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HYDROGEN AS A FUEL : A REVIEW

Shraddha Sonone[1], Dhiraj Khobragade[2], Yousuf Ali Asif Ali[3], Muhammad Musaddique Muhammad Nayeem[4]

[1] *Student, Mechanical Engg. Dept., JDIET, Yavatmal, Maharashtra, India, shraddhasonone02@gmail.com*
[2] *Student, Mechanical Engg. Dept., JDIET, Yavatmal, Maharashtra, India, iDKhobragade37K@gmail.com*
[3] *Student, Mechanical Engg. Dept., JDIET, Yavatmal, Maharashtra, India, yousufalisaad@gmail.com*
[4] *Student, Mechanical Engg. Dept., JDIET, Yavatmal, Maharashtra, India, musaddiquemuhammad395@gmail.com*

Abstract

In this paper we look at an alternative source of energy to hydrocarbons. The goal is produced energy of using hydrogen fuel cells. Hydrogen were produced by methods like fermentation and natural gas(methane) reforming; it is also an abundant chemical species that could be used to produce more efficient and environmentally friendly energy. However, hydrogen energy fuels are harder to store, and although it is an abundant species, it could be expensive to extract pure hydrogen. Hydrogen fuel cells can be used as an randomly to produce jets aeroplanes, electric cars, boats, electric motors, and possibly for home applications in the future. It is pollution free and eco-friendly.

Index Terms: *Hydrogen, cells, future energy etc.*

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1. Introduction

Hydrogen does not available freely in nature. It can be created fossil fuel or by natural gas. The combination of oxygen from the air and water through electricity produce large amount hydrogen Fuel Cell. Sufficient electricity can be created to power electric vehicle when hydrogen and oxygen from the air are fed into the proton exchange membrane fuel cell stack. Enough electricity is produced to power electric vehicles. Enough electricity can be produced to power electric stack. The usage of fuel cell and hydrogen technologies will affect significant social, economic and environmental which will impact.

Hydrogen is being used as a fuel in more numbers of today's motor vehicles which are expanding locally and internationally, with the goal to decrease carbon dioxide emissions. From 1950 The National Aeronautics and Space Agency (NASA) have been using hydrogen as fuel in their space shuttles. The market is also developing for buses, stationary application, ground support equipment, medium and heavy-duty vehicles, and material handling equipment. All of these applications will produce zero waste, and only releases water vapour back into the atmosphere. The paper will discuss how hydrogen is an important resource of energy without all the waste associated with conventional fuels. First the paper will discuss methods of creating hydrogen to be used in several application and how they can be stored. Moreover, a brief discussion on used of stored hydrogen, also known as hydrogen fuel cells, how to provide electricity to power vehicles. Finally, discuss on the advantages and disadvantages of using hydrogen for energy will be mentioned.

2. Methods of producing hydrogen

1. Natural gas reforming:

Synthesis natural gas (methane CH_4), a mixture of carbon monoxide, hydrogen, and a small amount of carbon dioxide, is produce by reacting natural gas with high-temperature steam and a pressure in between 3 - 25 bars using a processing device is called a reformer [2]. The process is endothermic and requires a catalyst in addition to the carbon dioxide reaction in order to successfully create hydrogen. This method is the cheapest, most efficient, and the most common way to produce hydrogen from hydrocarbons especially natural gas (methane – CH_4). The equation below shows the reaction that

was mentioned to produce hydrogen using the reforming method.

$$CH_4 + H_2O + heat \rightarrow CO + 3H_2$$

Another way to obtained hydrogen by using the partial oxidation method [2]. Hydrocarbons react with a very small amount of oxygen in the process. This method is faster than the reforming method, however, it also yields a smaller amount of hydrogen for the same amount of fuel that is used. Therefore, it is further better to use the reforming method to create hydrogen on a mass scale. The equation below shows the reaction that was mentioned to produce hydrogen using the partial oxidation method.

$$2CH_4 + H_2O \rightarrow CO + 2H_2 + heat$$

2. **Electrolysis**:

Electrolysis is simply explained as splitting or the decomposition of a water molecule into one oxygen and two hydrogen atoms using an electrical current. As shown in Figure 1, two electrodes are inserted in a water tank; a cathode that carries a negative charge in addition to an anode is carries the positive charge. An electric current is then passed through the electrodes and start the decomposition. Since the hydrogen is positively charged in the water molecule, it will escape the apparatus in the side where the cathode is located. Some of the other methods used in the splitting of the water are: High pressure electrolysis and high temperature electrolysis. The former is the application of a high temperature to induce the separation of atoms [3]. This method is sometimes preferable because the reaction is more efficient and cheaper to create in higher temperatures. Electrolysis is not considered renewable unless the electrical current create using a renewable source like solar power. However, hydrogen can be massed produced for a small amount of fuel, which in the long run can drastically decrease carbon emissions.

3. **Gasification**:

Gasification is the process in which coal or biomass is reacted with high-temperature steam and oxygen in a pressurized reactor called a gasifier and transfer into gaseous components. The resulting synthesis gas contains hydrogen and carbon monoxide, which can be reacted with steam to create more hydrogen. Instead of coal burn, it is disintegrated into its basic form and inserted into a gasifier. Steam is then let through it, which as mentioned, reacts with the coal's chemicals to create a clean way to convert coal to heat and electricity. Gasification can be seen to be the better way to produce hydrogen to be used in motor vehicles. It can be used to power turbines and generate electricity. Profits of gasification is its flexible use, where it can use the waste from coals, in this case sulphur, and convert it to hydrogen sulphide. This compound can be used in chemical industry to further produce a better use for it. Moreover, waste emissions are low compared to using natural gas(CH4), which is seen as the cleaner alternative to gasoline and coal.

4. **Fermentation**:

Biomass is converted into sugar-rich feedstock that can be fermented to create hydrogen. In other words, bacteria are sued for the manufacture of hydrogen. Since some strains of bacteria can thrive without light, it can be used to create hydrogen all night and all day. An example of this is by using Rhizo Bacteria spheroids SH_2C to transmits molecular fatty acids into hydrogen .

3. Hydrogen fuel cells

A fuel cell is an energy conversion device that can efficiently capture and use the power of hydrogen. There are two types of fuel cells; stationary fuel cell and portable fuel cells.

Stationary fuel cells are used as a backup power source; power provided to remote locations and in distributed power generation. The latter is used to power personal vehicles, buses, trucks, marine vessels, and other specialty vehicles such as lift trucks and ground support equipment, as well as provide auxiliary power to traditional transportation technologies.

4. How do hydrogen fuel cells function?

A single fuel cell consists of electrolyte in between two electrodes, an anode, and a cathode. Bipolar plated fuel cells convert the chemical energy in hydrogen to electricity, with potentially useful heat and pure water as the only by products. Hydrogen fuel cell are not only pollution-free, but also can have more than two times the efficiency of traditional combustion technologies.

In a Polymer Electrolyte Membrane (PEM) fuel cell, hydrogen gas flows through channels to the anode, where a catalyst causes the separation into protons and electrons of hydrogen molucules.

Only protons passing in to the membranes. While the protons are conducted through the membrane to the other side of the cell, the stream of negatively charged electrons as follow as an external circuit to the cathode. This flow of electrons is outputs power in the form of the heat and electricity that can be used to power of the motors. The more cells that are in stack of stacked, the more energy the block can produce or be prolonged. Hydrogen fuel cells are have a emit zero waste, where only water vapour is produced as the exhaust.

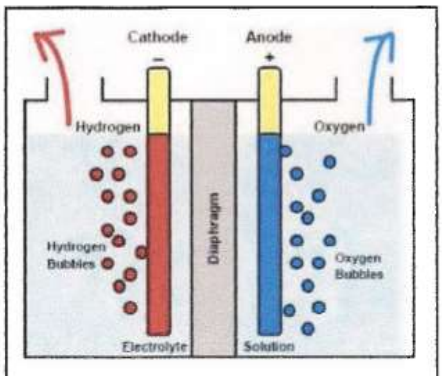

Fig. 1 Electrolysis Process

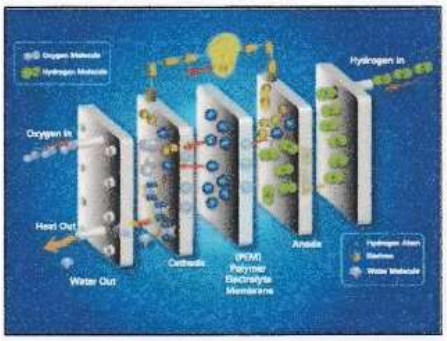

Fig 2. Hydrogen Fuel Cell Working Process

5. Cost of Hydrogen Cars:

As of October 2009, General Motors CEO Fritz Henderson noted that GM had reduced its hydrogen program because the cost of building hydrogen cars was too expensive. "It's still the ways of away from commercialization", he said. Most hydrogen cars are currently only of the available in the demonstration models of are or in a lease construction in limited numbers and are not yet ready for

In 2008, Hyundai Motors are announced its intention to produce 500 vehicles by 2010 and to start mass production of its Fuel Cell vehicles in 2012. In the early 2000, Daimler announced plans to begin its Fuel Cell vehicle production in 2009 with the aim of 100,000 vehicles in 2012-2013.In 2009, Nissan started in testing a new Fuel Cell vehicle in Japan

6. The Cost of Hydrogen Fuelling Stations:

According to the California Fuel Cell Partnership Report, Bringing Fuel Cell Vehicles to Market, "Opinions vary widely on the required minimum number of fuelling locations needed to sustain a mass market fuel cell vehicle introduction, with some major fuel providers urging 25% or more of the existing 9,500 retail gasoline stations are in California and at least one public agency suggesting that far fewer than 500 should suffice.

7. Advantages of hydrogen as a fuel

- Hydrogen can be stored as a compressed gas or liquid, or in a chemical compound.
- One of the ways to transport hydrogen is through pipelines, roads (via cylinders, cryogenic tankers, or tube trailers.
- One of the characteristics of hydrogen is that it burns nearly pollution-free, one can look at it as a final clean fuel.
- By using hydrogen to store energy from different sources would result in an unlimited supply of clear fuel.

8. Disadvantages of hydrogen as a fuel

- Hydrogen is a gas which can be compressed and stored in cylinders. One of the major problems is the fuel tanks. Hydrogen is compressed which will contain less energy compared to liquid fuels like ethanol or gasoline.
- Even though hydrogen is pollution-free, which in the future can make popular in transportation. However, some of the problem are: make popular in transportation. However, some of the problem are: how to store hydrogen in vehicles and high costs (in comparison to gasoline).
- The usage of Hydrogen is not a very good fuel for internal combustion engine, It is not a very good fuel for an internal combustion engine. For example, the companies of BMW, Mazda, and Ford have done several tests; one of the most efficient ways to use it is in fuel cell vehicles, however this is still in the experimental stage which are still in the demonstration stage.

9. Conclusion

Even though hydrogens are very expensive to manufacturing ting and to store, it is pollution-free and creates drinkable water. In the end of result the usage of hydrogen and fuel cell technologies can enhance and improve different aspects of our lives if its through economical, social and especially in environmental aspects. As seen from the ex., given above, the usage of hydrogen for As seen from the example, given above, the usage of hydrogen for transportation use is grown and developing through the usage of technologies, making a clear and happy environment to live.

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