International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

Hydrogen Fuel Cell System Automobiles: A Modern Mode to the Recent Scenario

Kancharana Padma Rao, Padala Tejaswi

[1]*B. Tech student, MVGR College of Engineering, Vizianagaram, India*
[2]*B. Tech student, MVGR College of Engineering, Vizianagaram, India*

Abstract - *Hydrogen fuel cells are the key alternative green energy technology to address issues such as energy sustainability and pollution due to fuel. Owning to a high standard living, increasing energy demand, and the need for uninterruptible energy have become necessary. The research on the growth of fuel cells improved rapidly in the last decade. Where in recent years, fuel cell technologies had their mark in sectors such as military, industrial, space, portable, transportation, residential, and trading, these fuel cell has the combination of range and refueling of conventional cars with the emission contraction potential, it tends to tackle the problems in transportation such as both oil dependency and the environment. Fuel cells are eco-friendly and provide energy without any interruption and three times more efficient than a conventional combustion engine. The main drawback is posed by the establishment of a chain of refueling stations is to be rectified. In this paper, the contemporary applications of fuel cells within the automobile industries are discussed and examine the challenges of profitable storage of hydrogen for a forthcoming of it. This analysis ascertains that the fuel cells are the paramount automotive power source in the future.*

Key Words: **Hydrogen fuel cells, Energy sustainability, Eco-friendly, Emissions, Power source.**

1. INTRODUCTION

Mainly all automobiles are on the road, which produces noise & pollution, and energy is the main criterion for automobiles, it is one of the main factors for the country's economy. Fuel cells are the upcoming major components that will be inaugurated commercially, revolutionizing the way we instantly generate power. The 21st Century will be the century of-Hydrogen Fuel Cell Vehicles (HFCV) (fig-1) because of its applications and significances. Fuel cells can utilize hydrogen as fuel giving the possibility of replenishing the world with sterile and sustainable electrical power. Hydrogen and oxygen were the input products and releases the water and heat as by-products, called an electrochemical process, it explains how the hydrogen is being produced and power is supplied. In this paper, we are going to discuss Hydrogen fuel cell vehicles, which are eco-friendly, sustainable, less release of harmful gases, and does effect on the rate of global warming.

Hydrogen fuel cell vehicles are presently being studied for their feasibility of extensive mode in automobiles and other forms of transportation. Hydrogen fuel does not occur commonly on earth and thus is not an energy source, but is an energy carrier. Currently, it is most continually made from methane or other fossil fuels. However, it can be propagated from a wide range of sources (such as wind, solar, or nuclear) that are intermittent, too diffuse, or too beefy to rapidly propel vehicles.

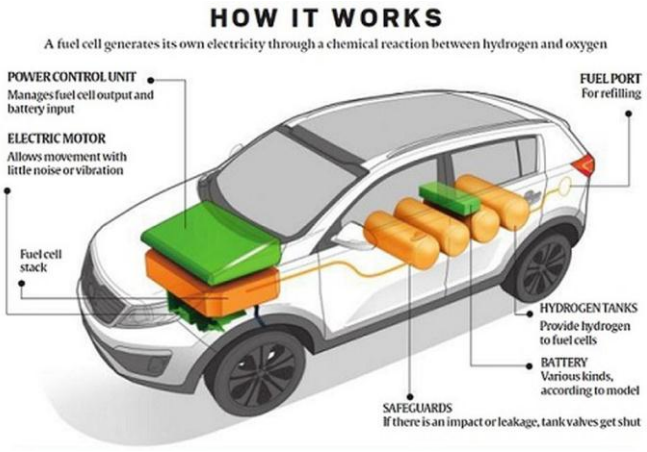

Fig-1: Hydrogen Fuel Cell Vehicle [1]

2. PORTRAYAL:

HFCV's are a combination of major components that are listed below and had significant uses and performance than EV's and I.C engines.

2.1 Fuel cells:

Imagine a device that can produce electricity with the help of hydrogen and oxygen and by-products as heat and water (fig-2). In the same way, with emission-free are called fuel cells. It involves the conversion of chemical energy into electrical energy by the process named as the electrochemical process [2].

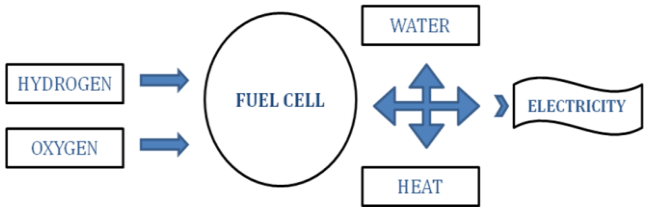

Fig-2: Operation of the system

These fuel cells are many types based on the catalyst used. Some of them are Polymer Electrolyte Membrane (PEM), Phosphoric acid, Solid oxide, Direct methanol, Alkaline, Molten carbonate, among these we preferred to use mainly PEM in HFCV's (fig-3).

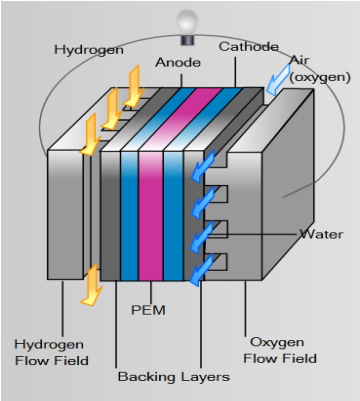

Fig-3: Proton Exchange Membrane

PEM electrode is placed in between the anode and cathode. The fuel flows on the left side, airflow from the right, and the reaction took place between them. The main thing about the selection of PEM is, it has lower inter resistance and allows for better separation during the phase of low electrolyze load. The main advantage of the design future with the lower temperature (50 to 100 C) and the disadvantages are the vulnerability of the catalyst and water management.

2.2 Hydrogen Fuel Tank:

The most reliable, safe, compact, and cost-efficient device in the HFCV is the Hydrogen storage tank (fig-4). Hydrogen has a low energy density, which is sustainably lower than any other fuels. Its energy per volume is much less than liquid fuels like gasoline, before days an HFCV is compactable of having a 300-mile range need about 5kg of hydrogen where it needs a fuel tank with 3-4 times larger [3]; than gasoline lines and the key challenge is how to store the hydrogen.

Fig-4: Hydrogen tank

Many kinds of research and developments are going on by the Fuel Cell Technology (FCTO) to develop and verify the Onboard Automotive Hydrogen systems [4] which have to fulfill the customer needs, expectations for range, passenger and cargo space, refueling time, and overall vehicle performance. In recent times Toyota had come up with a change of 1.7times more hydrogen in 350 bar tanks than the previous one with 700 bar tanks resulting in a cruising range of more than 310 miles [5].

2.3 Electric motor and Power supply:

Electric motors are induced in hydrogen fuel cell vehicles where the power is generated by the chemical reaction of hydrogen and oxygen. The electric motor impels the vehicle with little commotion and vibrations. It can also recoup energy during deceleration. The power control unit governs the fuel cell and the battery output and input following the driving condition.

2.4 Battery:

The electricity produced in the fuel cell of a hydrogen engine can take two routes, relying on the needs of the specific driving condition. It either flows to the electric motor and powers the FCEV directly, or it charges a battery, which stores the energy until it's required for the engine. This battery, known as a Peak Power Battery, is significantly smaller and consequently lighter than the battery of an entirely electric car, as it's being often recharged by the fuel cell.

Like other e-cars, hydrogen vehicles can also recover or rebound braking energy. The electric motor converts the car's kinetic energy back into electrical energy and provides it into the back-up battery [6].

3. ENVIRONMENTAL BENEFITS:

Hydrogen fuel cells are acclaimed as an environmentally-friendly alternative to conventional fossil fuels. By the oxidation of hydrogen, water and heat are the by-products that can be recycled to produce hydrogen and are also the significance of reducing pollution. Fuel cells play a crucial role in emission reductions in the transportation sector. These provide high value for improving air quality and decreasing GHG emissions. Generally, diesel transit vehicles emit significant amounts of GHG. Hydrogen Fuel cell vehicles have a 40% higher fuel economy than diesel vehicles. These also tend to minimize noise pollution in the conventional sense. In the case of leaks/spills, this quickly evaporates and does not pose any environmental threats. Domestic production will also allow for energy independence.

4. COST:

Hydrogen fuel prices are much more for several years. Many kinds of studies and improvements are taking place to curtail the price of it. Price ranges from $12.85 to more than $16 per kilogram (kg), but the most common price is $13.99 per kg (equivalent on a price per energy basis to $5.60 per gallon of gasoline), which interprets to an operating cost of $0.21 per

mile [7]. The below bar chart shows the decrease in fuel rate and the expected rate from year to year (fig-5).

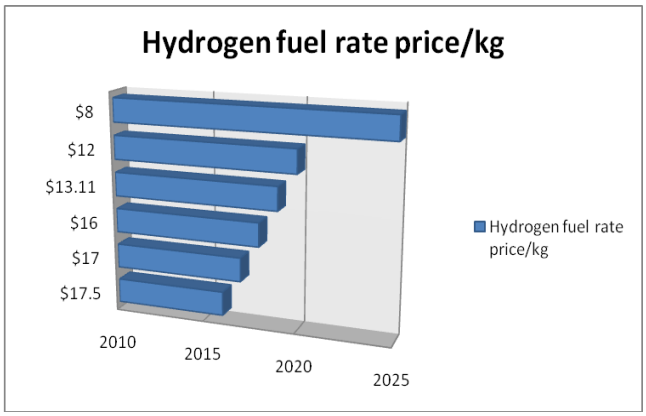

Fig-5: Hydrogen Fuel rate

5. CURRENT SIGNIFICANCE:

Fuel cells elicit much smaller amounts of greenhouse gases and none of the air pollutants that induce health problems. Such cells are also far more energy-efficient than conventional combustion technologies. Various battery-powered electric vehicles, fuel cell vehicles do not require to be plugged in [8]. It is a calm, sterile, and highly productive process- two to three times more profitable than fuel burning.

6. CONCLUSIONS:

In this paper, an investigation into hydrogen fuel cell vehicles and their significant uses was conducted. Various types of fuel cells and PEM applications were analyzed. FC's with adequate control strategies could become the more advantageous choice for applications in vehicles over batteries alone. Hydrogen fuel cells will play a significant role in the transportation industry soon. The price of fuel cells will reduce when producing fuel cells in large quantities and commercializing them.

The cost and also the efficiency of the hydrogen plant depend on the electricity tariff and the sources for producing hydrogen were discussed. If the location is near to its natural resources, it will help in reducing its cost, so for the development of hydrogen plants, location with its sources should be considered. We could expect fuel cell-based transportation, power plants, and electricity generators to become prominent in the coming decades.

REFERENCES

[1] https://indianexpress.com/article/explained/hydrogen-cars-electric-vehicle-supreme-court-how-cars-can-run-on-hydrogen-6168796/

[2] Brian Cook, "An Introduction to Fuel Cells and Hydrogen Technology," Science, West 5th Avenue Vancouver, BC V6R-1S2, pp. 4-5, Dec. 2001, Canada.

[3]https://www.energy.gov/sites/prod/files/2017/03/f34/fcto-h2-storage-fact-sheet.pdf

[4] Etienne Rivard, Michel Trudeau and Karim Zaghib, "Hydrogen Storage for Mobility," Centre of Excellence in Transportation Electrification and Energy Storage, Jun. 2019, pp. 4-5, MDPI.Materials.

[5] https://en.wikipedia.org/wiki/Toyota_FCHV

[6] https://www.bmw.com/en/innovation/how-hydrogen-fuel-cell-cars-work.html

[7] https://cafcp.org/content/cost-refill

[8] https://vajiramias.com/current-affairs/hydrogen-fuel-cell/5df714551d5def34eab543b7/