Experiment on Single Cylinder CI Engine with Various Proportion of WCOBD in Diesel

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Abstract*:* India is one of the largest petroleum consuming and importing countries .India imports about 75% of its petroleum demands. The current yearly consumption of diesel oil in India is approximately 55 million tones constituting about 48% of the total petrol-product consumption. India imports substantial amounts of fossil fuels for its requirements of transportation and industries[4]. The dependence on other countries or the Fuel needs makes out nation vulnerable. Waste Cooking Oil (WCO) is a bio-fuel whereas high Speed Diesel is a fossil fuel. Fossil fuel may become extinct in near future but "WCO" is a renewable fuel extracted from the residual waste of used cooking oil. Bio-fuels are also advantageous when ecological factors are taken into account. Using WCO pollution can be controlled to certain extent [6]. This is very cheap and renewable, they are safe to store and non volatile, biodegradable, release comparatively less carbon-di-oxide and has clearer exhaust. Thus it can be best considered as the most favorable alternative fuel. Even from the economic perspective, the cost of WCO is less than that of Standard Diesel. The limitation is the production of oil [7]. Since the extraction of oil is done in small scale, the cost of extraction is little high[12]. The cost can be reduced when extraction is done on large scale. The present work is to conduct experiment on single cylinder CI Engine with various proportion of WCO in diesel and compare it with stand alone fossil fuel.

Key words: waste cooking oil, biodiesel, renewable fuel, biodegradable and eco-friendly.

INTRODUCTION

The concept of Bio-Fuel dates back to 1885 when Dr. Rudolf Diesel built the first Diesel engine with the full intention to running it on vegetative source [8]. In 1912 he observed, "The use of vegetable oils for engine fuels may seem insignificant today". But such oils may in the course of time become as important as fossil fuels [10]."In 1970, scientists discovered that the viscosity of vegetable oils could be reduced by a simple chemical process and that it could be employed as diesel fuel in modern engine. Since then the technical developments have travelled a long journey and the plant oil today has been highly established as BIO-FUEL, with better prospects and equivalent status to standard diesel [15]. Recent environmental (e.g. Kyoto protocol) and economic concerns have prompted resurgence in the use of bio-diesel throughout the world. In 1991, the European community proposed a 90% tax reduction (subsidization) for the use of bio-fuels, including bio-diesel. Today 21 countries worldwide produce bio- diesel [2].

It is possible to reduce its viscosity by converting vegetable oil into alkyl esters using transesterification reaction [3]. In the present work Waste Cooking Oil (WCO) is taken as feedstock, thus food against fuel conflict will not arise if this is used for biodiesel production.

The vegetable oils, animal fats, and their derivatives such as alkyl esters are suitable as diesel fuel because there must be some similarity to petro diesel fuel or at least to some of its components. The fuel property that best shows this suitability is called the cetane number. In addition to ignition quality as expressed by the cetane scale, several other properties are important for determining the suitability of biodiesel as a fuel. Heat of combustion, pour point, cloud point, (kinematic) viscosity, is among the most important of these properties.

STORAGE OF BIODIESEL

As mild solvent, biodiesel tends to dissolve sediments normally encountered in old diesel storage tanks. Brass, Teflon, lead, tin, copper, zinc etc. oxidize biodiesel and create sediments. The existing storage facilities and infrastructure for petrol & diesel can be used for the biodiesel with minor alterations. For biodiesel storage, shelf life and how it might break down under extreme conditions assume importance [1].

Biodiesel has poor oxidation stability. Use of oxidation stability additives is necessary to address this problem [18].

Low temperature can cause biodiesel to gel, but on warming it liquefies quickly. Hence, insulation of storage tanks and pipelines would need to be done at the low temperature zones.

To avoid oxidation and sedimentation of tanks with biodiesel, storage tanks made of aluminum, steel etc. are recommended for usage.

ENGINE MODIFICATION

Several modifications have been proposed by researchers to enable the smooth usage of WCO in CI engines. Among them is the introduction of a fuel heater to pre-heat the oil before injecting it into the cylinder, the provision of extra filters, an electric heater in the fuel tank in colder climate and dedicated fuel pumps to handle the higher viscosity of the WCO/WVO.

SPECIFICATION OF THE ENGINE

Single Cylinder Four-Stroke,
Variable Compression Ratio Ignition
Forced Air Cooled Engine.
Brake Diameter D=85mm

Stroke Length L=110mm
Orifice Diameter=20mm
C_d=0.64, Compression Ratio=20.03
Calorific Value WCO=39000 kJ/kg

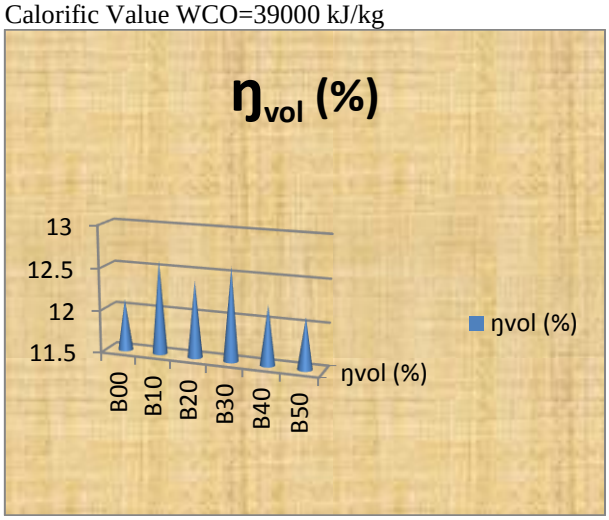

Fig 1 Volumetric efficiency for standard diesel and its various blends.

PROBLEMS FACED:

• **Viscosity**: As has been mentioned earlier, BD has comparatively higher viscosity then the conventional diesel, this sometimes comes as a hindrance at cold regions ,where the temperature is likely to fall below 250 C. Fuel becomes thick in consistency and is more likely to get blocked in the minor cavities of fuel injector.
• **Blockage**: Citing viscosity an issue, the problem of blocking of valves and injector was faced.
• **Mixing**: Precise blending of fuel is very important, minor negligence may be reflected in the comparison and data collection.
• **B50:** when B50 was employed it was found that, fuel incurred a problem of travelling through supply, therefore manual blowing to facilitate the movement was carried out, and this again however can be attributed to viscosity.

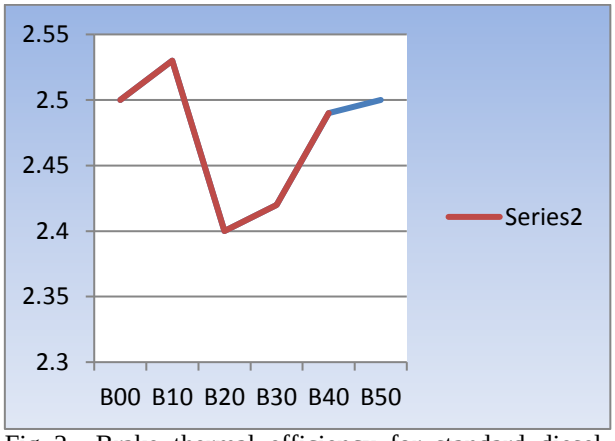

Fig 2 Brake thermal efficiency for standard diesel and various blends.

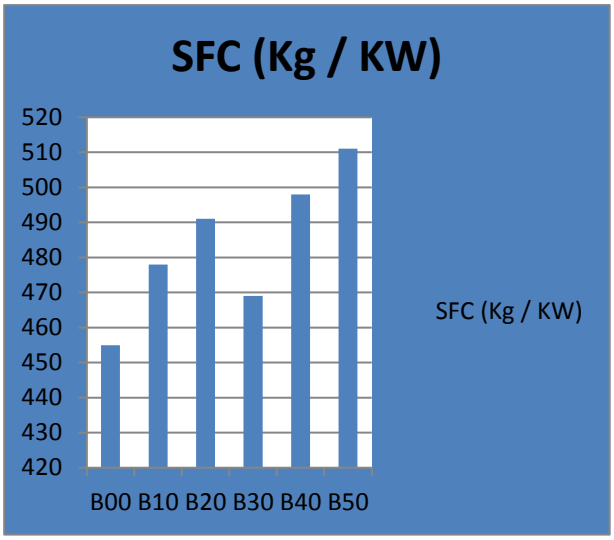

Fig 3 Specific fuel consumption in Kg / KW for standard diesel and various blends.

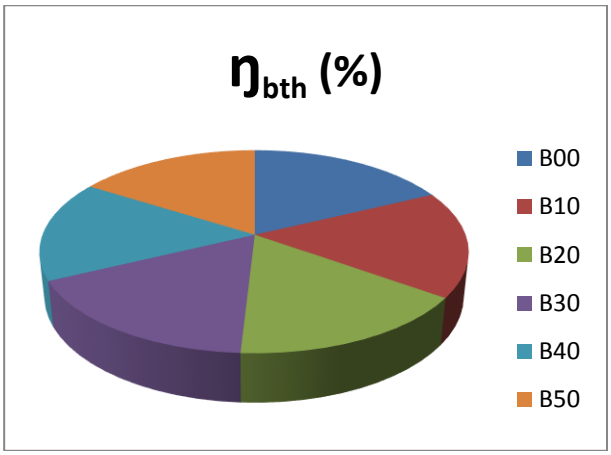

Fig 4 Brake thermal efficiency for standard diesel and various blends.

ENVIRONMENTAL AND HEALTH BENEFITS

The use of BIO-DIESEL will help preserve our environment. Bioactive™ is completely biodegradable and contains no toxic or harmful elements. It is non-flammable, safe to handle, and poses no danger to the environment[5]. Best of all, it is made from a renewable resource that is abundant. It will also improve the air that we breathe. Air pollution is a serious problem worldwide and the rising incidence of pollution-related illnesses has become a serious concern. Extensive field and laboratory tests prove that Bioactive™ dramatically reduces smoke emissions through complete combustion. With the elimination of air pollution caused by smoke, a cleaner air will result in better respiratory conditions of people.

GENERAL ADVANTAGES

• **National security**.
Since it's made domestically, it reduces our dependence on foreign oil.
• **National economy**

Using bio-diesel keeps our fuel buying pesos at home instead of sending it to foreign countries. This reduces our trade deficit and creates jobs.

• It's sustainable & non-toxic.

• **Emissions**

Bio-diesel is nearly carbon-neutral, meaning it contributes almost zero emissions: global warming.

• **Engine life**

Studies have shown it reduces engine wear by as much as one half, primarily because it provides excellent lubricity. Even a 2% bio-diesel/98% diesel blend will help.

• **Drivability**

We have yet to meet anyone who doesn't notice an immediate smoothing of the sngine with bio-diesel. It just runs quieter, and produces less smoke.

General Disadvantages

• Primarily, bio-diesel is not readily available in retail market but that available are with commercial suppliers, however whose production has not yet been commercialized. With the novel move by the railways in India and the RTC in the East while Andhra Pradesh, this idea gained momentum and has been a success to much extent.

• Bio-diesel is not suitable to any engines, more of the older one.

• It has a higher gel point. B100 (100% bio-diesel) gets slushy a little under 32°F. But B20 20% bio-diesel, 80% regular diesel -more commonly available than B100) has a gel point of -15°F. Like regular diesel, the gel point can be lowered further with additives such as kerosene.

CONCLUSION

The Engine was running smoothly with the use of Bio-Diesel. The Bio-Diesel was added in the Diesel -Blend resulted in better performance and reduced smoke. The brake power for blends doesn't show much deviation from petroleum diesel The Brake specific fuel consumption is increased with the blends when compared to diesel. Brake thermal efficiency increased with all blends when compared to the conventional diesel fuel.

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