RECENT TRENDS IN AUTOMOBILE ENGINEERING

Use Of Hydrogen as Alternative Fuel To Power Vehicles

ABSTRACT:

Depleting fossil fuel reserves and increasing vehicular emission have forced the attention of various petroleum industries to find and alternate fuel that will power the vehicle in future based on the present day internal design as the deposits of crude oil is expected to last for another 50 years at the minimum utilization level .the proposed fuel should suitably replace the existing fuel and at the same time it should be renewable Hydrogen is one such fuel that has been proposed for the purpose which was suitable for spark ignition engines .hydrogen combines the properties of higher calorific value ,higher velocity of flame propagation ,non toxicity as well as lowest possible emission levels that do not affect the balance of the water of the hydrosphere.

More over the by product of combustion are devoid of carbon dioxide, carbon monoxide which is the major advantage of vehicles powered by fuel cell vehicles.

Fuel cell vehicles represent one of the emerging technologies of the innovation age. An efficient, combustion less, virtually pollution free, free power source capable of being sited down town urban areas or in remote regions, that runs almost silently, and has few moving parts but these vehicles are

more reality than dreams. Fuel cells are one of the cleanest and most efficient technologies for generating electricity. In the quest of environment friendly energy generation researchers have come up with comparatively much safer fuels. It is truly a green technology. Fuel cell is the practical, feasible and marketable solution to the energy crisis. The technology is extremely intersecting to people in all walks of life because it offers a mean of making power more efficiently and without pollution.

World automakers seem to believe that low emissions, high efficiency fuel cell will eventually deliver the power and the performance that users expect. Despite difficult technical and market challenges to over come, the latest crop of fuel cell powered concept car appears to exhibit many basic feature required for the success of this concept.

Fuel cell or ZEV'S as they are called are vehicles to look up for as future vehicles. The topic on fuel cell vehicles deals with all the issues and signs related to fuel cell vehicles and their future that is sometimes questioned. However the answers to these questions have been successfully dealt with in the following sub-topics:

INTRODUCTION:-

Another type of Zero-Emission Vehicle is the fuel cell powered vehicle. When the fuel cells are fueled with pure hydrogen, they are considered to be zero emission vehicles. Fuel cells have been used on spacecraft for many years to power electric equipment. These are fueled with liquid hydrogen from the spacecraft's rocket fuel tanks.

What Is a Fuel Cell?

A fuel cell produces electricity directly from the reaction between hydrogen (derived from a hydrogen-containing fuel or produced from the electrolysis of water) and oxygen from the air. Like an internal combustion engine in a conventional car, it turns fuel into power by causing it to release energy. In an internal combustion engine, the fuel burns in tiny explosions that push the pistons up and down. When the fuel burns, it is being oxidized. In a fuel cell, the fuel is also oxidized, but the resulting energy takes the form of electricity **.**

The Proton Exchange Membrane (PEM) fuel cell is the focus of vehicle-power research. The following are the major different types fuel cells:

- *Proton Exchange Membrane (PEM -- sometimes also called "polymer electrolyte membrane")* - Considered the leading fuel cell type for passenger car application; operates at relatively low temperatures and has a high power density.

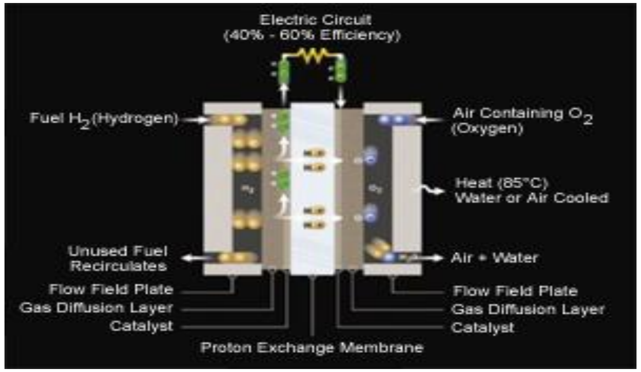


FIG:1

- *Phosphoric Acid* - The most commercially developed fuel cell; generates electricity at more than 40 percent efficiency.
- *Molten Carbonate* - Promises high fuel-to-electricity efficiencies and the ability to utilize coal-based fuels.
- *Solid Oxide* - Can reach 60 percent power-generating efficiencies and be employed for large, high powered applications such as industrial generating stations.

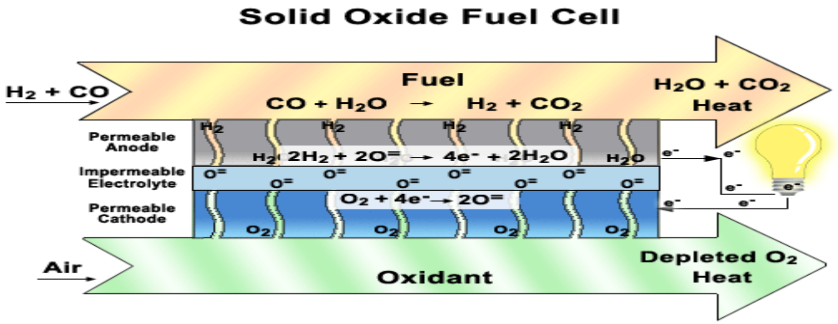


FIG:2

-*Alkaline* - Used extensively by the space program; can achieve 70 percent power-generating efficiencies, but is considered too costly for transportation applications.

- *Direct Methanol* - Expected efficiencies of 40 percent with low operating temperatures; able to use hydrogen from methanol without a reformer. (A reformer is a device that produces hydrogen from another fuel like natural gas, methanol, or gasoline for use in a fuel cell.)

PRINCIPLE:

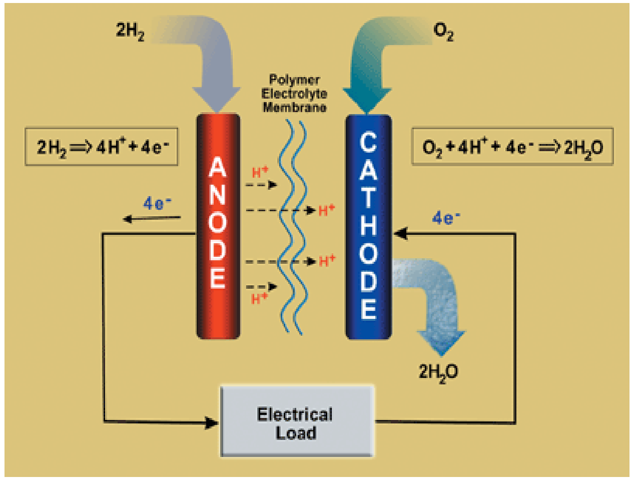


FIG:3

Hydrogen & fuel cell vehicles: Hydrogen is the most abundant element in the universe, but it currently is not be a practical transportation fuel by itself because of storage problems. Hydrogen is normally a gas at room temperature, and storage as a gas requires large containers. Storing it as a liquid requires super-cold temperatures. And because hydrogen is the simplest element, it can even "leak" through the strongest container walls.

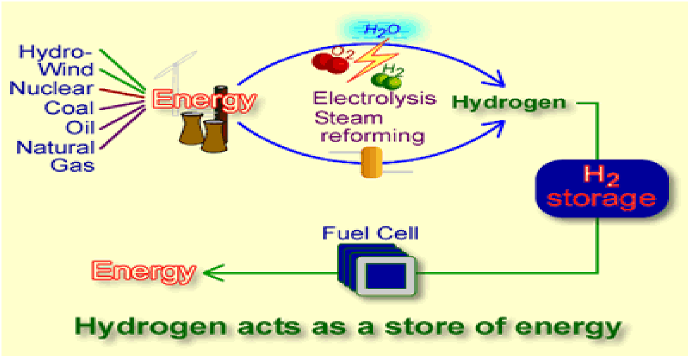
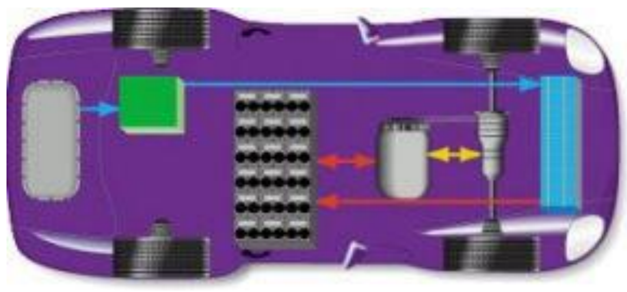


FIG:4

One of the most widely suggested sources of electricity for a hybrid electric vehicle is a fuel cell powered by hydrogen. By chemically combining hydrogen and oxygen, rather than "burning a fuel," electricity is created. Water vapor is the by-product.

The fuel cell power system involves three basic steps. First, methanol, natural gas, gasoline or another fuel containing hydrogen is broken down into its component parts to produce hydrogen. This hydrogen is then electrochemically used by the fuel cell.

Fuel cells operate somewhat like a battery. Hydrogen and air are fed to the anode and cathode, respectively, of each cell. These cells are stacked to make up the fuel cell stack. As the hydrogen diffuses through the anode, electrons are stripped off, creating direct current electricity. This electricity can be used directly in a DC electric motor, or it can be converted to alternating current.



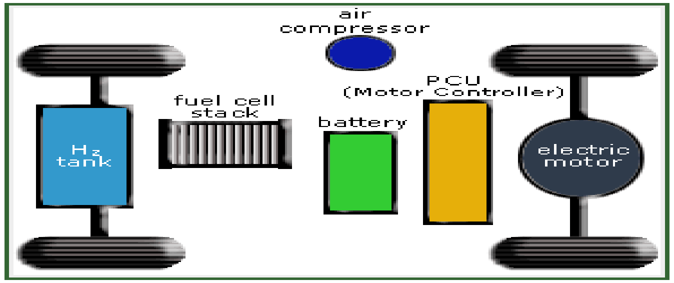


FIG:5

To carry gaseous hydrogen on a vehicle, it must be compressed.

When compressed (usually to a pressure of about 3000 pounds per square inch). Hydrogen is stored under great pressure, 3600 and 5000 PSI in the big tanks, 7000 PSI in the smaller distribution tanks.

The other way to provide hydrogen gas to the fuel cell is to store it on the vehicle in liquid form. To make hydrogen liquid, it is chilled and compressed. Liquid hydrogen is very, very cold--more than 423.2 degrees

Fairenheit below zero! This super-cold liquid hydrogen is the kind used in space rockets. The containers are able to hold pressure, but they are also insulated to keep the liquid hydrogen from warming up. Warming the liquid, or lowering the pressure, releases gas (like boiling water), and the gas can go to the fuel cell.

NICKEL HYDROGEN:-

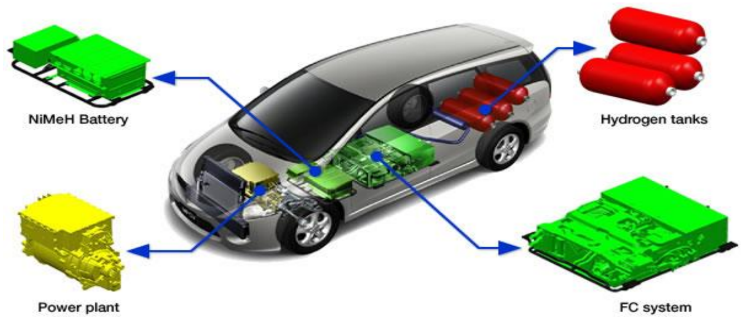


FIG:6

Another way to get hydrogen to the fuel cell is to use a "reformer". A reformer is a device that removes the hydrogen from hydrocarbon fuels, like methanol or gasoline. . A reformer turns hydrocarbon or alcohol fuels into hydrogen, which is then fed to the fuel cell. Unfortunately, reformers are not perfect. They generate heat and produce other gases besides hydrogen. They use various devices to try to clean up the hydrogen, but even so, the hydrogen that comes out of them is not pure, and this lowers the efficiency of the fuel cell

When a fuel other than hydrogen is used, the fuel cell is no longer zero-emission, but it

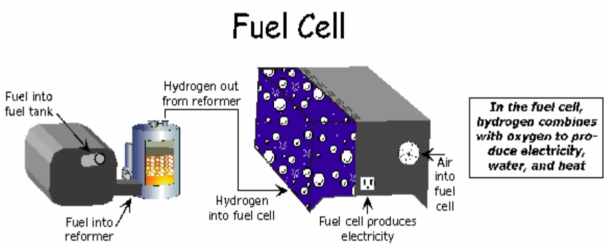


FIG:7

Use of battery unit:-

Small test batteries made under the technology department are stored in one unit to form a single module model of ten batteries.This unit is then used to power the vehicle through the power train and motor as well as the controller which are installed accordingly and this method proves useful in special cases where the fuel cell stack is not work properly due to technical difficulties.

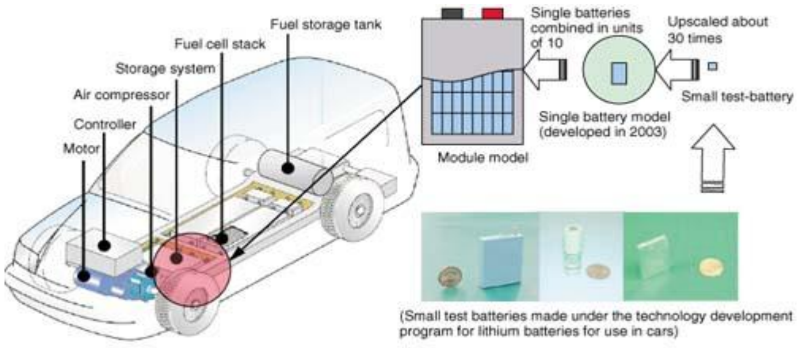


FIG:8

The only real problem is the pressure that's involved, and that's not a problem with proper tanking systems and in all these test cases the hydrogen tank did not explode, in spite of being under pressure. the tanks are designed to blow up, not out.

If, for example, that tank back there exploded 90% of the debris would fall within the fence around it.

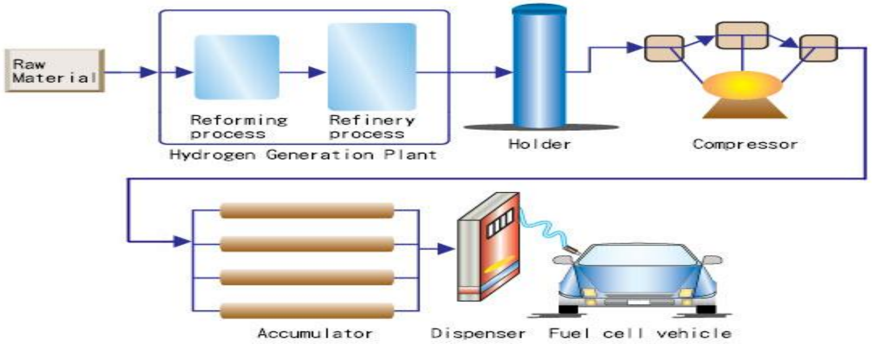


FIG:9

Hydrogen is a very clean fuel, it would ignite easier than gasoline, but the likelihood of it igniting is still slim . If it did ignite, the flame doesn't put out much heat. Gasoline fires usually consume.

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FIG:9

<u>Fuel cell design issues</u>:

At the same time many other variables must be juggled, including temperature throughout the cell (which changes and can sometimes destroy a cell through thermal loading), reactant and product levels at various cells. Materials must be chosen to do various tasks which none fill completely. In vehicle usage, many problems are amplified. For instance, cars must be required to start in any weather conditions a person can reasonably expect to encounter: about 80% of the world's car park is legally subject to the requirement of being able to start from sub-zero temperatures. Fuel cells have no difficulty operating in the hottest locations, but the coldest do present a problem..

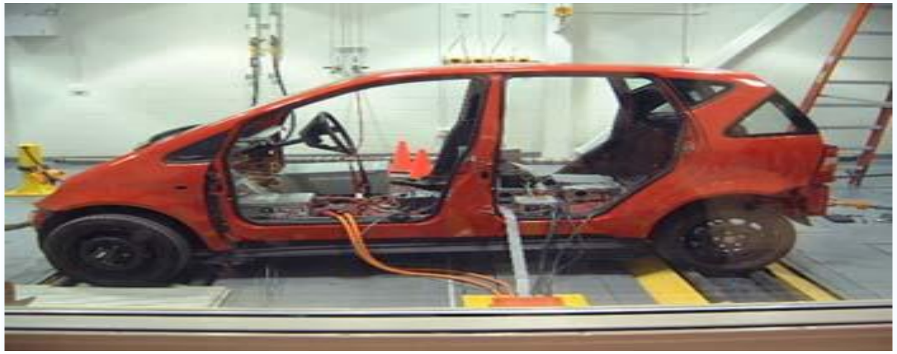


FIG:10

Operational Performance :

Fuel cell vehicles are being developed to meet the performance expectations of today's consumers. These vehicles are expected to be extremely quiet and have very little vibration.

Safety:

The goal is to develop fuel cell vehicles with levels of safety and comfort that are comparable to those of conventional vehicles. If used, high-pressure hydrogen tanks will be designed for maximum safety to avoid rupture. Additionally, manufacturers are perfecting sensors that will immediately detect impact in the case of collision and additional sensors that will detect any leakage from the hydrogen tanks. In both cases, the sensors will instantly shut the valves on the tanks.

Benefits:

Using pure hydrogen to power fuel cell vehicles offers the distinct advantage of zero emissions, but only on the vehicle, not at the hydrogen production source. However, emissions created at a single point of production are often easier to control than those produced by a moving vehicle. A fuel cell vehicle that runs on pure hydrogen produces only water vapor—using any other fuel will produce some carbon dioxide and other emissions, but far less than what is produced by a conventional vehicle.

Fuel cell vehicles are expected to achieve overall energy conversion throughput efficiencies around twice that of today's typical gasoline internal combustion engines. The fuel cell system is being targeted by DOE to achieve 60% efficiency by 2010. Fuel cell vehicles can run on any hydrogen-rich liquid or gas, as long as it is suitably processed. Gasoline is one possibility, but in addition to pure hydrogen, alternative fuels such as ethanol, methanol, natural gas, and propane can also be used.

Why fuel cells for vehicles?

The advantages of fuel cells for transport are both environmental and economic. The only emissions from a fuel cell vehicle come from the generation of hydrogen. These emissions are hardly measurable, making fuel cell vehicles virtually equivalent to zero-emission vehicles. Fuel cell cars will have similar range and performance to cars with internal combustion engines, but the superior energy efficiency of fuel cell engines will bring a significant reduction in carbon dioxide, a greenhouse gas, for every mile travelled. If fuelled directly by hydrogen, there will be no carbon dioxide emissions at all.

Portable fuel cells:

Fuel cells can compete with batteries and generators for portable use, from a few kilowatts to power a mobile home down to a few watts to power a laptop computer. Prototypes have been publicly shown of this type of technology and fuel cell powered mobile phones and laptops are being exhibited at the World Expo 2005 in Japan.

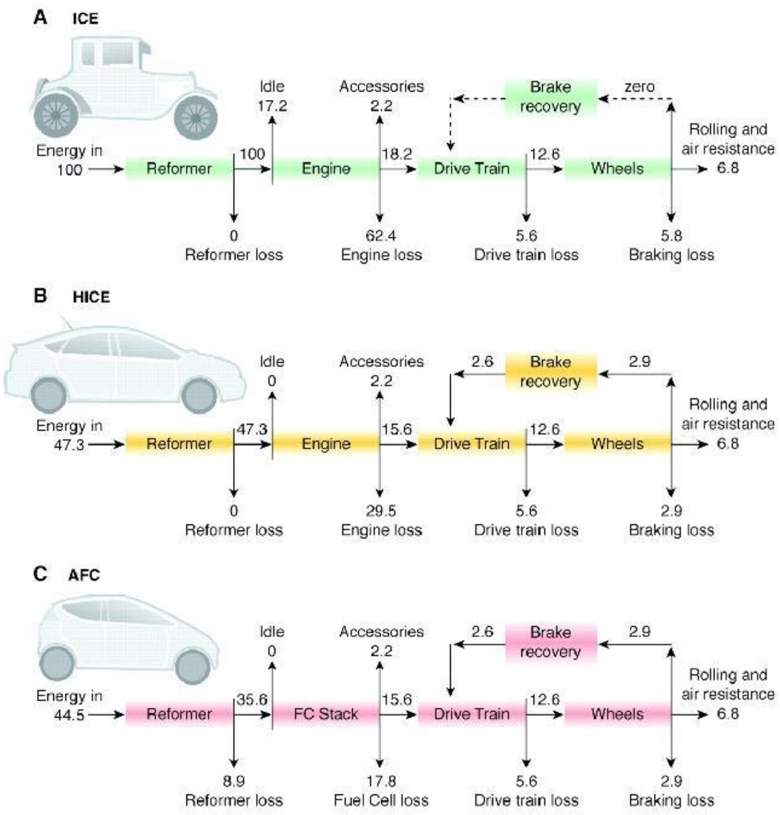
NEW BICYCLE POWERED BY FUEL CELL:

Manhattan Scientifics Inc. has developed a fuel-cell-powered mountain bike that uses hydrogen and air as fuel and emits only water vapor as a waste product. According to its developers, the "Hydrocycle" has a top range of 40 to 60 miles (70-100 km) along a flat surface and can achieve a top speed of 18 mph (30 km/h). Because a fuel cell stack powers its electric motor, the Hydro cycle is extremely quiet and does not need to be recharged like existing electric bicycles; it only needs to be refueled. This would come as a welcome advancement for electric-bike riders frustrated with waiting hours to recharge their battery-powered bicycles

Efficiency of Fuel Cells:

Pollution reduction is one of the primary goals of the fuel cell. By comparing a fuel-cell-powered car to a gasoline-engine-powered car and a battery-powered car, you can see how fuel cells might improve the efficiency of cars today.

Since all three types of cars have many of the same components (tires, transmissions, etc.), we'll ignore that part of the car and compare efficiencies up to the point where mechanical power is generated. Let's start with the fuel-cell car. (All of these efficiencies are approximations, but they should be close enough to make a rough comparison.)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Accessories
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Brake recovery
zero
Rolling and air resistance
6.8
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15.6
Drive Train
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Wheels
8.9
Reformer loss
17.8
Fuel Cell loss
5.6
Drive train loss
2.9
Braking loss

FIG:11

Fuel-Cell-Powered Electric Car:

If the fuel cell is powered with pure hydrogen, it has the potential to be up to 80-percent efficient. That is, it converts 80 percent of the energy content of the hydrogen into electrical energy. But, as we learned in the previous section, hydrogen is difficult to store in a car. When we add a reformer to convert methanol to hydrogen, the overall efficiency drops to about 30 to 40 percent.

We still need to convert the electrical energy into mechanical work. This is accomplished by the electric motor and inverter. A reasonable number for the efficiency of the motor/inverter is about 80 percent. So we have 30- to 40-percent efficiency at converting methanol to electricity, and 80-percent efficiency converting electricity to mechanical power. That gives an overall efficiency of about 24 to 32 percent

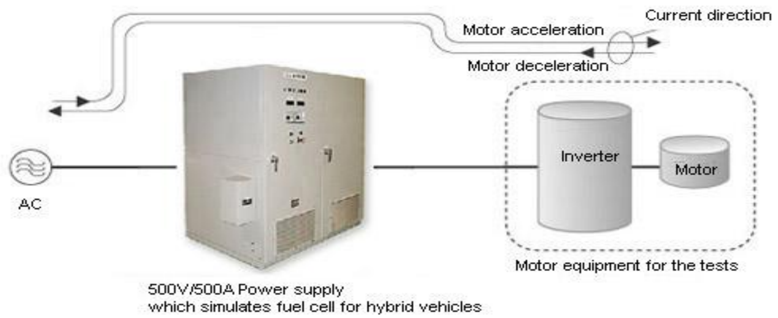

FIG:12

TINY FUEL CELL TO POWER SENSORS IN VEHICLES:

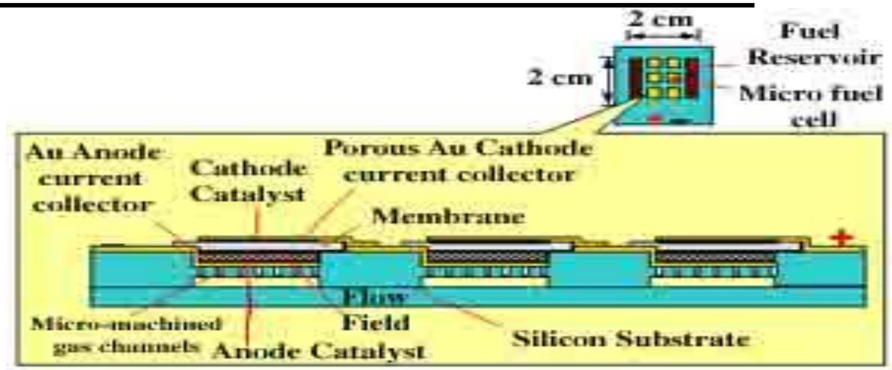

FIG:13

A cell phone, for example, needs about 500 watts. The first use will be in sensors for the military.
The prototype micro fuel cell uses an electrochemical process to directly convert energy from hydrogen into electricity. The fuel cell works like a battery, using an anode and cathode, positive and negative electrodes (solid electrical conductors), with an electrolyte. The electrolyte can be made of various materials or solutions. The hydrogen flows into the anode and the molecules are split into protons and electrons. The protons flow through the electrolyte, while the electrons take a different path, creating an electrical current. At the other end of the fuel cell, oxygen is pulled in from the air and flows into the cathode. The hydrogen protons and electrons reunite in the cathode and chemically bond with the oxygen atoms to form water molecules. Theoretically, the only waste product produced by a fuel cell is water. Fuel cells that extract hydrogen from natural gas or another hydrocarbon will emit some carbon dioxide as a byproduct, but in much smaller amounts than those produced by traditional energy source.

Gasoline and Battery Power

Gasoline-Powered Car :

The efficiency of a gasoline-powered car is surprisingly low. All of the heat that comes out as exhaust or goes into the radiator is wasted energy. The engine also uses a lot of energy turning the various pumps, fans and generators that keep it going. So the overall efficiency of an automotive gas engine is about 20 percent. That is, only about 20 percent of the thermal-energy content of the gasoline is converted into mechanical work.

Battery-Powered Electric Car :

This type of car has a fairly high efficiency. The battery is about 90-percent efficient (most batteries generate some heat, or require heating), and the electric motor/inverter is about 80-percent efficient. This gives an overall efficiency of about 72 percent.
But that is not the whole story. The electricity used to power the car had to be generated somewhere. If it was generated at a power plant that used a combustion process (rather than nuclear, hydroelectric, solar or wind), then only about 40 percent of the fuel required by the power plant was converted into electricity. The process of charging the car requires the conversion of alternating current (AC) power to direct current (DC) power. This process has an efficiency of about 90 percent.

So, if we look at the whole cycle, the efficiency of an electric car is 72 percent for the car, 40 percent for the power plant and 90 percent for charging the car. That gives an overall efficiency of 26 percent. The overall efficiency varies considerably depending on what sort of power plant is used. If the electricity for the car is generated by a hydroelectric plant for instance, then it is basically free (we didn't burn any fuel to generate it), and the efficiency of the electric car is about 65 percent.

Surprised?

Maybe you are surprised by how close these three technologies are. This exercise points out the importance of considering the whole system, not just the car. We could even go a step further and ask what the efficiency of producing gasoline, methanol or coal is.

Efficiency is not the only consideration, however. People will not drive a car just because it is the most efficient if it makes them change their behavior. They are concerned about many other issues as well. They want to know:
Is the car quick and easy to refuel?
Can it travel a good distance before refueling?
Is it as fast as the other cars on the road?
How much pollution does it produce?

Fuel cell cars are a long way off:

Hybrid cars already exist as commercial products and are available to cut pollution now. On the other hand, fuel-cell cars are expected on the same schedule as NASA's manned trip to Mars—and have about the same level of likelihood.

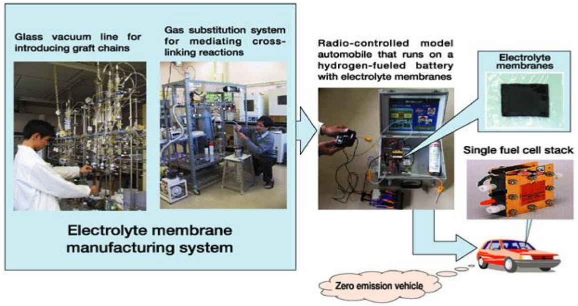

FIG:13

Hydrogen fuel cells cost more: Hydrogen fuel cells in vehicles are about twice as efficient as internal-combustion engines; however, hydrogen fuel cell costs are nearly 100 times as much per unit of power produced.

Hydrogen fuel cells are dirtier:- Fuel-cell cars emit only water vapor and heat, but the creation of the hydrogen fuel (via burning coal, for example) can be responsible for more overall greenhouse gas emissions than conventional internal combustion engines.

Hydrogen fuel is harder to transport:

Moving large volumes of hydrogen gas requires compressing it. Hydrogen compression rates mean that 15 trucks are required to power the same number of cars that could be served by a single gasoline tanker. Liquid hydrogen would require less (about three trucks), but would require substantially more effort and energy to liquefy.

Hydrogen is much more dangerous:-As dangerous as a leak of natural gas is, a hydrogen leak is worse because hydrogen ignites at a wider range of concentrations and requires less energy to ignite. And hydrogen burns invisibly. "It's scary—you cannot see the flame.”

CONCLUSION: -

We have succesfully studied the various technicialities and the experimental procedures carried out by the various automobile companies and their respective research and development departments in depth which do provide a ray of hope .the practical implementation being’s dependancy on oil reserves and their rising costs and their by stabilise the economy for the common man and hence make the environment polution free which is the ultimate goal

“Save environment save world”

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