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Comparison of Combustion HRR & Pressure of 1-Decanol, Diesel and WLDPE in Engine with the Blend Ratio of (10%, 20% & 30%) in Single Cylinder CRDi. Diesel engine.

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ABSTRACT

Aim: The aim of this research is to find the perfectly suited Fuel for supreme Heat Release energy and Higher Incylinder pressure 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 Heat which was released for Diesel is 6.49 J/deg and D70L30 with 5.2 J/deg and the best blend produced D70L20D10 5 J/deg. The In-cylinder pressure was found toam be 79.57625 bar for Diesel and 79.629375 bar for D70L30 and the best blend D70L20D10 produced 80.233125 bar. The significance level obtained among the group was p=1.000 where ($p>0.05$) which shows that it is not significant. **Conclusion:** Within the limits of the study, The In-Cylinder pressure for D70L20D10- 0.6% higher when compared with diesel. The heat release rate for D70L20D10- 1.5% higher when compared with diesel.

Keywords : Novel blend, Green energy, Environmental Engineering, Decanol, Waste Low Density Polyethylene, Pyrolysis, In-Cylinder Pressure and Heat release rate.

INTRODUCTION

Novel blend is used to find the suitable green energy and to reduce the diesel fuel consumption, Decanol and Waste Low Density Polyethylene are the alternate sources to reduce the quantity of diesel to form a green energy (Poures et al. 2017). Due to the increase in greenhouse gas, increasing the blending ratio from 10% to 15% gives a positive impact on mechanical efficiency because it seems to increase vehicular emissions. It is important to follow the stringent emission norms (Bharat stage-6) and we need to find an appropriate diesel blend candidate (Ghosh et al. 2020).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 (Kulandaivel et al. 2020a). 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 and

Environmental Engineering. 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 (Viskup 2020).

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 et al. 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 (Demirbas and Demirbas 2010). Due to their Hauling capacity they are employed in wood hauling,Forest equipment and Cargo sectors.Previously our team has a rich experience in working on various research projects across multiple disciplines(Ezhilarasan et al. 2021; Balachandar et al. 2020; Muthukrishnan et al. 2020; Kavarthapu and Gurumoorthy 2021; Sarode et al. 2021; Hannah R et al. 2021; Sekar, Nallaswamy, and Lakshmanan 2020; Appavu et al. 2021; Menon et al. 2020; Gopalakrishnan et al. 2020; Arun Prakash et al. 2020)

In the previous study no Decanol blends were carried out and engine modifications were not made (Depoures, Dillikannan, and Kaliyaperumal 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 in-cylinder pressure and heat release rate (Adhinarayanan et al. 2020).

MATERIALS AND METHODS

All logical grades were bought from a nearby provider in Chennai, Diesel was bought from the Bharath petroleum bunk near to Saveetha University, Chennai. Decanol was purchased from local chemical sellers in Parrys Chennai.A single-cylinder CRDi diesel engine was used at 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 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).

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

Figure 1 shows the single cylinder CI diesel engine was used for testing the heat release rate and In-cylinder Pressure. The experiment is made in the motive to obtain higher combustion ,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 which showed a confirmatory result condition when compared with diesel. From Table 1 we can see that Tested fuel for physical properties The combustion In-cylinder pressure and Heat release rate 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 Table 2 shows the full setup.

Statistical Analysis

In-cylinder Pressure and Heat release rate 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.To validate the results of the measured value, statistical analysis was done using IBM-SPSS software. As the three values are independent of each other, independent samples ANOVA was performed for independent variables Heat release rate and In-cylinder pressure (Viskup 2020).

RESULTS

IBM-SPSS is used in this study to depict the comparison of Analytical results with the Experimental Table 3. In-cylinder pressure and Heat release rate shows better results for Group 2 compared with Group 1(Depoures, Dillikannan, and Kaliyaperumal 2020).

In-Cylinder pressure for WLDPE blend- 0.2% higher and D70L20D10- 0.6% higher when compared with diesel Fig. 2 The heat release rate for the WLDPE blend- 1.2% higher and D70L20D10- 1.5% higher Fig. 3 when compared with diesel Table 4 (Kulandaivel et al. 2020b).

DISCUSSION

Figure 4 depicts In-cylinder pressure measurement for Decanol /Diesel blend and Fig. 5 shows the mean value for Heat release rate calculated Heat release rate for neat diesel-6.49 J/deg, WLDPE- 5.2 J/deg, the best blend D70L20D10- 5 J/deg. The maximum and minimum value calculated for the experimental group (Damodharan et al. 2018).The mean value of In-Cylinder pressure for neat diesel- 79.57 bar and for WLDPE- 79.62 bar, the best blend is D70L20D10- 80.23 bar. The maximum and minimum values were calculated for the control group.

Combustion from the In-cylinder pressure for premixed in primary fuel depends on pressure (Kulandaivel et al. 2020b)(Shanmugam et al. 2020; Depoures, Dillikannan, and Kaliyaperumal 2020). Table 3 & Table 4 shows the Heat release rate pressure measurement for WLDPE / Decanol /Diesel blend below mentioned graph depicts X-axis pressure values of diesel blends and Y-axis standard crank angle. The heat release rate is the proportion of a motor that changes over the synthetic energy of the fuel into heat energy through the interaction of ignition (Damodharan et al. 2017a). 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. 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). Since the characteristics of all the fuels are almost identical, the lower calorific content of the D70L20D10 than diesel is countered by a higher oxygen content of the mix, which may be the reason for providing the same traces of HRR (Damodharan et al. 2017a; Kulandaivel et al. 2020a). Table 5&6 display Independent sample test values of statistical insignificance ($p=1.000$) for CRDi engine concentration between Decanol and WLDPE for Heat Release Rate and its in-cylinder pressure.

This study is not considering the effect of MGT. In this, we reduce all the fuel for not smoke opacity. Ether property is not considered to be the combustion of the pyrolytic oil. It can be changed in the future for optimization by the multiple injections in the CRDi diesel engine. The parameter and higher level of C-V value will be found. The in-cylinder pressure Fundamentally relies upon the fuel burnt within the premixed (Damodharan et al. 2017b; Kulandaivel et al. 2020b)combustion phase. Compares the pressure traces for the test fuels concerning the crank angle at the engine peak load condition.

CONCLUSION

Within the limits of the study,D70L20D10 mix showed the longest start postpone period among the test powers. Supplanting 10% by vol. of WLDPE oil in D70L30 mix with WLDPE and Decanol the postpone period accordingly improving the burning attributes of the test engine.

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

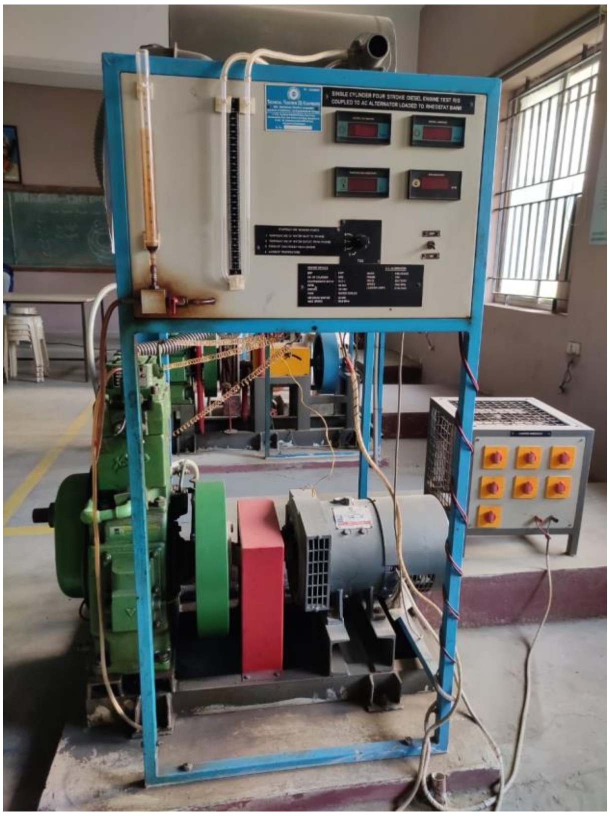

Fig. 1. Engine setup is a single-cylinder Kirloskar bore, stroke length mounted on the same base frame with eddy current.

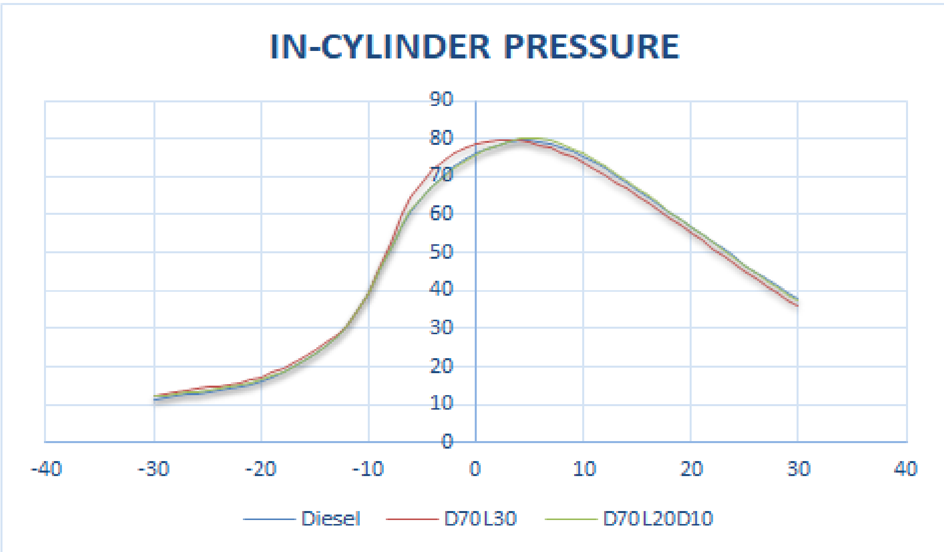

Fig. 2. In-cylinder Pressure comparison of Diesel D70L30 and D70L20D10. above mentioned graph depicts X-axis pressure values of diesel blends and Y-axis standard crank angle

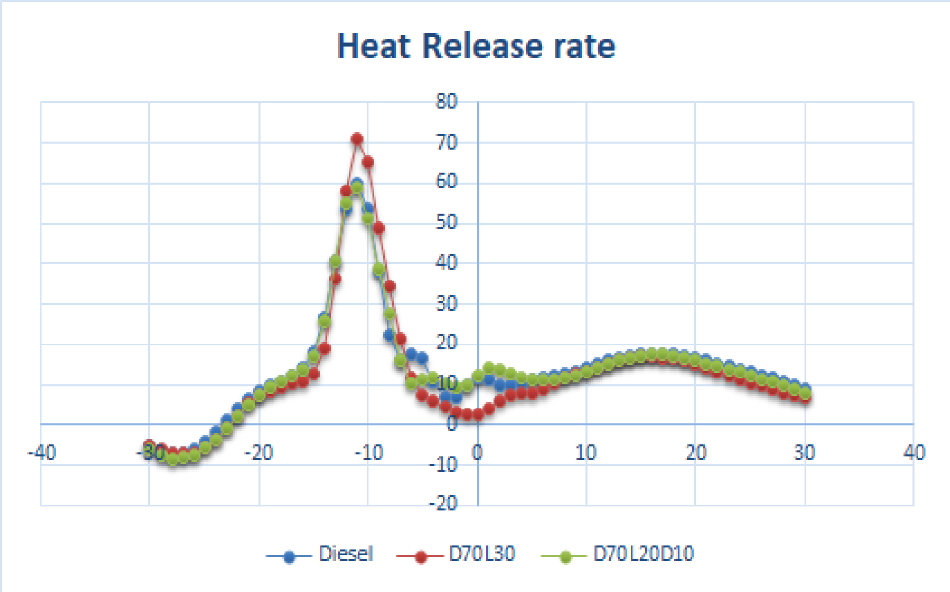

Fig. 3. The Heat Release Rate is given above for the comparison of Diesel, D70L30, D70L20D10 and the graph depicts pressure values of diesel blends in X-axis and standard crank angle in Y-axis.

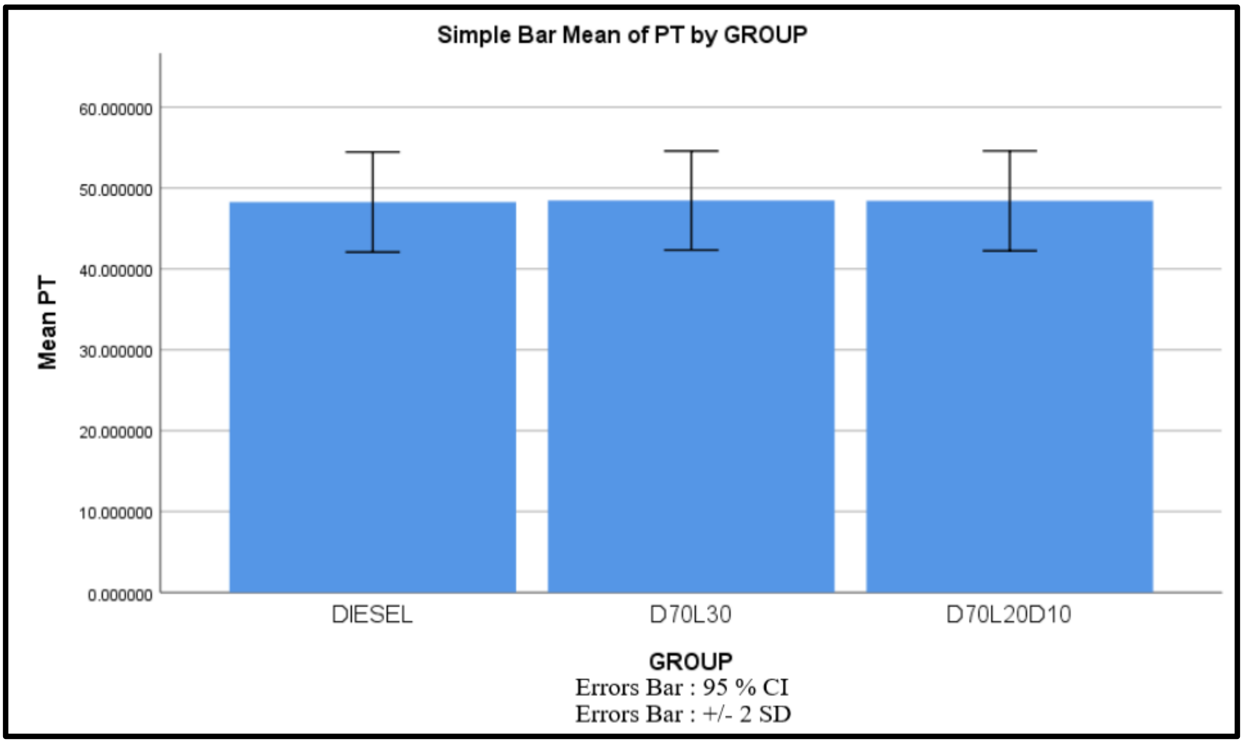

Fig. 4. In-cylinder pressure measurement for Decanol /Diesel blend, above mentioned graph depicts X-axis pressure values of diesel blends and Y-axis standard crank angle, diesel is increased by 100% by volume (+/- 2SD).

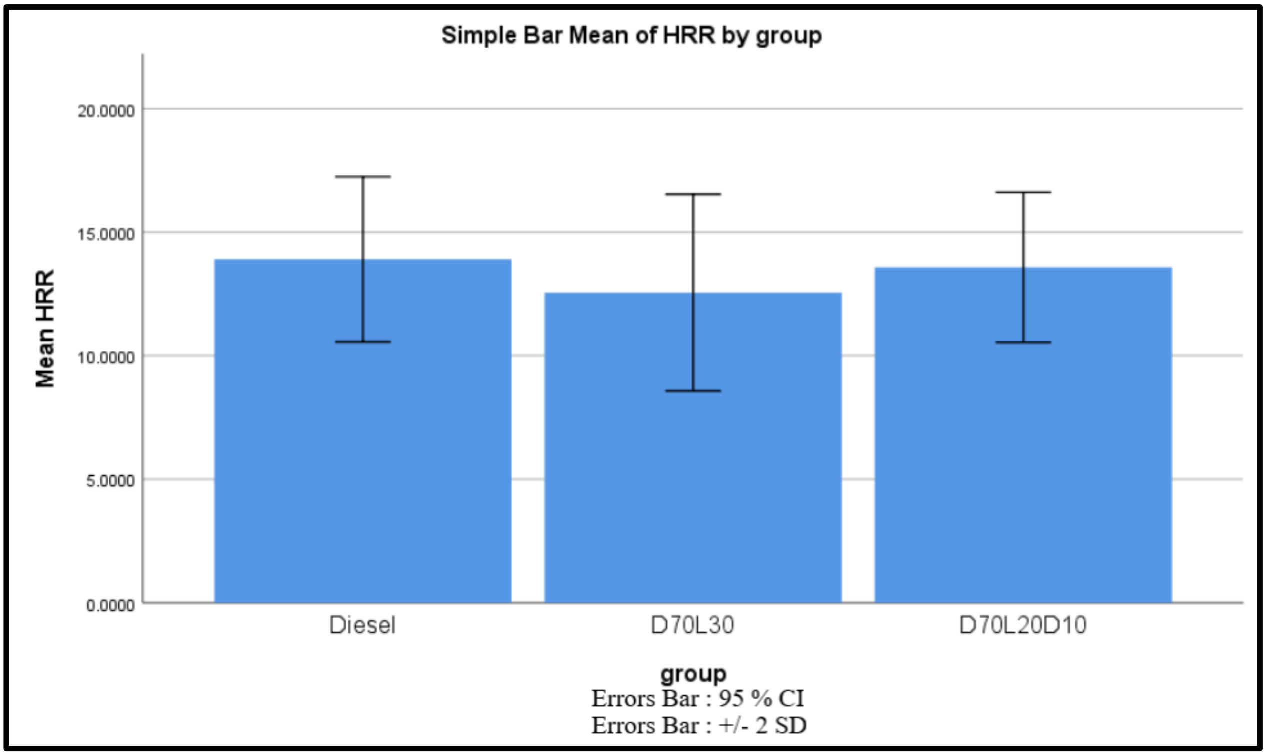

Fig. 5. Heat release rate pressure measurement for WLDPE/Decanol/Diesel blend, above mentioned graph depicts X axis pressure values of diesel blends and Y axis standard crank angle diesel is increased by 100% by volume (+/-2SD).

Table 1. Tested fuel for physical properties. The physical properties are Density, Kinematic viscosity, LHV, Lantern heat of vaporization, 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.

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 In Cylinder Pressure fueled with Diesel/D70L30/D70L20D10 blends.

CA	**Diesel**	**D70L30**	**D70L20D10**
1	77.35188	79.32875	77.17375
2	78.39188	79.61688	78.318125
3	79.17125	79.62938	79.275
4	79.5725	79.43063	79.95
5	79.57625	79.03063	80.233125
6	79.24188	78.39688	80.08625
7	78.63188	77.5075	79.538125
8	77.7725	76.3875	78.640625
9	76.66875	75.09063	77.445625

Table 4. Experimented values obtained from System integrated data acquisition system for Heat Release Rate fueled with Diesel/D70L30/D70L20D10 blends.

CA	Diesel	D70L30	D70L20D10
-25	-4.27	-5.88	-5.86
-24	-1.92	-3.85	-3.68
-23	0.93	-0.97	-0.93
-22	3.92	2.29	2.11
-21	6.49	5.2	5
-20	8.32	7.23	7.34
-19	9.56	8.38	9.17
-18	10.72	9.2	10.75
-17	12.16	10.16	12.22

Table 5. Independent sample test shows statistical insignificance (p=1.000) for CRDi engine concentration between Decanol and WLDPE for Heat Release Rate.

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound
DIESEL	D70L30	-.186567623	4.355588623	1.000	-10.71211454
	D70L20D10	-.142233607	4.355588623	1.000	-10.66778053
D70L30	DIESEL	.186567623	4.355588623	1.000	-10.33897930
	D70L20D10	.044334016	4.355588623	1.000	-10.48121291
D70L20D10	DIESEL	.142233607	4.355588623	1.000	-10.38331332
	D70L30	-.044334016	4.355588623	1.000	-10.56988094

Table 6. Independent sample test shows statistical insignificance (p=1.000) for CRDi engine concentration between Decanol and WLDPE for pressure.

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval
					Lower Bound
Diesel	D70L30	1.3478689	2.4575728	1.000	-4.591007
	D70L20D10	.3222951	2.4575728	1.000	-5.616580
D70L30	Diesel	-1.3478689	2.4575728	1.000	-7.286744
	D70L20D10	-1.0255738	2.4575728	1.000	-6.964449
D70L20D10	Diesel	-.3222951	2.4575728	1.000	-6.261171
	D70L30	1.0255738	2.4575728	1.000	-4.913302