Performance Testing of VCR Engine using Plastic Oil Produced by Pyrolysis Method

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ABSTRACT : Recycling is the retrieval, reclamation, reprocessing or refining process of waste to produce new products. Recycling has always been a top priority in waste management since it enables us not only to maintain the health of the environment, but also to reuse garbage profitably. Many techniques are utilised to transform plastic waste into articles that are not present in virgin plastic with distinctive features. Polymers undergo molecular and structural changes in this process leading to simpler basic materials with superior thermal properties than original plastics. While gasification and pyrolysis processes break plastics down, fluid and semi-liquid products are also generated.

Keywords: Waste plastic pyrolysis oil, diesel Compression ratio feature, Output

1. INTRODUCTION

Endothermally irreversible thermochemical disintegration The disintegration of complex, long-chain organic polymer molecules into units of simple short-chain composites occurs with or without pressure at temperatures over 300 C in the absence of air oxygen. A plastic waste pyrolyse involves the breakdown into solid, liquid and gas components of polymers. Char is primarily carbon in the solid phase, with minor quantities of other components depending on
plastics. Oil-like material is employed in a liquid product that has features akin to diesel, similar to those originally petroleum-based polymers. Petroleum products like plastics are produced from a liquid material similar to oil. The gaseous phase results from Syngas (synthetic gas) and has a high calorific value. While pyrolyses need a number of phases Temperature Residence time

- Presence of catalyst
- Catalyst loading
- Catalyst contact mode
- Reactor Type

2. DISCRIBTION
2.1 PYROLYSIS TECHNOLOGY

Pyro: heat, lysis: pafis disintegration. Pyrolysis is a chemical process that divides big molecules into smaller ones. The simplest example is the boiling of complex food molecules into smaller and easily consumable ones.

Plastic waste and pneumatic is long-chain molecules or hydrocarbons of polymer. Pyrolysis technology is the industrial process for the breakdown of big plastic/tire molecules into smaller oil, gas and carbon black molecules. In the absence of oxygen, plastic or tyre waste is pyrolysed at 350 to 550 degrees C and the reaction time is about 15 to 90 minutes.

2.1 pyrolysis process

2.2 PYROLYSIS OIL

Pyrolysis oil is a sorney called biological crude oil or biological oil. It is a synthetic fuel under study as a replacement for petroleum. Biomass is extracted from dry biomass in a reactor with a temperature of about 500 degrees Celsius, with subsequent cooling, using liquid technique of destructive distillation. Pyrolysis oil is a kind of tar, which usually includes oxygen that is too high to be a hydrocarbon. This differs significantly from comparable petroleum products

2.3 CHARACTERST PYROLYSIS

The pyrolysis-produced oil is acidic with a PH of 1.5-3.8. Acidity may be reduced by adding easily accessible basic components. There was little study on the stability of bio-oil acidity which has been changed with base components, whereas the precise composition of bio-oil relies on the bio mass source and circumstances. A typical falls of water is 20-28%,
suspended particles and pyrolytic lignine 22-36yo, hydroxylacetaldehyde 8-120, levoglucosane 3-8o/o, acetyl acid 4-8%, acetol 3-6o/o, glycol 1-2 0/o, formic acid 3-6. During pyrolysis the water molecules are broken up and kept separately in other compounds with the pyrolysis liquid in the complex. The difference is important, since "water" does not separate as normal fossil fuels in pyrolysis oils

Batch Mode, Continuous Flow Mode, Fixed Bed, Fluidized Bed Reactor, and more variations are available.

Product yield at 430 degrees Celsius from actual waste plastics (from a German source) in a batch reactor was measured.

| Product(s) | Thermal Pyrolysis Cat. | Pyrolysis (zeolite) |
|------------|----------------------|-------------------|
| Oil        | ±78.7                | ±76.7 %           |
| Gas        | ±7.6 %               | ±9.4 %            |
| (char & CaO)| ±17 %               | ±8.8 %            |

The inclusion of a catalyst increased the production of both gas and oil products while decreasing the yield of char product (char product).

2.4 PYROLYSIS BY CATALYTIC PYROLYSIS

Because of the ease with which heterogeneous catalysts may be recovered, they have become increasingly popular.

Lewis acids such as AlCl3, FeCl3, and other similar compounds are employed as homogeneous catalysts.

Solid acids, zeolites, silica alumina, and FCC catalyse reactions in heterogeneous catalysts.

Because of the acidity of their active sites and the crystalline microporous structure of their materials, they are particularly well suited for achieving high conversion at low temperature (temperature).

The acidic characteristics of these solids, particularly the strength and number of acidic sites, are responsible for the differences in their catalytic activity.

Properties of structures such as particle size, pore size distribution, and specific area have an important influence in the performance of these materials and composites.

3. EXPERIMENT SETTINGS FOR THE TEST:

The engine is directly connected to an eddy current dynamometer with a capacity of 3.5 kW (1500 rpm) and a direct drive. The engine and the air-cooled eddy current dynamometer are connected together by means of a tyre coupling system. The output shaft of the engine is linked to the dynamometer by way of a torque transducer, which measures the torque produced by the engine. A torque transducer generates an electrical signal that is proportional to the amount of torque applied to it. It is possible to transform a force into an electrical signal using a load cell, which is an electronic device (also known as a transducer). The load placed on the engine may be changed by manipulating the potentiometer on the control panel or by using the computer to control the load.
4. EXPERIMENTAL PROCEDURE

Plastic oil poured into a tank and monitored the engine installations like coolant water, lubrication oil, fuel flow pipes, air lock and tested before engine experiments were started. And the test engine has been started and may be operated till steady conditions have been reached. The load of the engine was progressively raised to the maximum weight needed. At the same time, the dynamometer, all analyzers and measuring meters were activated, and manufacturers' instruction manuals carried out the proper preparation and measuring settings according to recommended methods. The testing were begun after the test engine was steady and the measurements were arranged and settings completed. The experiment technique is a continuous engine status test. Load settings were five phases with loads 0%, 25%, 50% and 75% correspondingly. Or each load-point, measured air intake, fuel consumption, air intake temperature, air intake temperature, gas exhaust temperature, engine cooling temperature, injection fuel speed, combustion pressure, crank angle, emission of hydrocarbon (HC), CO emissions, nitrogen oxides (NOX) emissions and sm.
5. RESULT AND DISCUSSION

Plastic oil tested in VCR engine and 5 gas analyzer has got readings. Based on that emission & performance reading I plot the graphs

5.1 CARBON MONOXIDE VS LOAD

![Graph showing CO vs Load](image1)

**Fig.5.1** Variation of load Vs. CO

In this graph CO value shows the pyrolysis plastic oil compare with diesel with different load testing. The plastic oil value was higher then the diesel value in middle load but higher load plastic oil value is same to compare the diesel value.

HYDROCARBON VS LOAD

5.2 HYDROCARBONS VS LOAD

![Graph showing HC vs Load](image2)

**Fig.5.2** Variation of load Vs HC

In this graph HC value shows the pyrolysis plastic oil compare with diesel with different load testing. The plastic oil value was higher then the diesel value in initial load but higher load plastic oil value has lower to compare the diesel value higher engine load. From the results it is seen that the unburnt hydrocarbons is more at full load conditions, due to improper atomization of fuel.

5.3 CARBON DIOXIDE VS LOAD

![Graph showing CO2 vs Load](image3)

**Fig.5.3** Variation of load Vs CO₂
In this graph CO value shows the pyrolysis plastic oil compare with diesel with different load testing. The plastic oil value was all most same like the diesel value

5. 4. NITRIC OXIDE VS LOAD

![Fig.5.4 Variation of load Vs NOX](image)

In this graph NOₓ value shows the pyrolysis plastic oil compare with diesel with different load testing. The plastic oil value was shows lower than the diesel value

5.5 SPECIFIC FUEL CONSUMPTION VS LOAD

![Fig.5.5 Variation of load Vs SFC](image)

In this graph SFC value shows the pyrolysis plastic oil compare with diesel with different load testing. The plastic oil value was shows lower than the diesel value

5.6. BREAK THERMAL EFFICIENCY VS LOAD

![Fig.5.6 Variation of load Vs BTH](image)

In this graph BTE vale shows the percentage of pyrolysis plastic oil compare with diesel with different load testing. The plastic oil value was all most same like the diesel value
6. CONCLUSION

Engine worked well without any significant changes to WPO. Thermal brakes The efficiency of the mixtures is reduced compared to diesel. The use of the mixture compared to diesel reduced CO emissions. The use of waste plastic oil as diesel has increased the emissions of NOx. In comparison to conventional diesel, the performance, emission and combustion characteristics of the multi-fuel variable compression engine fuelled by waste plastic oil and diesel mixes have been examined. The experimental findings indicate that the BTE, SFC of a variable compression motor, is based on the mixing waste, load and compression ratios of plastic oil. From this study the following findings are drawn: The thermal brake efficiency of the B30 mix is somewhat better than the regular diesel at a higher compression ratio. The particular fuel consumption of the B30 mixture is lower than that of all other combinations and diesel. This may be attributed to improved combustion and an increase in the mixture's energy content. For B30 and diesel the highest power generated at the compression ratio 18 is 2.07 kW and 2.12 kW. At greater compression rates, hydrocarbon emissions from different mixtures are increased. The increased compression ratio increases the HC emissions for the B30 mixture. The emission of nitrogen oxides (NOx) from the B30 waste plastic oil mix is greater than diesel. The CO emissions from the B30 combination are closer to the normal diesel and at the compression ratio 18 are much higher. NOx emissions have increased somewhat, but they are still similar to those of regular diesel fuel and are likewise acceptable. The experimental results also show that lower and medium percentages of waste petrol may be replaced by incomplete combustion of diesel fuel.

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