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Comparison of Emissions NOx, Co, Co2 and Smoke Number of 1-Decanol in CRDi Diesel Engine under Influence of WLDPE/Diesel.

P.Sudharsun[1], Melvin Victor Depoures[2]

[1]Research Scholar, Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamilnadu. India. Pincode:602105

[2]Project Guide, Corresponding Author, Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamilnadu, India, Pincode:602105.

ABSTRACT

Aim: The aim of this research is to find the perfectly suited Fuel for the lowest Co, NOx and Smoke opacity of WLDPE Diesel blend. **Materials and Methods:** Decanol is Blended with diesel in the ratio of 10%,20%,30%. Single cylinder Kirloskar Bore - 87.5mm and stroke length-110mm onboard stationary engine mounted with eddy current dynamometer experimented with conventional settings. **Results:** The amount of NOx produced for Diesel is 2985 ppm and D70L30 with 2668 ppm and the best blend produced D70L20D10 2447 ppm. The significance variance exists among the considered groups p=0.041 ($p<0.05$). **Conclusion:** Within the limits of the study, the Nitrous oxide level for D70L20D10 is 4.9% lower when compared with diesel, Smoke opacity for the blend D70L20D10 was found to be 6.2% lower when compared with Diesel.

Keywords: Novel blend, Green energy, Decanol, Waste Low Density Polyethylene, Carbon monoxide, Nitrous oxide, Smoke Opacity, Environmental Engineering.

INTRODUCTION

Due to their Hauling capacity they are employed in wood hauling, Forest equipment, green energy and Environmental engineering (Demirbas and Demirbas 2010),(Damodharan and Gopal 2019). However These emissions tend to harm both the living creatures and the human beings by getting deposited on water bodies and polluting the food cycle (Aloui and Dincer 2018). Due to their lower pricing and longer lifespan and lesser weight plastics are chosen on a higher basis they were designed to serve for more years but they are maximum used as an one time use or for very short duration,mainly in packing sectors,these can be converted to fuel using technology and techniques and they are very high on energy content (Intergovernmental Panel on Climate Change. Working Group III. 2005).

Based on similar research, 550 journals are published in Science Direct and 117 journals are available in google scholar from the last 5 years. Among those journals, the best-cited papers are Performance and emission study of a single cylinder diesel engine fuelled with n-octanol/WPO with some modifications (Damodharan and Gopal 2019).The transport power generation sectors and industrial sectors the usage and demand for fossil fuels has spiked in recent times. Owing to this demand a need for an alternative renewable energy source which is combustible and releases lesser emission is being researched (Ghosh et al. 2020). Due to higher fuel efficiency and hauling capacity Diesel engines are mostly preferred to Gasoline engines even though they emit more NOx and carcinogenic smoke into the atmosphere mainly in the transport sector (Ghosh et al. 2020; Sładkowski 2020). Already our group has a rich involvement with chipping away at different examination projects across various disciplines (Samuel et al. 2019; Johnson et al. 2020; Venu, Subramani, and Raju 2019; Keerthana and Thenmozhi 2016; Thejeswar and Thenmozhi 2015; Krishna and Babu 2016; Subashri and Thenmozhi 2016; Sriram, Thenmozhi, and Yuvaraj 2015; Jain, Kumar, and Manjula 2014; Menon and Thenmozhi 2016)

In the previous report no Decanol blends were carried out and engine modifications were not made (Rajasekaran et al. 2020). Since diesel fuel is used in the majority of commercial vehicles, there is a need for alternative fuel to power the diesel engines to find sufficient fuel and reduce fuel costs (Ghose and Roy 1999). The present study motivates the experiment to see how Decanol can be mixed with diesel in a diesel engine to improve the NOx, Co2, smoke opacity in the emissions characteristics (Gopal et al. 2018).

MATERIALS AND METHODS

The WLDPE oil is extracted using pyrolysis oil extraction unit, the Waste Low Density Polyethylene plastics were bought from Solid waste management at perungudi in Chennai,these WLDPE plastics are dried and other dirts are washed and moisture is removed and they are resized to various minute particles for oil extraction.

A single-cylinder CRDi diesel engine was used at the thermal engineering lab, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai. This engine was coupled with an eddy current dynamometer and built on the same base frame. The sample size was reduced to 60 and was split into two classes depending on the different novel blends. The power is 0.8, with a mean of 33.67 and a standard deviation of 2.1 which was calculated with G power calculator v.3.1.9.7 (Gopal et al. 2018; Shanmugam et al. 2020). All logical grades were bought from a nearby provider in Chennai, Diesel was bought from the Bharath petroleum bunk near to Saveetha Institute of Medical and Technical Sciences Chennai. Decanol was purchased from local chemical sellers in Parrys Chennai. Figure 1 shows the single cylinder CI diesel engine which was used for testing the Nitrous oxide ,Carbon mono-oxide and Smoke opacity.The experiment is made in the motive to obtain lesser emission ,the fuel is blended with Decanol and WLDPE with two blend ratios ,the CRDi diesel engine is tested with D70L30 (70% diesel and 30% of WLDPE by vol).

The binary blend were blended with (1) D70L20D10 (70% vol. of diesel + 20% vol. of WLDPE oil + 10%vol. of Decanol); The test blends were kept in isolation for five weeks and were found to be stable with no phase separation.these blends were observed for five weeks if they were to show any signs of phase separation. The test of the binary blend experimented with a single-cylinder CI diesel engine and thereafter it was compared with diesel fuel and novel blends, which showed a confirmatory result condition when compared with diesel. The Nitrous oxide ,Carbon mono-oxide and Smoke opacity from the CI engine was tabulated with the help of a data acquisition system which was connected with a Krystler Pressure sensor mounted on the head of the cylinder From Table 1 we can see that Tested fuel for physical properties Table.2 shows the full setup

Statistical Analysis

The Nitrous oxide ,Carbon mono-oxide and Smoke opacity was measured using a Data Acquisition System with the help of a Combustion pressure sensor which was mounted on the head of the combustion chamber. As the three values are independent of each other, independent samples ANOVA was performed for independent variables, To validate the results of the measured value, statistical analysis was done using IBM-SPSS software.

RESULTS

IBM-SPSS is used in this study to depict the comparison of Analytical results with the Experimental Table 3.The Nitrous oxide ,Carbon mono-oxide and Smoke opacity shows better results for Group 2 compared with Group 1. (Damodharan and Gopal 2019)

Nitrous oxide for WLDPE blend- 0.02% lesser and D70L20D10- 0.2% lesser when compared with diesel Fig. 2. The Carbon monoxide emission for the WLDPE blend- 1.92% lower and D70L20D10- 4.8 % lower Fig. 3

depicts the Co emission details which helps in understanding that emission of the chosen best blend proved to be 0.7 times lesser emission when compared with diesel Table 4 *(Kulandaivel et al. 2020)*.

The Smoke opacity characteristic of the best blend is lesser than Diesel is proved from Fig. 7 & Table 8.

DISCUSSION

Figure 4 depicts In-cylinder pressure measurement for Decanol /Diesel blend and Fig. 5 shows the mean value for Nitrous Oxide for neat diesel 2985 ppm and D70L30 with 2668 ppm and the best blend produced D70L20D10 2447 ppm. The maximum and minimum value calculated for the experimental group (Damodharan et al. 2018). Fig. 6 shows the value Co for WLDPE/Decanol/Diesel blend, above mentioned graph depicts X axis values of diesel blends and Y axis fueling of diesel is increased by 100% by volume (+/- 1SD). The mean value of smoke opacity for neat diesel- 66.1mg/m^3 and for WLDPE- 56.2mg/m^3, the best blend is D70L20D10- 38.2 mg/m^3. The maximum and minimum values were calculated for the control group. Fig. 7 shows the mean value for Carbon Mono-Oxide for neat diesel 0.381 ppm and D70L30 with 0.289 ppm and the best blend produced D70L20D10 0.153 ppm

Combustion for premixed in primary fuel depends on pressure (Kulandaivel et al. 2020); (Shanmugam et al. 2020; Depoures, Dillikannan, and Kaliyaperumal 2020). Table. 3 & Table. 4 shows the emission measurement for the WLDPE / Decanol /Diesel blend below the mentioned graph depicts X-axis blend mixture values of diesel blends and Y-axis fuel mixing ratio. Table 5 shows the tested qualities got from System coordinated information obtaining framework for smoke darkness from with Diesel/D70L30/D70L20D10 mixes. The smoke mistiness is the extent of an engine that changes over the manufactured energy of the fuel into heat energy through the connection of start (Damodharan et al. 2017). Table 6 shows the independent sample test shows statistical insignificance (p=0.0410) for CRDi engine concentration between Decanol and WLDPE for NOx. The varieties of warmth discharge rate versus wrench plot for all test mixes in correlation with standard diesel at the evaluated power yield of the motor. Table. 7 shows the independent sample test shows statistical insignificance (p=0.10) for CRDi engine concentration between Decanol and WLDPE for Co. The pinnacle heat discharge rate (PHRR) for benchmark diesel, D70L30 and D70L10D10 mixes are 59.75 J/deg, 72.27 J/deg, 71.13 J/deg (Damodharan et al. 2018; Gopal et al. 2020).Table 8 shows the independent sample test shows statistical insignificance (p=0.06) for CRDi engine concentration between Decanol and WLDPE for Smoke opacity.

Since the attributes of the relative multitude of powers are practically indistinguishable, the lower calorific substance of the D70L20D10 than diesel is countered by a higher oxygen content of the blend, which might be the justification for giving similar hints of HRR (Damodharan et al. 2017; Kulandaivel et al. 2020). This study isn't thinking about the impact of MGT. In this, we lessen all the fuel for smoke mistiness. Ether property isn't viewed as the ignition of the pyrolytic oil. It tends to be changed coming down the line for enhancement by the numerous infusions in the CRDi diesel motor. The boundary and more elevated level of C-V worth will be found. The NOx discharge depends upon the fuel copied inside the premixed burning stage. Thinks about the tension follows for the test fills concerning the wrench point at the motor pinnacle load condition.

CONCLUSION

D70L20D10 blend showed the longest beginning defer period among the test powers. Replacing 10% by vol. of WLDPE oil in D70L30 blend in with WLDPE and Decanol the defer period in like manner working on the consuming ascribes of the test motor. The importance fluctuation exists among the considered gatherings p=0.041 ($p<0.05$).

DECLARATIONS

Conflict of Interests

There is no conflict of interest in this manuscript.

Author Contributions

Author PS was involved in data collection,data analysis and manuscript writing. Author MVD was involved in data validation and review of manuscripts.

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FIGURES AND TABLES

Fig. 1. Engine setup is a single-cylinder Kirloskar bore, stroke length mounted on the same base frame with eddy current.

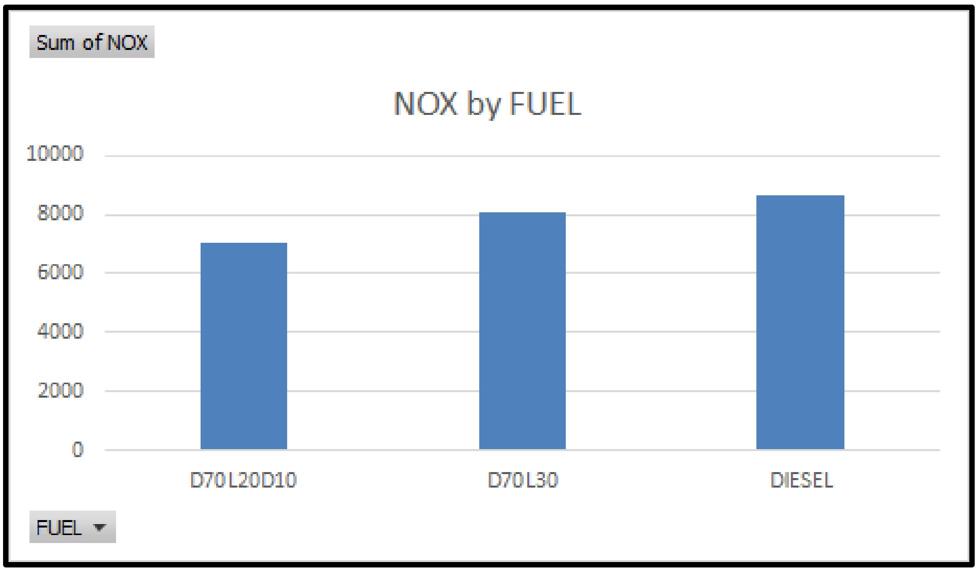

Fig. 2. NOx comparison of Diesel ,D70L30 and D70L20D10. The above mentioned figure depicts X-axis values of diesel blends and Y-axis Fueling ratio.

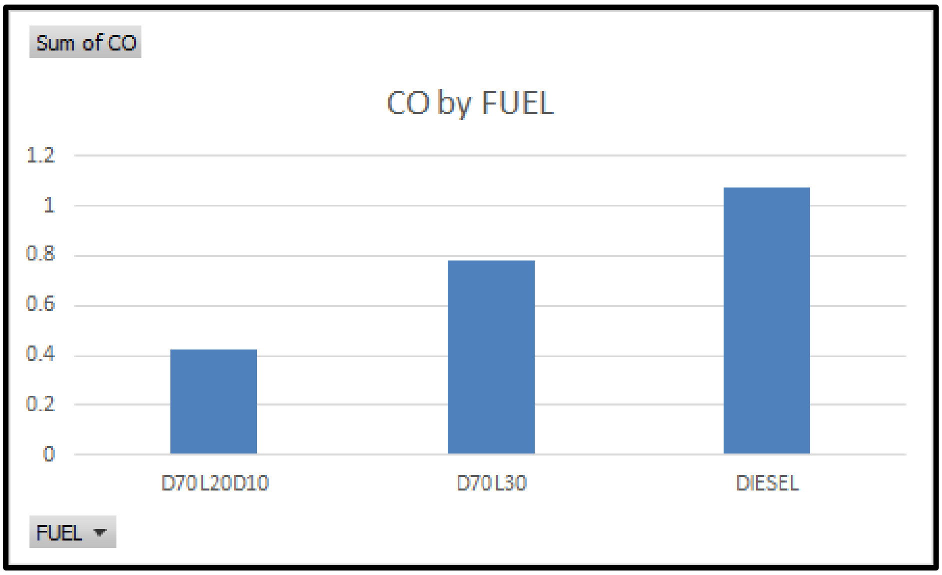

Fig. 3. The Co emission is given above for the comparison of Diesel,D70L30,D70L20D10,and it depicts values of diesel blends in X-axis and fueling in Y-axis.

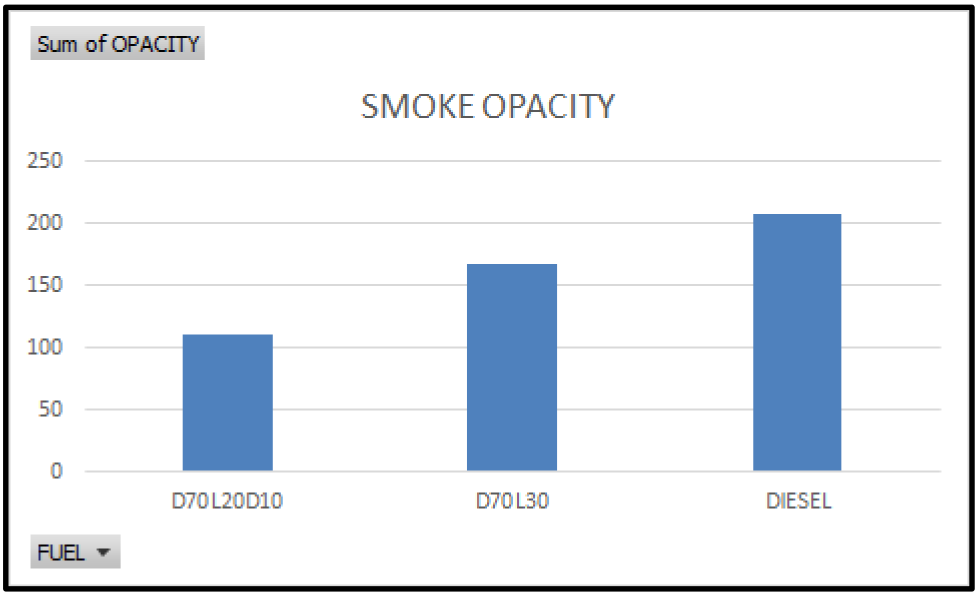

Fig. 4. The Smoke opacity comparison is given above for the comparison of Diesel,D70L30,D70L20D10,and the graph depicts values of diesel blends in X-axis and fueling in Y-axis.

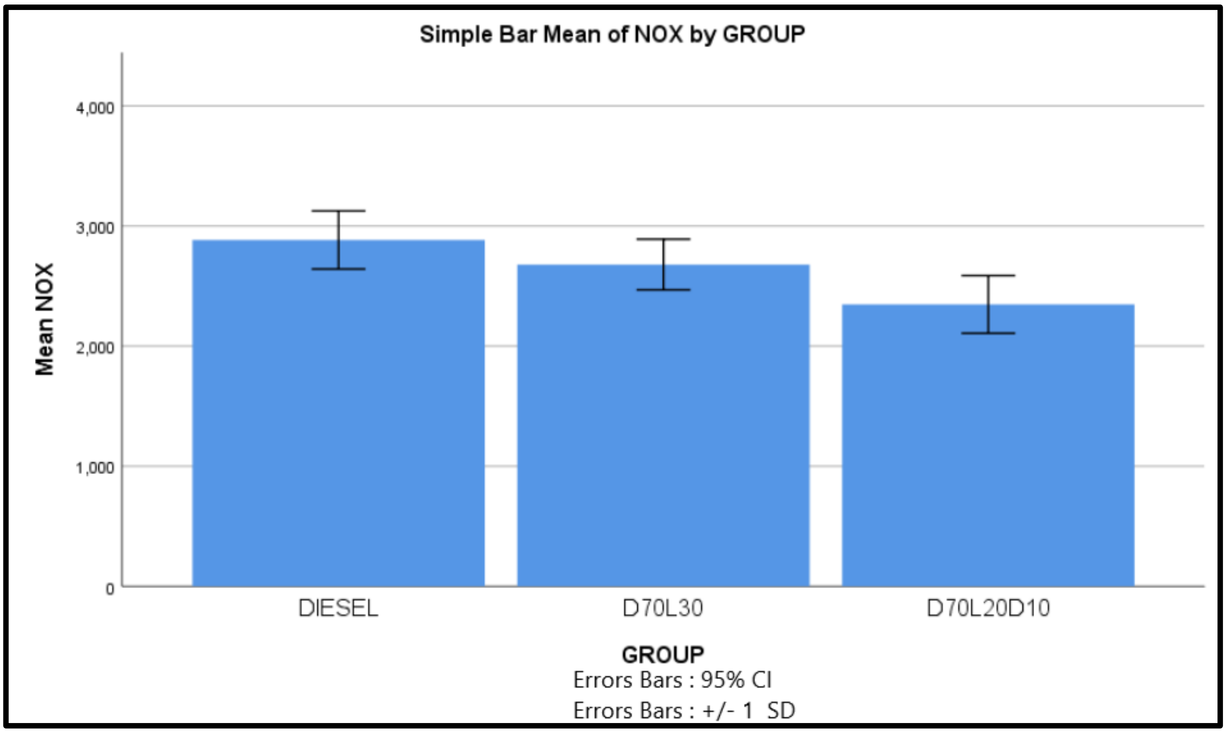

Fig. 5. NOx for Decanol /Diesel blend, above mentioned graph depicts X-axis values of diesel blends and Y-axis fuel percentage is increased by 100% by volume (±1 SD).

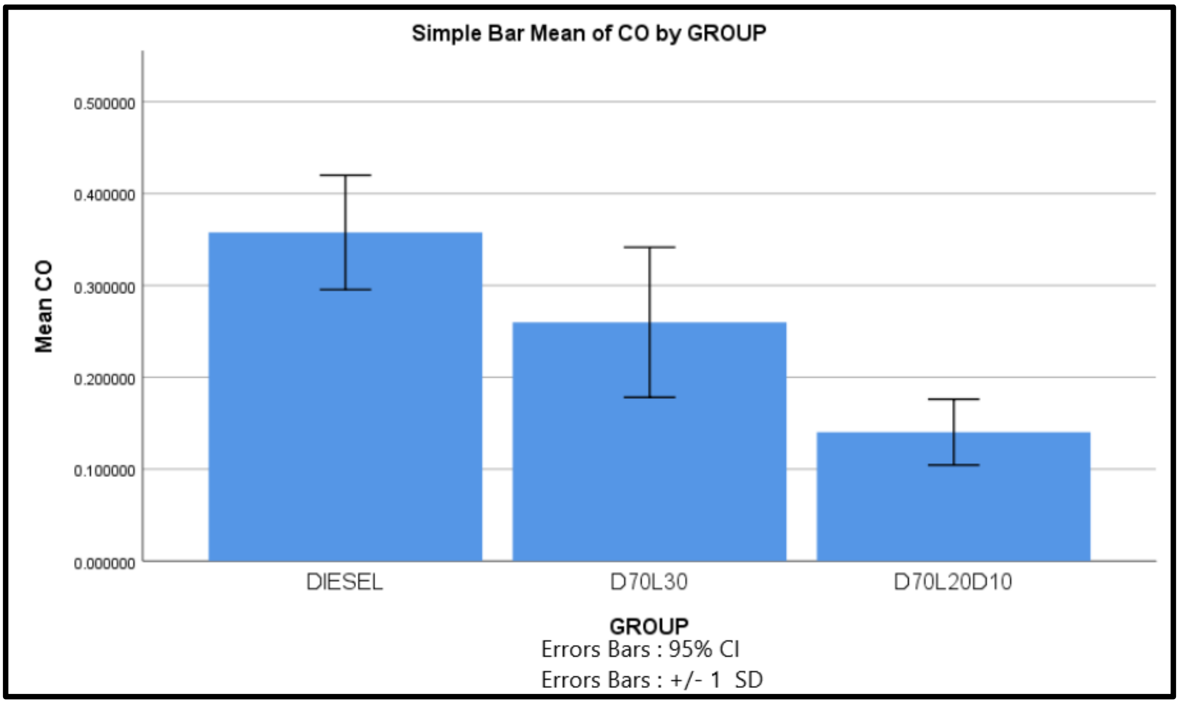

Fig. 6. Co for WLDPE/Decanol/Diesel blend, above mentioned graph depicts X axis values of diesel blends and Y axis fueling of diesel is increased by 100% by volume (±1SD).

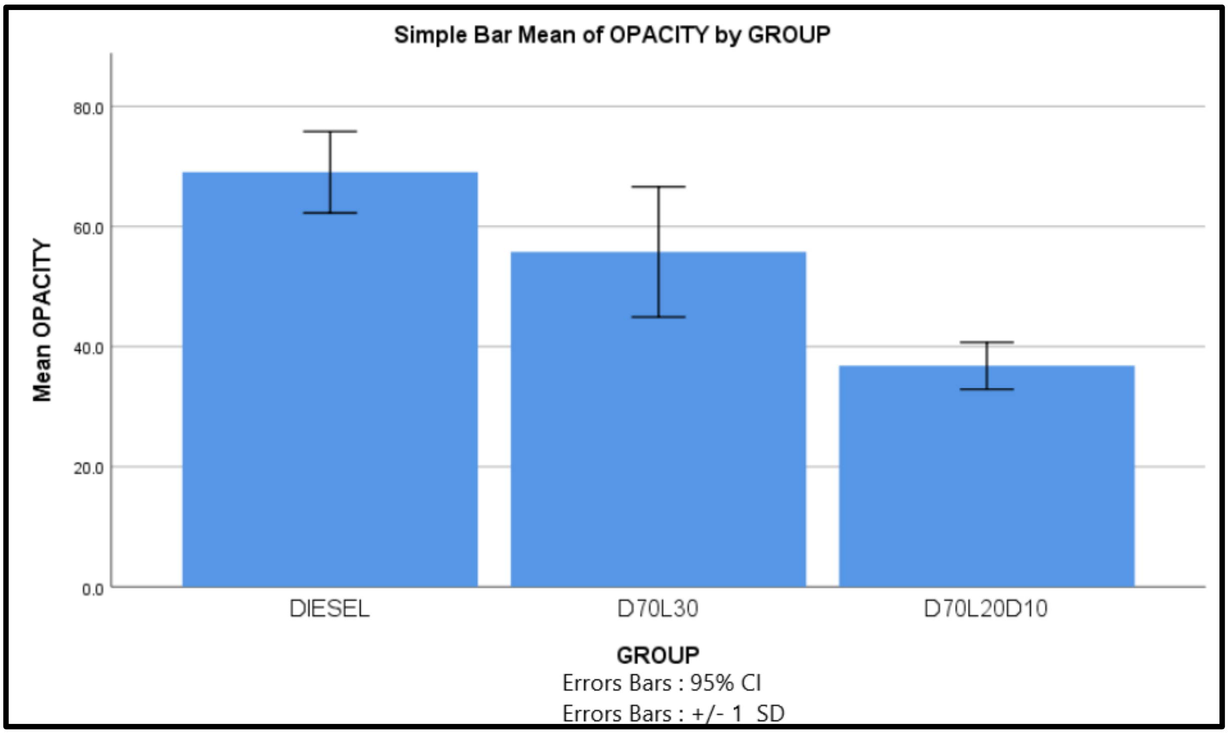

Fig. 7. Smoke Opacity measurement for WLDPE/Decanol/Diesel blend, above mentioned graph depicts X axis values of diesel blends and Y axis fueling of diesel is increased by 100% by volume (±1SD).

Table. 1. Tested fuel physical properties are Density, Kinematic viscosity, LHV, flashpoint.

Properties	DIESEL	Decanol	D70L30
Kinematic viscosity (at 40°C)	2.93	2.75	3.86
Density (at 15°C (kg/m^3)	830	833	830.4
LHV	42.5	43.5	41.60
Latent heat of vaporization (kJ/kg)	250	-	-
Flashpoint (°C)	75	45	66

Table. 2. Engine specifications are the number of cylinders in stroke, bore, stroke length, swept volume, compression ratio, rated output, rated speed, cooling system, lubrication oil., injection timing, CA TDC & injection pressure.

Description	**Value**
Number of cylinders	one
Stroke	four
Bore	87.5mm
Stroke length	110mm
Swept volume	661cc
Compression ratio	17.5
Rated output	3.5kw at 1500rpm
Rated speed	1500rpm
Cooling system	Water-cooled
Lubrication oil	SAE40
Injection timing, CA TDC	23°
Injection pressure	600 bar

Table. 3. Experimented values obtained from system integrated data acquisition system for NOx emissions for fuels with Diesel/D70L30/D70L20D10 blends.

EGR %	FUEL	NOx
0%	DIESEL	2985
10%	DIESEL	2876
20%	DIESEL	2791
0%	D70L30	2668
10%	D70L30	2769
20%	D70L30	2600
0%	D70L20D10	2447
10%	D70L20D10	2341
20%	D70L20D10	2254

Table. 4. Experiment values obtained from System integrated data acquisition system for Co emission based fuels with Diesel/D70L30/D70L20D10 blends.

EGR %	FUEL	Co
0%	DIESEL	0.3815478
10%	DIESEL	0.35986
20%	DIESEL	0.331597
0%	D70L30	0.289654
10%	D70L30	0.265244
20%	D70L30	0.22457
0%	D70L20D10	0.153654
10%	D70L20D10	0.14226
20%	D70L20D10	0.124987

Table. 5. Experimented values obtained from System integrated data acquisition system for smoke opacity from with Diesel/D70L30/D70L20D10 blends

EGR %	FUEL	Smoke Opacity
0%	DIESEL	66.1
10%	DIESEL	71.5
20%	DIESEL	69.5
0%	D70L30	56.2
10%	D70L30	51.2
20%	D70L30	59.9
0%	D70L20D10	38.2
10%	D70L20D10	37.1
20%	D70L20D10	35.1

Table. 6. Independent sample test shows statistical insignificance (p=0.041) for CRDi engine concentration between Decanol and WLDPE for NOx.

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.
Diesel	D70L30	33.333*	9.649	.041
	D70L20D10	69.000*	9.649	.001
D70L30	Diesel	-33.333*	9.649	.041
	D70L20D10	35.667*	9.649	.030
D70L20D10	Diesel	-69.000*	9.649	.001
	D70L30	-35.667*	9.649	.030

Table. 7. Independent sample test shows statistical insignificance (p=0.010) for CRDi engine concentration between Decanol and WLDPE for Co.

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.
DIESEL	D70L30	.097845600*	.020638302	.010
	D70L20D10	.217367933*	.020638302	.000
D70L30	DIESEL	-.097845600*	.020638302	.010
	D70L20D10	.119522333*	.020638302	.003
D70L20D10	DIESEL	-.217367933*	.020638302	.000
	D70L30	-.119522333*	.020638302	.003

Table. 8. Independent sample test shows statistical insignificance (p=0.06) for CRDi engine concentration between Decanol and WLDPE for Smoke opacity.

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.
DIESEL	D70L30	13.2667*	2.5380	.006
	D70L20D10	32.2333*	2.5380	.000
D70L30	DIESEL	-13.2667*	2.5380	.006
	D70L20D10	18.9667*	2.5380	.001
D70L20D10	DIESEL	-32.2333*	2.5380	.000
	D70L30	-18.9667*	2.5380	.001