

A REVIEW ON WASTE PLASTIC FUEL FOR AUTOMOTIVE ENGINES

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Abstract: ‘Necessity is the mother of innovation. The present-day civilization is completely dependent upon the conventional sources of energy as a part of their useful daily needs and activities. Here, emerges the need for alternative fuels as the conventional sources of fuels are about to run out. As these fuels are not renewable sources of energy. This is the major cause of concern for alternative fuels. Also the increased level of environmental pollution due to the harmful emissions leading to global warming, temperature rise, and various health hazards is now clearly demanding a cleaner and greener environment. The increasing production of plastics along with its advantages and convenience has lead a major threat of its disadvantage of not getting decomposed. Its proper disposal and treatment for recycling or conversion is necessary which is our aim of the project. As the country faces a major problem of plastic waste management and fuel crisis and their burning prices the conversion of waste plastic into a fuel having properties similar to petrol, diesel, and kerosene would prove to be a boon for the common man. Pyrolysis is the process for converting the waste plastic into fuel with help of certain additives. Thus implementation of this project and setups would be greater relief for the common man and would be effective tool for waste management and as well as will be a clean source of alternative fuels having similar properties reducing the pollutants and help in building a cleaner and greener environment. Also tackling the serious issue of the price-hikes.

Index Terms- Alternative fuels, Environmental pollution, Fuel crises, Plastic waste management, Pyrolysis

I. INTRODUCTION

Large amount of monomers when react to form a chain structure are called as polymers. Most of the basic kinds of plastics are made out of monomers which are of same type. Plastics are difficult to be degraded in small period of time. The plastics waste are segregated into two types by their source which may be either municipal or industrial. Polypropylene, Polystyrene, HDPE (High Density Polyethylene), LDPE(Low Density Polyethylene)are the types of plastics. The chain structures and polymers sizes also distinguish the plastics. The most commonly used plastics in this type are silicones, acrylics, polyurethanes. Refrigerated containers, bags, most bottle lids, carpets and some food wraps. There are two main types of plastics: Thermoplastics and Thermosetting polymers. These waste plastic convert to useful oil and reduces many problems increasing in world. ^[1]

II. LITERATURE REVIEW

Prof. Raj Kumar Yadav & Prof. Yogesh Kumar Themburne using pyrolysis method converted the waste plastic fuel into fuel effectively and found out that HDPE plastic exhibited approximately similar properties to petrol and LDPE plastic after cracking had approximately similar properties to diesel. Using Taguchi method they also checked the feasibility of the fuel and Signal to Noise Ratio considering parameters catalyst, time, and temperature. They concluded that plastic fuel used in petrol engine 100cc bike increased the efficiency by 15-20%. Also increased the thermal efficiency as well. Conversion of plastic at lower temperature in the presence of catalyst can be feasible alternative fuel. ^[1]

Asst Prof. P. K. Ingawale, Prof. V. V. Dhonde, Prof. A. D. Kumkar, Prof. T. D. Chendge using thermal pyrolysis produced plastic fuel they also gave the selection of plastic criteria, feasibility, and physical properties were also evaluated .The petrol engine was effectively run on 100% plastic fuel and it had 50% increase in the thermal efficiency at rated power and 75% increase in thermal efficiency when used in diesel engine.20% increase in mechanical efficiency and brake power was observed as compared to diesel engine when plastic fuel was used in petrol engine.^[2]

Prof. Y. P .Chauhan, Prof G. H. More, Prof C. R. Mane, Prof T. Y. Salunkhe, Prof D. D. Shinde carried out thermolysis of waste plastic using LDPE and got the properties similar to diesel fuel. Controlling various parameters like temperature, pressure, catalyst amount yield can be increased was their observation. ^[3]

III. METHODOLOGY

Pyrolysis method: -

The process which is used for conversion of plastic into fuel is pyrolysis. Chemical decomposition of organic substances with the help of heat is pyrolysis. It is the chemical reaction which primarily takes place after burning of organic fuels and also of wood, cotton, paper, etc. Pyrolysis process in the absence of water can also be used to produce liquid fuel similar to diesel from plastic waste. This is the technology of degeneracy of plastic by application of heat in the absence of oxygen. Waste Plastic is heated in a cylindrical combustion chamber at temperature of about 300°C – 350°C. Plastic waste is adversely affecting the human life as well as the nature cycles. So, it is of utmost importance that the recycling of plastic is done. This transforms plastic to a better alternative for use reducing the degradation of nature as well as harm to mankind.

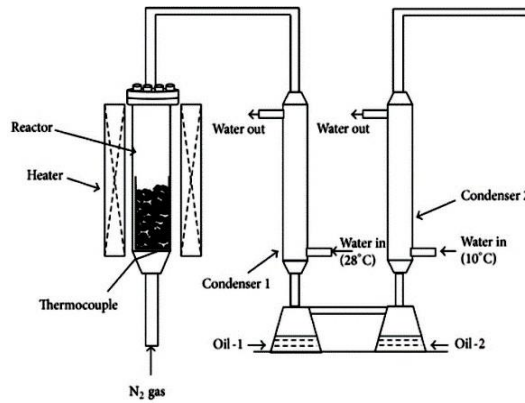


Fig 1-Pyrolysis Process Setup^[4]

SELECTION OF PLASTICS

There are two types of plastic: -

1. THERMO PLASTIC

Plastic once produced can be performed to various shape over and over until that point it loses its property.

Thermoplastics can more than once mellow and liquefy if enough warmth and solidified on cooling, with the goal that they can be made into new plastic items

ILLUSRATION:-

Polypropylene, polyethylene, polystyrene, nylon, etc.

APPLICATION: -

Low density polyethylene (LPDE) utilized as a part of plastic packs and adaptable compartments. High Density Polyethylene (HDPE) utilized as a part of channelling, cleanser bottles, and oil bottles. Polyethylene is utilized as a part of basins and sustenance compartments, Nylon ropes; Polystyrene is utilized as a part of glasses and plates, etc.^[5]

2. THERMOSETTING PLASTIC: -

Plastics which once delivered can't be re-adjusted by the use of warmth. In the event that the warmth connected builds, plastic will swing it to scorch.

Thermosets or thermosetting can soften and come to fruition just once. They are not appropriate for rehashed warm medicines; along these lines after they have set, they remain strong.

ILLUSRATION:-

Polyester, Phenol formaldehyde, Melamine Formaldehyde, Urea Formaldehyde, etc.

APPLICATION: -

Melamine cutlery for electrical protections, Electrical switches, Formica table tops, etc.^[5]

Table 1: Properties^[5]

RESIN	THERMOFUEL SYSTEM STABILITY
Polyethylene(PE)	Very Good
Polypropylene(PP)	Very Good
Polystyrene(PS)	Very Good(gives excellent fuel properties)
ABS Resin (ABS)	Good
Polyvinylchloride (PVC)	Not suitable, should be avoided

IV. CONSTRUCTION

Combustion Chamber: -We used pressure cooker as a combustion chamber. It is an aluminium 10 litre capacity pressure cooker purchased from market. In combustion chamber, 1 kg plastic shredded into small pieces put into pressure cooker & heating plastic at temperature of 300°C – 350°C. Temperature gauge, Thermowell and pressure sensor and safety valve are mounted at the top of pressure cooker.



Fig 2-Pressure Cooker

Heating Coil: - For this purpose, electrical coil heater of rating 2 KW is used to provide heat energy required for cracking of the plastic molecules present inside the combustion chamber. The special type of heater having coil shown in following figure uses electric energy resistance as a heating source.



Fig 3-Heating Coil

Pressure gauge: - Pressure gauge is used to measure pressure inside the combustion chamber. The pressure range of gauge is 0 – 10 bar.



Fig 4-Pressure Gauge

Temperature sensor: - Temperature gauge is used to determine temperature of the reactor. The temperature range of gauge is 0°C – 400°C.



Fig 5-Temperature Gauge

Safety valve: - The safety valve is provided at the top cover of the combustion chamber or pressure cooker to release the excess pressure to avoid the bursting due to high pressure.



Fig 6-Safety Valve

Catalyst: - Catalyst Coal Fly Ash was used for speeding up the reaction and increasing the yield of fuel. It consists of Silicon dioxide, Aluminium oxide and calcium dioxide about 70%.

V. ADVANTAGES

Effective tool of Plastic Waste Management-Plastic waste influences the environment and has harmful effects on plants, animals, or humans.

Environmental pollution has been decreased as the pollutants have been reduced than the conventional fuels:-Plastic has noxious pollutants which contaminate the environment and cause land, water and air pollution. No harmful pollutants evolved or emitted during the pyrolysis process:-

In comparison to petrol and diesel fuels, the plastic fuel has more feasibility as an alternative fuel with a low cost.

Problem of shortage of fuels to the industries as well as automobile sector may be solved:-The demand of fuel increases due to the depletion of fossil fuels. This problem may be resolved due to the process of pyrolysis.

VI. FUTURE SCOPE

1. This fuel can be blend with certain oils and additives in order to get various blends of diesel for operating at various conditions.
2. The properties of the petrol fuel can be changed by certain additives to reduce the excess of HC & CO₂ emissions.
3. The plant can be setup at a domestic level for producing fuels at a lower cost as per the requirement.

VII. CONCLUSION

1. The problems of plastic waste management and fuel shortage occurred due to the depletion of fossil fuels may be resolved with the help of pyrolysis process.
2. Harmful emissions, CO and NO_x were observed to be lower than gasoline in all working conditions.
3. The unburned HC and CO₂ has been observed as slighter higher with the use of plastic petrol than the gasoline.
4. It may reduce the cost of fuel source and it may become more environment friendly which leads to clean and green environment.

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