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Performance and Emission Analysis Experimentally On Diesel Engine by Using Biodiesel Fuels

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Abstract: -- **In today's world one of the major concerns is the limited amount of fuels available with mankind. The decreasing amount of fuels has resulted in a major increase in price also they give higher air pollution. Diesel is one of the most used fuels across the world due to its higher efficiency. This report presents an attempt of using the blends of Bio Diesel to reduce a cost and emissions of a diesel engine without compromising on higher efficiency as diesel fuel. The source of the fuel generated is Mahua Oil which is non-edible oil. We have used double trans esterification process to produce biodiesel. Steps used in the production of Biodiesel were concentrated on optimizing the amount of biodiesel produced. The biodiesel blends with different quantity were tested on an experimental diesel engine setup. The major concern here was to run a production engine without any modification safely. The type of emissions produced in the blended sample and diesel sample are compared and performance also compared. Emissions were measured with gas analyser as well as smoke meter. From this it has been found that HC, NOx and CO emissions are reduced in B5 and B10 fuel compared with pure diesel without much compromising on performance.**

I. INTRODUCTION

Bio fuels are drawing increasing attention worldwide as substitutes for petroleum-derived transportation fuels to address energy cost, energy security and global warming concerns associated with liquid fossil fuels. The term bio fuel is used here to mean any liquid fuel made from plant material that can be used as a substitute for petroleum-derived fuel. Second-generation fuels are generally those made from non-edible biomass, either non-edible residues of food crop production (e.g. corn stalks or rice husks) or non-edible whole plant biomass (e.g. grasses or trees grown specifically for energy) or waste product of refinery oil industry. With abundance of forest and plant based non-edible oils being available in India such as Pongamia pinnata (karanja), Jatropha curcas (jatropha), Madhuca indica (mahua).So there is lot of scope of making biodiesel from such non edible oil. In this investigation, Mahua oil (crude) is studied. This oil is widely available in India and neighbouring countries. India being very highly populated is fighting against poverty and hunger. Choice of any edible item is not practically feasible for the nation. Mahua Oil being a non edible oil was the best possible and the most commonly available source of biodiesel. It is well established thatfor alkali hydrolysis, the raw vegetable oil has to meet certain specifications. For examplethe acid value should be less than one and the moisture content should be less than 0.5%. The acid catalyst is the choice for transesterification when low-grade vegetable oilused as raw material because it contains high free fatty acid and moisture. For the presentstudy, sulfuric acid (H_2SO_4) is used as an acid catalyst for transesterification process.

EXPERIMENT SETUP

Fig.1. Smoke meter

Fig.2. Gas analyzer

Fig.3. Internal Combustion engine

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II. RESULTS AND DISCUSSION

We will now discuss the effect on BSFC (Brake specific fuel consumption), thermal efficiency, different type of exhaust gas emission.

Effect on thermal efficiency of diesel engine

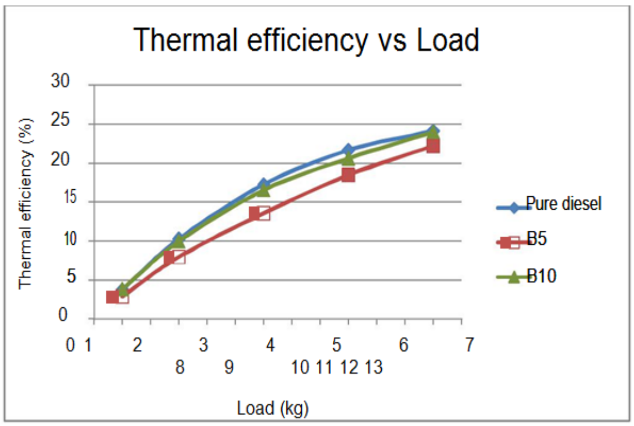

Figure 4 Thermal efficiency vs Load (kg)

As shown in Figure 4 thermal efficiency of engine is increasing as load increases for all three cases, but blend B5 i.e. mixing of biodiesel is 5% and remaining 95% fuel is diesel only and B10 i.e. mixing of 10% biodiesel in diesel as 90% fuel has less thermal efficiency compared to pure diesel at load higher than 5 kg. And one other thing to notice in this figure is that as we increase the biodiesel percentage in blend it gives almost same efficiency as pure diesel as it is happening in case of B10.

Effect on BSFC (Brake specific fuel consumption) of diesel engine

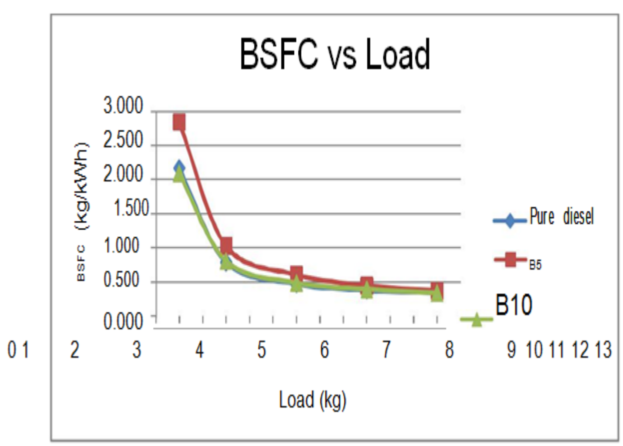

Figure 5 BSFC vs Load

As shown in above figure as load increases BSFC decreases for all three cases. Pure diesel and B5 have almost same BSFC curve, but B5 has more BSFC compared to both of them (Pure diesel and B10). Itwas observed that a larger amount of B5 and B10 type of fuel is supplied to the engine compared to that ofstandard diesel. Fuel pump of the engine delivers fuel in volumetric basis. As the densityof B5 and B10 is higher than diesel, the plunger in the fuel injection pump discharges more B5 and B10type of fuel compared to that of pure diesel. Therefore, BSFC for B5, B10 is higher than pure diesel.From both graphs we can infer that as we increase the biodiesel percentage in blend we can get close to pure diesel.

Effect on Hydrocarbon emission:

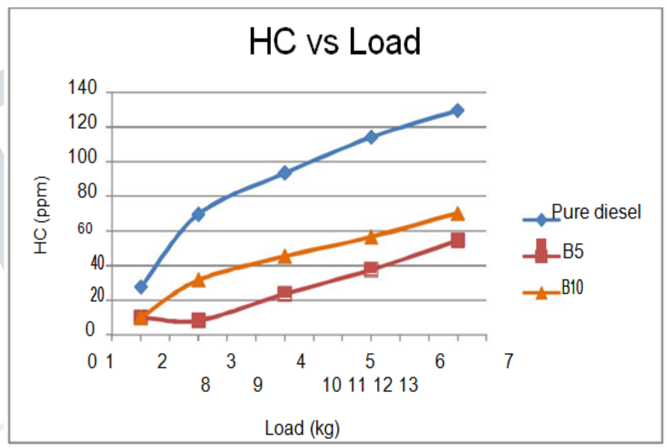

Figure 6 HC vs Load

For efficient combustion, the fuel has to atomize, mix and ignite properly. Atomization and mixing of fuel again depends on the physical properties of the fuel. Fuel viscosity and surface tension affect the penetration rate, maximum penetration and droplet size which in turn affect the mixing of fuel and air. HC percentage in emission shows that how much un-reacted fuel is there in exhaust pipe due to delay in combustion. As shown in Figure 6 pure diesel has highest Amount of HC emission, which is certainly not a good thing. Both B5 and B10 blends are good in terms of HC emission. That is because cetane number of ester-based fuel is higher than diesel; it exhibits a shorter delay period and results in better combustion.

Effect on CO emission

Since the ester-based fuel contains small amount of oxygen and that acts as a combustion promoter inside the cylinder. This results in better combustion for blended fuels than pure

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diesel fuel. Hence CO, which is present in the exhaust gas due to incomplete combustion, is lower in comparison to diesel. Almost 50% reduction in CO is there for blended fuels.

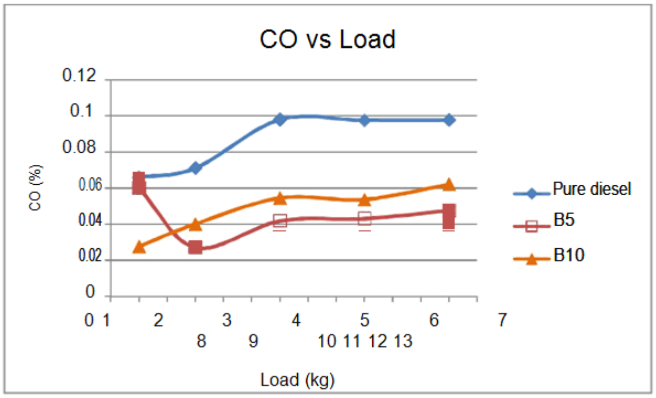

Figure 7 CO vs Load

Effect on CO2 emission

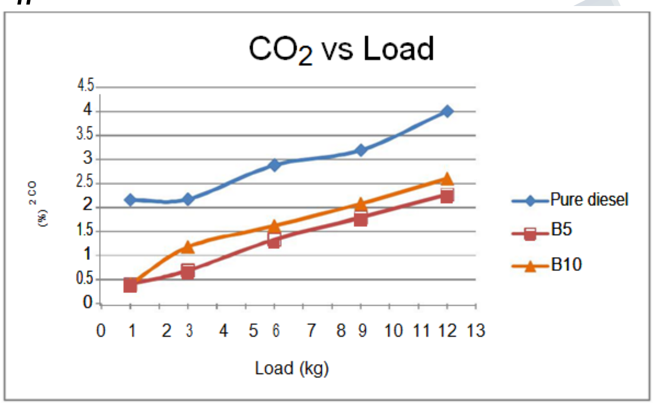

Figure 8 CO2 vs Load

Actually what should happen is that, if there is a decrease in CO emission for blended sample then there should be increase in CO_2, because complete combustion is taking place. But surprisingly, CO_2 emission also decreased in case of blended fuels.

Effect on NOx emission

Figure 9 shows oxides of nitrogen (NOx) emission for pure diesel, B5 and B10. In a DI natural aspirated 4-stroke diesel engine, NOx emissions are sensitive to oxygen content, adiabatic flame temperature and spray characteristics. It is well known that vegetable based fuel contains a small amount of nitrogen. This contributes towards NOx production. The fuel spray properties depend on droplet size, droplet momentum and degree of mixing with air and penetration rate, evaporation rate, and radiant heat transfer rate. A change in any of those properties may change the NOx production. The trend for blended fuel and pure diesel is increasing, and both blended fuels have less NOx emission compared to pure diesel.

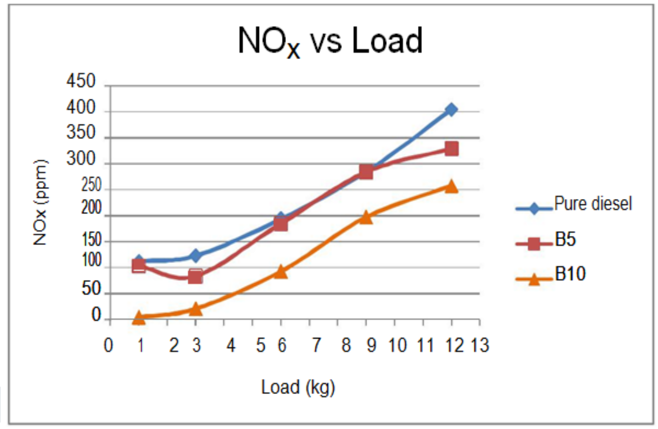

Figure 9 NOx vs Load

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