A DIESEL BLEND PROPERTIES COMPARISON OF PLASTIC OIL AND BUTANOL

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ABSTRACT

Demand for energy sources day by day increasing drastically; an era of using alternative energy sources becoming needy. Most positively all over the world usage of plenty of plastic, now it become unworthy, taking it in to account generating of waste plastic oil, sonicated to the ignition levels and blended it with diesel becomes a solution in both the ways. Even the idea of making it was good most hydrocarbons generated from plastic investigations needed to decrease emissions after blending with diesel, most researches worked on butanol as blend properties comparison with butanol also worthy in future investigations. Present work focuses on the preparation and properties evaluation of plastic oil and a comparative statement with butanol properties. Reviews and the possible ways discussed for better approach when the oil blend with diesel.

Key words: Plastic Oil, Butanol, Properties, Blends

INTRODUCTION

Due to its high efficiency, diesel fuel is widely used in industry, power and transport as a main fuel. This would cause significant impacts on human health and the atmosphere on pollutants like carbon monoxide, diesel smoke and hydrocarbons. Fuel from renewable sources is highly promising to help lower these emissions Biodiesel and bio alcohols are the alternative fuels that can be used without significant alteration in the current engines These fuels have similar diesel fuel characteristics. However, clean biodiesel in a diesel motor leads to increased viscosity problems the viscosity of neat biodiesel should therefore be lowered to mitigate the described disadvantages as much as possible. In several studies, low carbon-hydrogens, C–H alcohols such as methanol and ethanol were misunderstood, which led to phase separation to decreased ignition and the possible additives to diesel-biodiesel mixtures are alcohol with a longer chain of C–H and a larger calorific value, normally butanol, pentanol and octanol.

Characterization of Waste Plastic Oil

The waste plastic oil or pyrolysis oil used in this study was extracted from mixed plastic wastes. The chemical compounds contained in the waste plastic oil were analysed by gas chromatography–mass spectrometry (GC–MS), using a gas chromatograph Agilent 7890A coupled to a mass spectrometer Agilent 7000B

2.0 LITERATURE REVIEW

Several researchers have conducted experimental investigation on the diesel engine fueled with diesel blended fuels. Some of them are briefly highlighted in the following section compared the short-term performance of a direct injection diesel engine fuelled with different 1-butanol/diesel blends (from 10% to 30% of 1-butanol by volume) and 1-pentanol/diesel fuel blends (from 10% to 25% of 1-pentanol by volume), without any modifications of the engine. Experimental results showed a slight engine power loss and an increase in brake thermal efficiency when the engine was fuelled with higher alcohols blends instead of straight diesel fuel and a diesel engine, without any modifications, can run successfully on a blend up to 30% 1-butanol/70% diesel fuel or 25% 1-pentanol/75% diesel fuel It has numerous advantages over ethanol and methane, and particularly mixing effects, as an alternative fuel for diesel engines. Researchers performed a study of the use of butanol as diesel engine fuel. It was used for mixing petrol and as a diesel fuel for IC engines. [1] In this study the effects on motors output and exhaust emissions of a single cell direct injection compression ignition engine with the engine running at consistent motor speeds (2000 rPm) and different engine loads were examined by the use of butanol (normal butanol) in conventional gasoline biodiesel blends. [2] The oxygen in fuel molecules helps improve pollution combustion processes. In this research, the impact of bio-diesel on waste plastic oil in terms of basic physical and chemical fuel properties of the resulting combustion fuel, focussing primarily on fuel lubrication and viscosity, engine efficiency, combustion and emission of a single-cylinder diesel engine. The basic parameters of in-cylinder pressure and crank angle were reported during the engine test in the combustion characteristics section. [3] The constant growth in plastics demand contributed, on the other hand, to an increase in the accumulation of plastic waste in sites of waste. For plastics to natural degrade takes billions of years. Continuous plastic dumping in sites that lead to significant and serious contamination of the atmosphere. The system of recycling is seen as an alternative to minimizing plastic waste. However, plastic recycling is an expensive and difficult method because plastic waste includes industrial and municipal waste [4] While plastic recycling can minimize plastic waster, it has attracted much attention to turn plastic waste into fuel these days, either because of the decrease in fossil fuels and because of the fast increase in the cost of producing petroleum fuels. Plastic waste oil is called plastic oil waste (WPO). [5] Several methods for manufacturing WPOs, such as the pyrolysis mechanism, thermal treatment and catalytic conversion have been employed. Pyrolysis process has been shown to be an efficient way of generating WPO using these methods. Pyrolysis is the mechanism of thermally degradation by heat and pressure of the long chain polymer molecules into smaller and less complex Three main products, oil, gas and char, will be formed during pyrolysis. [6] The quantity of WPO produced influences parameter, including temperature pyrolysis, type of catalytic residence type used and type of fluidized gas and its flow rate.

3.0 EXPERIMENTAL SET UP AND PROCEDURE:

The engine shown in plate. 2.1 is a 4 stroke, vertical, single cylinder, water cooled and constant speed diesel engine which is coupled to rope brake drum arrangement to absorb the power produced. The engine crank started. Necessary dead weights and spring balance are included to apply load on brake drum. Suitable cooling water arrangement for the brake drum is provided. Separate cooling water lines fitted with temperature measuring thermocouples are provided for engine cooling. A measuring system for fuel consumption consisting of a fuel tank, burette, and a 3- way cock mounted on stand and stop watch are provided. Air intake is measured using an air tank fitted with an orifice meter and a water U- tube differential manometer. Also, digital temperature indicator with selector switch for temperature measurement and a digital rpm indicator for speed measurement are provided on the panel board. A governor is provided to maintain the constant speed.

Figure: Diesel Engine Test Rig

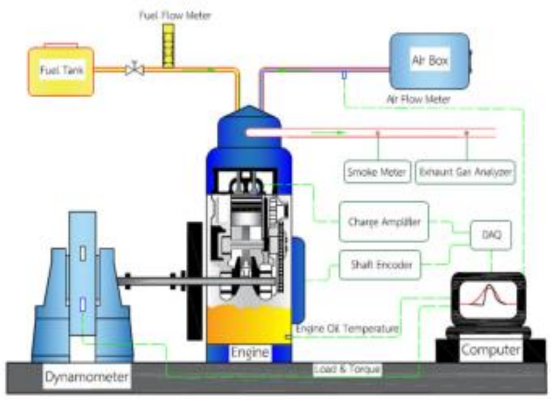

Figure. A schematic diagram of the experimental installation.

Properties comparison of plastic oil and butanol for bio-diesel blend

Information from the previous work shows that adding higher alcohols, namely butanol, pentanol, hexanol and octanol, in certain volume proportions to diesel/biodiesel and its blends is an effective way of reducing the associated emissions. The conventional diesel fuel employed in the tests was obtained locally. Density, kinematic viscosity, heating value, and flash points of the fuels were determined using an Anton Paar densitometer model DMA5000, a Herzog kinematic viscosity meter model HVM 472, an KA C2000 Basic Calorimeter, and a Herzog HFP360 closed-cupPensky Martens apparatus, respectively. These tests were per-formed in accordance with ASTM standards. The fuel-related properties of biodiesel, diesel fuel, and n-butanol are presented in Table 1. It can be seen that the latent heat of evaporation ofn-butanol is 585 kJ/kg, which is higher than that of other fuels. The heating value of biodiesel is approximately 9.5% lower and that of n-butanol is 22.5% lower than that of diesel fuel. The viscosity of biodiesel is evidently higher than that of n-butanol and diesel fuel. The oxygen content of n-butanol is 21.6% and higher than that of biodiesel. Furthermore, CSOME has higher distillation temperatures than that of diesel fuel. Contrary to the initial distillation temperature, the final distillation temperature for CSOME was lower than that of diesel fuel.

Butanol:

It contains ten hydrogen and four carbon atoms with the molecular formula of $C_4H_{10}O$ and is classified as a higher alcohol. Since it has a longer C–H chain, it can be used as neat CI engine fuel. Butanol is obtained by anaerobic fermentation. It is a flammable and colourless alcohol having a calorific value of 29,200 kJ/Kg, a self-ignition temperature of 340 °C and kinematic viscosity of 2.6 psi. Butanol, when blended with Punnai biodiesel, lowers the overall viscosity which has a positive impact on ignition properties. Improved properties, eco-friendly nature and ease in availability make butanol an encouraging additive to biodiesel/diesel fuels. Table 1 shows the properties of butanol.

- The process uses renewable substrates.
- Butanol can replace ethanol as a liquid fuel.
- The newer strains can grow on waste starch and whey and metabolic engineering is being attempted so that it can be grown on cellulose.
- The waste can now be treated anaerobically forming biogas.
- The process may be able to operate at 60°C so that the solvents can be removed as they are formed.

Solvent may be recovered during fermentation using reverse osmosis, per traction, pervaporation, membrane evaporation, liquid–liquid extraction, adsorption and gas stripping. Any process that avoids distillation will be considerably cheaper and able to compete with fossil fuels.

Waste plastic:

The waste plastic materials were collected from various solid waste management sectors and cut down into small piece of size approximately 0.50–1.2 cm2. Water was used to wash the plastic materials in order to remove the dirt and foreign particles and kept them in an electric oven at 100 to 120 °C for removing moisture. Dried plastic material mixed with 10% of coal and 1% of silica as catalyst was fed into pyrolytic reactor under inert nitrogen atmosphere. The mixture then undergoes pyrolysis at the temperature of 450 to 500 °C at atmospheric pressure, monitored by PID controller. After 4 to 5 h, the plastic vaporcoming out from the reactor unit passes through a double walled condenser.

Table: Properties of butanol

Energy density	*29.1 MJ/L*
Air–fuel ratio	*11.2*
Specific energy	*3 MJ/kg air*
Heat of vaporization	*0.92 MJ/kg*

Kinematic viscosity	*3.54 mm2 /s*

Table 1. Fuel Properties of Biodiesel, n-Butanol, and Diesel Fuel

parameters	Plastic oil	biodiesel	n-butanol
kinematics viscosity, mm2/s (at 40°C)	2.72	4.34	**3.6**
Lower heating value, kJ/kg	42700	8630	33100
density, kg/m3(at 15°C)	825.6	883.9	810
cetane number	47	**56**	**25**
oxygen, % weight	-	11	21.6
latent heat of evaporation, kJ/kg	250	230	585
boiling point (°C)	365	347	118

Performance characteristics:

the variation of BTE at different loads for different blends of butanol. BTE increases with an increase in load for all blends. Higher the percentage of butanol in the mixture, improvement in the brake thermal efficiency can be observed compare to neat diesel fuel. This is due to better combustion because of the presence of oxygen, which involves higher combustion efficiency. Butanol minimizes the interfacial tension between two or more interacting immiscible liquids helped the better atomization of fuel, which improves the combustion of diesel. With butanol- diesel fuel blend operation, the high latent heat of evaporation of butanol which produce more cooling effect that results in low exhaust gas temperature which tends to lesser the heat loss through exhaust and hence higher brake thermal efficiency can be obtained. Furthermore, butanol has a lower flame temperature than neat diesel fuels thereby limiting the heat losses in the cylinder, which further enhance the BTE. In addition, the longer ignition delay due to lower cetane number of butanol involves a rapid rate of released energy which reduces the heat loss from the engine because there is not enough time for this heat to leave the cylinder through heat transfer to the coolant

blends Combustion characteristics

the variation of peak pressure with brake power for diesel butanol blends which is higher than that of the neat diesel. Auto ignition temperature of the fuel is a predominant element which causes variations in the shape of the curve in the pressure angle diagram of engine. Due to combustion of diesel with lower self -ignition temperature, peak pressure is obtained initially, and then a depression is formed due to continuous heat absorption by butanol due to its high latent heat for vaporization. Due to latent heat of evaporation of the butanol higher than that of the diesel and stabilization of the mixture, when auto ignition condition of butanol which is slightly higher than the diesel is reached in the cylinder, combustion takes place and hence sudden rise of temperature and pressure is observed. With the increase of butanol, ignition retards and combustion duration shorten, which contributes to rapid butanol combustion.

HC emissions: HC is partially burned and unburned fuel emission. Figure 8 shows the variation of Total Hydrocarbon with load for different percentage of butanol blends. At lower loads, THC emissions increased for all blends compared with diesel fuel due to fact that low cetane number of blends that promotes quenching effect, to be the main cause for the increase of THC emissions. Higher fuel consumption and high latent heat of vaporization which lowers cylinder temperatures which causes the emission of unburned hydrocarbons. At higher load, no noticeable change in THC emissions for the blends and remains almost same as that of diesel fuel.

CO emissions: the variation of CO with load for different percentage of butanol blends. CO emissions are higher at lower loads. This is due to fact that its latent heat of evaporation is slightly higher than that of diesel; as result there is not enough vaporization and hence very less time to burn fuel completely that results in considerable increase in CO emissions. At higher loads, enough time available for combustion to occur, better mixing and inbuilt fuel oxygen that results in complete combustion and hence slightly reduced the CO emissions, for blends at high load.

NOx emissions: the variations of NOx emissions with engine loads for different butanol blend percentage. The rate of formation of NOx is primarily a function of flame temperature, the residence time of nitrogen at that temperature, and the availability of oxygen in the combustion chamber. It is observed from the figure that NOx emissions with diesel –butanol blends were found to be comparable with neat diesel at low loads due to lower calorific value and high latent heat of vaporization of butanol results in reduced flame temperature. At higher loads, due to increased quantity of fuel injection, the combustion temperature and oxygen availability is more; slightly higher NOx with increased butanol percentage in the blend compared to neat diesel.

CONCLUSION:

It is concluded that, waste plastic oil indeed is found to be a potential alternative fuel where in the waste management along with energy crisis could be addressed. This study is limited to analyse the performance combustion and emission characteristics of diesel – plastic oil blends on diesel engine. However, there are other issues such as kinetics of plastic oil, effects of combustion improvers and engine modifications that are to be considered for in depth analysis of combustion using plastic oil blends. The present study involved the effect of temperature and pressure on the quality and quality of plastic oil. As the future work to maintain the optimum temperature and pressure in the reactor to increases the quantity and quality. Another one of the process parameters is type of quantity of catalyst used in the process. So as a future work, to use different catalyst and its mixing ratio may also changes the quantity and quality of the oil. Above mention the parameter changes may also reduce the production time. From the present work it is observed that the emission characteristic of plastic oil blends shows more percentage than diesel.

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