electricity.**

Index terms: **Renewable energy, Salt water or Sea water (Brine), electrolysis process, fuel cell, Electric motor.**

I. INTRODUCTION

Renewable sources play an important role in surmounting the increased energy demand. So there started a demand for renewable resources. Brine is one of the renewable sources which are been more significant on the globe. It is also available more in quantity on earth. There is also a concern about the future where there is a growth in the level of ocean and sea water. To stop these consequences it is important to use the sea water in various ways. This paper speaks one among them. The main ideology of the paper is to consume sea water at the sufficient usage. This reduces the consequences in the future and there will be a control in the consumption of fossil fuels in 2030's. Also there will be reduction in the I.C engines which may lead to minimize the hazardous gases or toxics coming out of the vehicle. Using electric motor is one of the best instead of using I.C engine. This doesn't leave any outlet to the atmosphere. Fuel cell which is used to produce electricity for an electric motor leaves water as an outlet but this could also be used again without leaving to environment or can be used for any other purpose. But even though these method are been eco-friendly, fossil fuels have changed the minds of people in using them as they have greater efficiencies. Hydrogen has been a matter which is overcoming the fossil fuels efficiency. Government, other companies and international efforts are on the way in using renewable sources like brine for most of the applications. Brine is one of the important source on the earth which has more amount of minerals. This could be used as per the requirement. Our project tells about extracting hydrogen from the sea water to use as a fuel for an automobile.

II. DESIGN

The first design was done in autocad which was not satisfying. There were drawbacks in the design for several conditions. Then the second design was designed in Catia. There were bit satisfactory in the results. It was made to attempt many designs. After several designs, the automobile was designed with satisfying results. Since it was a prototype design, the major criteria was based upon the size. It was designed based on the sizes of the parts and according to the positions of the parts. Thus finally the design was successful.

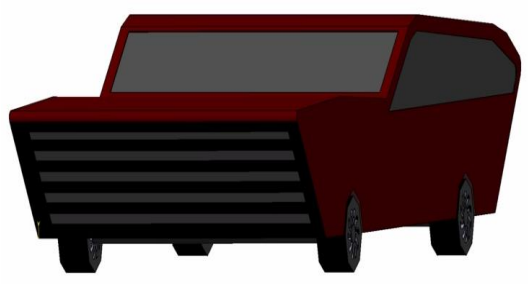

Fig 1: Sample Design

III. PRODUCTION OF HYDROGEN

The hydrogen is very well known to be extracted from fossil fuels by steam deforming or partial oxidation since 1999. Also other routes such as biomass gasification or electrolysis of water is been used. Hydrogen production is the family of industrial methods for generating hydrogen. Currently the dominant technology for direct production is steam reforming from hydrocarbons. Many other methods are known including electrolysis and thermolysis. In 2006, the United States was estimated to have a production capacity of 11 million tons of hydrogen. 5 million tons of hydrogen were consumed on-site in oil refining, and in the production of ammonia (Haber process) and methanol (reduction of carbon monoxide). 0.4 Million tons were an incidental by-product of the chloro-alkali process. Hydrogen production is an estimated $100 billion industry. According to the U.S. Department of Energy, 53 million metric tons were consumed worldwide in 2004. There are no natural hydrogen deposits, and for this reason the production of hydrogen plays a key role in modern society.

As of 1999, the majority of hydrogen (~95%) is produced from fossil fuels by steam reforming or partial oxidation of methane and coal gasification with only a small quantity by other routes such as biomass gasification or electrolysis of water. Developing affordable methods for producing hydrogen with less damage to the environment is a goal of the hydrogen economy.

A. TYPES OF PRODUCTION

Fuel reforming : Fossil fuels, biomass, heat, water.

Steam reforming in membrane reactors : Fossil fuels, bio fuels , heat, water.

Electrolysis : Electricity, water (electrochemical reaction).

Thermochemical process: Heat, water.

Thermochemical reforming: Fossil fuels, bio mass, water.

Photocatalysis: Solar radiation, water (H_2O split by photocatalyst)

Biophotolysis : Solar radiation, bio mass, water(biochemical H_2 production by microbes and bacteria)

Artificial photosynthesis : Solar radiation, bio mass, water(engineered system mimic photosynthesis)

Plasma cracking of hydrocarbons : Fossil fuels, electricity.

Thermolysis : Heat, water(decomposition of water>2500K)

Dark fermentation : Biomass(biochemical H_2 production without light)

B. SELECTED METHOD

The suitable process to extract hydrogen is by electrolysis process which is clearly explained above. To have a low impact on environment from hydrogen, emissions of CO2 and other pollutants are been avoided and a perfect renewable hydrogen is been produced. Brine water consists of salt like sodium chloride which is removed in HHO generator. The production of hydrogen always depends upon the environmental conditions and the storage capacity of the tanks. But here it is not mandatory to have a hydrogen tank since hydrogen is directly carried to the fuel cell. Hydrogen is one of the hazardous gas which can create a dangerous surrounding. So it is concerned to be safe while implementation of the method of hydrogen production.

Among the hydrogen production technologies, electrolysis process is suitable to use for our needy. The production of hydrogen from the brine water is been formulated as follows:

$$2NaCl + 2H_2O \rightarrow 2NaOH + H_2 + 2Cl.$$

Thus hydrogen can be used and the products can be re-bonded to produce water again. The equation will be followed as below:

$$2NaOH + 2Cl \rightarrow NaCl + NaClO + H_2O.$$

The electrodes like steel, stainless steel, nickel, nickel with platinum coated can be used. But comparatively, amount of chlorine gas will be generated at anode and hydrogen at cathode.

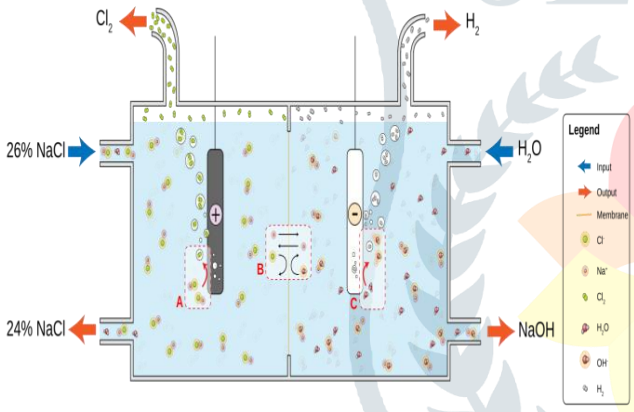

Fig 2: Electrolysis of hydrogen

C. SAMPLE CALCULATIONS

From battery description,

Current, I = 2 A

Voltage, V = 12 V

1. Calculation of Resistance

Resistance, R = V / I

R = 12 / 2

R = 6 Ω (ohms)

2. Calculation of specific conductance

Specific Conductance, C = 1 / ρ = (1/R)*(L/A)

Where, L = length between electrodes (in cm) = 25cm

A = area of each electrode (in sq. cm) = 12*30 cm^2

1 / ρ = (1/6)*(25/360) = 0.011574 Ω / m

3. Calculation of weight of substance discharge

Weight of substance discharged atom electrode, w = zIt

Where, z = constant = 1 coulomb

t = time of flow of electricity (in sec)

w = 1*0.02*10

w = 0.2 g

IV. SELECETED FUEL CELL

Proton-exchange membrane fuel cells, also known as polymer electrolyte membrane (PEM) fuel cells (**PEMFC**), are a type of fuel cell being developed mainly for transport applications, as well as for stationary fuel-cell applications and portable fuel-cell applications.

PEMFCs distinguishing features include lower temperature/pressure ranges (50 to 100 °C) and a special proton-conducting polymer electrolyte membrane.

PEMFCs generate electricity and operate on the opposite principle to PEM electrolysis, which consumes electricity. They are a leading candidate to replace the aging alkaline fuel-cell technology, which was used in the Space Shuttle.

PEMFCs are built out of membrane electrode assemblies (MEA) which include the electrodes, electrolyte, catalyst, and gas diffusion layers. An ink of catalyst, carbon, and electrode are sprayed or painted onto the solid electrolyte and carbon paper is hot pressed on either side to protect the inside of the cell and also act as electrodes.

A. REACTIONS

A stream of hydrogen is delivered to the anode side of the MEA. At the anode side it is catalytically split into protons and electrons. This oxidation half-cell reaction or hydrogen oxidation reaction (HOR) is represented by:

1. **At the anode:**

$2H^+ + 2e^- = H_2$

2. **At the cathode:**

$½ O_2 + 2H^+ + 2e^- = H2O$

3. **Overall reaction:**

$H_2 + ½ O_2 = H_2O$

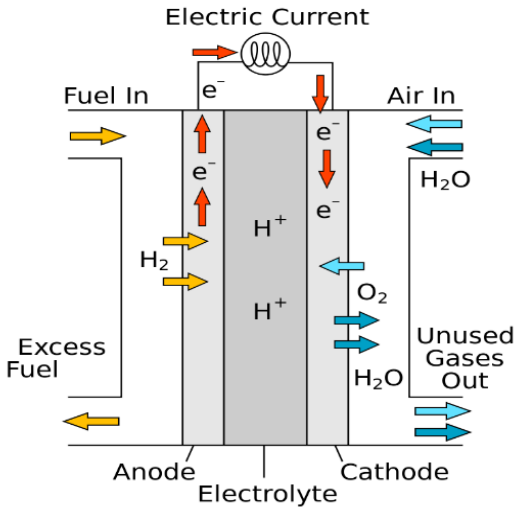

Fig 3: Scheme of operating principle of a proton exchange membrane (PEM) fuel cell

B. SAMPLE CALCULATIONS

1. **Calculation of electrical work done**

Electrical work done, $W_{el} = qE$

Where, q = charge in coulombs / mol

E = voltage in volts

$q = \eta * N_{avg} * q_{el}$

where, N_{avg} = no. of molecules per mole = $6.022*10^{23}$ molecules/mol

η = 2 electron/molecule (no. of electron per molecule of hydrogen)

q_{el} = charge of 1 electron = $1.602*10^{-9}$ couloumb/electron

$W_{el} = (\eta * N_{avg} * q_{el}) * E$

But, Faraday constant, $F = N_{avg} * q_{el}$ = 96485 coulombs/electron-mol

$W_{el} = \eta * F * E$

$W_{el} = -\Delta G$

Where, $-\Delta G$ = Gibbs free energy = 237340 J/mol^{-1}

$E = -\Delta G/(\eta * F)$

$E = (237340\ Jmol^{-1}) / (2*96485\ As\ mol^{-1})$

E = 1.23 volts (For single cell)

V. BLDC MOTOR

Brushless DC electric motor (BLDC motors, BL motors) are known as electronically commutated motors (ECMs, EC motors), or synchronous DC motors, are synchronous motors powered by DC electricity via an inverter or switching power supply which produces an AC electric current to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the motor.

The construction of brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor.

A. SPECIFICATIONS

- Voltage : 12V
- Power : 120 W
- Motor type : Brushless DC motor
- Motor net weight : 1.0 kg
- Motor speed : 3350 rpm
- Max. torque : 0.45 Nm

VI. CONCLUSION

Brine fueled automobile do not use fossil fuels and is one of the eco-friendly vehicle which does not release harmful gases to the atmosphere. This can save the fossil fuel which is supposed to get diminished. Presently there may not be a demand for the brine water, but when the proposing idea makes changeover in the fuel technologies, there will be a great demand for the brine water. The major calamities occurring in the early 2030's can be totally controlled by the usage of brine water. The main ideology is to make the brine water in use and to nullify the hazardous effects. Brine water has many

hidden minerals which could be useful when analyzed thoroughly. The clear explanation of the brine water is that the sodium chloride content may also be used for many purposes where there are more in demand. Hydrogen acts as a great source which has been possible to extract easily from the brine water. Moreover the latest technological views have made hydrogen to be handy in use with the elements. Also it is been studied with a clear knowledge of electrolysis process, hydrogen production, cell voltage and efficiency. This could be used for an attempt to use the theoretical methods in classifying the usage of brine water as a fuel. It is also shown that brine water is one of the most important source on globe and a brief explanation on using the brine water. Thus there won't be any scarcity of fuel when brine water comes into existence.

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