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EMISSION PERFORMANCE OF DIESEL ENGINE BY FUELLING IT WITH DIESEL-BIODIESEL BLENDS

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Abstract. Biodiesel is sustainable fuel obtained from renewable resources. The purpose of this paper is to determine the suitability of diesel-biodiesel blends for Kipor KDE-6500E diesel engine. Emission characteristics are determined with the help of VLT-4588 exhaust gas analyzer. The experiments are performed with D100, B10, B20 and B30 at different loading conditions. CO_2, O_2 and HC emissions are measured to determine the performance of the biodiesel blends. There is considerable decrease in CO_2 and HC emissions by increasing the biodiesel blend ratio.

Keywords: biodiesel; diesel engine; emission analysis.

1. Introduction

Conventional energy resources make the major share of fuel consumption. This results in climate change and environmental hazards (Abas *et al*., 2015). Alternate or renewable energy resources can be used to produce environment friendly fuels. Biodiesel is a substitute to the diesel fuel derived from renewable resources (Elbehri *et al*., 2013). Romania has high potential of

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producing biodiesel. This is estimated 523toe of theoretical potential to produce biodiesel from edible and non-edible resources (Dusmanescu *et al*., 2014; Patrascoiu *et al*., 2013). Biodiesel can be used directly in diesel engines without further modification. The usage of diesel-biodiesel blends can decrease CO_2 emissions by 78% while NO_x emissions will increase slightly but can be controlled by using fuel additives (US EPA., 2002). Most of the researchers have found the significant decrease in CO_2 emissions and slight increase in NO_x emissions by the direct usage of biodiesel in diesel engines (Shahir *et al*., 2015a, 2015b). In the present work, biodiesel is obtained from sunflower oil. Emission performance of KDE 6500E diesel generator is measured with the help of VLT-4588 gas analyzer.

2. Materials and Methods

2.1. *Experimental Setup*

2.1.1. *Biodiesel Standards*. Biodiesel is obtained from a tranesterification of sunflower oil. The physical and chemical properties of biodiesel lie within the limits of standard EN 14214 given below.

Table 1
EN-14214 (*Rutz and Janssen, 2006*)

Property	EN-14214 Standard
Density at 15°C	860-900 kg/m^3
Kinematic viscosity at 40°C	3.5-5.0 mm^2/sec
Flash Point	> 101°C
Sulphur content	≤ 10 mg/kg
Cetane number	≥ 51
Oxidation stability at 110°C	≥ 6 h
Acid value	≤ 0.5 mgKOH/kg
Iodine value	≤ 120 mgIod/g
Water content	≤ 500 mg/kg
Total contamination	≤ 24 mg/kg

2.1.2. *Diesel Engine and Exhaust Gas Analyzer*. KDE 6500E diesel generator is used to determine the emission performance of biodiesel blends. The specifications for the engine are given in Table 2.

Table 2
Diesel Engine Specifications

Engine Model	KM186FA
Rated frequency	50 Hz
Rated power	4.5 kVA
Maximum Power output	5 kVA
Rated speed	3000 rpm
DC output	12 V/8.3 A
Engine type	Single cylinder vertical four sttroke direct injection
Cylinder capacity	418 ml
Compression ratio	19:1
Cooling system	with air
Rated Voltage	230 V

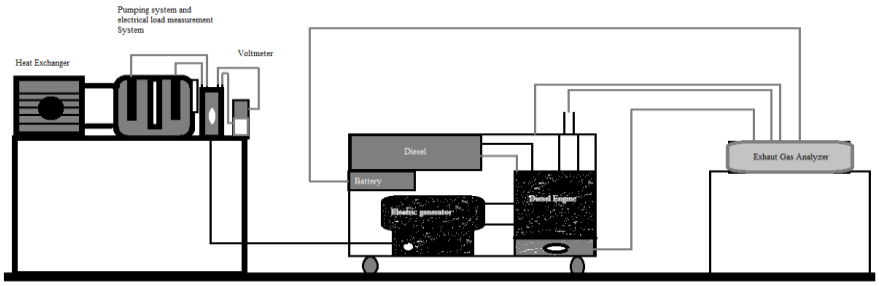

Fig. 1 – Experimental setup scheme.

The experimental setup can be described by a scheme given in Fig. 1. Exhaust gas analyzer is attached after starting the engine. The measurements are recorded by using different blends of biodiesel at different loading condition adjusted by resistances and voltmeter. The electric current is measured at different loads. The power is calculated by the equation given below.

$$P = I \times U \tag{1}$$

where: I is the electric current in Amperes, U is voltage in volts while P is power in Watts.

3. Results and Discussions

Graphical representation of the results obtained from the experiments is given below.

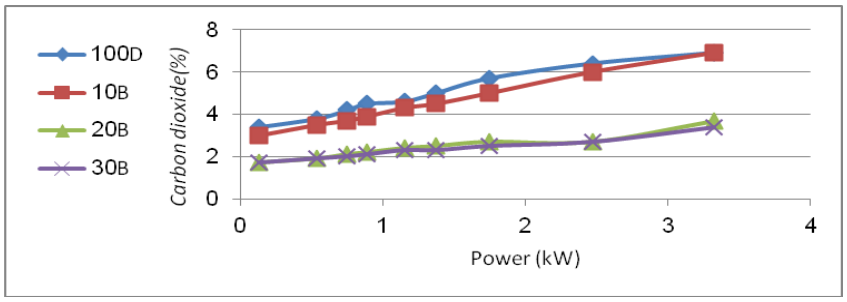

Fig. 2 – CO_2 Emissions for diesel and biodiesel blends.

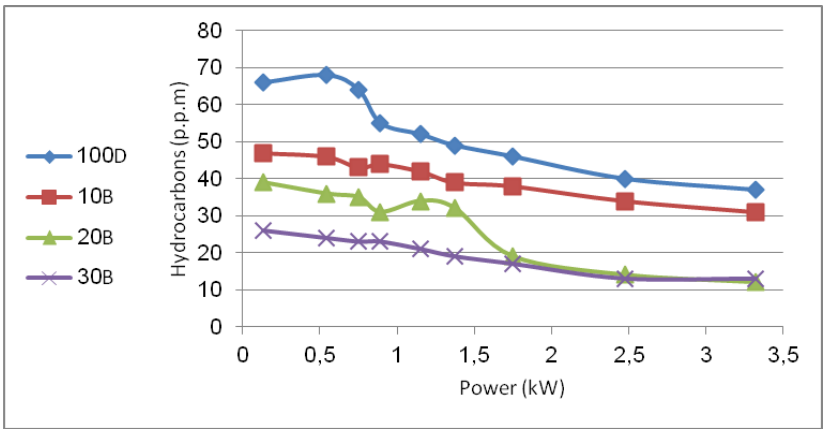

Fig. 3 – CO_2 Emissions for diesel and biodiesel blends.

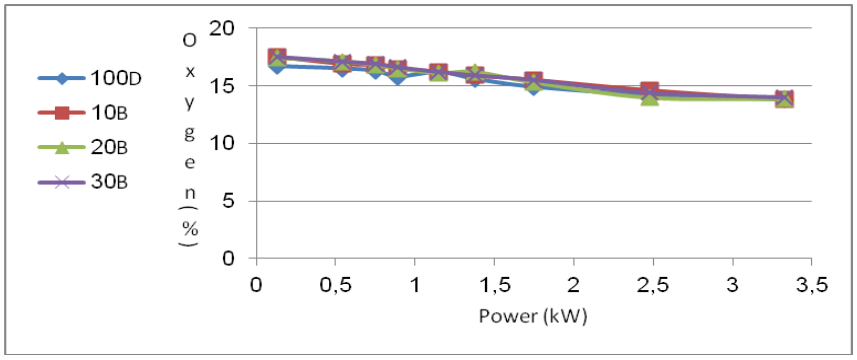

Fig. 4 – O_2 Emissions for diesel and biodiesel blends.

Considerable decrease in CO_2 and HC emissions can be observed by increasing the biodiesel blend. There is no significant change in O_2 emissions. Lower values of HC and CO_2 emissions make it possible for its commercial usage.

4. Conclusions

1. Biodiesel is renewable fuel derived from renewable energy resources and can be directly be used in diesel engines.

2. Diesel-biodiesel blends derived from sunflower exhibit standard physical and chemical properties which make them suitable for diesel engine as fuel.

3. CO_2 and HC emissions can be reduced by increasing blend ratio of biodiesel. An investigation of B10, B20 and B30 shows lowest emissions for B30.

4. There is no significant change in O_2 emissions is observed.

5. Further research is required in bringing these blends in fuel market. Transportation sector of Romania can benefit from this research within European biofuel targets and laws.

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PERFORMANŢA DE EMISIE A MOTORULUI DIESEL DE ALIMENTARE CU DIESEL-BIODIESEL DE AMESTECURI

(Rezumat)

Biodiesel-ul este un combustibil obţinut din resurse regenerabile. Scopul acestei lucrări este de a determina posibilitatea folosirii amestecurilor biodiesel-motorina pentru alimentarea unui generator alimentat de un motor diesel - Kipor KDE-6500E. Emisiile poluante sunt măsurate cu ajutorul analizorului de gaze tip VLT-4588. Experimentele au fost efectuate în cazul alimentării motorului cu motorină şi amestecuri B 10, B 20 şi B 30 pentru diferite condiţii de încărcare. Au fost măsurate emisiile de CO_2, O_2 şi HC pentru determinarea performanţelor obţinute în urma folosirii amestecurilor biodiesel-motorină. Se poate observa o scădere considerabilă a emisiilor de CO_2 şi HC pe măsura creşterii amestecului biodiesel-motorină.