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Investigation of waste cooking oil Biodiesel effects on performance and emissions in a CI engine

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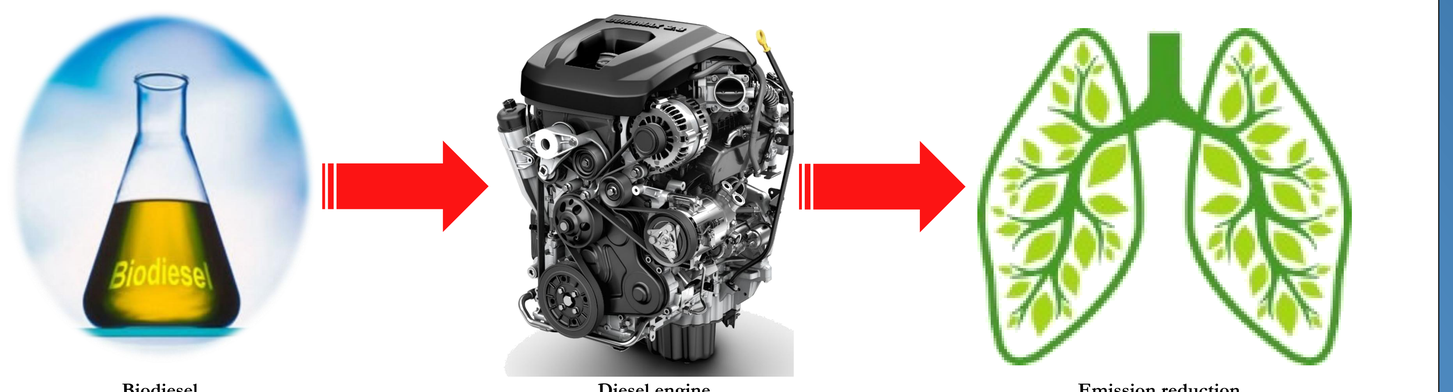
Abstract

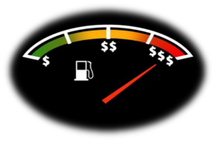
In this study, different blends of diesel biodiesel (B0, B5, B10, B15 and B20) of waste cooking oil have been considered on an air cooled 4 stroke engine in various engine speeds (1700, 2100, 2500 and 2900 rpm) and loads (0, 25, 50, 75 and 100%). Then, effect of this factors on engine have been evaluated by its performance (engine power, torque, specific fuel consumption (SFC) and exhaust gas temperature) and emissions (CO, CO_2, HC, NO_x, soot) parameters.



Biodiesel | Diesel engine | Emission reduction

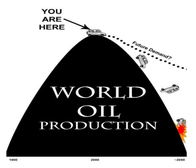
Introduction

- The growth in price of common energy sources
- spread of pollution caused by fossil fuel
- Renewable energy



Increase of oil price

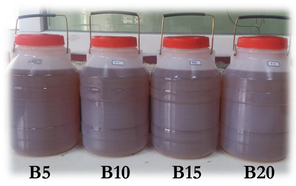
Health problem



Requirement to renewable energy

Materials and methods

- Starting up the central control unit of dynamometer
- Applying load under engine steady state condition (for each fuel mixture, five loads including 0, 25, 50, 75 and 100% were applied to engine at different speeds of 1700, 2100, 2500 and 2900 rpm)
- Measurement of torque and calculation of power
- Measurement of pollutants: The emission sensor was placed on the engine exhaust path and the amounts of emissions were therefore recorded from the system screen. At the end of each test, the emission sensor was cleaned for preventing the effect of exhaust soot on the accuracy of measurements.



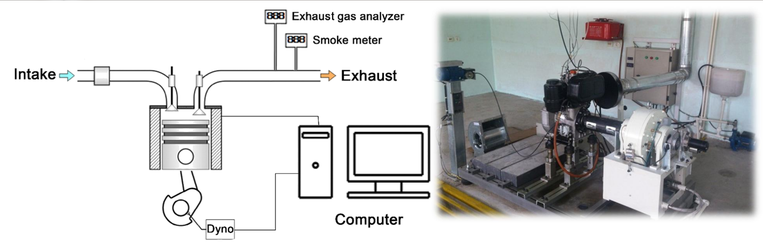


Table 1. Some important characteristics of the produced biodiesel fuel

Specification	range	Biodiesel	Diesel	Unit
Kinematic viscosity	3.5 - 5	4.72	3.5	mm^2/s
Density	----	0.862	0.837	g/cm^3

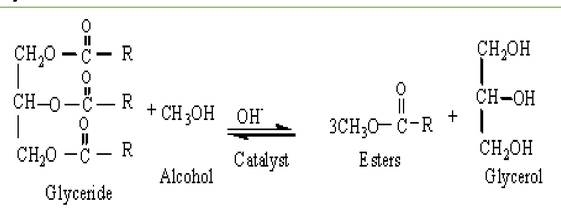
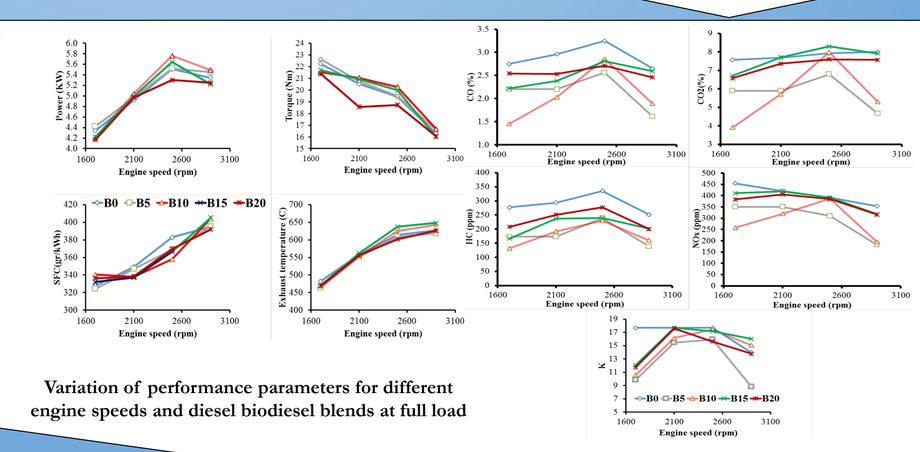
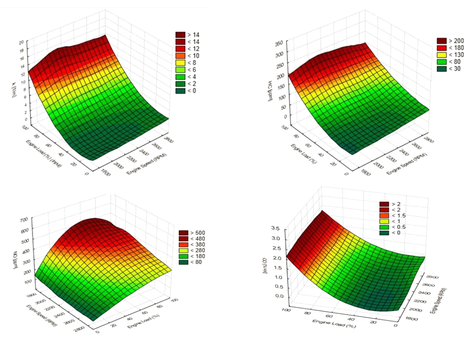


Table 2. Specifications of the evaluated engine

Model	3LD 510
Manufacturer	Lombardini, Italy
NO. Cylinder	1
Piston stroke	90 mm
Cylinder diameter	85 mm
Cylinder volume	510 cm^3
Maximum power (at 3000 rpm)	12.2 hp (9 kW)
Maximum torque (at 1800 rpm)	33 N.m



Variation of performance parameters for different engine speeds and diesel biodiesel blends at full load



Effect of engine load and speed on emissions

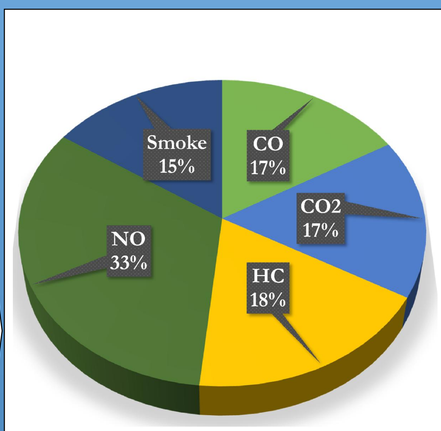
Variation of emissions for different engine speeds and diesel biodiesel blends at full load

Results and discussion

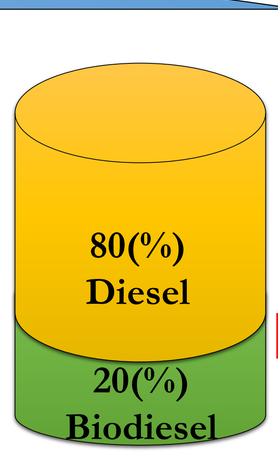
- The highest reduction was for NO_x and HC emissions, 94.55% and 52.37%, respectively.
- The smoke opacity for biodiesel blends are lower than that of the diesel fuel.
- Totally it can be stated that the k value for the all fuel blends in 1700 rpm have been decreased considerably regard to B0 (44.29, 40.21, 31.79 and 33.60 % for B5, B10, B15 and B20, respectively).

Conclusion

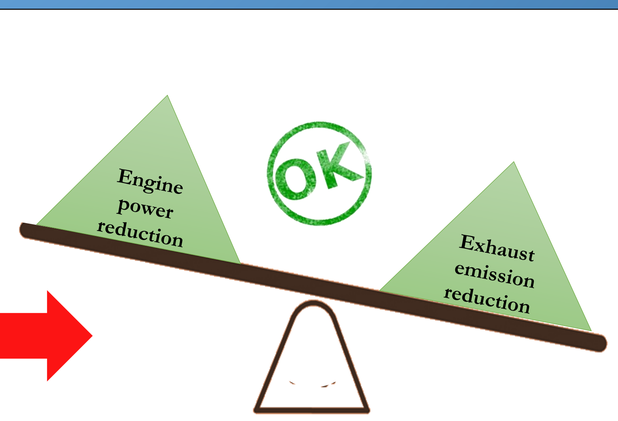
- The highest reduction for CO, CO_2, HC, NO_x and smoke emissions were 47.25, 48.23, 52.7, 94.55 and 44.29 %, respectively.
- This reduction in engine emissions has a penalty and it was reduction of biodiesel performance parameter of the engine in higher percentages of blends.
- The lower biodiesel blends did not have any considerable negative effect on the engine performance.
- The higher viscosity and density of the biodiesel cause some undesirable effect on the engine performance and emissions parameters, especially in higher percentages of biodiesel diesel blends.



Exhaust emission reduction (%)



The lower biodiesel blends did not have any considerable negative effect on the engine performance



Reduction in engine emissions has a penalty and it was reduction of biodiesel performance

References

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