C-fuel

Converting Carbon-dioxide into CNG and Plastic to CNG and Diesel

Authors

Sarowar Jahan Saurav

Adil Hossain

Nayem Hossain Saikat

Table of contents

1. Abstract

Environment pollution is a wide-reaching problem and it is likely to influence the health of human populations is great. Carbon Dioxide, plastic, and polythene are very much responsible for air, soil and water pollution. Analysis shows that People who live in high-density air pollution areas have a 20% higher risk of dying from lung cancer, than people living in less polluted areas. Statistics show that Composting and recycling alone have prevented 85 million tons of waste to be dumped in 2010. Considering these important facts, this paper provides a solution which can recycle Carbon Dioxide and plastic, polythene into fuel. And To save our environment, we have been working on this project called c-fuel for the last 4 years. Our main objective is to convert Carbon Dioxide into CNG where cars and industry are our target audience. Then, our second objective is to convert plastic and polythene into diesel.

Firstly, we will collect carbon dioxide in a chamber. Then we will mix 4 moles of hydrogen with carbon dioxide. This reaction will need at least 400 degree Celsius and nickel. Analysis shows that the temperature of the combustion chamber and exhaust pipe reaches up to 800 degree and we will use that temperature to do the reaction .To get the hydrogen, we will use ocean water. After electrolysis, we will get hydrogen and oxygen both. We will use the oxygen in the combustion chamber .It will reduce the use of air oxygen.

For plastic and polythene recycling, we will put all the plastic and polythene in a cylinder and increase the heat up to 400 degrees .By doing pyrolysis we will get diesel and only carbon that can be used as ink. For Collecting plastic we will introduce a system named Plastic currency

2. Problem Statement

We all know about the negative impacts of carbon dioxide in our environment. One of the major contributors in carbon footprint is using fossil fuels and industrial power plants. Transports and Power plants contribute 24% of the whole carbon-dioxide emission. As we do not have alternative energy, we have to rely on fossil fuel which is non-recyclable energy. Currently 100,110,000 bbl of fossil fuels are consumed daily. While we were doing our research, we found that 1litre of fuel consumption can release up to 2.34 liter of Carbon-dioxide in the atmosphere. That is why we have been doing our research for last 4 years to recycle Carbon-dioxide into CNG at different industrial level.

2.1. Environmental Impact

• Sea level Rise • Deforestation • Greater disease risk • Decreasing crop yields • Water problems

3. Objective

- ecology of plastic
- alternative approaches
- large scale plastic pyrolysis
- overcoming negative impacts of pyrolysis by reusing the byproduct
- carbon recycling in automobiles
- electric automobile power exchange with plastic
- Plastic based business sustainability.
- plastic currency
- Energy efficiency and innovation
- Recycling fossil fuel

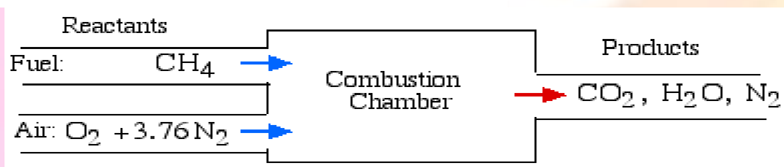
4. Action Plan

We have completed our research work and applied for patents. This conversion process has been done for 3 different industries.

- CNG Cars
- Fuel Based Industrial Power Plants
- Plastic and Polythene Industry

4.1.1. Car industry:

We have not modified any working principles .We have done our research after completing the combustion and completed the experimental work with the smoke after completing the work cycle. We have installed a secondary fuel tank of 10 liter volume and an electrolysis kit of 1 liter volume at the back of the car. The general combustion reaction in a CNG car is:



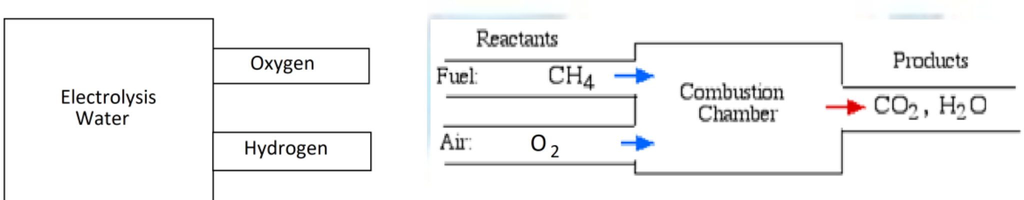
$$CH_4 + 2(O_2 + 3.76N_2) \Rightarrow CO_2 + 2H_2O + 7.52N_2$$

Fig 3.1 : General combustion reaction in the car

But we have slightly modified the process and added an electrolysis kit into the car. After water electrolysis we will get hydrogen and oxygen.

Electrolysis reaction: $2\ H_2O(l) \rightarrow 2\ H_2(g) + O_2(g)$

We will connect the only oxygen tube with the combustion chamber and there will be no connection with the external air tube for combustion process.



$$CH_4 + 2O_2 \Rightarrow CO_2 + 2H_2O$$

Fig 3.2 : Connecting electrolysis kit with Combustion process

Simultaneously we will store the Carbon-dioxide into the secondary fuel tank for a few seconds. Then begins the experimental research we have done.

The recycling reaction: $CO_2 + 4H_2 = CH_4 + 2H_2O$

After the combustion process, the stored Carbon dioxide will react with 4molecules of hydrogen that came from electrolysis process .The whole reaction needs 240 degree Celsius of temperature while using Nickel as catalyst . 240 degree Celsius in the car is a tough ask .While we were doing our work in the car ,we found that the temperature of the smoke is 90-110 degree Celsius and we can conduct the heat from car engine to the reaction chamber .But it decreases the efficiency to 1.4%-1.8%.After running the car for an hour with at least 40km/h ,the last temperature we got 380 degree Celsius .
Some might think it's a risk .But according to Le Chatelier's principle, if we increase the temperature in equilibrium condition, it will increase the reaction rate as well. Thus we get Methane which is the main component of natural gas.

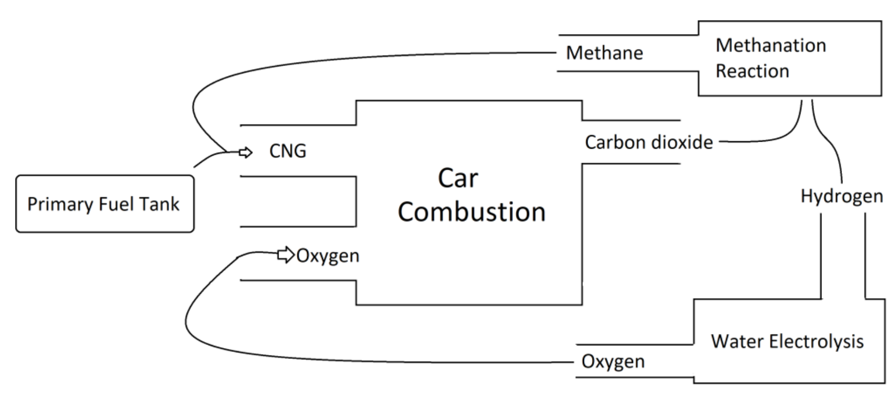


Fig 3.3 : Recycling process

But that is not CNG. The product will be generated in gaseous form. For the compressing method, we have used ideal gas law which is PV=nRT. We can forward this into P1v1=P2v2 where we pass the methane from lower radius pipes to higher radius pipes and again to the smaller radius pipes .It is a natural compression process and we can get the output in compressed form. But it will be in 1700-1800 psi which is ideal for combustion process.

It is a recycling rate of 83% and after the successful reaction we can get 834ml of CNG after using 1 liter of fuel .It is a continuous process and before the gas volume becomes Zero, it completes 7 cycles and recycles 4874ml of fuel.

Our proposed method can recycle 1 liter fuel into almost 5 liter of fuel and it uses only water for completing the cycle .Any kind of water like tap water, mineral or sea water can be used.

4.1.2.Industrial Power Plants :

Our researched work only can be implemented in those industries where they use fossil fuels and release a lot of carbon dioxide. Industrial power plants have the same principle from the above mentioned principle of making eco cars. But it has to generate temperature using external methods which may increase the recycling cost.

4.1.3.Plastic-Polythene industry :

Plastic pyrolysis is a common reaction over the world. Almost every country does not support pyrolysis as it releases a lot of toxic gases like carbon dioxide, carbon monoxide, sulfur dioxide and Nitrogen dioxide. But burning plastics into pyrolysis plant can give us Diesel. As we are converting Carbon dioxide and Carbon monoxide into CNG, it matches with our ideology and we have converted 630gm diesel and 240gm CNG from 1KG of plastic in our pilot pyrolysis plant. Rest of the amount was used as ink .

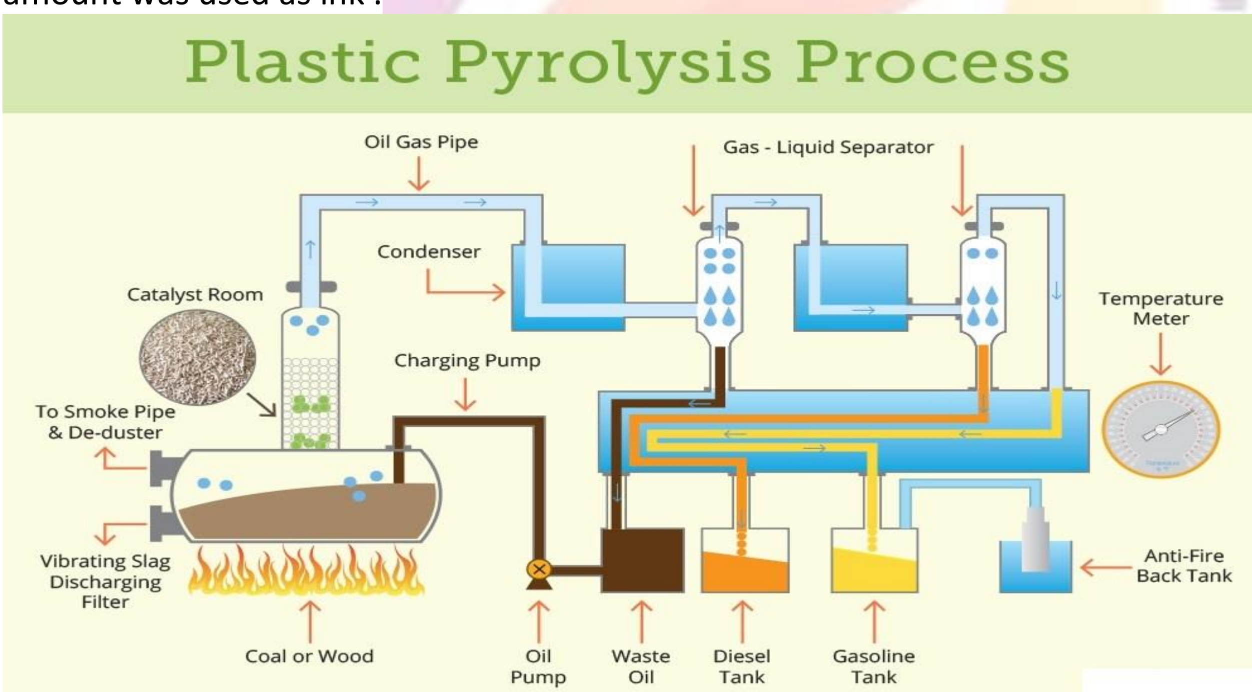
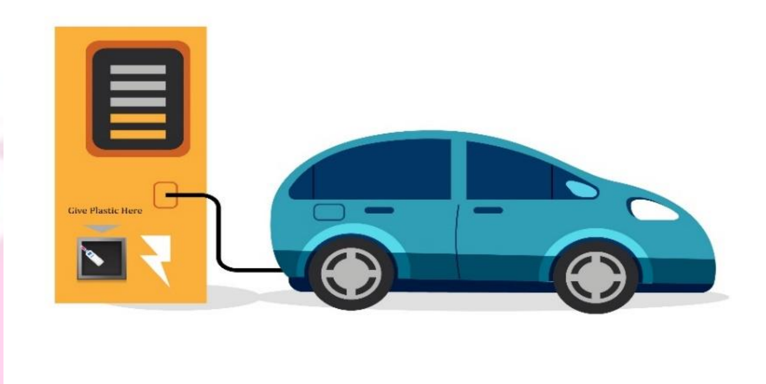


Fig 3.1.1. Plastic Pyrolysis Process

4.1.5 Plastic recycling based electric car charging station:

This is an idea to run an electric automobile charging station by recycling plastic. And using plastic In exchange to provide charge. This is also an implementation of plastic currency. Where we can create a both way recycling a sustainable platform and make profit.



4.2.1. Cost Analysis:

	Car Industry	Industry	Plastic	Coal mines
Our cost	0.029 USD	0.20 USD	0.0082 USD	0.059 USD
Installation cost	470.89 USD	5000 USD	882 USD	7063 USD
User cost	0.18 USD	0.18 USD	0.18 USD	0.18 USD
Monitoring by user	Yes	Yes	Yes	Yes
Maintenance cost	None	None	None	None

4.2.2.Comparison

Features	Hybrid Cars	Electric Car	CNG Car	Eco Car
Fuel consumption	✓ 30% less consumption	✓ No fuel	X High	✓ Average
Efficiency	~ 34%-42%	✓ 59%-62%	X 22%-28%	✓ 68%
Buying Cost	✓ 19424.16 USD	X 64747.21 USD	✓ 11772.22 USD	✓ Any car+ 471 USD
Maintenance cost	~ Average	X High	✓ Low	✓ Low
Eco-friendly	✓ Yes	✓ Yes	X No	✓ Yes
Conclusion	~ CONSIDERABLE	~ CONSIDERABLE	X REJECTED	✓ ACCEPTABLE

4.2.3.Business Model Canvas

Key Partners

- Gas stations
- Power plants
- Car companies
- Plastic and polythene industry
- Recycling industry
- Ink industry

Key Activities

- Car maintenance and growth
- Marketing
- Scheduling management

Key Resources

- Service points
- Conversion points
- Fueling stations

Value Proposition

- A easy way to reuse your wastes
- Increases Efficiency
- Eco Friendly
- Less fuel consumption
- Saving money
- Saving energy

Customer Relationships

- Self service system online
- Online monitoring
- Call centers 24*7

Channels

- Car points
- Fueling stations
- Social Media
- Digital marketing

Customers

- People who want more efficiency
- Power plants that emits more Carbon dioxide
- Save money and environment both

Cost Structure

- Cars maintenance
- Gas station
- TVC and promotional activities

Revenue Streams

- Refueling process
- Installation of the product

4.3.Advantage

• Recycling rate is 83.4%

• Getting 4840gm of fuel after using 1 liter fuel

• Decreasing

• Carbon Dioxide emission rate

• Increasing efficiency up to 56%

• Reducing fuel cost up to 62%

• Decreasing soil pollution rate up to 6%

4.4.How it can save the climate :

We have highlighted all the negative effects of using fossil fuels and how it is harming the climate. Our solution can decrease the usage of fossil fuels and rate of pollution because of plastic, polythene .We have introduced a new sustainable method of recycling fossil fuels with the car and industry . Not only it saves ecologically also helps the user economically .We have been doing the research and completed all the work and made it work flawlessly .We are in the right time to reveal our research work through capsule hackathon and our research work have potential to change the context of fossil fuel all over the world. We have attached few documents of our lab data in the document.

5. Future Plan :

We are currently research on implement this process to coal mines. We can use coal as the source of Carbon dioxide and convert that into CNG later on .
We will also be focusing on creating an ecosystem based on plastic recycling.

5.1. Introducing plastic currency:

So far we have been more concerned about plastic recycling and fuel generation. But have we forgot about the plastic circulation. Or how these source of plastic can be circulated. Let's have a look in the geographic agenda on plastic circulation. Recently we heard Malaysia returned 42 containers of illegal plastic waste to UK. These type of news are getting common. Leaving these, if we focus on the plastic waste found on the coast, the unidentified plastics all over the world. They do not have a claim to pass on. It is also to add that in some 3rd world countries there is a monopoly chain of plastic market, but still not evaluated as it should be.

Now if we focus on the ideology of the fact the currency is an object that is circulated all over the world. It has been valued by humans because of its value and worth. The purpose it can serve.

With that ideology we build up the system of "Plastic currency". Think of the fact that, plastic is serving a standard of benefit. It's worth increased not the price.

We tried of build up an ecology based on plastic currency. So that the plastic is no more scattered and people do not treat it as a waste rather reusable and getting advantages for it. Here we can see a vending machine based on plastic currency. The plastic is giving its worth and we getting some products in return. So here the main advantage is the collection and moderation of plastic. And reusing or producing energy with plastic. Moreover it's a win win.

6. Lab data:

Please find the lab data as attached file: C_fuel_labdata

Or visit: https://github.com/Adilhossain227/Cfuel_capsulhack.git to get the lab data.

7.Bibliography

Emmett, PH 1951, Catalysis, Reinhold, New York.

Fogler, HS 2006, Elements of chemical reaction engineering, 4th edn, Pearson education, United state.

Frolov, S.M., Kuznetsov, N.M., Krueger, C 2009, ' Real-gas properties of n-alkanes O2,N2,H2O,CO,CO2 and H2 for diesel engine operation conditions', Russian journal of physical chemistry B, vol 3, no. 8, pp. 1191-1252.

Kester, FL 1974, 'Hydrogenation of carbon dioxide over a supported Ruthenium catalyst', Am Chem Soc, Div Fuel Chem, vol 19, no. 1, pp. 146 -156.

Lunde, PJ 1974, 'Modeling, simulation. and operation of a Sabatier Reactor', Industrial Engineering Chemical Process Design Develop., vol 13, no. 3, pp. 226-233.

Lunde, Peter J., Kester, Frank L. 1974, ' Carbon dioxide methanation on a Ruthenium catalyst', Industrial Engineering Chemical Process Design Develop., vol 13, no. 1, pp. 27-33.

Lunde, Peter J.,Kester, Frank L 1973, 'Rates of Methane formation from carbon dioxide and hydrogen over a ruthenium catalyst', Journal of catalysis, no. 30, pp. 423-429.

Passut, Charles A., Danner, Ronaldo P. 1972, 'Correlation of ideal gas enthalpy, heat capacity and entropy', Industrial Engineering Chemical Process Design Develop., vol 11, no. 4, pp. 543-544.

Taglia P.G, P 2010, 'Biogas: rethinking the mid west's potential', clean Wisconsin.

Violeta Bescós, LCSC 2008, 'Integration of synthetic methane into the existing biogas production of Henriksdal', Report for the design course, p. 3.