A Review of Alternate Fuels

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Abstract

At the present time, virtually all of the world's transportation needs are supplied by fuels derived from petroleum, also known as crude oil. Gasoline, diesel, jet fuels are examples of transportation fuels that are produced from petroleum. The combustion of petroleum in motor vehicles results in emission of gases associated with global warming, acid rain and urban air pollution. Using hydrogen as fuel can fundamentally change our relationship with the natural environment. Hydrogen boasts many important advantages over other fuels. So, it is the fuel of choice in this paper for energy.
Keyword- Gasoline, Diesel, Jet Fuels

I. INTRODUCTION

Alternative energy sources, is one that can be adopted to save energy for our future generation and to reduce ecological threads like pollutions, scarcity, global warming etc. Some of the commonly used alternative fuels are wind energy, solar energy, tidal energy, geothermal energy and the blooming alternative fuel is hydrogen.

A. Fossil Fuels and Its Effects

Fossil fuel is the "incompletely oxidized and decayed animal and vegetable materials, specifically coal, peat, lignite, petroleum and natural gas". Technically it is defined as "material that can be burned or otherwise consumed to produce heat".

Combustion of these fossil fuels is considered to be the largest contributing factor to the release of greenhouse gases into the atmosphere. Usage of fossil fuel causes air pollution, water pollution, accumulation of solid waste, not to mention the land degradation and human illness.

This fossil fuel affects small plants and animals via smoke exhaust from vehicles and by producing air pollution. Many toxic substances like VANADIUM and MERCURY are released by these fossil fuels.

When fossil fuel like coal is burnt it will produce nitrous oxide and sulphuric oxide which will retain in the atmosphere for a long term and at times of raining it will mix with the moisture and it form harmful nitric acid and sulphuric acid and reaches earth. This is known as Acid rain.

Sometimes the leakage of these fossil fuels during the delivery via pipeline will leads to leakage and produces oil rigs and pollute water and damages the water living organisms.

II. METHODS TO REDUCE FOSSIL FUEL'S DAMAGE

- Use of unleaded gas has helped to reduce the release of lead into the environment. But it has slighter less octane number when compared to the actual leaded petrol. But it affects the environment in minor amount since lead is not released.
- Use of alternative and renewable energy resources will reduce the effect of fossil fuels and environment and helps to meet the energy demand.

III. ALTERNATIVE FUELS OR RENEWABLE ENERGY SOURCES

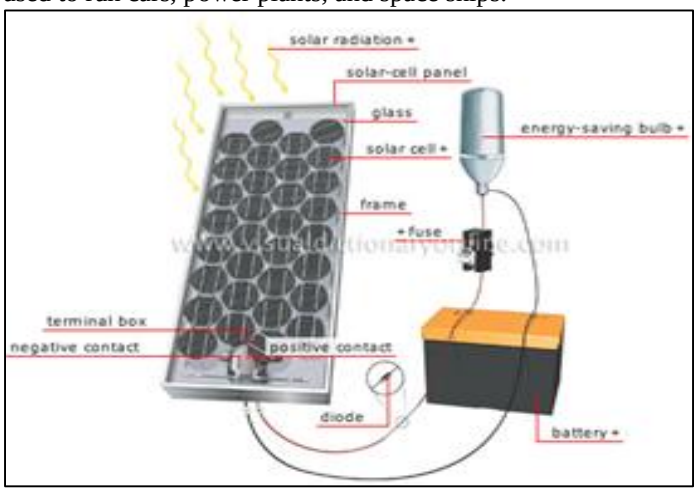
These energies are produced by absolute natural sources and these energies can be replenished. Some of the alternative fuels are,

- Solar Energy
- Tidal Energy
- Wind Energy
- Geo Thermal Energy
- Bio Mass Fuel
- Hydrogen Energy

A. Solar Energy

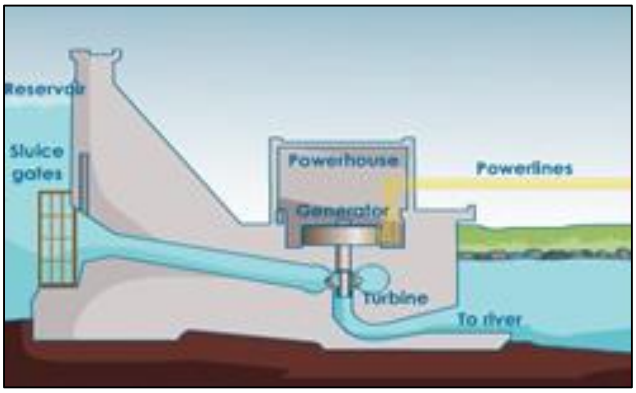
Solar energy is one the most resourceful sources of energy for the future. One of the reasons for this is that the total energy we receive each year from the sun is around 35,000 times the total energy used by man. However, about 1/3 of this energy is either absorbed by the outer atmosphere or reflected back into space (albedo process).

Solar energy is presently being used on a smaller scale in furnaces for homes and to heat up swimming pools. On a larger scale use, solar energy could be used to run cars, power plants, and space ships.



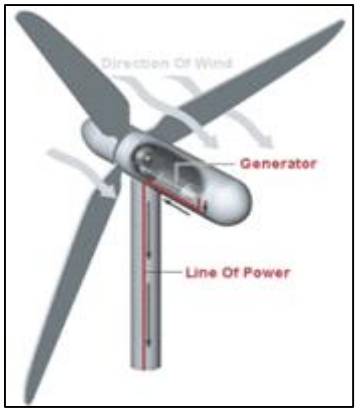
B. Tidal Energy and Hydro Electric Energy

In this method the energy is produce from the tides. Hydroelectricity comes from the damming of rivers and utilizing the potential energy stored in the water. As the water stored behind a dam is released at high pressure, its kinetic energy is transferred onto turbine blades and used to generate electricity. This system has enormous costs up front, but has relatively low maintenance costs and provides power quite cheaply.



C. Wind Energy

Wind energy is the kinetic energy associated with the movement of atmospheric air. Wind turbines transform the energy in the wind into mechanical power, which can then be used directly for grinding etc. or further converting to electric power to generate electricity. Wind turbines can be used singly or in clusters called ‘wind farms’. Small wind turbines called aero-generators can be used to charge large batteries.



D. Geo Thermal Energy

Geothermal energy is obtained from the internal heat of the planet and can be used to generate steam to run a steam turbine. This in turn generates electricity, which is a very useful form of energy. But it is not resourceful enough to replace more than a minor amount of the future's energy needs. Naturally occurring large areas of hydrothermal resources are called geothermal reservoirs. Most geothermal reservoirs are deep underground with no visible clues showing above ground. But geothermal energy sometimes finds its way to the surface in the form of volcanoes, hot springs and geyser

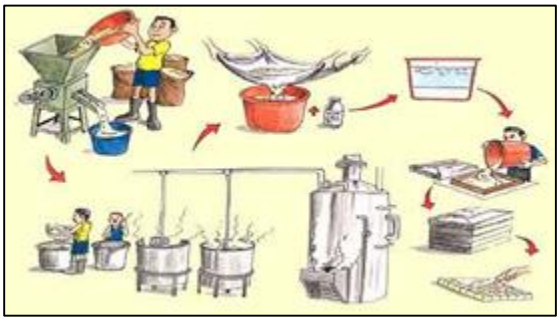
E. Bio Mass Fuels

Biomass, a renewable energy source, is biological material from living, or recently living organisms, such as wood, waste, (hydrogen) gas, and alcohol fuels. Biomass is commonly plant matter grown to generate electricity or produce heat. Biomass may also include biodegradable wastes that can be burnt as fuel. It excludes organic materials such as fossil fuels which have been transformed by geological processes into substances such as coal or petroleum.

Biomass energy is derived from five distinct energy sources: garbage, wood, waste, landfill gases, and alcohol fuels. Wood energy is derived both from direct use of harvested wood as a fuel and from wood waste streams. The largest source of energy from wood is pulping liquor or “black liquor,” a waste product from processes of the pulp, paper and paperboard industry. Waste energy is the second-largest source of biomass energy. The main contributors of waste energy are municipal solid waste (MSW), manufacturing waste, and landfill gas. Biomass alcohol fuel, or ethanol, is derived primarily from sugarcane and corn. It can be used directly as a fuel or as an additive to gasoline.

Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and biodiesel. Methane gas is the main ingredient of natural gas. Smelly stuff, like rotting garbage, and agricultural and human waste, release methane gas - also called "landfill gas" or "biogas." Crops like corn and sugar cane can be fermented to produce the transportation fuel, ethanol. Biodiesel, another transportation fuel, can be produced from left-over food products like vegetable oils and animal fats. Also, Biomass to liquids (BTLs) and cellulosic ethanol are still under research.

1) Biomass is carbon, hydrogen and oxygen based. Nitrogen and small quantities of other atoms, including alkali, alkaline earth and heavy metals can be found as well. Metals are often found in functional molecules such as the porphyrins which include chlorophyll which contains magnesium. Plants in particular combine water and carbon dioxide to sugar building blocks. The required energy is produced from light via photosynthesis based on chlorophyll. On average, between 0.1 and 1 % of the available light is stored as chemical energy in plants. The sugar building blocks are the starting point for the major fractions found in all terrestrial plants, lignin, hemicellulose and cellulose.



F. Hydrogen Fuel

Hydrogen is one of two natural elements that combine to make water. Hydrogen is not an energy source, but an energy carrier because it takes a great deal of energy to extract it from water. It is useful as a compact energy source in fuel cells and batteries.

IV. WHY HYDROGEN AS A FUEL

Although we have a lot of alternate resources of energy hydrogen is under a great research and great demand to use due to the following properties of hydrogen.

A. High Degree of Flammability

Hydrogen combines with oxygen to form water. The reaction releases a great deal of energy.

B. Burns without Air

Rockets can burn hydrogen fuel in space because oxygen is taken along as well. The oxygen can be pure or combined into oxidants (reactive oxygen compounds) to reduce its pressure requirement.

C. Pollution

Hydrogen is eco-friendly fuel since its exhaust will be only oxygen (o2). But the production of hydrogen involve fossil fuels and Steam methane reforming by which lot of carbon-di-oxide is produced and pollute the environment. So in order to reduce this

pollution of hydrogen generation we shall use electrolysis by which the hydrogen can be separated from the water in less efficient way but without any pollution. Generating H_2 from natural gas reduces greenhouse gas emissions 50 percent compared to gasoline.

D. High Energy

One kilogram of H_2 provides the same amount of energy as one gallon of gasoline. To cover the same driving distance, a hydrogen fuel cell vehicle needs to hold only 40 percent of the energy versus a gasoline-powered vehicle does.

E. Renewable Source

The supply of hydrogen is virtually unlimited when renewable hydrogen is converted back to power in a fuel cell.

F. Compatibility with Cold

Cars functioning with gasoline will get struck up at low temperature but hydrogen fuels will overcome this with ease. It is compatible with cold weather.

G. Less Dangerous

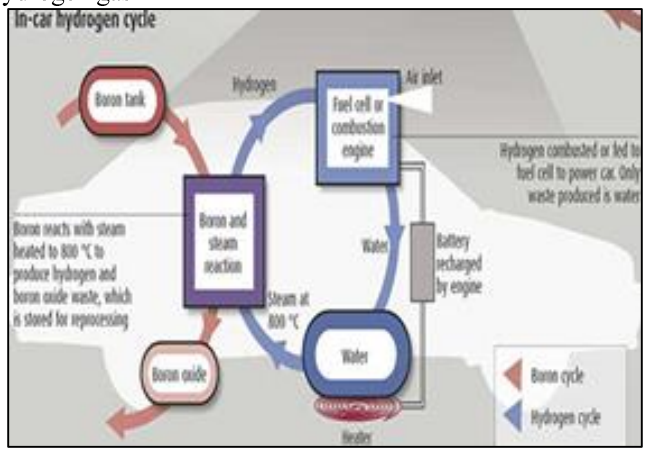
Since hydrogen is the lightest element in the universe, it is much safer than gasoline or any other hydrocarbon fuel in the event of a leak or accident involving a vehicle's fuel storage and delivery system. Leaking hydrogen rapidly disperses up and away from its source. If ignited, hydrogen burns rapidly with a nonluminous flame that cannot readily scorch a person at a distance. It emits only one-tenth the radiant heat of a hydrocarbon fire and burns 7% cooler than gasoline. Victims are not generally burned by hydrogen unless they are actually in the flame, nor are they choked by smoke.

V. PRODUCTION OF HYDROGEN FUEL FROM WATER

A. Using Boron

Chemical process allows for rapid liberation of hydrogen from water. The resulting boron oxide can then be regenerated to boron using renewable energy.

Boron + Water Boron oxide + hydrogen gas



B. Using AIIH2 Cells

The cell is a combination of magnesium, aluminium and stainless steel. It weighs .061 lbs. and has a lifetime shelf life. Its dimensions are 3" X 12" X 1/4". This cell when immersed in seawater releases hydrogen gas.

C. Using Coal

By coal gasification, Coal can be converted into syngas and methane, also known as town gas. Syngas consists of hydrogen and carbon monoxide. Another method for conversion is low temperature and high temperature coal carbonization.

D. Using Electrolysis

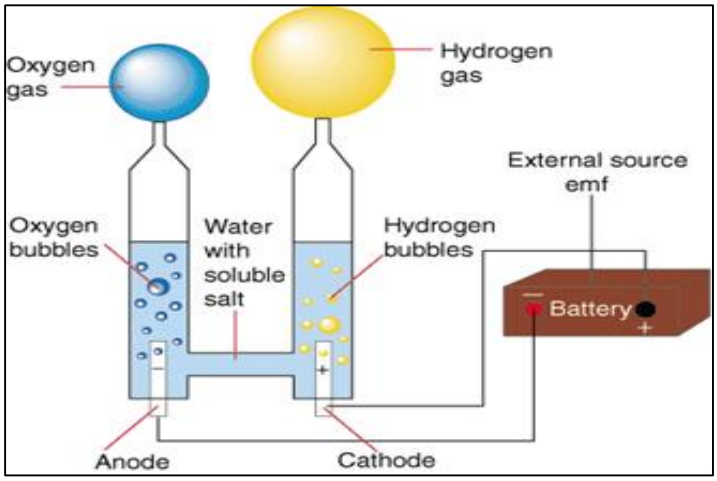
Fossil fuel currently is the main source of hydrogen production. Hydrogen can be generated from natural gas with approximately 80% efficiency or from other hydrocarbons to a varying degree of efficiency. Specifically, bulk hydrogen is usually produced by the steam reforming of methane or natural gas.At high temperatures (700–1100°C), steam (H2O) reacts with methane (CH4) to yield syngas.

$$CH_4 + H_2O \rightarrow CO + 3\ H_2 + 191.7\ kJ/mol$$

In a second stage, further hydrogen is generated through the lower-temperature water gas shift reaction, performed at about 130°C:

$$CO + H_2O \rightarrow CO_2 + H_2 - 40.4\ kJ/mol$$

Essentially, the oxygen (O) atom is stripped from the additional water (steam) to oxidize CO to CO_2. This oxidation also provides energy to maintain the reaction. Additional heat required to drive the process is generally supplied by burning some portion of the methane.



VI. ADVANCEMENT IN THE ELECTROLYSIS

- If the lower limb of the electrolysis chamber is increased in its length then the bubbles formed will not be interfered and thus the generation of hydrogen will increase and thus it leads to increase in efficiency of the system.

VII. ADVANCEMENT IN STORAGE

- Then usage of chicken feather fibres which is rich in keratin can be used to store the hydrogen more efficiently. Since it becomes more strong and porous on heating it can store more amount of hydrogen. The feather fibre amounts used ranged from 20% to 95% and a 5% concentration of phenol formaldehyde resin was used as the adhesive.
- Cryogenic tanks can be used to store the liquid hydrogen where the hydrogen can be store efficiently without usage up to 4 days.

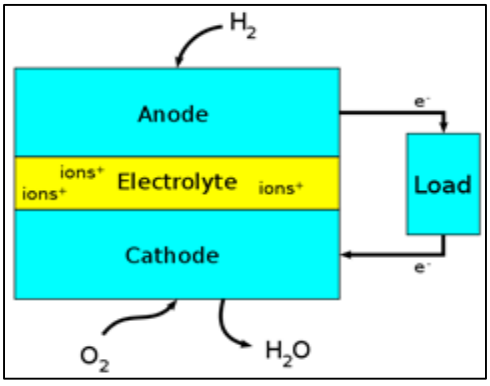
VIII. FUEL CELL

A fuel cell is an electrochemical cell that converts a source fuel into an electric current. It generates electricity inside a cell through reactions between a fuel and an oxidant, triggered in the presence of an electrolyte. The reactants flow into the cell, and the reaction products flow out of it, while the electrolyte remains within it.

- The most important design features in a fuel cell are:
- The electrolyte substance. The electrolyte substance usually defines the type of fuel cell.
- The fuel that is used. The most common fuel is hydrogen.
- The anode catalyst, which breaks down the fuel into electrons and ions. The anode catalyst is usually made up of very fine platinum powder.

$$Pt + H_2 \qquad H^+(ions) + e^-$$

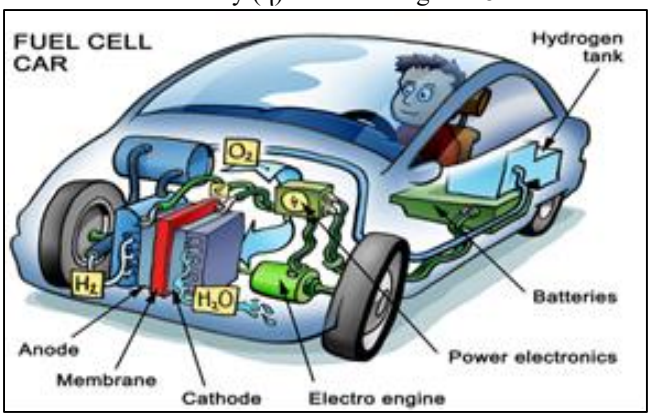
- The cathode catalyst, which turns the ions into the waste chemicals like water or carbon dioxide. The cathode catalyst is often made up of nickel.



General block diagram of a fuel cell.

Here the hydrogen ion produced in the anode passes through the electrolyte but the electrons can't pass through the electrolyte and hence it is circuited and used to run the load as electricity is produced. Then the hydrogen pass via the electrolyte and reach the cathode and there it reacts with the oxygen ion and form water or carbon-di-oxide as the output.

Efficiency (ή) = Cell voltage/1.48V



IX. DEMERITS IN HYDROGEN FUEL

A. Storage

Storing hydrogen fuel is a great task. Since it is a less dense molecule it has be store under compressed condition which has a great disadvantage.

B. Storage Tanks

Hydrogen is highly volatile. Special tanks have to be used to hold it and specially-pressurized pumps have to be used to convey it. The tanks being used in prototype cars take up most of the trunk space.

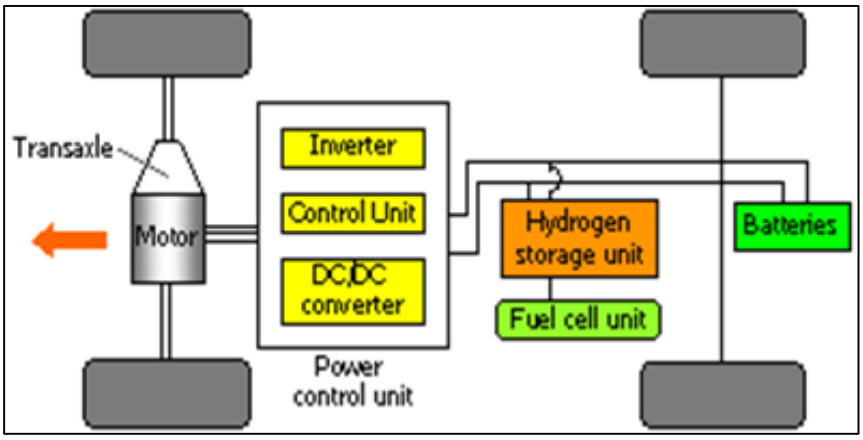
C. Expensive

Because hydrogen is a gas, it cannot be compressed into a liquid form without intensive cost and energy input. At present production of hydrogen seems more expensive when compared to other fuels. Since it depends on fossil fuels or electrolysis (chemical method) and hence the investment is higher.

D. Solution

As volume increases and the technology is refined, the cost of hydrogen will be reduced over time. In contrast, oil and other fossil fuels are increasing in cost as global supplies are impacted by geopolitical events and are exponentially consumed.

E. Model



X. CONCLUSION

Thus utilization of fossil fuels has to be reduced and the alternative fuels should be utilized in proper way to reduce pollution and to save energy for our future generation. Even though there are lot of alternative fuels available the hydrogen seems to be the most efficient and better fuel. Hence it fits to say hydrogen as the FUEL OF FUTURE.

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