

## A Review Paper on Alternative Fuel (HYDROGEN) Vehicle

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### ABSTRACT

Aim is to design a vehicle on the alternative fuel which is free from all kinds of pollution. Study of all the research work done till date was done. The effects of the main performance analysis such as safety, efficiency, exhaust emissions, environmental effects and power to run the vehicle are dealt. Electrolysis and de-electrolysis is carried to produce hydrogen and electric charge respectively. Thus, the vehicle would run on hydrogen fuel. Solar energy is utilized to power electrolysis to avoid any kind of direct or indirect pollution.

**Keywords--** Hydrogen Fuel, Electrolysis, De-electrolysis, Solar energy, Efficient Vehicle, Reduced losses

- Exhaust gas temperature in the case of waste plastic oil compared to diesel is higher which results low thermal efficiency.
- Amount of Char formation increases with load which has high percentage of carbon and ash.

### Solar Energy

- A solar panel is able to convert only 15% of the sunlight it receives into electricity under normal operating conditions.

### Bio diesel

- At present bio diesel is one and a half times more expensive than petroleum diesel fuel. It requires energy to produce bio diesel fuel from soy crops, for sowing, fertilizing and harvesting. It can harm rubber hoses in some engines.
- It can result in clogging fuel filter.

### Compressed natural gas (CNG)

- The efficiency of the engine goes down significantly. On an average there is 10% reduction in the performance of the engine.
- The storage space is eaten up badly.
- Risk of getting the injectors blocked.
- Running on a low fuel tank decreases the pressure and increases the risk of valve bursting.

### C. Why hydrogen?

Hydrogen is Energy vector which is free from above drawbacks with added up merits.

The chemical element Hydrogen was discovered in 1766 by a British scientist Henry Cavendish and it was later named by Antoine Lavoisier in 1783 as "Hydrogen" it comes from a Latin word Hydro Gen-um which means making water. Hydrogen is the first element in the periodic table with one electron and one proton, having mass: 1.008u; radius: 25pm; melting point: -259°C; Boiling point: -252°C. It is colourless and odourless gas, it is the lightest and most abundant element in the world with energy density three times higher than the fuels which are currently being used, therefore it has higher potential thermodynamic efficiency. About 92.1% of sun is comprised of hydrogen and even every human body

## I. INTRODUCTION

### A. Current Scenario

Crude oil has been the major source of energy for last few decades. World consumes about 34 billion gallons of crude oil per year of which China consumes 32 billion barrels of crude oil. Due to this high consumption rate of crude oil, it may last hardly for 50 years. Also, the excessive use of crude oil has led to adverse effects on the environment such as air pollution, noise pollution which are leading to increasing greenhouse effects which ultimately results into the depletion of ozone layer. The rapid increase in depletion of ozone layer is the cause of concern for the whole world, hence there is an immediate need to have a control on harmful gases such as Hydrocarbons, Nitrogen oxides, Carbon monoxide, Sulphur dioxide, Hazardous air pollutants, Greenhouse gases and etc, which are emitted by the combustion of crude oil.

### B. Available alternative resources

As said "Necessity is the mother of all inventions"

There is a need for some Alternative source of energy which is cleaner, safer to use and abundantly available in the nature.

Problems with some alternative sources of energy are:

Pyrolysis (oil obtained from plastics or tires)

contains about 7 kg of Hydrogen on an average. It has negligible environmental impact and is a clean and pure source of energy hence it can be ideal partner for future. Hydrogen even though the most abundant Energy vector can't be directly used as a fuel since it is not in its pure form i.e. Elemental hydrogen is hardly found on Earth and is needed to be produced using some energy source.

**Processes used for obtaining elemental Hydrogen:**

- Natural Gas Reforming/Gasification
- Renewable Liquid Reforming
- Fermentation
- Electrolysis

Above all processes electrolysis is the safest and soundest method to produce Hydrogen since it does not produce any greenhouse gas or any hazardous effects on environment.

The National Aeronautics and Space Agency (NASA) have been using hydrogen as fuel in their space research programme from 1950 onwards.

## II. OBJECTIVE

One litre of water has a mass of 1000gm. And molar mass of water is 18.016g/mole. One litre of water contains 55.5 moles of water molecules (55.5 moles of hydrogen and 27.5 moles of oxygen). Avogadro rule for molar volume states that one mole of any ideal gas occupies 22.4 litres of volume. Density of hydrogen and oxygen are 0.0899 and 1.429 g/l at 0°C. one litre of water will thus produce  $111/0.0899 = 1235$  litres of hydrogen and  $888.81/1.429 = 622$  litres of oxygen. On an average 4kg of hydrogen can power the vehicle for around 4km of distance.

The electricity produced is stored in a battery, which is then utilized for supplying electricity to induction motor for providing motive power to the vehicle and the electricity required for carrying out the electrolysis is generated from solar energy by using a solar panel which is mounted on a vehicle.

**Energy Losses are avoided by**

The use of whole transmission system i.e. gears, propeller shaft, and differential is avoided which also helps us to eliminate clutch pedal from the pedal assembly. This can be achieved since the torque produced in the gasoline engines is progressive torque so transmission system plays a significant role to obtain the desired torque at different

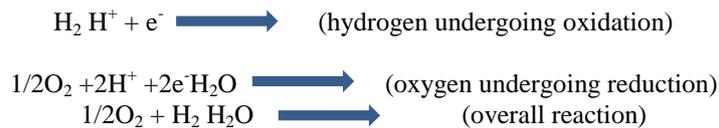
**To Design a vehicle working on alternative fuel which is:**

- Abundantly available
- Economical
- Free from all kinds of pollution
- Safer to use
- And Efficient

Maximize the utilization of energy and reduce the unnecessary losses of energy such as frictional losses.

## III. METHODOLOGY

The vehicle is basically powered through a hydrogen gas which is obtained by electrolysis of water carried out in a tank. During the electrolysis hydrogen is accumulated at negative electrode from where it is extracted and supplied in another tank where de-electrolysis is carried out, by supplying airborne oxygen this airborne oxygen then reacts with hydrogen to produce electric charge. Thus, hydrogen undergoes simultaneous oxidation and reduction reaction to produce electricity. The above-mentioned reactions can be represented as: -



speed ratios whereas in this case instantaneous torque is produced because of which desired torque could be obtained at any speed. This reduces loss of energy during transmission which is lost in the form of friction and heat. This not only reduces the energy losses but also helps us to reduce the overall weight of the vehicle which gradually lowers down the cost and time of manufacturing.

**Optimum Utilisation of Energy:**

In conventional vehicle friction braking is used in which kinetic energy of vehicle is converted into friction which is then dissipated into atmosphere in the form of heat energy which remains unused thus there is a loss of energy. This loss could be overcome or avoided by re-utilizing the energy which is spent on braking i.e. regeneration of energy during braking by recovery of kinetic energy during braking. During regenerative braking as soon as driver presses the brake pedal induction motor is converted into generator. Now the induction motor which is switched into a generator receives kinetic energy from wheels and rotates, through its rotation generator converts a portion of kinetic energy into electrical energy. This energy is then stored in a battery. Hence generative electric torque which is the reason for generation of electricity retards the vehicle.



Fig 1. Growth in fossil fuel consumption

#### IV. DATA ANALYSIS

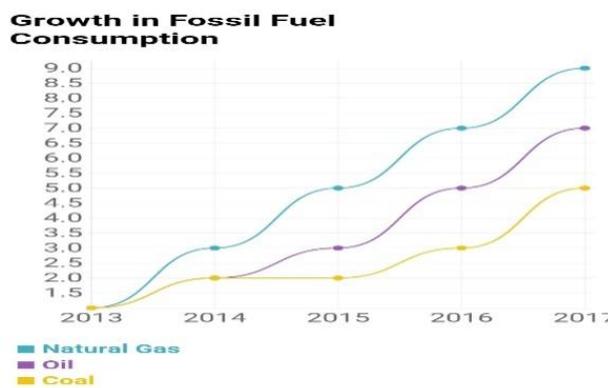


Fig 2. Vehicle Production in India (in thousands)

#### V. DESIGN

The foundation of vehicle constitutes of a light weight (since 10% reduction in weight can lead to 6 to 8%

improvement in the energy utilization) stiff and ultra-rigid square tube space frame chassis. All parts of the vehicle are mounted at their lowest possible position which will help lower the centre of gravity of the hydrogen fuel vehicle.

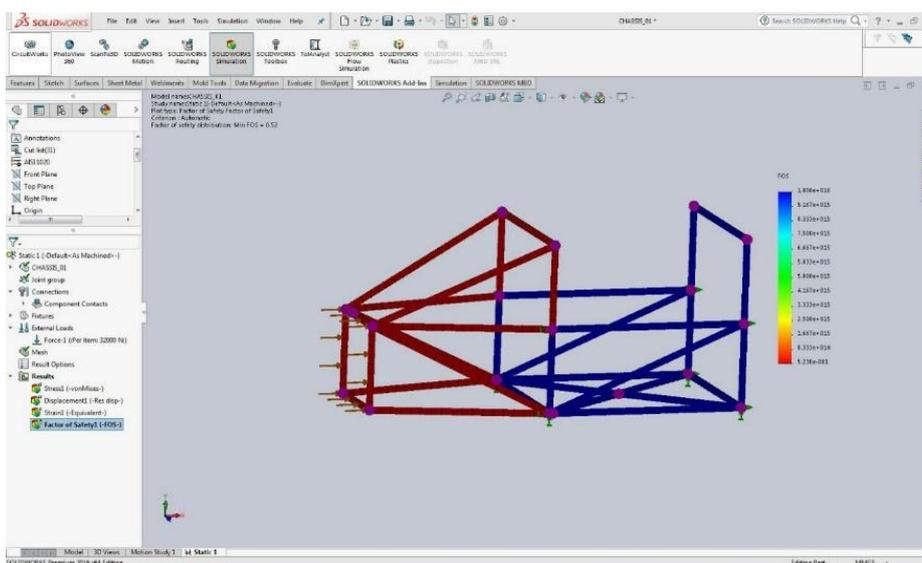


Fig.3 Load Analysis of frame

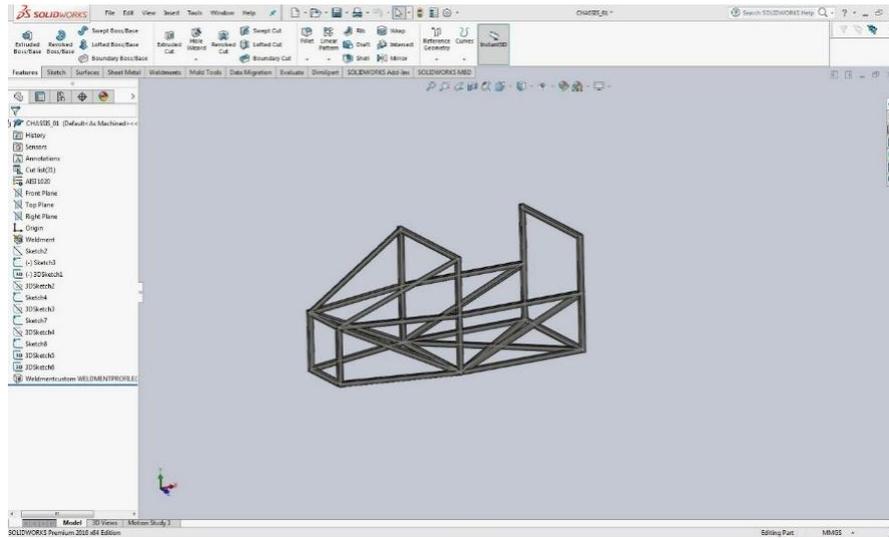


Fig 4. 3D modelling of frame

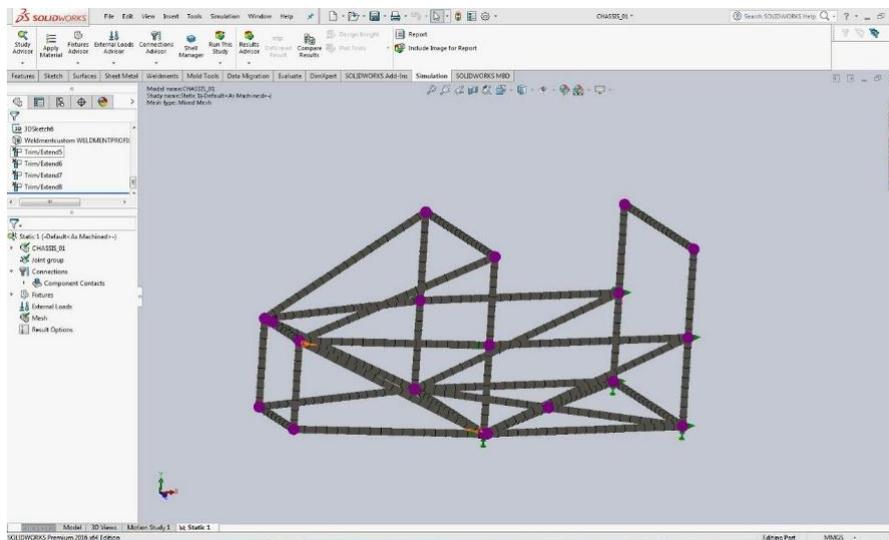


Fig 5. 3D modelling of frame

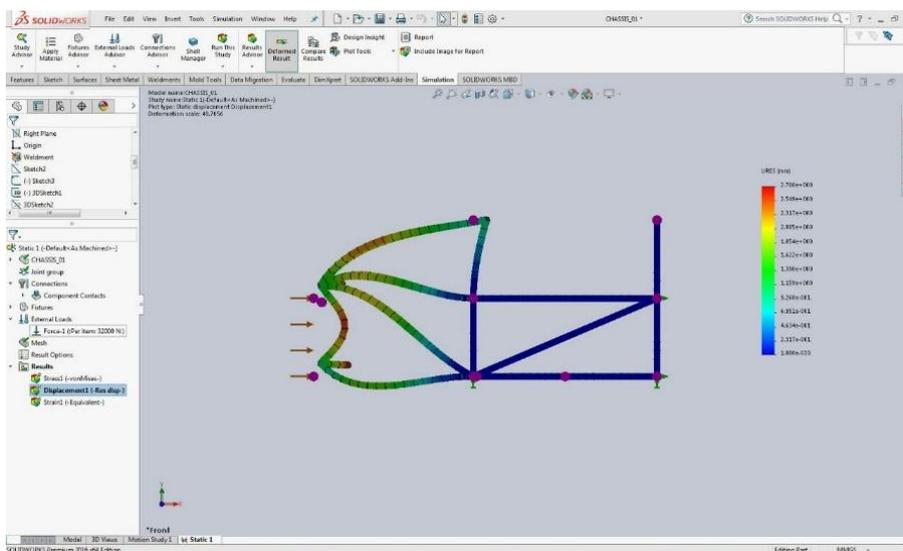


Fig 6. Impact Analysis of frame

## VI. CONCLUSION

Thus, hydrogen gas can be used as an alternative energy vector to power vehicles with minimum losses and maximum utilization of available energy at an economical price, without causing any kind of direct or indirect pollution for upcoming generations.

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