POMORSKI FAKULTET KOTOR
KOMISIJI ZA DOKTORSKE STUDIJE
VIJEĆU FAKULTETA

PREDMET: Predaja doktorske disertacije

Poštovani,

Predajem svoju doktorsku disertaciju pod nazivom „Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije", u dovoljnom broju primjeraka, u pisanoj i elektronskoj formi sa pratećim izjavama.
Takođe predajem i pisanu saglasnost mentora, biografiju i kopije naučnih radova.
Molim da predložite sastav komisije za ocjenu moje doktorske disertacije i sprovedete dalji postupak.

Srdačno,

DOKTORAND
Mr Nada Marstijepović Đurdić

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da rad pod nazivom: **"Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije"** autorke mr Nade Marstijepović Đurđić, zadovoljava kriterijume doktorske disertacije propisane Statutom Univerziteta Crne Gore i Pravilima doktorskih studija.

U Kotoru, 29. 04. 2024. godine

Mentor

Prof. dr Danilo Nikolić

Izjava o autorstvu
Izjava o istovjetnosti štampane i elektronske verzije doktorskog rada
Izjava o korišćenju

Prilog 1.

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Potpisani-a: mr Nada Marstijepović Đurđić

Broj indeksa/upisa: 3/DS-2011

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Ime i prezime autora mr Nada Marstijepović Đurđić
Broj indeksa/upisa 3/DS-2011
Studijski program Pomorske nauke
Naslov rada "Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije"

Mentor Prof. dr Danilo Nikolić

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Potpis doktoranda

Kotor,

Influence of Biodiesel Blends on Characteristics of Gaseous Emissions from Two Stroke, Low Speed Marine Diesel Engines

Danilo Nikolic, Sead Cvrk, Nada Marstijepovic, Radmila Gagic and Ivan Filipovic

Abstract As a renewable source of energy, biofuels have a favourable impact on the environment and can replace fossil fuels to some extent. Biodiesel is one option for reducing the emission of pollutants and GHG in the shipping sector. By 2030, Lloyd Register predicts a global demand for about 100 million tons of biofuel in shipping, mostly biodiesel. This study investigates the influence of biodiesel blends on the characteristics of gaseous emissions from a two-stroke, low speed marine diesel engine. For this research, a reversible low-speed two-stroke marine diesel engine was used, without any after-treatment devices installed or engine control technology for reducing pollutant emission. Tests were carried out on three regimes of engine speed, 150, 180 and 210 rpm under heavy propeller condition, while the ship was berthed in the harbour. The engine was fuelled with low sulfur diesel fuel and blends containing 7 and 25% v/v of three types of second-generation biodiesel made from cast-off sunflower and palm oil waste from frying. For biodiesel production, a base-catalyzed transesterification was implemented. Biodiesel blends show better emission performance in regard to NOx, SO_2, CO, and CO_2 than pure low sulfur diesel fuel.

Keywords Used frying oils · Biodiesel · Low sulfur diesel fuel · Two-stroke low speed marine diesel engine · Gaseous emission

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includes production from microalgae. The price of biofuels is another key factor limiting their widespread use, mainly because of their higher cost of production compared to fossil fuels.

There is little practical experience with the use of biofuels in shipping. Several companies have tested biofuels, mostly in cargo and passenger ship engines. Most of these experiments have been carried out by shipping companies, sometimes in cooperation with classification societies. Tests were mostly conducted using FAME (fatty acid methyl esters—biodiesel), vegetable oils and BioLNG (Florentinus et al. 2011). The implementation of biodiesel as a marine fuel was tested in several research programs (RCCL Project Royal Caribbean—Cruises testing on biodiesel, MAERSK/LR Project, BV energy Project, Earthrace), in which certain advantages of biodiesel over fossil fuels were noted: blending can be made up to 100% of biodiesel, there was a reduction in particulate emissions, no adverse effects were detected in marine engines, and no bacterial formations were detected in tanks of biofuels during storage for more than 6 months. The potential problems when using biodiesel are: it acts as a solvent and tends to soften and degrade certain rubber and elastomer compounds that are often used in older engines, and it can easily remove deposits that remain after diesel fuel has been in the system, and thus clog filters (Florentinus et al. 2011). The IMO study (IMO 2007) concluded that low blends of biodiesel up to 20% (B20) could be used without any fuel system degradation. The application of smaller biodiesel blends at marine fuels distillates could be introduced relatively easily. This compound could be prepared at the time of bunkering. These studies were conducted on medium speed 4-stroke marine diesel engines.

The used frying oils, generated from fried food, could be a candidate for biodiesel production in regions with negligible vegetable oil production. Wastes containing oils are products of decomposition that impair the oil's quality, causing a reduction in productivity in the trans-esterification reaction and also possibly generating undesirable by-products that can spoil the final product. Therefore, it is of great importance to refine used frying oils for biodiesel production, using filtration, de-acidification or neutralization and whitening processes.

The influence of biodiesel (FAME) blends with low sulfur diesel fuel on the characteristics of gaseous emissions from marine diesel engine was investigated. A reversible, two-stroke, low speed, cross-flow scavenging, 4-cylinder marine diesel engine was used for the experiment. The engine was fuelled with low sulfur diesel fuel and blends containing 7 and 25% of two types of biodiesel. The two types of biodiesel were produced under lab conditions, using cast-off sunflower and palm oil waste from frying. Base-catalysed trans-esterification was used in this research.

2 Experimental Procedure

For this study, a marine diesel engine was employed. It was a reversible 4—cylinder, 2-stroke engine with cross-flow scavenging, model "ALPHA 494 R" produced by LITOSTROJ Ljubljana (Slovenia) under a Burmeister licence,

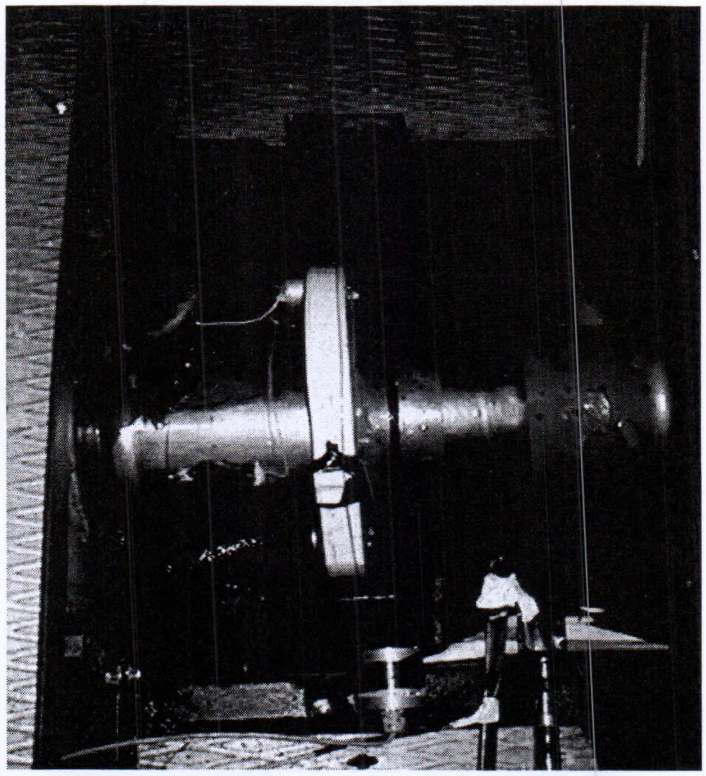

Fig. 1 Strain gauges mounted on the propeller shaft

XY21-6/350 strain gauges, connected in the Wheatstone bridge and powered with an AC voltage of 9 V, are installed onto the propeller shaft. The strain gauges are mounted at an angle of 180° relative to one another. From the Wheatstone bridge, a measuring signal is delivered to the radio transmitter, allowing a transfer of data to the receiver. A power source, transmitter and antenna are mounted on a ringed disc made of plastic in order to eliminate noise, and this is placed on the propeller shaft. Next to the shaft, a signal receiver and speed sensor are placed (Fig. 1). The signal receiver and speed sensor are connected to an electronic measuring device, the "Spider 8." The "Spider 8" is connected to a personal computer with "Catman 3.0" data processing software. Equipment was produced by Hottinger Baldwin MESSTEHNIK (HBM).

Hourly fuel consumption was measured for each engine speed and fuel type. For the fuel mass flow estimation, the volumetric method of fuel consumption measurement was employed according to the formula (Borkowski et al. 2011)

$$B = \frac{V_p \cdot \rho_p}{t} [\text{kg/h}], \qquad (3)$$

where

B is the fuel mass flow [kg/h]
V_p is the fuel volume consumed during the measurement time [m^3]
ρ_p is the fuel gravity [kg/m^3]
and t is the time of measurement [h].

Table 3 Test fuels basic properties

Parameters	Units	Fuel 1 DF	Fuel 2 DP7%	Fuel 3 DP25%	Fuel 4 DS7%	Fuel 5 DS25%
Density @ 15 °C	kg/m^3	833.4	836.37	844.8	837.2	846.6
Viscosity @ 40 °C	mm^2/s	2.92	3.00	3.21	2.95	3.23
Cetane number		51.3	52.5	53.9	53.5	54.2
Distillation % (v/v) recovered @ 250 °C % (v/v) recovered @ 350 °C 95% (v/v)	% (v/v) % (v/v) °C	29 91 354	26 92 356	20 92 360	28 91 357	19 89 361
Sulfur content	mg/kg	8.57	7.91	5.68	7.79	5.64
Water content	mg/kg	40.94	71.93	153.65	79.99	177.42
Total aromatics	% m/m	22.8	22.5	20.5	22.3	19.8
FAME content	v/v	0	7	25	7	25

waste from frying. This frying oil waste was collected from hotel restaurants. Base-catalysed trans-esterification was used for biodiesel production. The basic properties of the test fuel are given in Table 3, where DF stands for pure diesel fuel, DS stands for blends of diesel fuel and biodiesel made of sunflower oil waste from frying, and DP stands for blends of diesel fuel and biodiesel made of palm oil waste from frying. For blended fuels, to the initial letters, a percentage of biodiesel is added to it. The poor low-temperature properties of biodiesel were avoided by performing tests during the summer period. Also, the biodiesel was used in an experiment a couple days after it was produced in the laboratory, so the poor stability properties of biodiesel were avoided.

Tests were conducted under identical conditions. Fuel was supplied to the engine by an outside tank. For each fuel change, the fuel lines were purged, and the engine was left to run for a minimum 20 min in order to be stabilized under new conditions. Fuel samples were poured into separate tanks connected to the suction side of the engine fuel pump. Excess fuel was returned into the same tank. The tank was located on the gallery in the engine room about two meters above the engine, so that the fuel came to the fuel pump by force of gravity. A glass burette of known volume was used for fuel consumption measurements. It was attached in parallel to the tank.

The engine ran for 8600 h after the last overhaul, and there were no adjustments of the engine for this experiment. The purpose of the performed measurements was to determine trends of gaseous emissions in relation to different types and content of the second-generation biodiesel in the blends for the marine diesel engine in service.

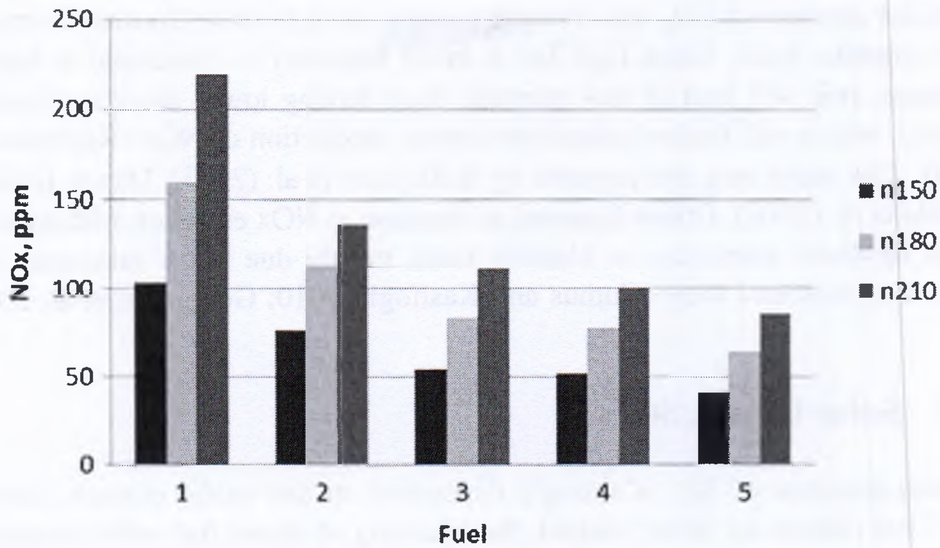

Fig. 3 Exhaust emission of NOx for different fuels, %

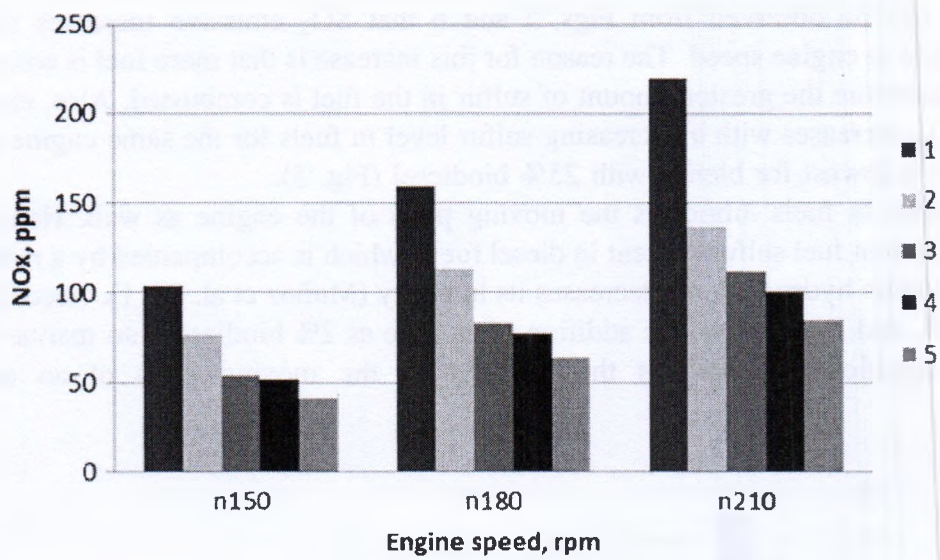

Fig. 4 Exhaust emission of NOx for different engine speeds, %

and dilution, and leading to the lower local gas temperatures (Kalligeros et al. 2003; Lee et al. 1998).

Furthermore, aromatic and poly-aromatic hydrocarbons are responsible for higher NOx emissions (Kalligeros et al. 2003; Takahashi et al. 2001; Spreen et al. 1995; Martin et al. 1997). This could be due to the higher flame temperatures associated with aromatic compounds. In reducing the aromatic and poly-aromatic content of the fuel, the flame temperature will be reduced as well, leading to a lower NOx production rate. Since biodiesel does not contain the above classes of compounds, its addition will reduce NOx emissions from the engines. The aromatics have high carbon–hydrogen ratios, and thus fuels with lower aromatics will lead to

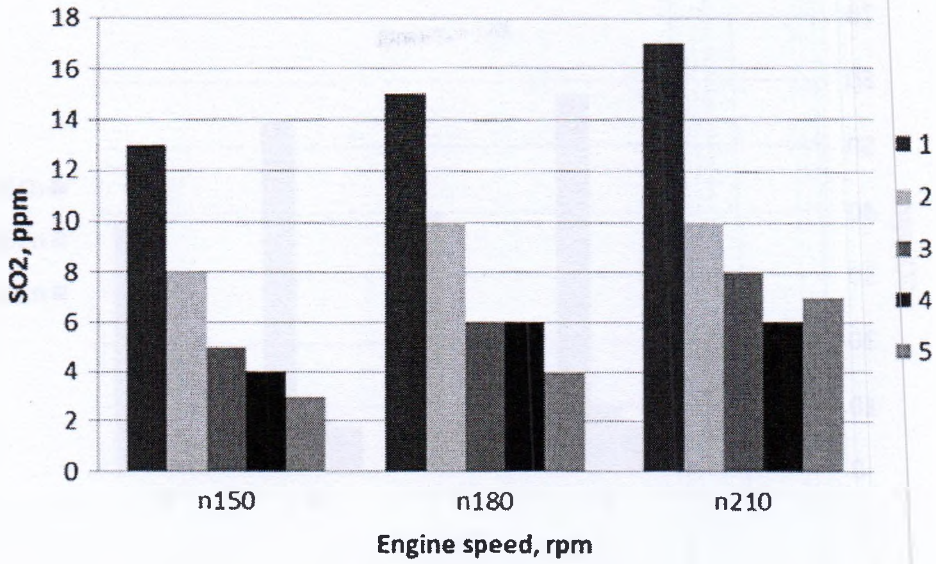

Fig. 6 Exhaust emission of SO_2 for different engine speeds, %

Therefore, adding biofuels into diesel fuel improves both SO_2 emission and fuel lubricity, the latter being very important for older two-stroke slow speed engines using low sulfur fuels, such as the engine used in this experiment.

3.2.3 Carbon Monoxide, CO

In an engine, CO emissions are controlled primarily by the air/fuel ratio. For fuel rich mixtures, CO emission increases steadily with a decrease in the air/fuel ratio, as the amount of fuel increases. For fuel lean mixtures, CO emission varies little with the air/fuel ratio. However, diesel engines always operate on the leaner side of the stoichiometric (Bhardwaj and Abraham 2008).

It can be observed from Figs. 7 and 8 that CO emission increases with an increase in engine speed. The reason for this increase is air/fuel ratio reduction with an increase in the load. Similar trends were reported by Gumus and Kasifoglu (2010), Usta et al. (2005) and Lertsathapornsuka et al. (2008).

Furthermore, emission of CO from a biodiesel-fueled engine is lower by more than 50% than that of a diesel-fueled engine at low and medium engine speeds. Considering only biodiesel blends, with an increase in biodiesel content from 7% to 25%, there is a reduction in CO emission regardless of engine speed, being most evident at maximum engine speed. This might be possible because of the oxygenated nature of biodiesel fuel. With biodiesel, owing to the inbuilt oxygen, the local air/fuel ratio during the combustion process becomes leaner, which results in the reduction in CO. This trend was also reported by Gumus and Kasifoglu (2010), Ramadhas et al. (2005). However, when applying maximum engine speed, there is notable increase in emitted CO when using biodiesel blends. At this high engine speed, poor combustion and other fuel characteristics annul the influence of

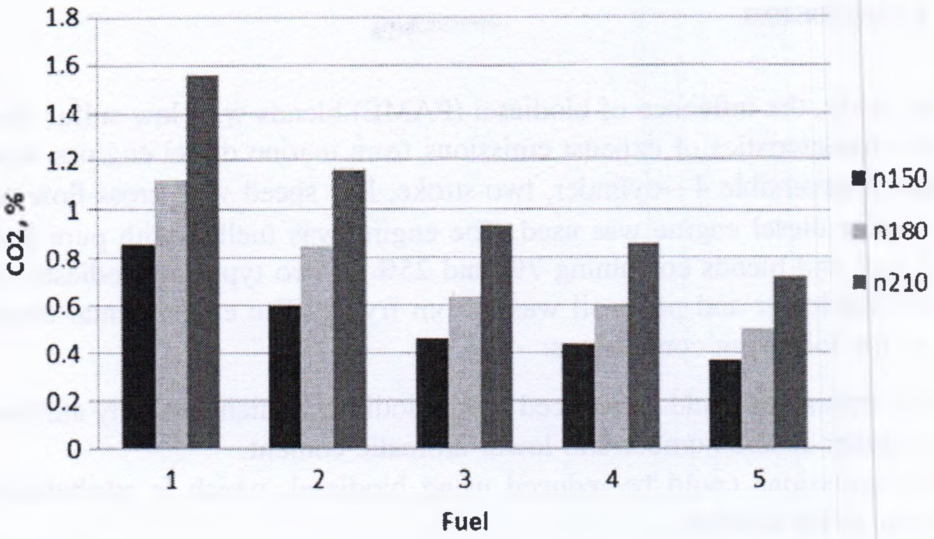

Fig. 9 Exhaust emission of CO_2 for different fuels, %

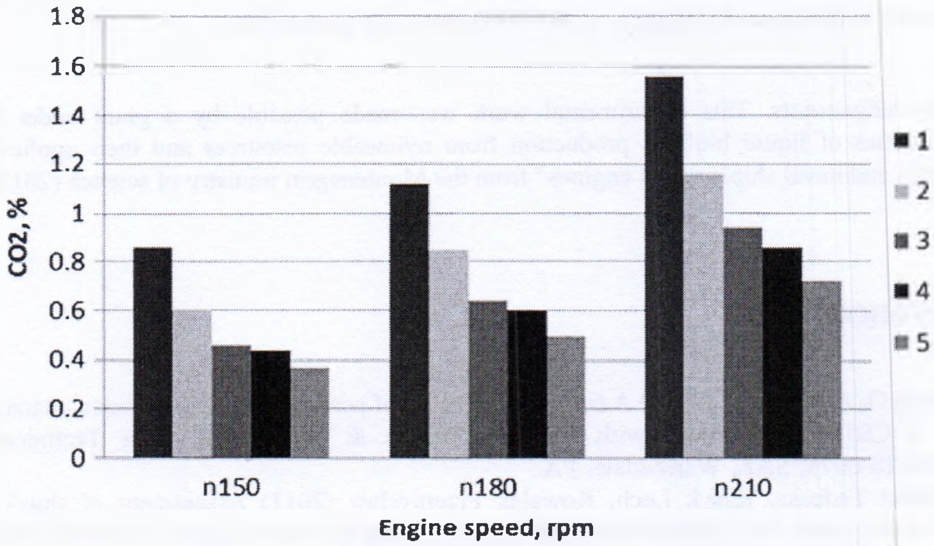

Fig. 10 Exhaust emission of CO_2 for different engine speeds, %

Emission of CO_2 from a biodiesel-fueled engine is lower than that from a diesel-fueled engine for a range of engine speeds, and this reduction is larger with biodiesel content in blends. The reason is that biodiesel blends have a lower carbon-to-hydrogen ratio than diesel fuel, and hence the combustion of these fuels produces less CO_2. This trend was also reported in Ozsezen et al. (2009), Utlu and Kocak (2008).

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APPLICATION OF BIODIESEL DERIVED FROM OLIVE OIL PRODUCTION WASTES AT MARINE DIESEL ENGINE AND EVALUATION OF GASSEOUS EMISSION TRENDS

by

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As a carbon neutral fuel, biodiesel is one option in future IMO scenarios for reducing carbon intensity in shipping sector, and at same time reducing emission of pollutants. Some oily wastes, such as waste from olive oil production, might be used for production of second-generation biodiesel. The current study looks into the effect of biodiesel on the characteristics of gaseous pollutant emissions of NO_x and CO from slow-speed two-stroke marine Diesel engines that do not have any after-treatment devices or engine control technology installed to reduce gaseous pollutant emissions. While the ship was berthed in the harbor, tests were performed on two separate loads at 210 rpm. The engine was powered by diesel fuel and blends of 7%, 20%, and 25% v/v of biodiesel derived from oily wastes generated during olive oil processing. For biodiesel production in lab conditions, base-catalyzed transesterification was implemented. According to the findings, there are tendencies of reduced gaseous emissions when utilizing blended fuels.

Key words: *biodiesel made of wastes from olive oil production, marine Diesel engine, gaseous pollutants*

Introduction

Total maritime transport sector has increased its CO_2 (GHG) emission from 962 million tonnes in 2012 to 1056 million tonnes in 2018, or from 2.76% in 2012 to 2.89% in 2018 of total anthropogenic global emission [1]. During same period, the carbon intensity of shipping operations decreased by around 11%, although efficiency gains were outpaced by increased activity [1].

Aside from GHG emission, maritime transport sector releases significant amounts of pollutants such as NO_x and SO_x, and in smaller amount CO and HC, as well. From 2014 to 2018, NO_x emissions climbed from 19 million tons to 20.9 million tons, while SO_x emissions increased from 10.2 million tons to 11.3 million tons, according to statistics [2].

The International Maritime Organization (IMO) regulates shipping air pollution and greenhouse gas emissions through MARPOL and Annex VI of the International Convention

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factured under Burmeister license by LITOSTROJ Ljubljana, Slovenia, tab. 1. The engine is classified as a low-speed engine because its maximum speed is 320 rpm and it produces 390 kW of power. Because it was an old-style marine Diesel engine, no after-treatment devices or engine management systems to limit pollutant emissions were fitted. In fact, a circumstance like this is ideal for studying the direct effects of biodiesel on exhaust emissions from marine Diesel engines. After the last overhaul, the engine has been operating for 8600 hours with no alterations made for this experiment.

Table 1. Marine Diesel engine specifications

Engine producer	Engine model	Working principle	Max power	Cylinder No.	Stroke/Bore
Burmeister	Alpha 494-R	two-stroke	390 kW at 320 rpm	4	490 mm/290 mm

The direct propulsion system of the ship comprises of the engine, propeller shaft connected to the output coupling, and a fixed-pitch propeller. Tests were conducted when the ship was berthed in harbour and during the same day – in order to have the identical atmospheric conditions. At the engine crankshaft speed of 210 rpm, two modes of load were achieved, the first with the rudder in the zero position (midship) and the rudder turned to the far left, which achieves an increased load for the same number of revolutions (designated as 210 and 210N, respectively).

During the engine operation, power is constantly changing depending on the connected consumer. In the conditions of operation of the vessel, engine power that is transmitted to the fixed pitch-propeller depends on the number of revolutions, pitch and propeller diameter. Effective power that is delivered to the propeller could be expressed via the torque which is transmitted from the engine crankshaft, via coupling, to the propeller shaft and propeller, where it reverses the angular velocity, ω. The recorded average torque and shaft speed data can be used for engine effective power estimation in accordance to the formula below [12]:

$$P_e = M\omega = \frac{M\pi n}{30} \text{ [kW]} \tag{1}$$

where M [kNm] represents measured torque [kNm] and n [rpm] represents engine-propeller rotational speed .

As for the set of engine speeds and different testing fuels, measurements of propeller shaft torque and power were conducted by means of strain gauges. This method establishes a functional connection between the elastic angular deformation of the propeller shaft and engine torque/power. Measurements of the propeller shaft torque and power were conducted by installing two pairs of strain gauges (type XY21-6/350), connected in Wheatstone bridge, onto the propeller shaft. The strain gauges were mounted at an angle of 180° relative to one another. Power was delivered to strain gauge from a 9 V source. Measuring signal from the Wheatstone bridge was delivered to the radio transmitter, allowing transfer of data to the receiver. A power source, transmitter and antenna were mounted on a ringed disc made of plastic, placed on the propeller shaft, with a view to eliminate noise. Next to the shaft, a signal receiver and a speed sensor were placed, fig. 1. The signal receiver and the speed sensor were connected to an electronic measuring device – Spider 8. The

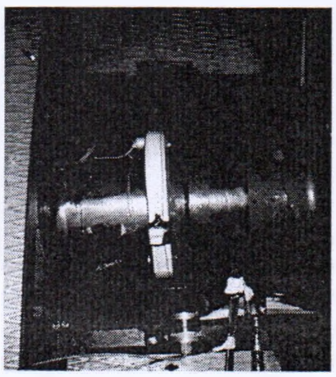

Figure 1. Strain gauges mounted on the propeller shaft

minutes of each running step. Measurements were taken on the same day to ensure that the atmospheric conditions were nearly identical in each test. Figure 2 depicts the exhaust emission test schematic.

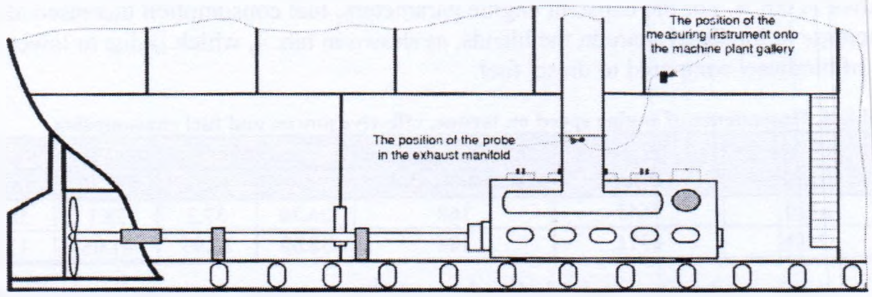

Figure 2. The position of exhaust emission testing equipment

An outside tank supplied fuel to the engine. The fuel lines were cleaned after each fuel type change, and the engine was left running for at least 20 minutes to stabilize under the new conditions. Separate fuel samples were prepared and poured into separate tanks that were connected to the suction side of the engine fuel pump. Excess fuel was pumped back into the same tank. The tanks were placed on the gallery in the engine room, about 2 m above the engine, so that the fuel was delivered to the fuel pump by gravity. In addition, a glass burette of known volume was attached to the tank and used to measure fuel consumption.

Given that the marine Diesel engine was running for 8600 hours after the last overhaul and that there were no adjustments of the engine for this experiment, the purpose of performed measurements was to give trends of gaseous emissions in relation to different types and content of the second-generation biodiesel in the blends for the marine diesel engine in service.

Results and discussion

Test fuel parameters

The engine was powered by diesel fuel and blends containing 7%, 20%, and 25% v/v of the FAME. None of the blends required any adjustments to the marine Diesel engine for this experiment [5]. The diesel fuel was a typical fuel used by the Montenegrin fleet in territorial waters, with a flash point above 60 °C. The FAME was produced in the lab conditions using oily wastes from olive oil extraction (olive pomace) collected from Montenegro's local olive oil producers. The FAME was produced using base-catalyzed transesterification. Table 3 shows the basic test fuel properties, with letter D representing pure diesel fuel with no biodiesel addition, DO representing blends of diesel fuel and biodiesel made of olive pomace oil. In the case of blended fuels, a percentage of biodiesel in the blend is added to the initial letters. Because the tests were carried out during the summer, the poor low temperature properties of biodiesel were avoided.

Table 3. Test fuels basic properties

Parameters	Units	D	DO7%	DO20%	DO25%
Density at 15 °C	kg/m^3	833.4	837.8	846.1	849.2
Viscosity at 40 °C	mm^2/s	2.92	3.02	3.21	3.28
Cetane number	–	51.3	53.8	55.1	55.4
Sulfur content	mg/kg	8.6	8.0	7.1	6.7
Total aromatics	% m/m	22.8	21.2	18.2	17.1
Lower heating value	MJ/kg	43.98	43.41	42.34	41.93
FAME content	v/v	0	7	20	25

Exhaust emission

Carbon monoxide

Diesel engines always operate with fuel lean mixtures [15]. In this case, CO concentration in the exhaust varies little with the air/fuel ratio [15].

Figure 5 shows that CO emission concentrations rose as engine loads increased due to a drop in air/fuel ratio. In addition, with increasing engine speeds and loads, more fuel has being injected. In works of [7, 13, 16-18] similar patterns was shown.

There is a trend of decreasing CO emissions with increasing biodiesel content in test fuels. This is feasible due to the oxygenated nature of biodiesel fuel. When biodiesel blends are used, the local air/fuel ratio increases during combustion, resulting in lower CO emissions from biodiesel blends. [7, 13] reported on this tendency.

The greater likelihood of being converted to CO_2 resulted in a reduction in CO emissions [7]. Furthermore, because biodiesel fuel has lower carbon content than diesel fuel, it emits less carbon oxides.

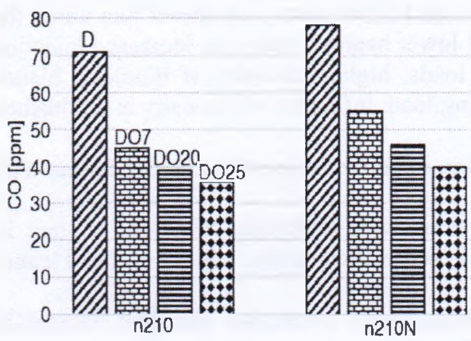

Figure 5. Exhaust emission of CO for different fuels and engine loads, [ppm]

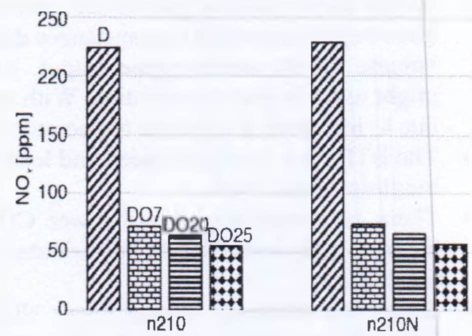

Figure 6. Exhaust emission of NO_x for different fuels and engine loads, [ppm]

Oxides of nitrogen

It can be observed from fig. 6 that the amount of NO_x slightly increased with an increase in engine load. The reason for this is a higher combustion temperature, because NO_x generation inside engine cylinders is temperature-dependent [19].

At both engine loads, there is a trend of decreasing NO_x emissions with increasing biodiesel content in test fuels, fig. 6. Higher cetane numbers and lower aromatic concentrations in biodiesel blends compared to diesel fuel might be explanations for NO_x reduction. In literature, higher cetane levels in biodiesel blends are typically linked with reduced NO_x emissions when compared to diesel fuel [13, 20, 21]. Higher cetane number reduces the size of the premixed combustion by shortening the ignition delay, resulting in lower NO_x formation rates as the combustion pressure rises more slowly, allowing more time for cooling via heat transfer and dilution and resulting in lower localized gas temperatures [20, 22].

Aromatic and poly-aromatic hydrocarbons, in particular, are responsible for increased NO_x emissions [20, 23-25]. This is most likely because aromatic compounds produce greater flame temperatures. By lowering the aromatics, the flame temperature falls, resulting in a decreased NO_x generation rate. As a result, adding biodiesel, which does not include aromatic compounds, reduces NO_x emissions from engines. Because aromatics have a high carbon-hydrogen ratio, fuels with lesser aromatics produce less CO_2 and more H_2O when com-

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Nada Marstijepović Đurđić rođena je u Baru, đje je završila osnovnu i srednju školu. Fakultet za Fizičku hemiju završila je u Beogradu kao i diplomske akademske studije fizičke hemije (diplomirani fizikohemičar-master). Magistarske akademske studije program Hemijske tehnologije smjer Neorganske hemije završila je na Metelurško-Tehnološkorn fakultetu u Podgoricu i stekla zvanje Magistra nauka. Završila je Diplomatsku Akademiju «Gavro Vuković« u Podgoricu. Radila je u Ekotoksikološkorn institutu u Podgoricu, u Upravi policije Crne Gore u Centru za krirninalističku tehniku. Radi u Ministarstvu unutrasnjih poslova Crna Gore. Sudski je vještak iz oblasti fiziko-hemijske-ekološke struke i zaštite životne sredine od 23.09.2010.godine. Učesnik je na više domaćih i međunarodnih konferencija, kongresa i simpozijuma iz oblasti fizike, hemije i životne sredine, ekologije, fundementelne fizičke hemije, bezbjednosti, rizika i dr. Predsjednik je i organizator Prve i Druge Međunarodne Konferencije ZEB-PES 2012 Bar i ZEB-PES 2013 Bar (zaštita, ekologija, bezbjednost-protect, ecology, safety) Crna Gora. Član je Inženjerske komore Crne Gore. Član je Matice Crnogorske. Član je Udruženja sudskih vještaka Crne Gore. Posjeduje Licencu za izradu projekata i elaborata procjene uticaja na životnu sredinu. Znanje engleskog jezika i rada na računaru. Služi se albanskim jezikom. Profesionalno je igrala košarku. Crnogorske je nacionalnosti. Udata je i majka dva đeteta Dara i Eva.

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POMORSKI FAKULTET KOTOR
Komisiji za doktorske studije

Poštovane kolege,

U postupku predaje doktorske disertacije kandidatkinje mr Nade Marstijepović Đurđić, pod nazivom „ Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije“, na ocjenu i obaveze predlaganja komisije za ocjenu, predlažem da članovi iste budu:

- Dr Nikola Račić, red. prof. Pomorskog fakulteta Sveučilišta u Splitu, predsjednik,
- dr Danilo Nikolić, red. prof. Pomorskog fakulteta Kotor Univerziteta Crne Gore, mentor,
- doc. dr Miroslav Vukičević, Pomorski fakultet Kotor Univerziteta Crne Gore, član.

Molim Komisiju za doktorske studije da ovaj sastav predloži na sljedećoj sjednici Vijeća Fakulteta.

Srdačno,
Prof.dr Danilo Nikolić, mentor

Na osnovu čl. 64. Statuta Univerziteta Crne Gore i čl. 38, 41. stav1 Pravila doktorskih studija, Vijeće Pomorskog fakulteta Kotor na sjednici odražanoj dana 31. 05. 2024. godine, donijelo je

ODLUKU

1. Utvrđuje se da su ispunjeni uslovi iz Pravila doktorskih studija za dalji rad na doktorskoj disretaciji „Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije", doktoranda mr Nade Marstijepović Đurđić.
2. Predlaže se Odboru za doktorske studije i Senatu Univerziteta Crne Gore da formira komisiju za ocjenu doktorske disertacije „Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije", doktoranda mr Nade Marstijepović Đurđić u sastavu:

- **Dr Nikola Račić, redovni profesor Pomorskog fakulteta Sveučilišta u Splitu, oblast Brodsko inžinjerstvo, predsjednik.**
- **Dr Danilo Nikolić, redovni profesor Pomorskog fakulteta Kotor Univerziteta Crne Gore, oblast Motori i vozila, mentor,**
- **Doc.dr Miroslav Vukičević, Pomorski fakultet Kotor Univerziteta Crne Gore, oblast Brodomašinstvo, član.**

3. Odluka se sa pratećim materijalima dostavlja Odboru za doktorske studije i Senatu Univerziteta Crne Gore.

O b r a z l o ž e nj e

Doktorand mr Nada Marstijepović Đurđić je uradila svoju doktorsku disertaciju „Optimizacija sastava izduvne emisije iz brodskih dizel motora upotrebom biodizela druge generacije", istu predala i uputila molbu Komisiji za doktorske studije i Vijeću Pomorskog fakulteta Kotor da predlože sastav Komisije za ocjenu disertacije.
Na osnovu podnijete dokumetacije i saglasnosti Komisije za doktorske studije, Vijeće je donijelo odluku kao u dispozitivu.
Odluka se sa pratećim materijalima dostavlja Odboru za doktorske studije i Senatu Univerziteta Crne Gore.

VIJEĆE POMORSKOG FAKULTETA KOTOR

Broj 01- **DEKANICA**
Kotor, 31.05. 2024. **Prof.dr Tatijana Dlabač**