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A REVIEW ON THE EFFECT OF SUPERCHARGING ON THE DIESEL ENGINE WITH COTTON SEED OIL

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Abstract

Diesel engines are the prime movers used in the transport and agricultural sectors for heavy duty vehicles. Diesel engines fulfill their requirements for energy from stored oils, i.e. petroleum products. The Twin Issues of both scarce resource depletion and atmospheric emissions caused by petroleum-based vehicles are prompting researchers to find a viable and immediate alternative to fossil fuels. The physical and combustion properties of vegetable oils are similar to those of petro-diesel fuel, and vegetable oils can be an immediate replacement candidate for stored fuels in this context. From the processing of the seeds of different plants, vegetable oils are produced and, hence, are renewable in nature. A country's sustainable development depends on the degree to which it manages and produces its own wealth. This also helps to preserve non-renewable petro-products that are depleting. Vegetable oils, however, would pose problems, such as fuel flow and poor atomization, due to inherent high viscosity and low volatility, and limit their direct use in engines without any modifications. The impact of supercharging on the output of a direct injection diesel engine using untreated cotton seed oil under varying injection pressures has been examined in the present investigation (IPs). In terms of brake specific fuel consumption (BSFC), exhaust gas temperature and smoke density, the engine's output is assessed. It is noted that when cotton seed oil is used as a fuel, when the engine is operated at the recommended IP and overcharging pressure of 0.4 bar (g) compared to the engine operated under naturally operated conditions, there is a decrease in BSFC of about 15 percent. The suggested IP of the engine is employed. The study found that while supercharging, cotton seed oil, in general vegetable oils, would best be used.

Keywords: *Cotton seed oil; Direct injection; Naturally aspirated and supercharged engine; Base line test; Eco-friendly operation.*

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I. INTRODUCTION

Now-a-days, vegetable oils are becoming more promising alternatives to fossil fuels for internal combustion IC engines due to their renewable nature. Currently, rigorous efforts are being made to reduce the viscosity of these oils by some means and use them straight in the conventional compression ignition CI engines without any modifications. However, it is necessary to understand the effect of using the vegetable oils on the durability, performance, and emissions characteristics of the engine before using them in commercial vehicles.

The effect of the twin problems of exhaust emissions and the depletion of precious foreign exchange reserves for imports of non-renewable crude oil and goods to keep vehicles going will also be quite serious, with the rapid growth of the population of motor vehicles and increased stress on industrialization in developing countries. The atmospheric pollution in major cities due to vehicles has already reached alarming levels. Oil technologists expect that plant-based oils will become as important for the transport industry as fossil fuels, such as gasoline and diesel oil, are today, over the next few decades[1]. Mixtures of fatty acid molecules containing atoms of carbon, hydrogen and oxygen are vegetable oils. Saturated, mono-unsaturated, or poly-unsaturated can be the fatty acids present in it. The larger the number of double bonds, the better the compound reacts on the shelves with oxygen from the air and goes poorly, as kitchen fats and oils do after months. The production of diesel engine fuels and lubricants based on vegetable oils is being intensively investigated. They obstruct fuel jet penetration and atomization due to the high viscosity of vegetable oils, contribute to higher fuel consumption, and leave gummy deposits upon combustion on the engine components.

Supercharging, as applied to internal combustion engines, is the process of supplying air for combustion at a pressure greater than that attained by natural or atmospheric induction. The purpose of supercharging is to increase the output of an engine, the conibustion of a greater quantity of fuel per cycle being made possible by the greater charge of air. Although patents on certain supercharging methods were granted as early as the beginning of the present century, it was not until World War I that their development commenced in earnest in this country, at which time the iiecessity for supercharging gasoline engines for aircraft use became apparent. These early efforts met with considerable success and no doubt paved the way for recognition of supercharging as a commercially feasible development when applied to Diesel engines.

The first types of superchargers to receive attention were the exhaust turbo-charger and the gear driven rotary blower. The former consisted of a gas turbine on the extended shaft of a centrifugal blower and derived its energy from the exhaust gases of the engine. The second type, the rotary blower, was mechanically driven from the engine by means of a light, high speed gear train. Both types were designed. to maintain sea level pressure in the induction manifold at various altitudes and thereby maintain substantially sea level output. Since its early development in the field of aviation, supercharging has found useful application to many installations of diversified nature, such as racing boats and automobiles, Diesel

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locomotives, Diesel cargo, passenger and naval vessels, power plants for peak load conditions and, in recent years to a limited extent, for gasoline enginecl passenger automobiles.

When working on 100 percent sun flower oil, 100 percent peanut oil and 50 percent (by vol.) mixtures of either sun flower oil or peanut oil with #2 diesel oil (i.e. diesel fuel with less than 0.01 percent sulfur by weight), Barsic and Humke analyzed the performance and emission characteristics of a DI naturally aspirated diesel engine and compared the findings with base line results obtained by usi oil (i.e. diesel fuel with less than 0.01 percent sulfur by weight)[2]. They introduced a fuel flow adjusted rotary fuel injection pump to provide equivalent input of fuel energy and noted that engine power and thermal efficiency decreased slightly and emissions increased marginally[3]. Higher densities, higher viscosities, comparatively lower heating values and thermal cracking of the droplets of vegetable oil fuel at elevated temperatures were the reasons assigned.

For automotive applications, Goering et al. researched the properties of different vegetable oils and adjusted hybrid fuels and stated that vegetable oils have reasonable cetane numbers (35-45), high viscosity (about 50 cSt), high carbon residue, high flash points (220-285 ⁇ C) and pour points (about 6 to 12 ⁇ C) and appreciable heating value (88-94% of diesel fuel), low sulfur content (<0.02% b b) and pour points (about 6 to 12℃)[4]. Akor et al. detailed the characteristics of the production and energy balance of the palm oil system in their investigations and presented details on the physical and chemical essence of palm oil and its derivatives[5]. The satisfactory performance of traditional diesel engines was also observed and the efficiency of palm oil diesel fuel mixtures was slightly lower.

A research on the use of vegetable oils as fuel for internal combustion engines was performed by Bhattacharyya and Reddy[6]. They stated that the key differences between diesel fuel and vegetable oil included substantially higher viscosities and moderately higher densities for the latter, lower heating values, an improvement in the stoichiometric fuel/air ratio due to the presence of molecular oxygen and the likelihood of thermal cracking at the temperatures encountered by the NA Diesel engine fuel spray. Many researchers have researched the exhaust emission characteristics of diesel engines working with vegetable oils. However, a review of the Fast, Barsic and Lhumke and Niehaus research papers revealed that harmful exhaust emissions, particularly sulfur-related compounds and carbon monoxide, are significantly reduced compared to diesel operations with the use of vegetable oil-based fuels.

Methanol and jatropha curca oil were used by Ravi et al. in a CI engine in dual fuel mode operation[7]. With different jet openings, the methanol was carbureted and they observed that the rate of pressure rise and peak pressures with neat jatropha oil activity were high. However, the rate of pressure rise and peak pressures have been significantly reduced with methanol induction in the dual fuel mode process. Srinivasa Rao et al. and Raju et al. have investigated the impact of IP by adopting jatropha curcas oil in a single cylinder of a naturally aspirated DI diesel engine and concluded that high fuel IPs could boost the efficiency of the engine[8].

II. CONCLUSION

1. Rising the IP to a value higher than the recommended IP (for Diesel) does not lead to any change in the engine's efficiency when working under the NA condition on cottonseed oil as the fuel.
2. The efficiency of the engine is steadily improving with an increase in supercharging pressure while maintaining the recommended IP with cottonseed oil as fuel. Compared to the naturally operated state, there is a decrease of about 15 percent in BSFC at full load with a supercharging pressure of 0.4 bar (g).
3. No change in engine performance with an increase in IP is observed when operating even in supercharged conditions.
4. When we want to implement untreated vegetable oils for the production of power with a low specific fuel consumption compared to diesel service, supercharging is necessary.
5. As the supercharging pressure is increased, the percentage reduction in smoke density is greater, and the engine output with untreated vegetable oils can be regarded as an environmentally friendly activity.
6.

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