Cetane Number Improver Added to Biodiesel-Diesel Blends Effects on Direct Injection Four Stroke Compression Ignition Engine Performance and Emissions

Abdul Salam Hamza Naser
Salam.dubba@gmail.com
University of Technology
Department of Machines and Equipment Engineering
Baghdad - Iraq

Abstract: *This study investigates the influence of cetane number improver on performance and emissions of a DI four stroke diesel engine fueled with biodiesel (derived from corn oil)–diesel blend fuel. Different percentages of cetane number enhancer (2, 4, and 6%) were added to blends. The results show that: the brake specific fuel consumption (BSFC) increased compared with diesel fuel. The brake thermal efficiency (BTE) improved remarkably, the enhancement achieved was about 6.1% on BTE of diesel fuel with adding 6% of CN improver to B20. NOx increased when CN improver was added to blends. The combustion characteristics of biodiesel–diesel blend fuel at large load may be resumed to* *diesel fuel by CN improver, but some difference exists at lower load yet.*

Keywords: Biodiesel, Cetane Number improver, CO, NOx, HC.

1. Introduction

Vegetable oil, commonly referred to as “biodiesel”, is prominent candidates as alternative diesel fuels. The name biodiesel has been given to transesterified vegetable oil to describe its use as a diesel fuel [1]. There has been renewed interest in the use of vegetable oils for making biodiesel due to its less polluting and renewable nature as opposed to conventional diesel, which is a fossil fuel that can be depleted [2 & 3].

Some of the important points of comparison between petroleum diesel and biodiesel are fuel economy, cetane number, emissions, cold weather performance, and lubricity [4 & 5]. The cetane number for diesel fuel is similar to the octane number for gasoline; both are a measure of the ignition characteristics of the fuel [6]. Autoignition is the combustion of fuel which is not initiated by an external source. Gasoline engines have an external source of ignition (spark plugs); thus, autoignition is not desirable. The octane number measures the ability of gasoline to resist autoignition [7]. A higher octane number corresponds to a greater ability to resist autoignition. Diesel engines do not have an external source of ignition, and thus rely on autoignition to ignite the fuel [8 & 9].

Various researchers have shown that biodiesel fuel exhibits chemical and thermodynamic properties which are substantially similar to those of petroleum diesel fuel [10]. However, the contribution of fatty acid; oleate acid, linoleate acid, etc., is derived from sources of plant oil [11 & 12]. Of course, the contribution of methyl esters in biodiesel fuel also depends on the contents of fatty acids [13 & 14]. For this reason, differences in characteristics of ignition, combustion and emission occur [15].

For a fuel to burn in a diesel engine, it must have a high cetane number or ability to self-ignite at high temperatures and pressures [16]. The cetane number (CN) is a measure of ignition quality or ignition delay, and is related to the time required for a liquid fuel to ignite after injection into a compression ignition engine [17]. The CN scale also shows that straight-chain, saturated hydrocarbons have higher CNs than branched-chain or aromatic compounds of similar molecular weight and number of carbon atoms [18]. The longer the fatty acid carbon chains and the more saturated the molecules, the higher the CN. The CN of biofuel from animal fats is higher than those of vegetable oils [19].

It can be seen that vegetable oils have lower cetane number than that of diesel, which is not desired when diesel engines are converted to biodiesel [20]. Fortunately, some additives can increase the cetane number of vegetable oils. This means that ignition delay period will become short, which will reduce tendency to cause a diesel knock [21]. It is preferable to add an ignition improver to raise the cetane number of biodiesel–diesel blends so that they fall within an acceptable range equivalent to that expected of diesel fuel [22].

The step towards “adapting the fuel to the engine” is to increase the ignition quality of it (corn oil used in this study) such that it is sufficient for all operating conditions. This is done by adding ignition improvers to it or by the introduction of ignition improvers, into the intake manifold [23].

Most of the effective ignition improvers that are added to improve the cetane rating are nitrogen based compounds, which can aggravate NOx emissions. Isoamyl nitrate, Ethyl nitrate, Butyl nitrate, Di-Ethylene Glycol Di-Nitrate (DEGDN), Tri-Ethylene Glycol Di-Nitrate (TEGDN) and Kerobrisol are some good ignition improvers [24].

This experimental study was performed on a 4-cylinder DI diesel engine fueled with various proportions of CN improver volume in biodiesel–diesel blend fuels. The aim was to find the influence of added quantity of CN improver on tested engine performance and emissions.

2. Experimental Setup

Equipment

Experimental apparatus of engine under study is DI, water cooled four cylinders, in-line, natural aspirated Fiat diesel engine whose major specifications are shown in Table 1. The engine was coupled to a hydraulic dynamometer through which load was applied by increasing the torque. The Multigas mode 4880 emissions analyzer was used to measure the concentration of nitrogen oxide (NOx), unburned total hydrocarbon (HC), CO2 and CO. The overall sound pressure is measured by precision sound level meter supplied with a microphone type 4615; the devise is calibrated by a slandered calibrator type pisto phone 4220.

The following equations are used in calculating engine performance parameters [25]:

- Brake power

$$bp = \frac{2\pi * N * T}{60 * 1000} \quad kW \tag{1}$$

- Brake mean effective pressure

$$bmep = bp \times \frac{2*60}{V_{sn} * N} \quad kN/m^2 \tag{2}$$

- Fuel mass flow rate

$$\dot{m}_f = \frac{v_f \times 10^{-6}}{1000} \times \frac{\rho_f}{time} \quad {}^{kg}/_{sec} \tag{3}$$

- Air mass flow rate

$$\dot{m}_{a,act.} = \frac{12\sqrt{h_o * 0.85}}{3600} \times \rho_{air} \quad \frac{kg}{sec} \tag{4}$$

$$\dot{m}_{a_{theo.}} = V_{s.n} \times \frac{N}{60*2} \times \rho_{air} \quad \frac{kg}{sec} \tag{5}$$

Where

$$V_{s.n} = \frac{\pi}{4} bore \times stroke \times n \qquad (m^3) \tag{6}$$

- Brake specific fuel consumption

$$bsfc = \frac{\dot{m}_f}{bp} \times 3600 \quad \frac{kg}{kW.hr} \tag{7}$$

- Total fuel heat

$$Q_t = \dot{m}_f \times LCV \quad kW \tag{8}$$

- Brake thermal efficiency

$$\eta_{bth.} = \frac{bp}{Q_t} \times 100 \quad \% \tag{9}$$

Preparation of the used fuel

Transesterification is the transformation of one type of an ester into another type of ester known as biodiesel. To prepare the fuel for the present work 200ml of methanol and 3.5 g of sodium hydroxide (lye) were taken in a beaker and mixed well for 5 min. To this 1 liter of corn oil was added and stirred for 15 min with heating at 65°C. The stirring was stopped and then the glycerin was allowed to settle down in the beaker. Later, the biodiesel (ester) was separated by washing and then boiled to remove the moisture. The resulted biodiesel was used in this work 20% biodiesel + 80% diesel fuel (called B20).

A common cetane improving additive, 2-ethylhexyl nitrate (also known as iso-octyl nitrate) is used to improve diesel fuel ignitability in small concentrations. It is commonly produced by several different manufacturers; the exact product used in these tests was manufactured under the name HiTec 4103. The more formal chemical formula is $C_8H_{17}NO_3$, with the basic structure an ethyl hexane molecule with one of the hydrogen atoms replaced with an NO_3 nitrate radical. It was used to raise cetane number in three different rates (CN=42, 45 &47.8). Fuel properties and the constitutions for the four fuels were measured at Al-Doura Refinery laboratory. These properties are recorded in **Table 2**.

Table 1, Tested engine specifications

Engine type	4cyl., 4-stroke
Engine model	TD 313 Diesel engine rig
Combustion type	DI, water cooled, natural aspirated
Displacement	3.666 L
Valve per cylinder	Two
Bore	100 mm
Stroke	110 mm
Compression ratio	17
Fuel injection pump	Unit pump 26 mm diameter plunger
Fuel injection nozzle	Hole nozzle: 10 nozzle holes Nozzle hole dia. (0.48mm) Spray angle= 160^o Nozzle opening pressure=40 Mpa

First of all, a dosage and cetane number improver were selected, 2% (by volume) of dosage was added to 20% biodiesel blend fuel

(B20), and the CN improver in blends were changed to 4% and 6%, respectively. Diesel fuel and B20 properties and the constitutions of three blends are given in Table 2.

Table 2, Tested fuels specifications

Fuel type	Calorific value (kJ/kg)	Density (g/dm^3)	Viscosity (mm^2/s at 27^{o}C)	Cetane No.	Flame point (^{o}C)	Cloud point (^{o}C)	Pour point (^{o}C)
Diesel fuel	44227	810	4.23	49	59	-13.8	-29
B20	37654	829	14.38	40.9	112	-11.78	-24.6
B20 +2% imp.	39848	826	13.6	42	107	-10.3	-21
B20 +4% imp.	41308	822	13.1	45	101	-9.7	-18.4
B20 +6% imp.	43165	219	12.67	47.8	93	-9.2	-16

Fig. 1, Photo of the engine used in present study

Tests Procedure

In the experiment, without any modification on the diesel engine parameters, the engine performance and emissions were compared with neat diesel fuel and B20. The above three CN improver blends with B20 were operated on the engine, meanwhile combustion characteristics and emissions were measured and analyzed at the same load and engine speed, and furthermore, these parameters were compared with those of pure diesel combustion in order to clarify the effect of an CN improvers addition on fuel combustion. All tests were conducted at Internal Combustion Laboratory, Machines and Equipment Engineering dept., University of Technology, Baghdad. Fig. 1 represents a photo for the tested engine.

3. Results and Discussions

Fig. 2 shows the BSFC for tested blends compared to pure diesel fuel equivalent BSFC versus BMEP. It is clear from the figure that as the load increases, the BSFC decrease for all fuels. It can be seen that adding biodiesel to pure diesel fuel increased BSFC. At the same time, it can be found that the BSFC decreased with the CN improver addition. This behavior is reasonable since the engine will consume more fuel with biodiesel–diesel blend fuels than with neat diesel fuel to gain the same power output owing to the decrease in the lower heat value of biodiesel–diesel blend fuels. The decrease of BSFC with CN improver addition is due to enhancement of the premixed combustion phase of blends, and improvement of the diffusive combustion phase on account of oxygen enrichment. In addition, the total combustion duration is shortened for blends. Based on these reasons, the energy consumption rate of blends decreased.

Fig. 3 shows that the comparison of fuel consumption of the engine fuelled with four kinds of blends at speed characteristics of full load. In comparison with those of neat diesel operation, the fuel consumption of B20 blend operation is higher at all speed range. The BSFC of the blends with CN improver operation are higher than that for neat diesel fuel, in the same time they are lower than those for B20. The fuel consumption of B20 is higher than diesel fuel due to lower heating value of biodiesel. However, adding cetane improvers increase the heating value of the blends and reduce BSFC for it, but still the blends of B20 and CN improvers' consumption are higher than that of neat diesel operation.

Fig. 4 presents the brake thermal efficiency of the engine fueled with diesel and different CN improver blend fuels. The brake thermal efficiency shows an increase with biodiesel addition with about 1.97%. Also shows a slightly increase with CN improver addition at lower load with about 4.1, 5.1 and 6.1% for adding 2, 4 and 6% of CN improver to B20 compared with BTE resulted from diesel fuel operation.

Fig. 5 represents the effect of engine load on exhaust gas temperatures for the five tested blends. Diesel emitted the higher exhaust gas temperatures due to its high heating value compared to the other blends. Adding CN improver enhanced blends combustion (increasing inner combustion chamber temperature and pressure) causing higher exhaust gas temperatures.

Fig. 6 shows the comparison of brake power output of the engine fuelled with four kinds of fuels at speed characteristic of full load. It can be seen from the figure that the power output of engine fuelled with 4 and 6% improver are higher than those of neat diesel at low speed (at 1500 rpm and below), regardless of that the low calorific value of blend is lower than that of neat diesel fuel. (The low calorific value of B20+6% CN improver is 96.7% of that of diesel and the low calorific value of B20+4% CN improver is 93.4% of that of diesel.) It is possible that the larger fuel delivery energy for these blends operation achieve a higher power for blend operation at low engine speeds. But the power for blend fuel operation is lower at high speeds (2200 rpm and above) than that of neat diesel fuel operation due to the lower calorific value and smaller fuel delivery energy for blend comparison with neat diesel. Power output of B20+2% CN improver is much lower than those of diesel operation due to its lower calorific value, which is only 90.1% of that of diesel. Low power output of B20/diesel blend fuelled engine can be improved by enlarging fuel supply amount of pump per cycle. It is also obvious that power output of engine decrease with B20 at full load.

The NOx emissions of diesel engine fueled with biodiesel–diesel blends and diesel fuel at selected operating conditions are illustrated in Figs. 7 & 8. NOx concentrations increased with adding biodiesel to diesel fuel, and it increased more with adding CN improver to the blends. For a specific engine speed, the NOx emissions increased with the increase in the CN improver rate addition. Adding biodiesel to diesel fuel increased its oxygen content which enhanced NOx increment. Adding CN improver to biodiesel-diesel blends enhanced combustion resulted in higher NOx rates. Similar behavior can be seen in Fig. 8, the NOx emissions increased with the increase of engine speed from low to medium speeds, and then it relatively reduced with increasing speed from medium to high speeds. NOx concentrations increased with the biodiesel addition at for all engine speeds due to its oxygen content. NOx emissions increased with increase in the CN improver addition at all engine speeds. Adding CN improver to biodiesel-diesel blends satisfied three main factors for increasing emitted NOx. In principle, the maximum temperature, high temperature duration, and oxygen concentration in the mixture have a dominant effect on NOx emission. It can be seen from above analysis that the ignition delay of biodiesel–diesel blend with CN improver blends reduced, the premixed combustion decreased, and their total combustion duration shortened. As a result, NOx emission increased for blend fuels.

Fig. 9 illustrates the CO emissions versus engine BMEP for diesel fuel and various biodiesel-diesel blend fuels. For B20 fuel, CO emission decreases remarkably at lower and medium loads. But it is worth noting that the CO emission concentration increases with increase in the CN improver addition. The presence of CO levels is a result of incomplete combustion of the fuel-air mixture. The high oxygen content in B20 structure could be responsible for the reduction of CO emission. While the reason for CO emission increment is the changing of ignition delay with CN improver addition. On the other hand, the CO emissions slightly increase for the blend fuels at large loads. This can be explained by the enrichment of fuel addition, as increasing the proportion of fuel will promote the further oxidation of CO during the engine exhaust process.

Fig. 10 represents CO concentrations versus engine speed for the five tested fuels. The same behavior in the last figure can be seen in this figure, adding CN improvers improve B20-diesel blends combustion, hence increased dissociation of CO_2 to CO, and move it to reach diesel fuel output. As well as CO emissions moved towards neat diesel concentrations.

From Fig. 11, it can be found that the HC emissions reduced highly for B20 blend, as well as with increasing BMEP. Adding CN improvers reduced these emissions less than that of diesel fuel but not less than that for B20. HC produced from incomplete combustion of blend fuels, but the presence of oxygenated B20 increased the oxygen content in the air-fuel mixture, improving the emitted HC concentrations. It is very interest to note that the HC emissions for blends with CN improver are less than that of diesel fuel for all tested load range.

HC concentration reduced slightly with increasing engine speed, as Fig. 12 represents. HC concentrations reduced remarkably with B20 operation. CN improver cause limited reductions in HC concentrations, because added improver improved combustion quality of the blends.

CO_2 is a greenhouse gas and will be limited in many countries. Based on the difference between the C/H ratios of fuel, CO_2 emissions with B20 operation is originally about 10% less than that of diesel fuel. Fig. 13 gives CO_2 emission characteristics when the five tested blends are used. There is almost no obvious trend of CO_2 emissions for different fuels. However, CO_2 emissions for B20 with CN improver blends are lower than those of diesel in a whole. It is due to the influence of low C/H ratio and oxygen content of the blends.

Engine noise reduced with using B20 compared to neat diesel, as Figs. 14 and 15 manifests. Engine noise increased with adding CN improver to B20. It also increased with increasing engine load and speed. The reductions in engine noise with B20 are for two reasons: Biodiesel has a characteristic of lubrication improvement which reduces the friction of moving parts. The second reason is better combustion due to oxygen presence in its structure that reduces combustion noise. Adding CN improver enhanced combustion (increased combustion chamber temperature and pressure) causing higher engine noise.

4. Conclusions

The biodiesel is produced from Iraqi sunflowers oil by transesterification accompanied by pre-oxidation. Five blends include neat diesel, biodiesel of 20% and 80% diesel, and blends of the three CN improvers are added to B20 and the fuels were tested in a direct injection diesel engine. The work conclusions are summarized as follows:

1. The brake specific fuel consumption (bsfc) increased with increasing load at constant engine speed, and it increased when using B20 also. Adding CN improvers to B20 enhanced the combustion and reduced the resulted BSFC.
2. Engine brake thermal efficiency improved when operated with B20 blend and with CN improver blends.
3. Using biodiesel reduces exhaust gas temperatures for all tested loads and engine speed ranges. Adding CN improver increases these temperatures.
4. As a result of higher oxygen content in the B20 structure, less CO_2 emissions obtained at the variable engine tests. Adding CN improver increases CO_2 concentrations but still lower than those of diesel fuel.
5. CO emissions reduced with biodiesel operation but high concentrations are observed at low engine loads operations. Adding CN improver increases these concentrations but still lower than that resulted from neat diesel operation.

6. Unburnt hydrocarbons emissions reduced highly with B20 and with adding CN improver also compared with diesel fuel.
7. NOx emissions increased with B20 blend utilization, and by adding CN improvers also.
8. Engine noise increases with increasing load. The biodiesel combustion reduced engine noise, but adding CN improver increases noise but still lowers than that resulted from diesel operation.

References

[1] Demirbas A, Biofuels securing the planet's future energy needs, Energy Conversion and Management, vol. 50, Issue 9, pp: 2239-2249, 2009.

[2] Ghadge S V and Raheman H, Process optimization for biodiesel production from mahua (Madhuca indica) oil using response surface methodology. Bioresour Techno, vol. 97, pp: 379−384, 2006.

[3] Devan P K, Mahalakshmi N V, Study of the performance, emission and combustion characteristics of a diesel engine using poon oil-based fuels, Fuel Processing Technology, vol. 90, pp: 513–519, 2009.

[4] Fayyad S M, Momani W, Abu-Ein S Q, Juditawy O and Abu-Rahmeh T, Experimental Investigation of Using Fuel Additives – Alcohol, Research Journal of Applied Sciences, Engineering and Technology, vol. 2, No. 2, pp: 164-169, 2010.

[5] Nagaraju V and Henein N, Quader A and Bryzik M W, Effect of biodiesel (B-20) on performance and emissions in a single cylinder HSDI diesel engine, SAE paper No. 2008-01-1401, 2008.

[6] Van Gerpen J A, Cetane number testing of biodiesel, Proc.3rd Conf, (ASAE) Liquid Fuel, September 15-17, Nashville, TN, USA, 1996.

[7] Najafi G, Ghobadian B, Yusaf T F and Rahimi H, Combustion analysis of a CI engine performance using waste cooking biodiesel fuel with an artificial neural network aid, American Journal of Applied Sciences, vol. 4, No. 10, pp: 756-764, 2007.

[8] Anand R, Kannan1 G R, Reddy1 K R and Velmath S, The performance and emissions of a variable compression ratio diesel engine fuelled with biodiesel from cotton seed oil, Journal of Engineering and Applied Sciences, vol. 4, No. 9, 2009.

[9] Basha M S, Reddy B G K, Comparison of performance and characteristics of direct injection diesel engine using blends of cotton seed oil, palm oil, neem oil with diesel, International J. of Eng. Research & Indu. Appls., (IJERIA), vol. 3, No. I, pp: 41-50, 2010.

[10] Yamane K, Ueta A and Shimamoto Y, Influence of physical and chemical properties of biodiesel fuel on injection, combustion and exhaust Emission characteristics in a DI-CI Engine, The Fifth International Symposium on Diagnostics and Modeling of Combustion in Internal Combustion Engines (COMODIA 2001), Nagoya, 2001.

[11] Myo T, The effect of fatty acid composition on the combustion characteristics biodiesel, Ph D thesis, Kagoshima University, Japan, 2008.

[12] Karabektas M, The effects of turbocharger on the performance and exhaust emissions of a diesel engine fuelled with biodiesel, Renewable Energy, vol. 34, Issue 4, pp: 989-993, 2009.

[13] Knothe G, Dependence of biodiesel fuel properties on the structure of fatty acid alkyl esters, Fuel Processing Technology, vol. 86, pp: 1059– 1070, 2005.

[14] Michael S G and Robert L M, Combustion of fat and vegetable oil derived fuels in diesel engines, Progr. Combust. Sci., 24, 125-164, 1998.

[15] Kadarohman A, Hernani, Khoerunisa F, Astuti R M, A potential study on clove oil, eugenol and eugenyl acetate as diesel fuel bio-additives and their performance on one cylinder engine, Transport, vol.25, No. 1, pp: 66-76, 2010.

[16] Freedman B and Bagby M O, Predicting cetane numbers of n-alcohols and methyl esters from their physical properties. J. Am. Oil Chem. Soc., 67(9), 565-571, 1990.

[17] Midwest Biofuels, Inc., Biodiesel Cetane Number Engine Testing Comparison to Calculated Cetane Index Number. Final Report to the National Biodiesel Board, New York, USA, 1993.

[18] Knothe G, Matheaus A C and Ryan T W, Cetane numbers of branched and straight-chain fatty esters determined in an ignition quality tester. Fuel, 82, 971-990, 2003.

[19] Knothe G, Bagby M O and Ryan T W, Cetane numbers of fatty compounds: influence of compound structure and of various potential cetane improvers, SAE Techn. Paper No. 971681, 1997.

[20] Basha M S, Reddy B G K, Reddy K V K, Kumar B S P and Kumar P R, Performance analysis of a single cylinder diesel engine using Jatropha Oil, International Journal of Applied Engineering Research, vol. 5, No. 6, pp: 1017–1024, 2010.

[21] Demirbas A, Biodiesel: A Realistic Fuel Alternative for Diesel Engines, Springer-Verlag London Limited, 2008.

[22] Xing-cai L, Jian-guang Y, Wu-gao Z and Zhen H, Effect of cetane number improver on heat release rate and emissions of high speed diesel engine fueled with ethanol–diesel blend fuel, Fuel, vol. 83, pp: 2013–2020, 2004.

[23] Iranmanesh M, Subrahmanyam J P and Babu M K J, Potential of diethyl ether as a blended supplementary oxygenated fuel with biodiesel to improve combustion and emission characteristics of diesel engines, SAE paper No. 2008-01-1805, 2008.

[24] Mittelbach M, Pokits B, and Silberholz A, Production and fuel properties of fatty acid methyl esters from used frying oil, Proceedings of an Alternative Energy Conference, 74-78, Nashville, TN, 14-15 December. St Joseph, MI: ASAE, 1992.

[25] Keeting E L, “Applied combustion”, 2nd edition, Taylor & Francis Group, LLC, 2007.

Notations

BMEP	brake mean effective pressure (kN/m^2)
BTE	brake thermal efficiency (%)
CO_2	carbon dioxide
CO	carbon monoxide
CN	cetane number
CR	compression ratio
CA	crank angle
^oBTDC	degree before top dead centre
DI	direct injection
N	engine speed (rpm)
N	engine cylinders number
T	engine torque (kN.m)
dB	Decibel
IT	Injection timing (^{o}BTDC)
LCV	Lower calorific value (kJ/kg)
NOx	nitrogen oxides
V_{sn}	swept volume (m^3)
UBHC	unburnt hydrocarbon

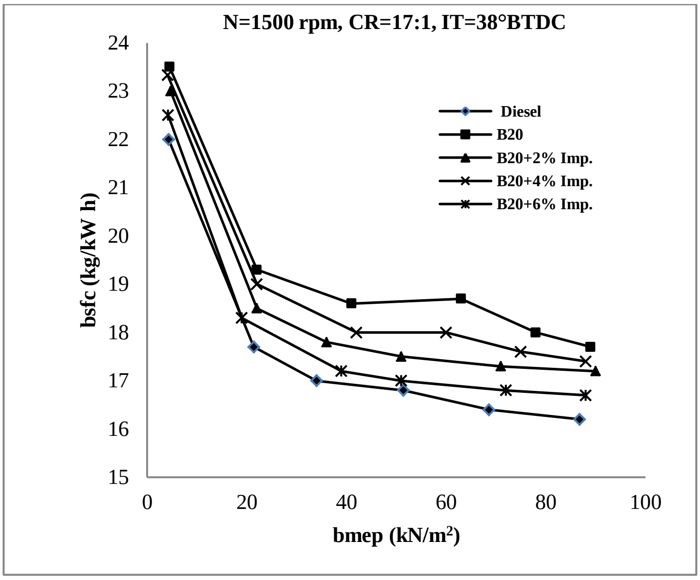

Fig.2, BMEP effect on BSFC for tested fuels at variable loads and constant engine speed

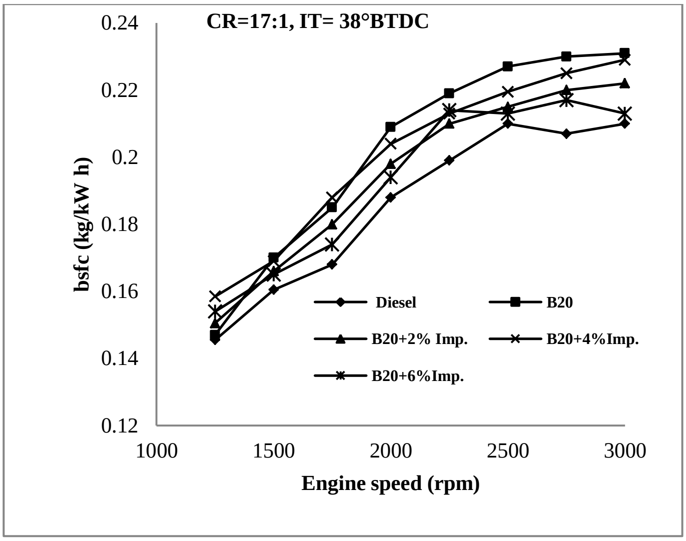

Fig.3, Engine speed effect on BSFC for tested fuels at constant load

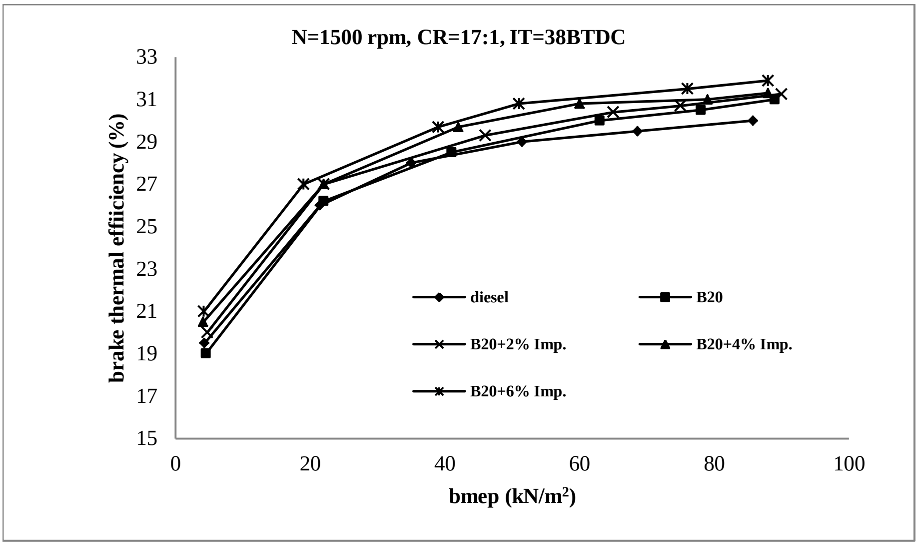

Fig.4, BMEP effect on brake thermal efficiency for tested fuels at variable engine loads and constant speed

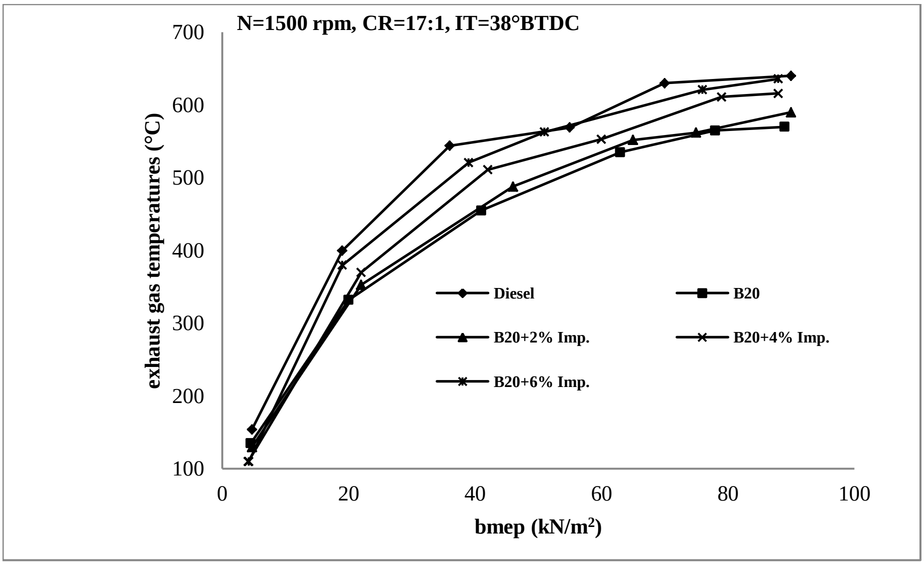

Fig. 5, BMEP effect on exhaust gas temperatures for tested fuels at constant speed

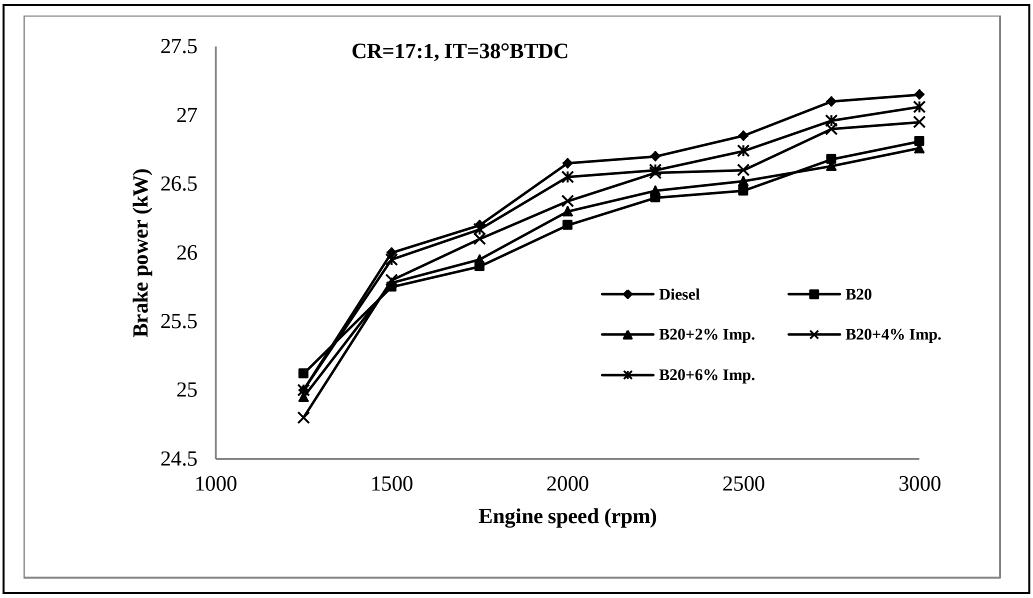

Fig.6, Engine speed effect on brake power for tested fuels

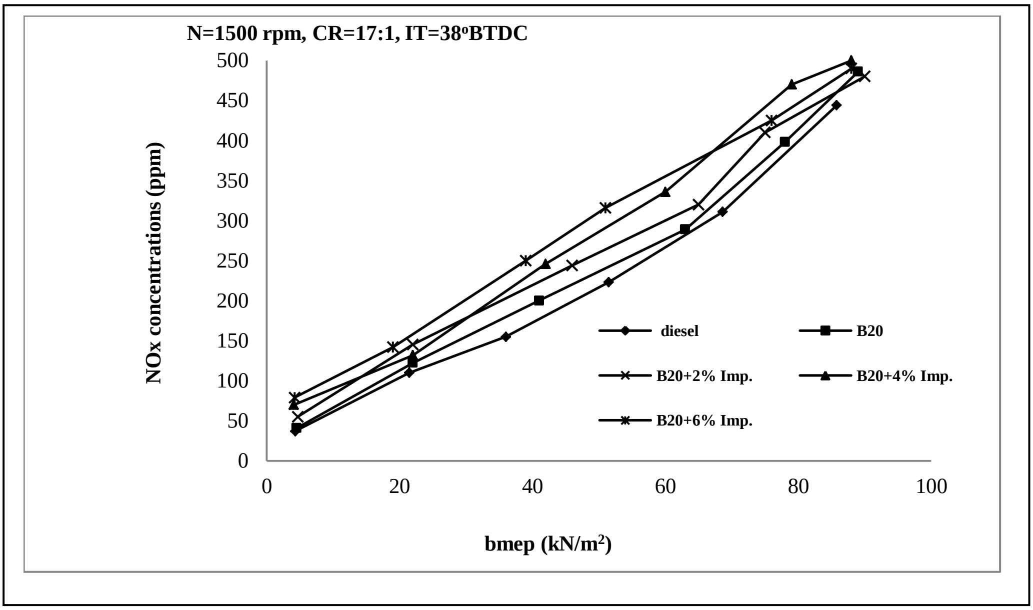

Fig. 7, BMEP effect on NOx concentrations for tested fuels at constant speed

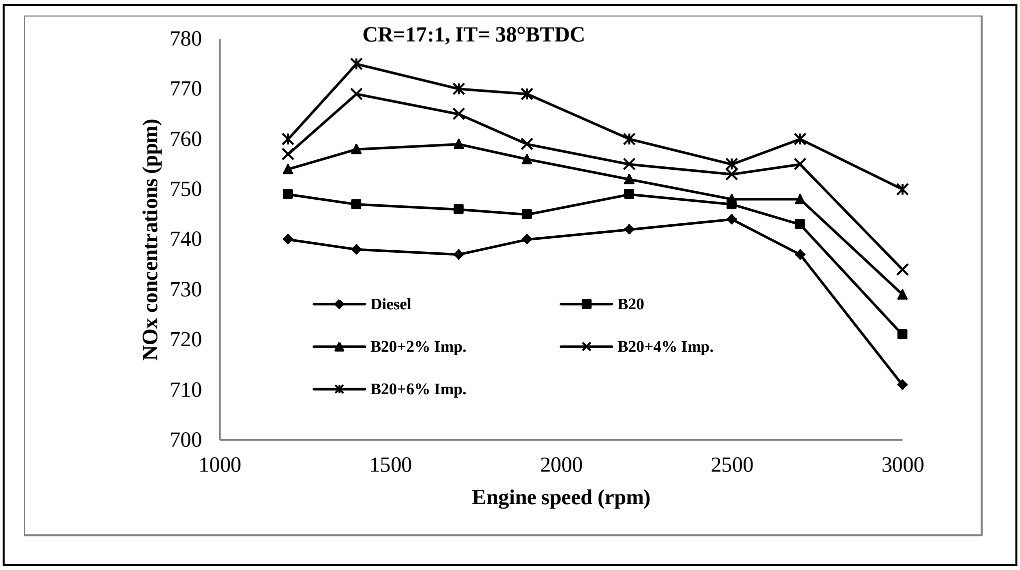

Fig. 8, Engine speed effect on NOx concentrations for tested fuels at constant load

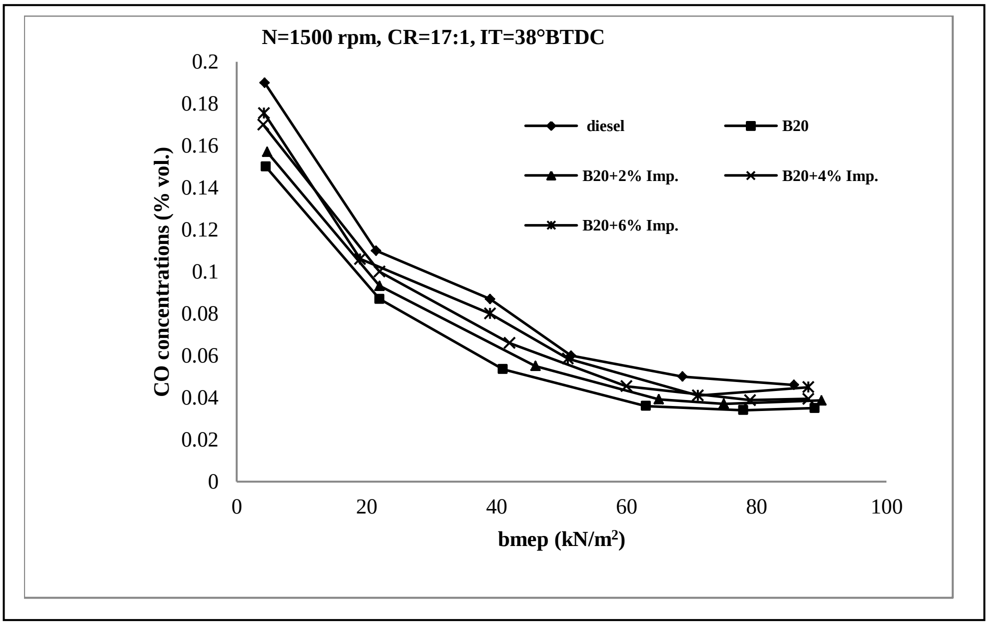

Fig. 9, BMEP effect on CO concentrations for tested fuels at constant speed

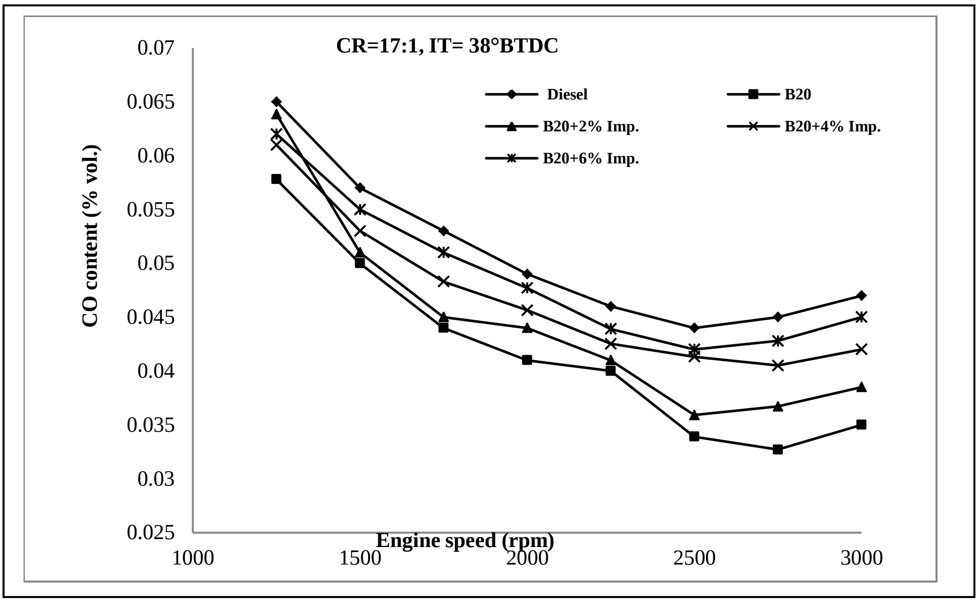

Fig.10, Engine speed effect on CO concentrations for tested fuels

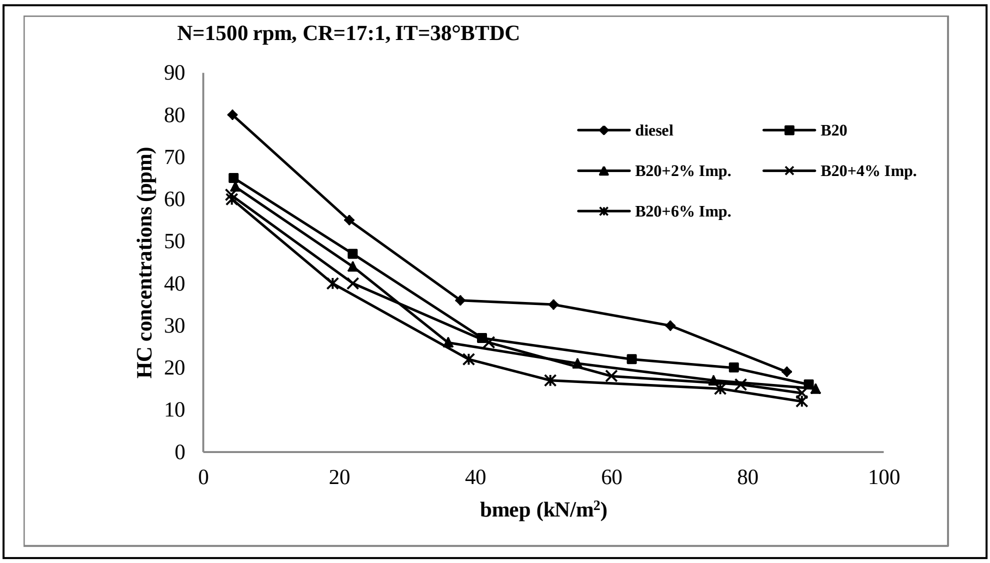

Fig. 11, BMEP effect on HC concentrations for tested fuels at constant speed

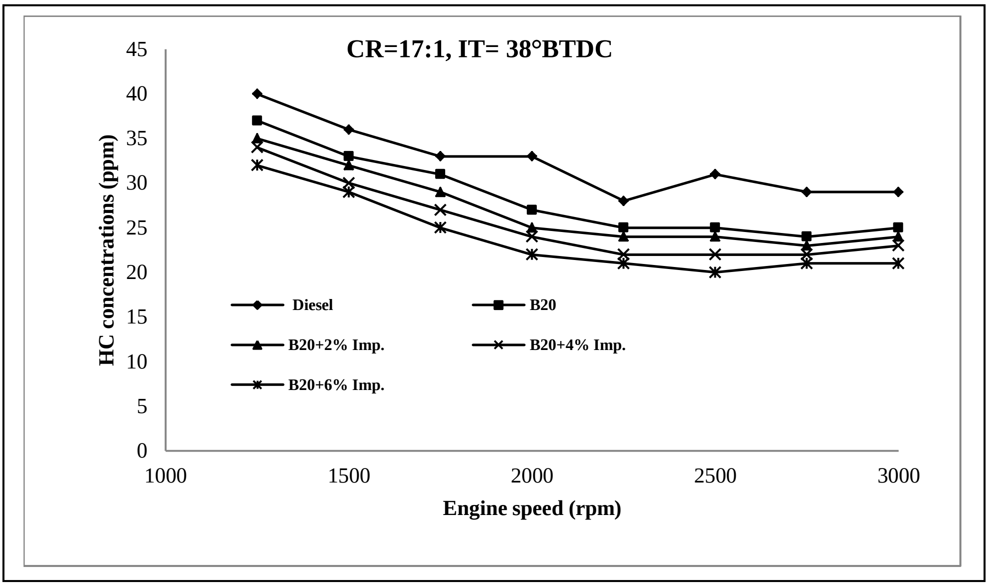

Fig.12, Engine speed effect on HC concentrations for tested fuels

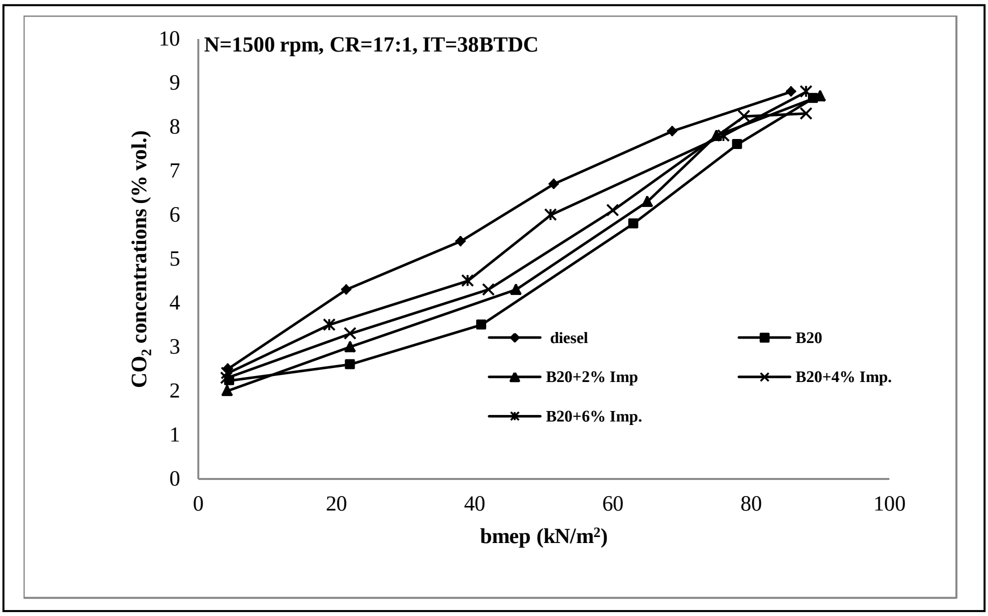

Fig. 13, BMEP effect on CO_2 concentrations for tested fuels at constant speed

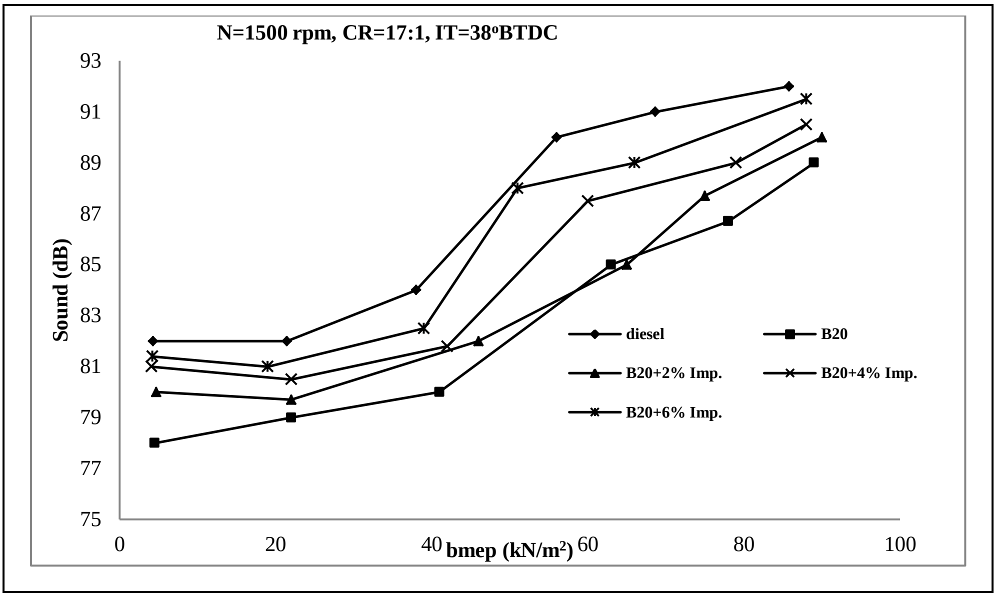

Fig. 14, BMEP effect on engine noise for tested fuels at constant speed

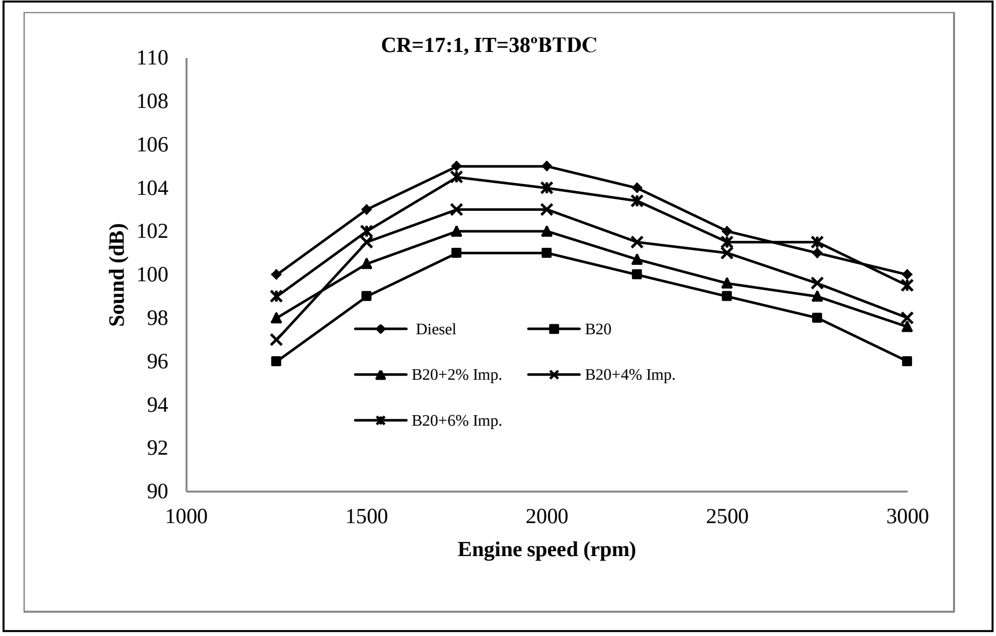

Fig.15, Engine speed effect on engine e noise for tested fuels

تأثير إضافة محسن الرقم السيتاني لخلائط ديزل حيوي - ديزل على أداء وملوثات محرك اشتعال بالإنضغاط رباعي الاشواط ذي حقن مباشر

م.م. عبدالسلام حمزة ناصر
Salam.dubba@gmail.com
الجامعة التكنولوجية - قسم هندسة المكائن والمعدات

المستخلص

تبحث هذة الدراسة تأثير أضافة محسن الرقم السيتاني على أداء وملوثات محرك ديزل رباعي الأسطوانات ذي حقن مباشر، يجهز بخليط من الديزل الحيوي (مشتق من زيت الذرة)-ووقود الديزل. تم أضافة نسب مختلفة من محسن الوقود (2، 4 و6%) الى الخلائط. تبين النتائج أن: يزداد الأستهلاك النوعي المكبحي للوقود مقارنة مع وقود الديزل. كما وتتحسن الكفاءة الحررية المكبحية بشكل واضح، إذ كانت أعلى زيادة تم الوصول لها بحدود 6.1% مقارنة مع الكفاءة الحرارية المكبحية لوقود الديزل عند اضافة 6% محسن الرقم السيتاني الى B20. كما تزداد تراكيز NOx باضافة محسن الرقم السيتاني للخلائط، إن مواصفات الاحتراق لخليط الديزل الحيوي-الديزل عند أحمال عالية تساوت تقريبا مع وقود الديزل باستخدام المحسن، ولكن بقيت بعض الأختلافات موجودة عند الأحمال القليلة.

الكلمات الرئيسية: خلائط الديزل الحيوي، محسن الرقم السيتاني، CO، NOx، HC.