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CONVERSION OF WASTE PLASTICS INTO ALTERNATIVE FUEL

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ABSTRACT

Plastic waste is regarded as potentially economy source of chemicals and energy. Lots of us have come across a variety of products that use plastic materials today. As a result of the increasing level of private consumption of these plastic materials huge amounts of wastes are discharged to the environment. Catalytic cracking is a process that converts waste plastics into valuable liquid hydrocarbon products that can be utilized as an energy source for numerous purposes such as diesel engines, generators, vehicles, etc. The gaseous by- product obtained in the process can be used for domestic use by refilling it in the cylinders and also to run gas turbines. Thus cracking process can be considered as another non-conventional energy source. Crude oil is the ultimate source of plastics and most of the chemicals. Out of total 100 million tons plastics produced every year all over the world, 25 million tons is dumped. By throwing away such heavy amount of waste plastics, wasting lots of energy in the form of crude oil that is used to make plastics. The wasted energy can be recovered back using Pyrolysis process. This process save our conventional energy source i.e. crude oil. In this scenario our paper aims to solve the twin problem of environment pollution due to plastic and need for an alternative fuel source.

KEYWORDS: Plastics, waste energy, fuel oil, environmental pollution.

INTRODUCTION

Waste plastic disposal and excessive use of fossil fuels have caused environment concerns in the world. Both plastics and petroleum derived fuels are hydrocarbons that contain the elements of carbon and hydrogen. The difference between them is that plastic molecules have longer carbon chains than those in LPG, petrol, and diesel fuels. Therefore, it is possible to convert waste plastic into fuels. Plastic wastes such as, polypropylene, low density polyethylene, high density polyethylene, polystyrene are the most frequently used in everyday activities and disposed of to the environment after service. Plastic are those substances which can take long periods of time to decompose if disposed off simply to the environment. Therefore, waste plastic should be changed into usable resources. The different waste plastics were thermally cracked at different temperatures and then it was tried to measure the oil produced, the residue left after the reaction is completed, and the gas produced. Then it is compared that which types of plastics can yield higher amount of oil. There are a number of methods by which plastic wastes can be managed such as incineration, recycling, land filling, and thermal cracking. But this work focuses on thermal cracking of waste plastic to change them into usable resources, because in this method the emission of hazardous gases to the environment insignificant. The waste can be changed into useful resources.

MATERIALS AND CHEMICALS

The following materials and chemicals are used for the thesis work for producing fuel oil from waste plastics.

- ✓ Various types of waste plastics are main raw materials which includes Polyethylene Terephthalate (PET), Low Density Poly Ethylene (LDPE), High Density Poly Ethylene (HDPE), Polypropylene (PP) Polystyrene (PS)
- ✓ Aluminium silicate - used as a catalyst

EXPERIMENTAL STEP UP AND DESCRIPTION

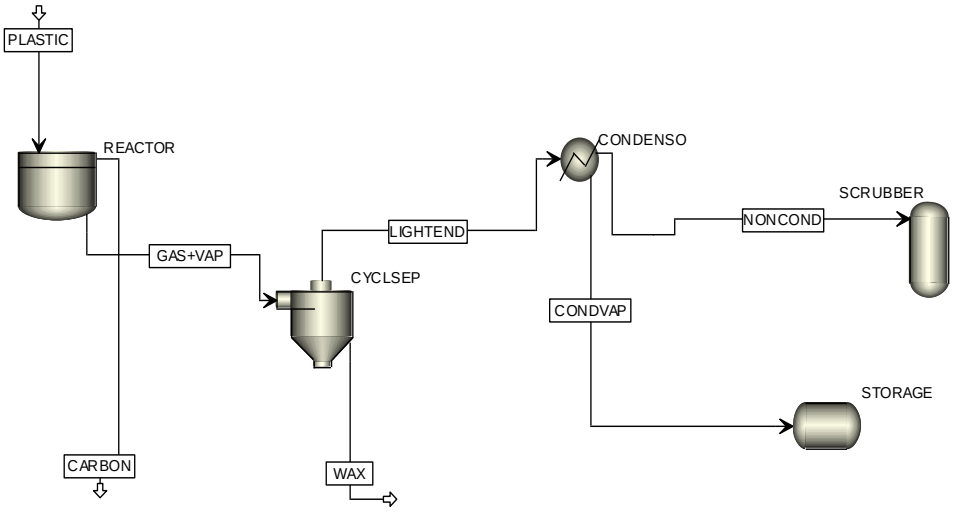

Figure 1: Experimental Setup with flow diagram

Waste plastics are first collected, after the waste plastics were collected, it was washed to remove the impurities and then was dried to remove any water droplets. Then the washed plastic was sorted according to their categories. Finally, it was shredded and cut into pieces for ease of feeding the raw materials and for good heat transfer. 1 ton was weighed and feed to the reactor and the reactor was properly sealed to protect the gas from leaking. Adequate precautions were put in place to make sure there is no leakage before start of experiment.

EXPERIMENTAL PROCEDURE

Preparation of raw material:

- ✓ 1 ton of waste plastics are taken and washed several times with water to remove dust and soil particles present on it.
- ✓ Later it is cut into long pieces.
- ✓ They are dried at room temperature for about 30 minutes to further reduce the water content.

Process Description:

- ✓ The waste plastic is placed into the reactor for drying.Aluminum silicate is used as a catalyst is fed into the reactor as Feed-1 kg + catalyst 2.5 %
- ✓ The reactor is placed in a heating furnace and maintained the temperature 330-450 ^{o}C
- ✓ Gases form the reactor is sent to a cyclone separator. The heavy ends from the separator are collected in a tank at the bottom as Wax and the light ends are sent to a condenser.
- ✓ From the condenser, two products condensable vapors and non-condensable gases are obtained
- ✓ Non-condensable gases are removed by using a gas scrubber. These gases are rich in methane, ethane, ethylene and can be used for power generationhe condensable vapors are collected as oil in a tank.
- ✓ The entire time required for the process is 12 hours. The products obtained are Oil (60% to 70%), Gas (15% to 20%) and Black Carbon (20% to 30%).

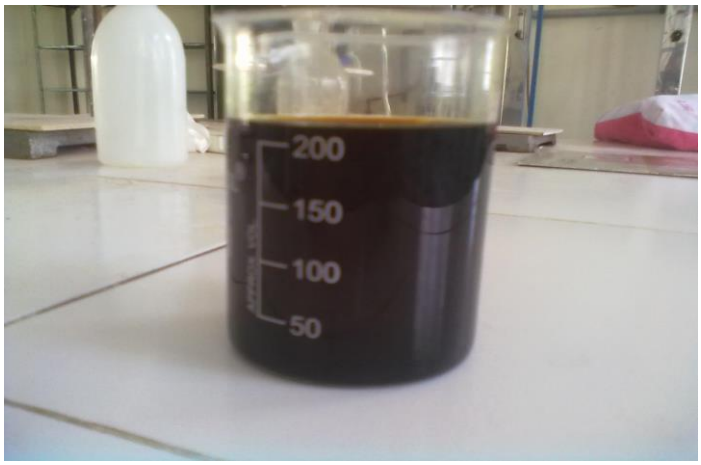

Figure 2: Plastic Oil

Distillation of Plastic Oil

- The obtained oil is distilled by differential distillation
- The Temperatures are maintained:- below 180˚C and between 210-340˚C

Products obtained at different temperatures are shown in figures.

Figure 3: Product 1 –Below 180 ˚C (extracted - 20%)

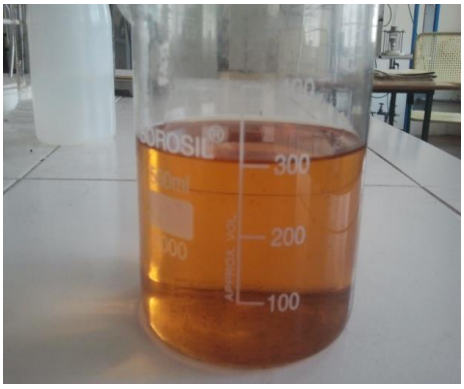

Figure 4: Product 2 –Between 210-340 ˚C (extracted - 34%)

Figure 5: Product 3 –Residue (Tar 46%)

RESULTS & DISCUSSION

The performance curves for fuel consumption Vs Brake power for 40% Oil +60% Petrol as shown below.

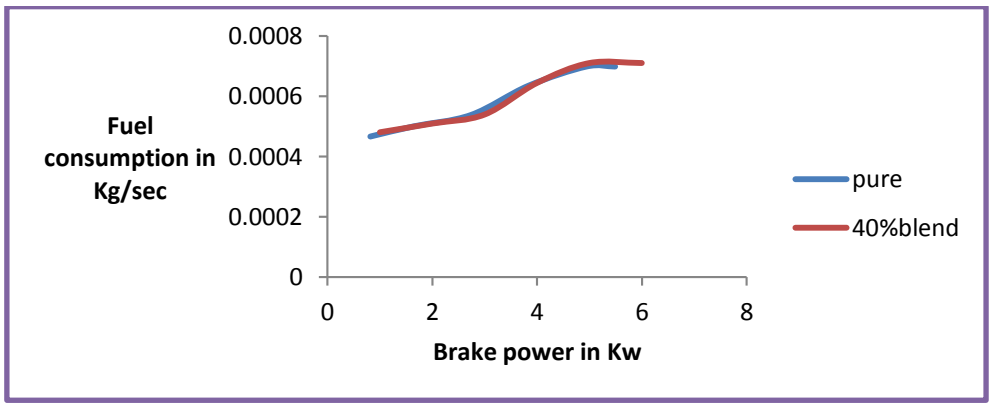

Figure 6: Fuel Consumption Vs Brake Power

As the Brake power increases the fuel consumption will gradually increases which indicates the engine performance.

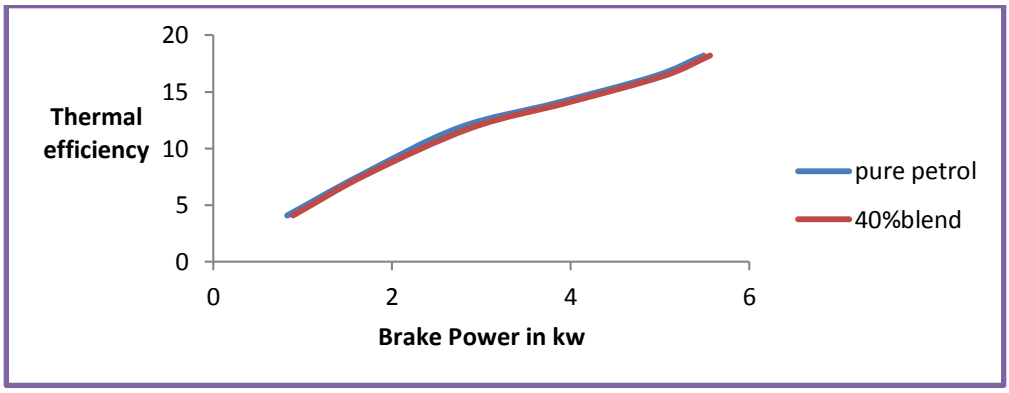

Figure 7: Thermal efficiency Vs Brake Power

As the brake power increases the thermal efficiency will be increases which indicate the efficiency of engine will depends on thermal characteristics of fuel.

For 10% Plastic Oil+ 90% Diesel:

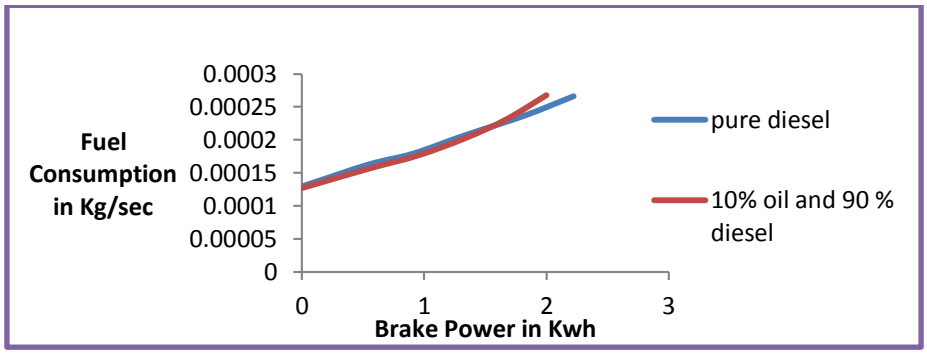

Figure 8: Fuel consumption Vs Brake power

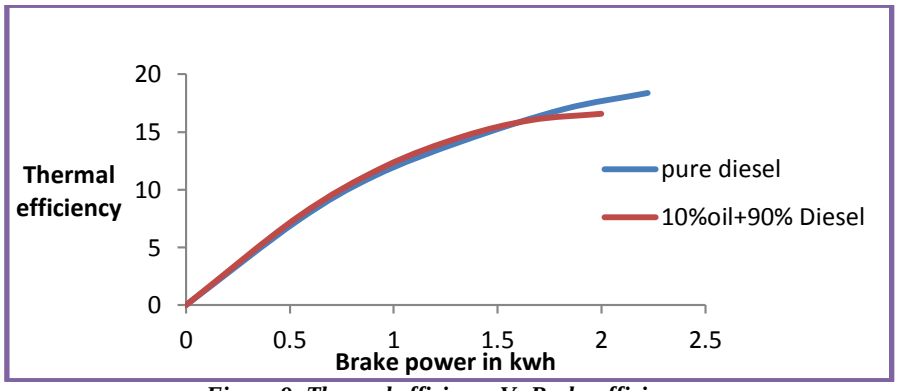

Figure 9: Thermal efficiency Vs Brake efficiency

For 30% Oil + 70% Diesel:

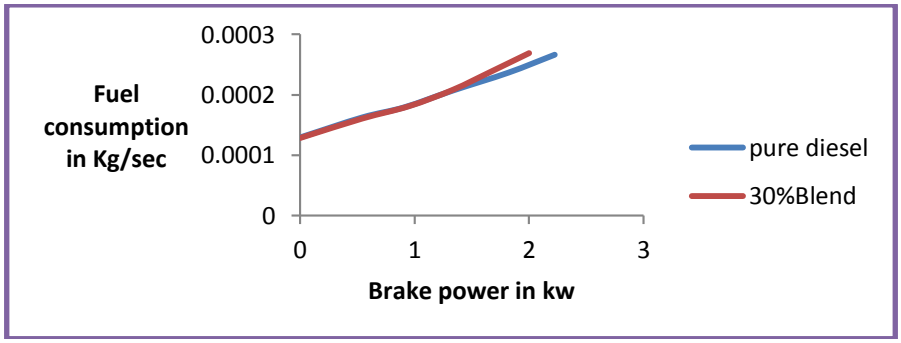

Figure 10: Fuel consumption Vs Brake power

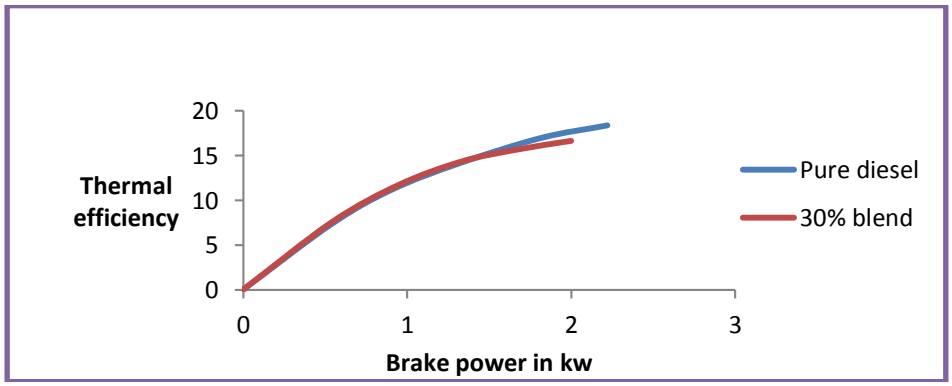

Figure 10: Thermal efficiency Vs Brake power

For 50% Oil + 50% Diesel:

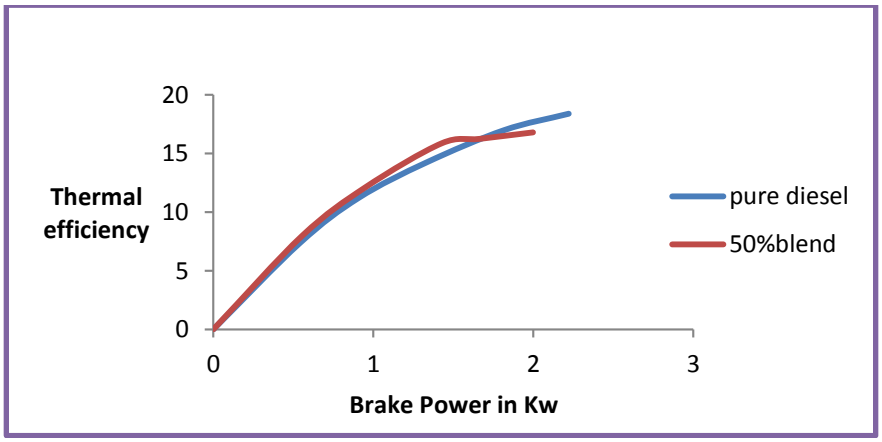

Figure 11: Thermal efficiency Vs Brake power

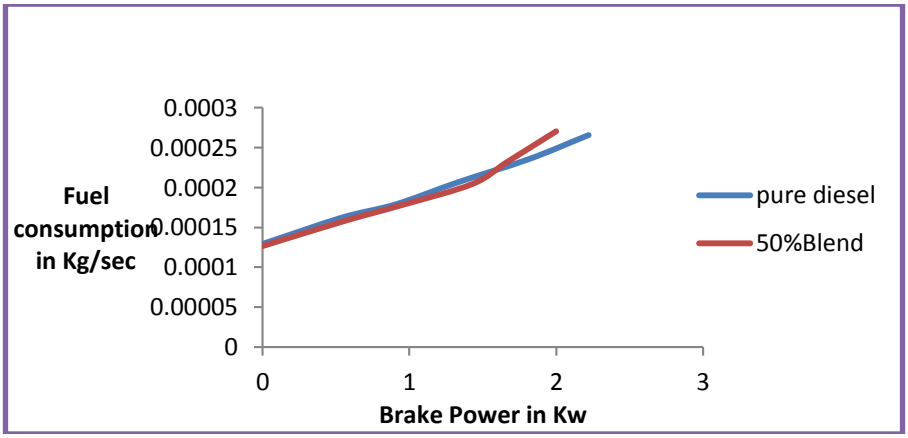

Figure 12: Fuel consumption Vs Brake power

The above stated figures will indicate the thermal efficiency, fuel consumption with brake power. It will indicate the characteristics curves for different ratios of oil and diesel. The characteristics curves will increase with increase of brake power.

CONCLUSIONS

Plastic waste from landfills, utilizing the embodied energy content of plastics and producing a highly usable commodity that, due to its cleaner burning characteristics, is in itself more environmentally friendly than conventional distillate. As the confirmation tests of the products obtained are satisfied when compared to diesel and petrol, thus the products obtained through this process can be used as fuel. The characteristic curves will indicate the brake power versus fuel consumption for different ratios of oil and diesel respectively. The present rate of economic growth is unimaginable without saving of fossil fuel energy like crude oil, natural gas or coal. Thermo fuel is a truly sustainable waste solution, producing a highly useful commodity.

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