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PROPERTIES ANALYSIS OF WASTE PLASTIC OIL AND SIZE MEASUREMENT OF NANO PARTICLE (ALUMINIUM OXIDE)

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ABSTRACT

Environment concerns and depletion of petroleum fuels have created a need for the search fuels for internal combustion engines. Transformation of waste to energy is one of the recent trends in minimizing not only the waste disposal but also could be used as another fuel for internal combustion engines. Plastics are vitally necessary materials in the modern world and application in the industrial field is continually increasing. In this context, waste plastic are currently receiving renewed interest. As an alternative, non-biodegradable, and renewable fuel, waste plastic oil its receiving increasing attention. In this work we choose plastic oil as alternate fuel its properties which relates almost same to diesel. So plastic oil is used as an alternate fuel for direct injection diesel engine.

KEYWORDS: Internal combustion engines, plastics, plastic oil, fuel, alternative fuel, performance, combustion, emission, direct injection.

INTRODUCTION

Diesel engines and petrol engines are the most efficient prime movers, from the point of view of protecting global environment and concerns for long-term energy security it becomes necessary to develop alternative fuels with properties comparable to petroleum based fuels. Unlike rest of the world, India's demand for diesel fuels is roughly six times that of gasoline hence seeking alternative to mineral diesel is a natural choice. Alternative fuels should be easily available at low cost, be environment friendly and fulfil Energy security needs without sacrificing engine's operational performance. Waste to energy is the recent trend in the selection of alternate fuels. Fuels like alcohol, biodiesel, liquid fuel from plastics etc. are some of the alternative fuels for the internal combustion engines. Utilization of biomass as alternative fuel for compression ignition engine has a great scope especially in developing and undeveloped countries. Plastics have become an indispensable part in today's world, due to their lightweight, durability, energy efficiency, coupled with a faster rate of production and design flexibility, these plastics are employed in entire gamut of industrial and domestic areas hence plastics have become essential materials and their applications in the industrial field are continually increasing. At the same time, waste plastics have created a very serious environmental challenge because of their huge quantities and their disposal problems. Instead of biodegradation, plastics waste goes through photo-degradation and turns into plastic dusts which can enter in the food chain and can cause complex health issues to earth habitants, through the thermal treatment on the waste plastic the fuel can be derive, by adopting the chemical process such as Pyrolysis can be used to safely convert waste plastics into hydrocarbon fuels that can be used for Transportation. Sunbong lee [1] studied that the pyrolysis oil property various depending on the raw waste plastic and pyrolysis condition. The raw plastic oil was blended with diesel 20% and 40% volumetric ratio. Present pyrolysis oil can be used in diesel engine with 20% without any engine limitation and with 40% blending at limited engine speed 2450rpm. Mani [2] did the experimental result shows that stable performance with brake efficiency similar to that of diesel engine. Carbon dioxide and unburned hydrocarbon were higher than that of the diesel base line. The toxic gas carbon mono oxide emission of waste plastic oil was higher than diesel. Smoke reduced by about 40% to 50% in waste plastic oil at all blends. Anup T J [3] Petrol Engine was able to

run with 100% waste plastic oil. Engine fueled with waste plastic pyrolysis oil exhibits higher thermal efficiency up to 50% of the rated power for petrol engine. Engine fueled with waste plastic pyrolysis oil exhibits higher thermal efficiency up to 75% of the rated power for diesel engine. The exhaust gas temperature for waste plastic pyrolysis oil is higher than diesel and petrol for engine performance. Unburned hydrocarbon emission of waste plastic pyrolysis oil is less than that of diesel and petrol; for the different load. The NOx emission in waste plastic oil varies from 55 ppm to 91 ppm for petrol grade fuel of plastic oil, and for diesel grade fuel of plastic oil varies from 192 ppm to 1268 ppm. CO emission increased by 5% in waste plastic oil compared to diesel operation. The CO2 concentration increases with increase in load, due to incomplete combustion.

Brewer [4] studied the use of sunflower seed oil as a renewable energy source. When operating tractors with 100% sunflower oil instead of diesel fuel, an 8% power loss accrued after 1000 hours of operation. The power loss was corrected by replacing the fuel injector and injector pump. After 1300 hours of operation, the carbon deposits in the engine were reported to be equivalent to an engine fueled with 100% diesel except for the injector tips which exhibited excessive carbon build-up. Mani [5] studied the experimental results have showed a stable performance with brake thermal efficiency similar to that of diesel. Carbon dioxide and unburned hydrocarbon were marginally higher than that of the diesel baseline. The toxic gas carbon monoxide emission of waste plastic oil was higher than diesel. Smoke reduced by about 40% to 50% in waste plastic oil at all loads. Ghaly [6] reported that the research on the production of biodiesel has increased significantly in recent years because of the need for an alternative fuel which endows with biodegradability, low toxicity and renewability. Theansuwan and Triratanasirichai [7] concluded that the biodiesel produced by transesterification showed similar properties to the standard biodiesel. Agarwal [8] investigated that the process of transesterification is found to be an effective method of reducing viscosity of vegetable oil. Lawrence [9] revealed that prickly poppy methyl ester (PPME) blended with diesel could be conveniently used as a diesel substitute in a diesel engine. The test further showed that there was an increase in break thermal efficiency, brake power and reduction of specific fuel consumption for PPME and its blends with diesel.

Deepanraj [10] described that the lower blends of biodiesel increased the brake thermal efficiency and reduced the fuel consumption. In addition to this, biodiesel blends produce lower engine emissions than diesel. Rahimi used Diesterol (combination of diesel fuel, bioethanol and sunflower methyl ester) as a fuel for diesel engines. The authors revealed that, as the percentage of bioethanol in the blends is increased, the percentage of CO concentration in the emission is reduced. This trend is due to the fact that bioethanol has less carbon than diesel.

Waste plastic processing

The feed systems consists of equipment foe sizing hard, thick flexible and thin flexible materials, which normally constitutes the municipal waste stream. The system essentially consists of sorter and sizing equipment like crusher, cutter and shredder. The various size and shape of the material are sorted into categories sui-table for crushing and shredding. The sorted material was crushed or cut or shredded and graded in to uniform size for ease of handling and melting in the melting/preheating process. This process of sizing and grading the waste was semi-automatic. The graded feed was sorted in a hopper before feeding to the process by a conveyor feeder. The sorted feedstock of known composition is stored separately for proportionate feeding for processing nonstandard feed design or processing special feed design. The dust and other fine wastes collected from the cyclone filter were disposed through a vent with particle size monitoring system. The assorted waste plastic was fed in to a reactor along with 1% catalyst and 10% coal and maintained at temperature of 300C to 400C at atmospheric pressure for about 3 hours to 4 hours. The pyrolysis process involves the breakdown of large molecules to small molecules. Produces hydrocarbons with smaller molecular mass that can be separated by fractional distillation and used as fuel and chemicals. This process gives on weight basis 75% of liquid hydrocarbons, which is a mixture of petrol, diesel and kerosene, 5% to 10% residual coke and rest is LPG.

MATERIALS AND METHODS

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.

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Pyrolysis process

Pyrolysis is the chemical decomposition of organic substances by heating the word is originally coined from Greek-derived elements pyro "fire" and lyses "decomposition". Pyrolysis is usually the first chemical reaction that occurs in the burning of many solid organic fuels, cloth, like wood and paper, and also of some kinds of plastic. Anhydrous pyrolysis process can also be used to produce liquid fuel similar to diesel from plastic waste. Conversion process The feed system consists of equipment's for sizing hard, thick flexible and thin flexible materials, which normally constitutes the municipal waste stream. The system essentially consists of sorters and sizing equipment's like crusher, cutter and shredder. The various sizes and shapes of the material are sorted into categories suitable for crushing, cutting and shredding. The sorted material was crushed or cut or shredded and graded into uniform size for ease of handling and melting in the melting/preheating process. This process of sizing and grading the waste was semi-automatic. The graded feed was stored in a hopper before feeding to the process by a conveyor feeder. The sorted feedstock of known composition was stored separately for proportionate feeding for processing nonstandard feed design or processing special feed designs. The assorted waste plastic was fed into a reactor along with 1% (by weight) catalyst and 10% (by weight) coal and maintained at a temperature of 300℃ to 400℃ at atmospheric pressure for about 3 hours to 4 hours. The plastic waste is gently cracked by adding catalyst and the gases are condensed in a series of condensers to give low sulphur content distillate. All this happens continuously to convert the waste plastics into fuel that can be used for generators. The catalyst used in this system will prevent formation of all the dioxins and furans. All gasses from this process are treated before it is let out in atmosphere. The flue gas is treated through scrubber and water/chemical treatment for neutralization. The non-considerable gas goes through water before it is used for burning. Since the plastics is processed about 300℃ to350℃ and there is no oxygen in the processing reactor, most of the toxics are burnt. However, the gas can be used in dual fuel diesel generator set for generation of electricity. 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 % 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 generation 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 1. Raw diesel & Plastic oil

Table1. properties of waste plastic oil and diesel

S.NO	PROPERTIES	WPPO	DIESEL
1	Density(kg/m)	793	850
2	Ash content (%wt)	0.002	0.045
3	Calorific value(kJ/kg)	44200	42000
4	Kinematic viscosity 40c(cst)	2.149	3.05
5	Cetane number	50	55
6	Flash point	40	50
7	Fire point	44	56

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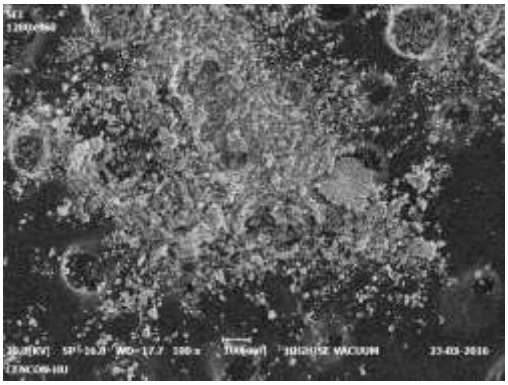
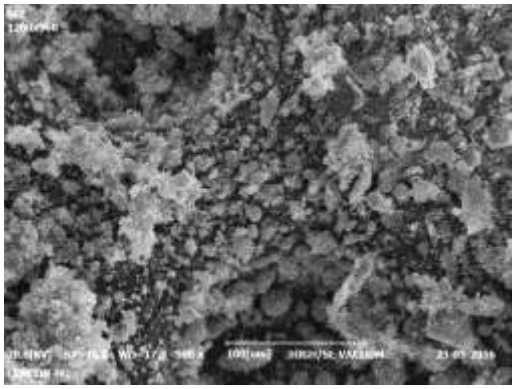
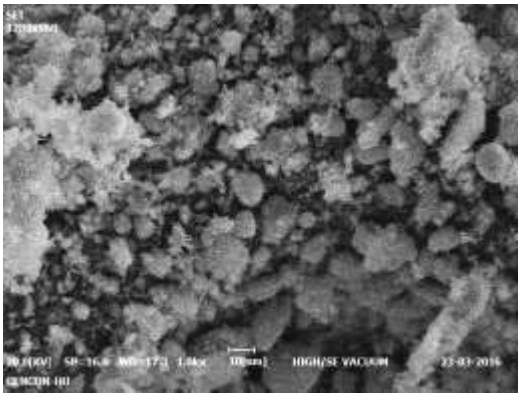
8	Carbon residue (%)	0.13	0.20
9	Sulphur content (%)	0.010	0.035
10	Specific gravity	0.83	0.85

SEM IMAGE FOR NANO PARTICLE (ALUMINUM OXIDE)







SEM imaging is the analysis to carry out the measurement of Nano particle size. Where this Nano particle Aluminium oxide will be used as addictive with fuel (wpo). By referring few journals we conclude that adding the addictive will increase the efficiency of the fuel and performance of the engine.

RESULT AND DISCUSSION

In this project phase the fuel properties of diesel and water plastic oil were tested. And compared the properties of the two fuel. Here conclude that the properties of the waste plastic oil is almost same which relates to diesel. So waste plastic oil will best suitable fuel of diesel engine.

CONCLUSION

In today's world energy consumption and waste in a major agenda, engineering and scientist are working day and night for few source of energy and also reduce the consumption of the fuels. Dependency on the fossil fuel has gone to extreme, with help of this project we can reduce the dependency and also make use of the waste products.

In this project we extracted the plastic oil by pyrolysis process. The properties of the plastic is attested. And the plastic oil which relates almost same to the property of diesel. So we confirmed for various blending with diesel to test the performance, compression, and emission. The above test is repeated by engine modification.

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