HYDROGEN FUEL CELL CAR-A NEW ERA FOR AUTOMOBILE SECTOR

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Abstract: **In present day, electric vehicle (EV) is replacing conventional IC engine vehicles. But there are some disadvantages of EV such as mileage problems, charging time is very high, unavailability of charging stations etc. Hydrogen fuel cell vehicle can be alternative option of electric vehicle with more mileage. But at present hydrogen fuel cell vehicle is under development stage. In this paper we have tried to show an overall scenario of hydrogen fuel cell vehicle.**

Keywords*: BEV, Fuel-cell hybrid electric vehicles (FCHEV).*

INTRODUCTION:

There are few number of hydrogen powered vehicles in worldwide, where EVs are out there in millions. While electric cars are getting popular and focusing on to make mostly electric car, hydrogen vehicles will be next future after EVs. Electric vehicles lately is to reduce carbon emissions from vehicles. But there's another kind of zero-emission vehicle, one that emits only water vapor as byproduct. Since 2015 three companies has manufactured hydrogen powered cars for sale, namely Honda Clarity Fuel Cell, Hyundai Nexo SUV and the Toyota Mirai. Toyota company has aim to use hydrogen power as an alternative fuel for vehicles Toyota, the company has sold roughly 10,700 hydrogen powered car as an alternative to battery-electric vehicles.

WHAT IS A HYDROGEN CAR?

A hydrogen vehicles generally use same electric motor to turn the wheels. It's powered by a fuel cell stack in which pure hydrogen passes through a chamber to combine with oxygen from air, producing the electricity that starts the wheel and water vapor. Fuel-cell vehicle is basically a series hybrid, which are sometimes classified as fuel-cell hybrid electric vehicles (FCHEV). At the atomic level, hydrogen is never found in its pure state. It's always combine with other elements. Hydrogen has strong tendency to bond with other molecule makes it a good energy carrier. Creating pure hydrogen for vehicles requires to "crack" a compound like natural gas (CH4) into pure H2, with CO2 as a byproduct. (Mostly hydrogen today is derived from fossil fuels like natural gas.) The hydrogen immediately gives back energy, in the form of electricity, as soon as it combines with oxygen.

BEHIND THE WHEEL?

In practice, the driver of an HFCV almost identical to driving a battery-electric vehicle. There's no transmission, and the car includes regenerative braking to recapture wasted energy as it slows down. The challenges for automobile engineer for hydrogen fuel cell car is steady power output. The power demand in average car vary from 20 horsepower to 20 times that amount of acceleration

of 60mph and higher. Toyota Mirai, hydrogen selling car in U.S is rated at 90KW (120 horsepower), but it's not enough to move into highly speed highway, it add high voltage low capacity battery to meet the requirement. High voltage battery recharged from either excess fuel-cell output when the car is running at a steady speed or via regenerative braking when the car slows.

ARE HYDROGEN CARS SAFE?

Hydrogen Cars are considered as safe as any other car, that high pressure tanks are designed so that during crashes there will no leaking.

No injuries or deaths due to hydrogen components in a crash have been found till date.

PROS AND CONS OF HYDROGEN FUEL-CELL VEHICLES:

HFCVs have some positive features, its smooth, quiet and noise less drive. Hydrogen Car emit no carbon dioxide or any other harmful gases. It just emit water vapor, which have no environmental issue. But it have charging time location problem that EVs have, it takes few minutes to refuel them for several mile stint. The most challenging is the availability of hydrogen fuel station. Not all those stations are online and availability of fueling at all times. The union roads and highways authority recently launched a unique pilot for hydrogen-based advanced fuel cell electric vehicles (FCEVs), marking a major shift from fossil fuels to environmental protection. This is an important initiative to promote clean energy and environmental protection by reducing dependence on fossil fuels and making India 'energy self-sufficient 2047.'

UPCOMING HYDROGEN CARS IN INDIA:

Almost every major automaker is preparing to launch a range of BEVs (Battery Electric Vehicle) in the near to medium term, but hydrogen FCEVs (In addition, few automakers are betting on the electric car model). With dozens of new BEV launches on the horizon over the next five years, several significant hydrogen FCEV launches and trials are slated.

POTENTIAL OF HYDROGEN CAR:

Hydrogen car is driven by only electricity just like electric vehicle. Its motor provides high torque even at low speed. Refueling time is very short whereas for electric vehicle battery charging time is minimum 3 to 4 hours. Mileage of hydrogen vehicle is comparatively large than electric vehicle. Example, once hydrogen refueling to BMWiX5 Hydrogen will cover more than 500km (tested in Germany). Hydrogen store transportation is very easy so that it can play pivotal role in future energy supply. Same motor drive is used in FCEVs and EVs. So that if FCEV promotes in the market then both fuel cell and battery technology will benefit.

COSTING OF HYDROGEN CAR:

Industrial hydrogen production is not fully developed yet. Platinum plays role of catalyst in the electricity production in the fuel cell. Platinum is very expensive. Platinum for automobile used

has already been reduced. For the above reason hydrogen car cost is very high. At present scenario 1 kg hydrogen costs is Euro 14, if hydrogen production increases the cost reduce to 4 to 6 Euro by 2030.

HOW MUCH ENVIRONMENTALLY FRIENDLY & SUSTAINABLE ARE HYDROGEN CAR:

Regenerative energies has no harmful emissions. As per rule alternative drives must be architeched to reducwe of pollutants particular CO2,NO2 which are very harmful for envionment as well as for living beings. The exahust air of a hydrogen car is mainly mixture of water vapour so hydrogen car is emission free. Hydrogen production is one of the main part of this project. In this process electrolysis is required. Electrolysis means requirement of electrical energy. Electrical energy beraks down water into oxygen and hydrogen particles. If that electricity for electrolysis comes from renewable energy, then hydrogen production is a neutral carbon footprint if not then there is always adverse effect on nature. Hydrogen is the by product of many industrial processes and it treats as a waste. Hydrogen car gives an offer to upcycle hydrogen. Hydrogen production from fossil fuels provides an opportunity to store resulting CO2. This hydrogen is trermed as ‘Blue Hydrogen’.

RISK ASSOCIATED WITH HYDROGEN CAR:

We know that hydrogen is inflammable. To prevent hydrogen & oxygen reaction during hydrogen car operation the hydrogen stores in gaseous form in a thick walled tank within the car which is safe. Several crash tested have been performed and it is seen that tanks were undamaged and no hydrogen leaked out.

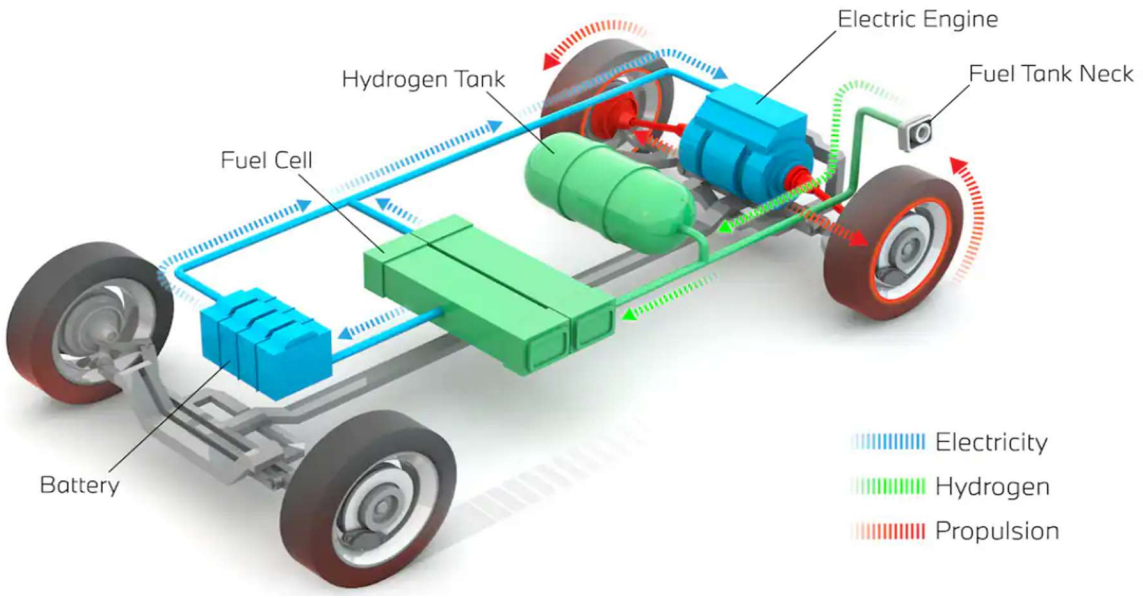

Fig 1: Hydrogen fuel cell car

CONCLUSION:

Hydrogen fuel cell car is a promising alternative to current automobile fuels. It combines the energy density and convenience of liquid fuels with the clean and efficient operation of electric vehicles.

REFERENCES:

1. BMW, Germany
2. Park, C.; Lim, S.; Shin, J.; Lee, C.Y. How much hydrogen should be supplied in the transportation market? Focusing on hydrogen fuel cell vehicle demand in South Korea: Hydrogen demand and fuel cell vehicles in South Korea. *Technol. Forecast. Soc. Chang.* **2022**, *181*, 121750.