Introduction:

Biodiesel emerges as one of the most energy-efficient environmentally friendly options in recent times to full fill the future energy needs. Biodiesel is a renewable diesel substitute that can be obtained by combining chemically any natural oil or fat with alcohol. During the last 15 years, biodiesel has progressed from the research stage to a large scale production in many developing countries. In Indian context, non-edible oils are emerging as a preferred feedstock and several field trials have also been made for the production of biodiesel. Vegetable oils either from seasonal plant crops or from perennial forest tree's origin, after being formulated, have been found suitable for utilization in diesel engines. Many traditional oil seeds like Pongamia glabra, Jatropha, Mallous philippines, Garcinia indica, Thumba, Karanja and Madhuca indica etc. are available in our country in abundance, which can be exploited for biodiesel production purpose. Many vegetable oils, animal fats and recycled cooking greases can also be transformed into biodiesel. Biodiesel can be used neat or as a diesel additive in compression ignition engines.

The compression ratio of an internal-combustion engine or external combustion engine is a value that represents the ratio of the volume of its combustion chamber from its largest capacity to its smallest capacity. In a piston engine, it is the ratio between the volume of the cylinder and combustion chamber when the piston is at the bottom of its stroke, and the volume of the combustion chamber when the piston is at the top of its stroke. A high compression ratio is desirable because it allows an engine to extract more mechanical energy from a given mass of air-fuel mixture due to its higher thermal efficiency.

In this work, an attempt is made to study the variation of performance and emission of the engine by varying the compression ratio under different biodiesel modes of operation and to understand the suitable compression for the given biodiesels.
Objectives:
1. To study the performance and emission characteristics of the diesel engine using various biodiesels.
2. To compare the effect of variation of compression ratio on the performance and emission characteristics under various biodiesels.
3. To optimise the compression ratio for the biodiesel based on performance and emission.

Methodology:
In the present work a vertical water cooled 4stroke diesel engine developing 3.75KW power is used. Basically, four non-edible oils such as Simaruba, Calipholiyum, Mahua and Pongam oils are transesterified to produce Simaruba oil methyl ester (SOME), Calipholiyum oil Methyl ester (COME). Cotton seed oil methyl ester (CSOME) and Pongama oil methyl ester (POME). The compression ratio of the engine is changed by changing the clearance volume of the engine and it is achieved by designing hemispherical bowls and augmenting them on the crown of the piston.

Experiments are conducted on the diesel engine for various loading condition for different compression ratio such as 18:1, 20:1 and 22:1 under various biodiesels such as SOME, CSOME, POME and COME modes of operation. The performance parameters like fuel consumption and thermal efficiencies are measured. Further the emission components like smoke density or opacity(HSU) is measured using gas analyser under various biodiesel modes of operation. The obtained results are compared for various compression ratios of the engine and optimum compression ratio is evaluated for each of the biodiesels.

Results and conclusions:
Fig. 1, Fig. 2 and Fig. 3 show the variation of specific fuel consumption, thermal efficiency and smoke density with brake power respectively for compression ratio 22:1. Similar results are obtained for compression ratios 18:1and 20:1

8.1 Fuel consumption:

![Fig.1 Variation of specific fuel consumption with brake power of all for compression ratio 22:1](image)
8.2 Brake thermal efficiency:

8.3 Smoke density

Conclusions:

- A slight increase in fuel consumption is observed when the compression ratio is increased from 18:1 to 20:1 under all biodiesels modes of operation. Moderate drop in fuel consumption is noticed under all biodiesel modes of operation when the compression ratio is changed from 18:1 to 22:1.
- About 22 % drop in fuel consumption is observed under COME when compression ratio is increased from 20:1 to 22:1 and about 16 % drop in fuel consumption is recorded while the compression ratio is increased from 18:1 to 22:1.
- A comparable change in thermal efficiency under all biodiesels is seen when the compression ratio is switched over from 18:1 to 20:1. However, the thermal efficiency of the engine under COME is increased by 28 % for the change of compression ratio from 20:1 to 22:1. Further, under POME, COME and SOME biodiesel modes of operation, efficiency is increased by 25 % compared to normal diesel operation for the increase in compression ratio from 18:1 to 22:1.
• No significant change in mechanical efficiency under all biodiesel modes of operation when the compression ratio is changed from 18:1 to 20:1. A marginal increase in mechanical efficiency under all biodiesel modes of operation when compression ratio is increased from 18:1 to 22:1.

• Noticeable increase in opacity of the engine exhaust is recorded when compression ratio is changed from 18:1 to 20:1 under all biodiesel modes of operation. However, about 10% decrease in smoke density in all biodiesel modes of operation when compression ratio is changed from 20:1 to 22:1.

• About 6% decrease in smoke density is observed in all biodiesel modes of operation when compression ratio changes from 18:1 to 22:1. Further, under SOME, COME and CSOME there is a gradual decrease of about 15% is noticed when compared to normal diesel operation for the increase in compression ratio from 18:1 to 22:1.

• It is concluded from the experiments that CSOME, COME and POME are found to be potential alternative fuels for pure diesel for the engine compression ratios of 18:1, 20:1 and 22:1 respectively in terms of performance and emission characteristics.

Future suggestion/scope

• Experiments may be made for different Compression ratios like 16:1, 17:1 and 19:1 and 23:1

• The study may be made for other biodiesels such as Jatropha, Mahua, Rubber seed, Castor, Rice bran and so on.

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