

Z.E.C.H (HYDROGEN-CAR)

Param Shah¹, Chirag Joshi²

¹Member, Science Kidz Educare, Mumbai, Maharashtra, India

²Member, Young Engineer's Club, Science Kidz Educare, Mumbai, Maharashtra, India

Abstract – Automotive Industry is one of the largest sectors in India with over 295.8 million cars present to date. The total number of cars amount to 1.45 billion and [6]Michael Gross Reports predicts 2 billion cars by 2030. The main fuels for these cars are Gasoline, Diesel Fuel, Ethanol, Bio-diesel, etc. According to International Energy Agency, transportation accounted for 24% of global Carbon Dioxide emissions in 2020 and this air pollution causes an estimated 385,000 premature deaths each year in the European Union alone. The economic costs of air pollution from transportation are estimated to be \$1.7 trillion globally. Yet, there is the only solution of Electronic Vehicles (E.V) which indirectly pollutes the atmosphere as 71% of electricity is generated by Thermal Power Plants in India. This Challenge can be easily surmounted with the introduction of a Combined work of Artificial photosynthesis and Hydrogen fuel cell. This paper aims on presenting the idea of a car that has a redesigned engine that aims at reducing the pre-existing Carbon Levels in the atmosphere and achieving zero harmful by-products. This will provide a major boost in the progress of a clean future and a drop in premature deaths by air pollution.

Key Words: Automotive Industry, Air pollution, Electronic Vehicles, Thermal Power Plant, Artificial photosynthesis, Hydrogen fuel cell

1. INTRODUCTION

Automotive Industry is a massive business today with almost 3 billion cars running throughout the world. The \$2.9 Trillion Automobile industry has been the cause of around [7]385,000 and [8]58,000 premature deaths in the European Union and United States respectively. The International Council on Clean Transportation found that if the usage of fossil fuels is not decreased, it could result in estimated 174,000 premature deaths per year by 2030. According to the WHO, air pollution is the leading environmental risk factor for disease, and exposure to particulate matter emitted by cars and other forms of transportation can lead to respiratory and cardiovascular disease, stroke and even lung cancer. The new range of “eco-friendly vehicles” which is Electronic Vehicles (E.V) has been pressurizing the environment indirectly. The U.S Energy Information Administration (EIA) has stated that fossil fuels account for 62% of electricity generation in the United States, 2020, with natural gas and coal being the two largest sources. According to the Central Electricity Authority of India, coal accounted for 71% of the country’s

total power generation capacity, 2020. By using the recent process of artificial photosynthesis and Hydrogen fuel cell, we can prevent the direct as well as indirect pollution. The artificial photosynthesis process produces hydrogen from carbon dioxide and water. This produced hydrogen will then be used in Hydrogen fuel cell to generate electricity for powering the car. This will not only reduce the pre-existing carbon levels from the atmosphere, but also provide a redesigned “eco-friendly” car.

1.1 FUELS AND ENERGY FOR CARS

This table shows the direct and indirect pollution from car.

<p><i>Fossil Fuels (Direct Pollution from Cars):</i></p> <ol style="list-style-type: none"> 1. Gasoline 2. Diesel 3. Liquefied Petroleum Gas
<p><i>Sources Of Indirect Pollution:</i></p> <ol style="list-style-type: none"> 1. Electricity for E.V 2. Liquefied Petroleum Gas (LPG)

1.2 HARMFUL TOXIC GASES EMITTED BY CARS

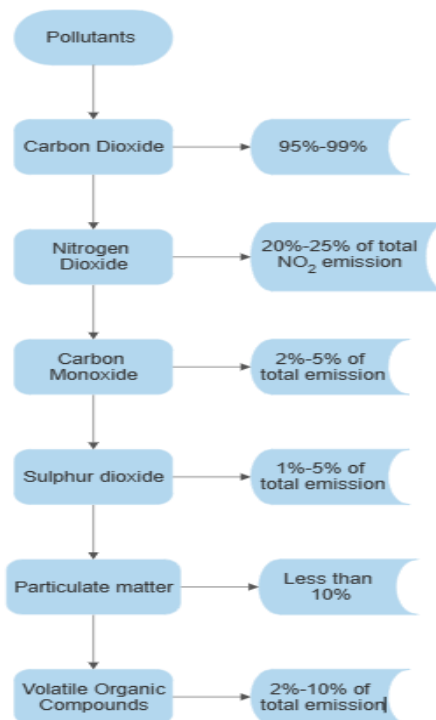


Fig –1 Pollution and Emissions from cars

2. SOLUTION

The proposed solution is a hydrogen powered car named “Z.E.C.H” (Zero Emission Car Hub), which aims to reduce the greenhouse emissions caused due to Automotive industry. A Car installed with Carbon dioxide filters, Artificial photosynthesis chambers and Hydrogen fuel cell. The air entered through the front vents of the car is filtered through the carbon nano fibrated filters which help in capturing carbon dioxide. The By-products exhausted out of the car is only water vapors. Both the processes are some of the unpopular innovations, which would greatly enhance the eco-friendly quotient of today’s modern world. This would help in decreasing the pressure of direct as well as indirect pollution on the atmosphere. These cars could be implemented in the most polluted cities such as Mumbai and Delhi in India, Dammam in Saudi Arabia, Oasis in California, etc. so that the greenhouse effects could get in control in these places and decrease the health risk of the people residing there.

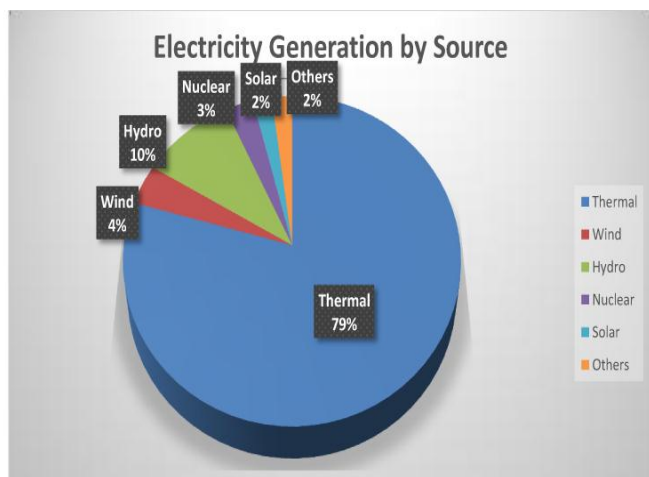


Fig -2: Electricity Generation Division (India)

3. METHOD

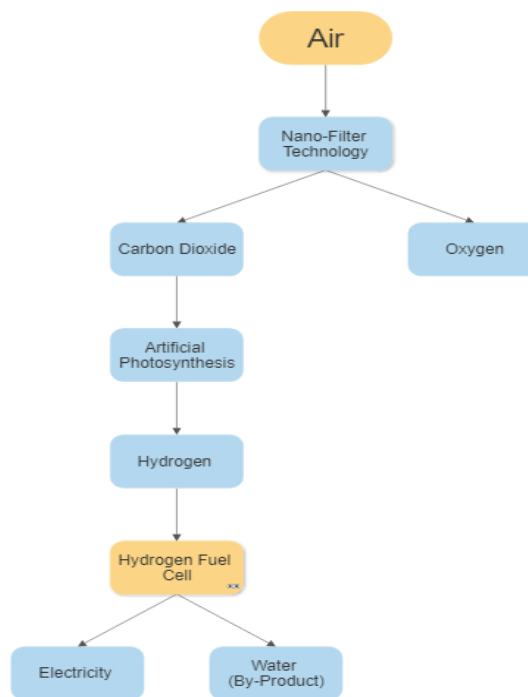


Fig -3: Methodology

The Car is built with the combined work of Artificial photosynthesis and Hydrogen fuel cell. The air entered through the front vents of the car is filtered through the carbon nano fibrated filters which help in capturing carbon dioxide. This Carbon dioxide is then pumped into the Artificial photosynthesis chamber. In this chamber, the carbon dioxide and water in presence of artificial U.V rays producing Hydrogen as the product of this looped reaction. This Hydrogen is then used in the Hydrogen fuel cell. Here the oxygen needed in the hydrogen fuel cell is again trapped from the atmosphere, in a less quantity. The Hydrogen and Oxygen gases are then pumped into the Fuel Cell.

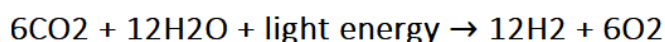


Fig -4: Artificial photosynthesis Reaction

Here the fuel cell, has two chambers, one containing the hydrogen whereas other contains the oxygen gas. In between these chambers is the electrolyte and a platinum catalyst to increase the efficiency and speed of the reaction. Here the electrolyte only allows the protons of hydrogen to pass through it and form compounds with the Oxygen gas in the Oxygen chamber. The formed compound is again Water which is reused in the car for artificial photosynthesis reaction. The electrons of Hydrogen are

then attracted to the anode of the electric circuit attached above the hydrogen chamber. When the electrons enter into the copper wire, it produces electricity as electrons moving all together in a specific linear direction, they produce electricity. This electricity produced, is then used for powering the car.

4. MAJOR MACHINERY DISTINCTION

Z.E.C.H has three main machinery which is used to power the whole car. The machines are carbon dioxide capturing system, Synthesized Photosynthesis and Hydrogen fuel cell.

4.1 CARBON DIOXIDE CAPTURING SYSTEM

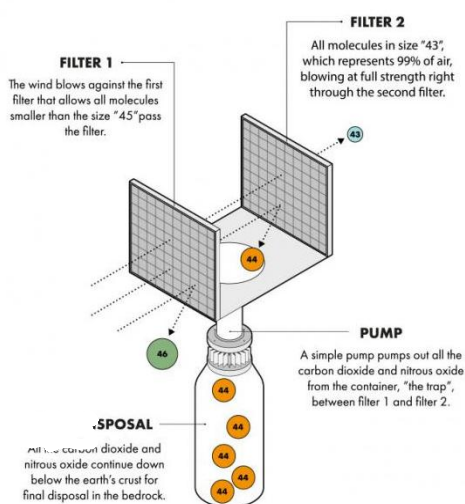


Fig -5: Carbon dioxide capturing system

With the latest world sensation of a filtering system which could collect/trap carbon dioxide from air. This could help us in trapping the carbon dioxide molecules directly from the air. The credit of this innovation goes to the Swedish company HyMeAir that has innovated a nano-filter technology which can easily capture any sort of molecules from air. This inexpensive and efficient technology could easily help us in our zero-emission car hub goal. This Nano-filter is made up of Graphene filter (GO) which is formed when carbon atoms are connected to each other in a two-dimensional layer, forming a net/filter. This Graphene is the strongest material which is 200 times stronger than steel.

4.2 ARTIFICIAL PHOTOSYNTHESIS

[4] Artificial photosynthesis is a chemical process replicating the natural photosynthesis to reduce Carbon Dioxide into fuels such as Hydrogen. Because of the Development of certain suitable technologies, we are able to perform synthesized photosynthesis which helps in the

useful production of hydrogen. In this process, Photoelectrochemical cells (PEC) uses artificial U.V rays to produce hydrogen. In our model, these cells use water and the trapped carbon dioxide to produce Hydrogen. This Hydrogen produced is then pumped into the fuel cell where it reacts with oxygen.

4.3 HYDROGEN FUEL CELL

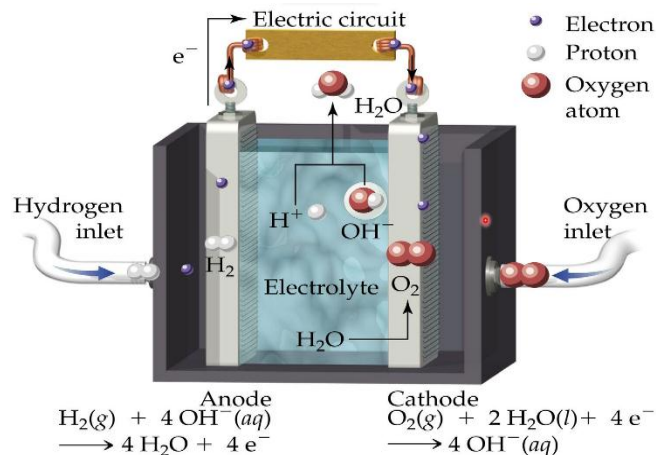


Fig -6: Hydrogen fuel cell

[5] Hydrogen fuel cell is the electrochemical cell which forms a reaction between hydrogen and the oxidizing agent, Oxygen, to form electricity. Fuel cells are different from normal batteries such as lithium batteries as the normal batteries have the chemical substances already present inside them. Whereas fuel cells have a requirement of supplying fuel and oxygen until enough electricity is produced.

In our case, the fuel cell is then filled with the gases hydrogen and oxygen. The fuel cell consists of two chambers, one of which holds hydrogen and the other oxygen gas. The electrolyte and a platinum catalyst to quicken the process are located between these chambers. Here, the electrolyte only permits hydrogen protons to flow through it and combine with the oxygen gas in the oxygen chamber to produce compounds. Water is once again the produced chemical, which is utilized in the car's artificial photosynthesis process. As an electric circuit is placed above the hydrogen chamber, the hydrogen's electrons are subsequently attracted towards the anode.

5. FEATURES OF THE CAR

5.1. THE CAPACITY AND SPEED RELATION

The latest hydrogen fuel cell requires 1Kg of Hydrogen to provide power for the car to cover an average distance of 99 kilometers. Our car has a storage capacity of 3Kg Hydrogen with two cylinders of 1.5kg each placed one above the other.

Therefore,

One Refill Of Hydrogen = Around 297 Km.

5.2 ECO-FRIENDLY CAR

The car produces its power from certain reactions which have their product as Water (H₂O). This water is exhausted out of the car as water vapors while some amount of it is used in the production of hydrogen in the artificial photosynthesis chamber. Water vapors does not harm the human as well as environment as it forms clouds once condensed in the troposphere.

CONCLUSION:

The target of this model of car is to decrease the greenhouse emissions and aims to be a part of the environmental fight against the fossil fuels. This would increase the lifespan of humans which was diminished by the fossil fuels. This project would also boost the popularity and the importance of these recent environment-saving innovations such as Artificial photosynthesis and Hydrogen fuel cell. This would revolutionize the whole automotive industry into an environment friendly industry as it would also lessen and gradually end the premature deaths due to air pollution.

REFERENCES:

[1]Fig.6Hydrogen fuel cell:-
<https://chemistry.stackexchange.com/questions/54090/on-what-principle-do-electric-alcohol-detectors-work>

[2]Fig.5Carbon dioxide capturing system:-
<https://www.einpresswire.com/article/411321117/world-sensation-collect-energy-water-and-co2-from-air-now-also-ventilation-s-that-filters-virus-and-bacteria>

[3]<https://hymeair.com/#:~:text=Nano%20filter%20ventilation%20that%20even%20filters%20out%20viruses,the%20amount%20of%20pure%20oxygen%20in%20the%20air.>

[4]Artificial photosynthesis: -
<https://www.sciencedirect.com/topics/engineering/artificial-photosynthesis>

[5]Hydrogen fuel cell:
https://en.wikipedia.org/wiki/Fuel_cell

[6]A planet with two billion cars - ScienceDirect

[7]Study: Volkswagen's excess emissions will lead to 1,200 premature deaths in Europe | MIT News | Massachusetts Institute of Technology

[8] [Air pollution causes 200,000 early deaths each year in the U.S. – MIT LAE](#)

BIOGRAPHIES:

1. **Param Mayur Shah:** Technology Enthusiast & Innovator.
2. **CHIRAG JOSHI:** Electronics Engineer, Technical Mentor and Researcher.