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Future of Hydrogen Technology and Its Use In Future

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Abstract - Now a day in Transportation we use Petrol, Diesel engines vehicles, and Electric vehicle. Therefore, more amount air pollution occurs so to prevent this pollution we choose 100% sustainable and pollution-free Transportation technology.

Hydrogen Technology is one of the best technics to prevent this factor.

We have seen today's living conditions, day to day life climate is changing. This climate change is unavoidable so research institutes are working on another energy source that runs vehicles without pollution. The Current scenario focus on EV (Electric Vehicle) Technology or CNG Technology etc. But these technologies and their energy source are limited and it is not environmentally free.

To maintain the earth's environmental condition we need transportation 100% pollution-free, as well as easily available energy, Hydrogen Fuel cell and Hydrogen engine both, are environment. Free as well as hydrogen gas is easily available in the surroundings. Currently, Hydrogen is used for launching space shuttles, processing food industry, fertilizers industry, refining the petroleum, treating metals, hydrogen fuel cell, and hydrogen engine.

***Key Words*: Hydrogen Technology1, Hydrogen fuel cell2, Hydrogen engine3, Future of hydrogen4, Hydrogen5**

1. INTRODUCTION

Transportation is part of life, transportation allows goods and services, as well as transportation, to make life easier. Until now for transportation, we using cars buses ships airplanes, etc. and these emit more amount of toxic gases Air pollutants such as carbon monoxide, nitrogen oxides, particulate matter, and volatile organic compounds, are emitted into the environment by vehicles. so that's why nearly half of the world's cursory permanent death nearly 181,000 pretty mature death whole world. Avoiding and reducing emissions of the world with the help of hydrogen technology:

A) Hydrogen Fuel

B) Hydrogen Engine

Hydrogen is Discovered by Henry Cavendish in 1766 it is placed in the first number in the periodic table. Hydrogen is the most copious element in the whole world it must have to live. Hydrogen is the most explosive gas and is lightweight. When hydrogen reacts with oxygen it produces energy that energy we use for the generation of electricity or heat. With the help of hydrogen fuel cells or hydrogen engines, we control the emission of Transportation,

Currently, most companies work on hydrogen technology like Toyota, GE aviation, Yamaha, Reliance industry, etc.

2. Hydrogen Chemical separation and collaboration.

The calorific value of hydrogen is high as compared to petrol, diesel, CNG, etc. calorific value of hydrogen is 120 to 140 MJ/kg and is easily available in the surroundings.

Table -1: calorific value for a different fuel.

Fuel	calorific value
petrol	44-46 MJ/kg
diesel	42-46 MJ/kg
LPG	46-51 MJ/kg
Hydrogen	120-142 MJ/kg

It is the most explosive gas and lightweight. When hydrogen reacts with oxygen it produces energy that energy we use for the generation of electricity or heat.

Two atoms are together and form one bond at that time energy will be produced it may be heat energy or electrical energy

2.1 Heat Generation:-

Combustion in the engine due to hydrogen is nothing but heat generation with hydrogen gas. Hydrogen engines work similarly to petrol engines. Air and hydrogen mixture come to the combustion chamber there is a spark generator due to that hydrogen and oxygen react with each other and it generates an explosion

Hydrogen-based Technology is also used in rocket engines. Hydrogen and oxygen reaction generate thrust for rocket engines

H2 + O + spark = H2O + heat

2.2 Electricity Generation:-

Everyone knows Lithium-ion batteries we use for electric vehicles But litmus are some limitations it discharges after some kilometers then we need to charge them again and it takes too much time to charge then we start over next journey. But hydrogen fuel cells refuel within seconds it does not require too much time for refilling

$$H2 \rightleftharpoons 2H^{\oplus} + 2e^{-}$$

The hydrogen goes through Anode sheets hydrogen gas atom is split into a proton and electron. Electrolyte sheet structure is such a way that it only allows to pass proton anode to cathode or cathode to anode. When the load is applied then electrons pass through the load electrons produce potential differences in the load and electricity is generated.

H2 + O = H2O+Heat +Electricity

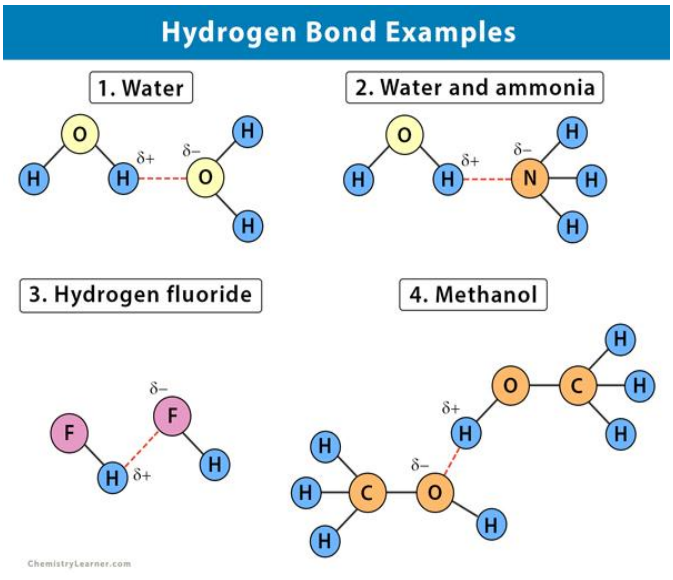

Fig -1: Hydrogen Examples

3 Hydrogen fuel cell.

3.1. Why do we need to use a Hydrogen fuel cell?

Nowadays everyone think about electric vehicle and lithium-ion cells are used for EV. everyone think that lithium iron cells save the nature everyone think due to lithium-ion cells or batteries there is no pollution happens but it's not the truth Lithium iron cell required electricity to charge and that electricity comes from a thermal power plant and that thermal power plants produce harmful gases for nature and human being We also say that electricity can be generated from renewable energy but that renewable energy also has some limitation So that we introduced you to future of the energy is hydrogen fuel cell this hydrogen fill cell is completely environment friendly with cost-effective and high efficiency.

3.2. Chemical reaction behind Hydrogen fuel cell technology?

Hydrogen fuel cell construction is shown in the figure in that we see one electrolyte separation membrane and two electrodes one is an anode and cathode. Hydrogen gas is supplied over the anode electrode.

Hydrogen atoms split into electrons and protons. Proton is passing through the electrolyte separation membrane

Electron is restricted with the help of electrolyte separation membrane so that electrons are passing through the load as shown in figure

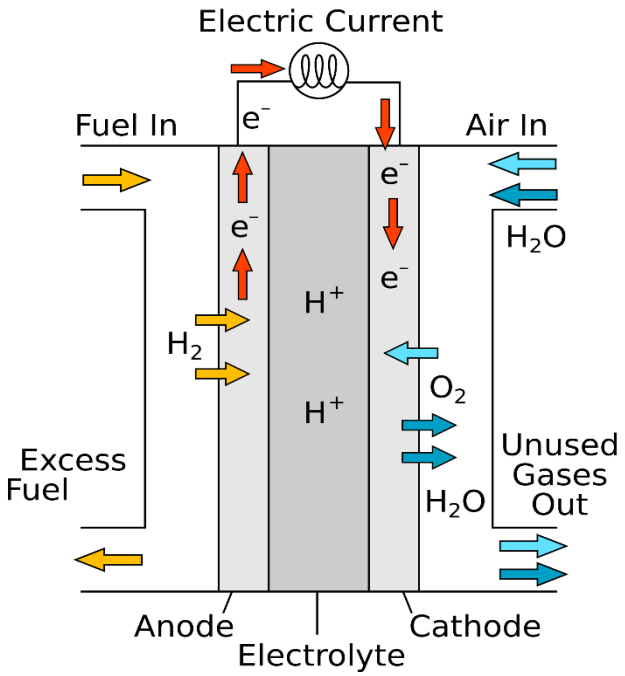

Fig -2: Hydrogen Fuel Cell.

Oxygen is passed over the cathode electrode. Electrons and protons come from the anode that reacts with oxygen and It forms into steam. This steam is removed from the exhaust

Reaction:- When hydrogen reacts with oxygen it produces electricity, heat, and water.

$$H2+O \longrightarrow H2O + Heat + electricity$$

3.3 How does it work?

A. A hydrogen fuel cell works like a battery and its construction is also a little bit similar to batteries

B. Hydrogen fuel cells contain three sheets first is the anode, the second sheet is the separator or electrolyte sheet and the third sheet is the cathode

C. Hydrogen comes from a hydrogen tank then it passes through an anode its split into a proton (+) and electron (-)

D. On another side oxygen is passed over the cathode this oxygen atoms attract the hydrogen proton and electron. proton pass through electrolyte sheet but electron unable to go through it

E. When we apply load electron tries to flow through the electrolyte but it is not allowed to electron then it goes through the load and electricity is produced,

F. After that hydrogen and oxygen bond is created this hydrogen and oxygen bond increases the heat due to collision and gets the output in the form of steam or water.

4 Hydrogen Engine.

Transportation increases day by day due to this pollution and global warming also increases everyday petrol diesel are generating lots of gases every year 4.6 metric tons carbon dioxide produce by engine it cause ozone layer depletion due to ozone layer depletion every year temperature increase around 1 to 2 degree on earth this toxic gases also affect the health of human bodies for example asthma, breathing problem, etc. due to that all problems we need to transfer to hydrogen energy. A hydrogen engine doesn't produce toxic gases because its output is steam or you can say hot water

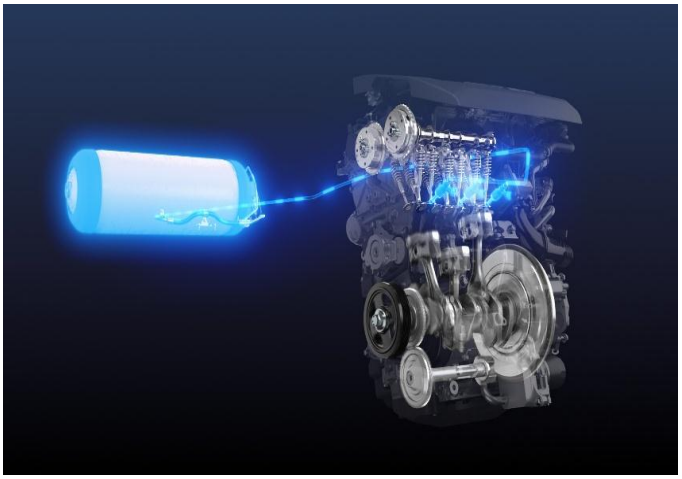

Fig -1: Hydrogen engine.

4.1 Working of hydrogen engine?

A. Hydrogen engine work similar to the petrol engine we know the four-stroke in petrol engine similarly hydrogen engine works in first stroke suction second stock compression third stroke expansion fourth stroke exhaust.

B. With pistons moving downwards and the opening of the inlet valve creates the suction of clean air and hydrogen mixture into the cylinders.

C. With the closing of the Inlet valve the area above the piston gets closed. The piston moves up resulting in compression of the air and hydrogen. After compression, the spark plug initiates a spark, and power produce

D. In power stroke both inlet and exhaust wall is closed and Pistons move download due to explosion of H2 gas.

E. In a hydrogen engine power production process doesn't create toxic gases because hydrogen reacts with oxygen and it forms into steam

$$H_2 + \text{Air} + \text{spark} \longrightarrow H_2O + \text{explosion} + \text{Other gas}$$

F. The exhaust stroke occurs gases (steam) are expelled from the combustion chamber and released to the atmosphere. The exhaust stroke is the final stroke and occurs when the exhaust valve is open and the intake valve is closed. Piston movement evacuates exhaust steam into the atmosphere.

Table -2: Compression ratio of fuel.

Fuel	Compression ratio.
Hydrogen	17:1 to 18:1
Diesel	14:1 to 22:1
Petrol	8:1 to 12:1

In the About chart we see different compression ratios for different fuels in that petrol has a minimum compression ratio and hydrogen has a maximum compression ratio. A high compression ratio takes more amount of air hence the efficiency of a hydrogen engine is more as compared to petrol or diesel

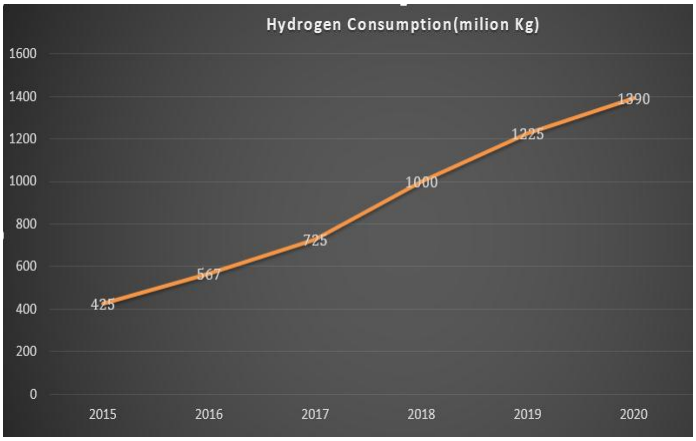

Chart -1: Hydrogen Consumption per year

About data shows day by day or we can see year by year hydrogen requirement is increased hydrogen consumption increases per year around 100 to 200 million kg.

Current hydrogen price is around 320 to 330 per kg because hydrogen plants are not available yet. When hydrogen plant quantity increases then hydrogen may be cheaper as compared to now some research says this cost goes to 50% of the current cost

5. CONCLUSIONS

A) HYDROGEN TECHNOLOGY GLOBAL GROUTH =

The India revolutionize its energy system to meet its commitment to reduce harmful gases to the nature, Hydrogen Technology or Hydrogen fuel cell is the one of the best choice to reduce the pollution. Hydrogen Fuel has low carbon emission and it has no alternative technic to reduce carbon emission,

B) HYDROGEN INFRASTUCTURE SETUP:

Indian Government is adopting a hydrogen fuel cell technology, Government is support for setup new hydrogen plant, Because, Hydrogen gas is easily available and emission-free.

C) HYDROGEN SAFETY AND STANDARDS;

Hydrogen is the most flammable gas in the atmosphere so safety is the most concern thing for handling the hydrogen. For that reason, we need experience engineers to operate hydrogen plants.

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