OPEN ACCESS

Int. Res. J. of Science & Engineering, 2015; Vol. 3 (5): 202-208 ISSN: 2322-0015

RESEARCH ARTICLE

A Comparative Study between Conventional Diesel Fuel and a Sample of E Diesel (Blue-Crude)

Mazumdar Digvijoy

Acharya Institute of Technology, Department of Mechanical Engineering Bangalore, Karnataka, India

Email: digvijoy.beme.11@acharya.ac.in

Manuscript Details

Received : 03.07.2015
Revised :23.08.2015
Revised received : 09.09.2015
Accepted: 26.09.2015
Published: 05.10.2015

ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Mazumdar Digvijoy. A Comparative Study between Conventional Diesel Fuel and a Sample of E Diesel (Blue-Crude), *Int. Res. J. of Science & Engineering,* 2015; Vol. 3 (5):202-208.

ABSTRACT

In this paper we compute the CO_2 emissions, power transmitted, NOx emissions and fuel efficiency of a diesel engine when run with E-DIESEl. We conclude that E-DIESEL has better emission characteristics than conventional fossil fuel(DIESEL)

Keywords: E-Diesel, Blue-Crude, Emissions Of E-Diesel, Alternate Fuels, CO_2 Cleansing.

INTRODUCTION

Since the start of the Industrial Revolution fossil fuels have dominated as the mainstay of power generation. Every engine has required fossil fuels like Petroleum, Diesel, Kerosene, ATF, etc as the main source of power. Whenever energy was needed to be created we have burnt coal to produce power. Slowly with the advent of time fossil fuels have proved to be a vulnerable resource, not only by its limited deposits but also by showing that it can enormously pollute the environment. The catastrophic degradation in the quality of the atmosphere has been caused mainly due to the pollutants released during the burning of fossil fuels.

To deal with the increased pollutants in the atmosphere and to reduce the dependency on fossil fuels various alternative sources of energies have been developed. Green car technologies have been around here for a while. These technologies have paved a way for lower emission from the burnt fuel as well as have showed us a possible path omitting out fossil fuels as the main energy source in the near future.

All the newer technologies till date have only dealt with how to use alternative sources of energy to drive engines. But very few have thought of actually converting the excess level of CO_2 in the atmosphere to produce fuels such that in the process we use up the excess CO_2 and cleanse the atmosphere.

A recent development by the AUDI motors of Volkswagen Group has led to a significant change in how we see the future of the alternative fuel. AUDI has successfully developed a fuel called E-DIESEL or BLUE CRUDE (Kacher, Georg, 2013) by using the CO2 in the atmosphere there by starting a process where we can now hope the draw out the CO2 we released earlier in the atmosphere.

What is E-Diesel?

It is a synthetically produced Diesel fuel made by AUDI[Palmer, Ewan (27 April 2015)].The fuel is made from carbon dioxide and water in a chemical a process that is powered by renewable energy sources to create a liquid energy carrier called blue crude [in contrast to regular crude oil] (MacDonald, 2015). The blue crude is refined to generate E-DIESEL. E-DIESEL is considered to be a carbon-neutral fuel as it does not produce new carbon upon combustion and the energy sources to drive the process are from carbon-neutral completely.

Production

The outline of the basic steps to create the synthetic fuel is summarized below:

First Step includes the electrolysis of water and splitting the water into H20 and CO2 molecules.

Second Step involves input of Hydrogen and Carbon Dioxide in the conversion reactor that converts produces Carbon Mono-Oxide, water and Hydrogen.

Third Step is Fischer-Tropsch process that uses Carbon Mono-Oxide and Hydrogen as inputs to produce paraffin and olefinic hydrocarbons like waxes and other higher end hydrocarbons. Audi is partners with a company named Climeworks which manufactures Carbon Dioxide capturing machines. Climeworks has developed technologies that can absorb atmospheric Carbon Dioxide. The Carbon Dioxide chemically captured at the surface of a sorbent until it becomes saturated. At that point, the sorbent is introduced with 95 °C (203 °F) heat in a desorption cycle to drive out the highly pure Carbon Dioxide that can be used during the conversion step of the blue crude generation process. The atmospheric Carbon Dioxide capturing process has 90% of energy demand in the form of low-temperature heat and the rest from electrical energy for pumping and control.

Testing

The purpose of this test is to demonstrate that when E-DIESEL is used as a fuel instead of conventional diesel, we get a significant improvement in results in terms of emissions. We evaluate the data from a test on an IVECO engine with both E-DIESEL and conventional diesel fuel and compare these results.

Engine Characteristics

The technical specifications of the engine are:

a) Producer: IVECO
b) Type: 8460.21B
c) Serial Number:8010013
d) Cylinder Volume:9.500cm^3
e) Power: 150 KW @2050 RPM
f) Torque: 1.110 Nm @ 1010-1800 RPM
g) Injection: BOSCH 255 bar inline pump

Bench Characteristics

The data given in this paper is based upon the experiments performed by RTR srl HI-TECH DIESEL engines located in GIORDANO BURNO, CERRO MAGGIORE(MILAN,ITALY)

The test is done by controlling the brake torque using a hydraulic engine and the fuel quantity to the injector pump, measuring:

1. Engine Turns (RPM)
2. Torque (Kgm)

3. Alpha (%)
4. Power (HP or CV)
5. Average effective pressure (Bars)
6. Fuel Consumption (Kg/Hr)
7. Specific Fuel Consumption-CONS_SP(g/CV*h)
8. Engine Temperature –H2O_E_DX(Celsius)
9. Inlet Fuel Temperature-T_GASOLIO(Celsius)
10. Fuel Pressure Inlet-T_Gasolio(Bars)
11. Engine Oil Pressure-OIL_f_rmp(Bars)
12. Back Side manifold temperature-t_cil1 (Celsius)
13. Front Side manifold temperature-t_cil2 (Celsius)
14. Inlet air temperature-t_cil3(Celsius)

The room temperatures had been checked well before the experiment. All fuel filters have been changed before the experiment

TEST: Three tests have been conducted. They are:

a. Torque and Power Measurement
b. Fuel Consumption
c. Particulate Measurement
d. Other Pollutant Measurement

Torque and Power measurements

The engine was first run using conventional diesel. The data of the torque at different rpms have been listed in table 1:

Measuring points

Because of the unavailability of the full measurement equipment during the same session it was necessary to define several measurement points. The measurements points were defined through engine RPM (table 2).

Power comparison

The measures were performed at rpm (measuring points) determined in accordance to the table 3.

Fuel consumption

A measurement of fuel consumption was performed in the same rpm regime. In order to have a good comparison the measuring units is grams per Horse power per hour (table 4).

Table 1: Data of the torque at different rpms

RMP	Torque(Kgm)	Power(HP)
2100	60.00	182.02
2000	68.00	196.07
1900	72.00	197.07
1800	75.00	195.04
1700	77.00	189.05
1600	80.00	185.04
1500	82.00	178.02
1300	85.00	160.01
1200	83.00	144.03

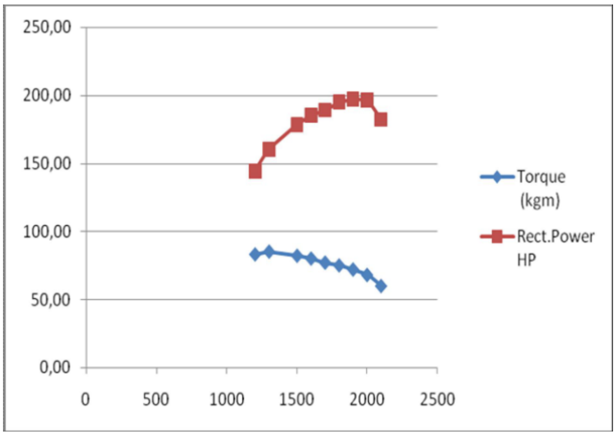

Fig.1 the first characterization torque and power were measured using standard Diesel fuel and O_2 Diesel.

Table 2: The measurements points were defined through engine RPM

Measurement Points	RPM
A	2000
B	1800
C	1800
D	1600
E	1400
F	640

Table 3: The measures were performed at rpm (measuring points)

POWER			
Measurement point	**Fuel**		**%O_2Diesel/ Diesel**
	Diesel	O_2 Diesel	
A	200.2	193.3	96.6
B	195.9	191.5	97.8
C	148.9	145.4	97.6
D	98.4	93.9	95.4
E	69.5	66.1	95.1
Average	96.5		

Table 4: A measurement of fuel consumption

FUEL CONSUMPTION (g/CV*h)			
Measurement point	**Fuel**		**%O2Diesel/ Diesel**
	Diesel	O_2Diesel	
A	173.40	176.83	102.0
B	170.80	171.00	100.1
C	172.78	175.25	101.4
D	179.50	175.86	98.0
E	176.78	179.63	101.6
Average	100.6		

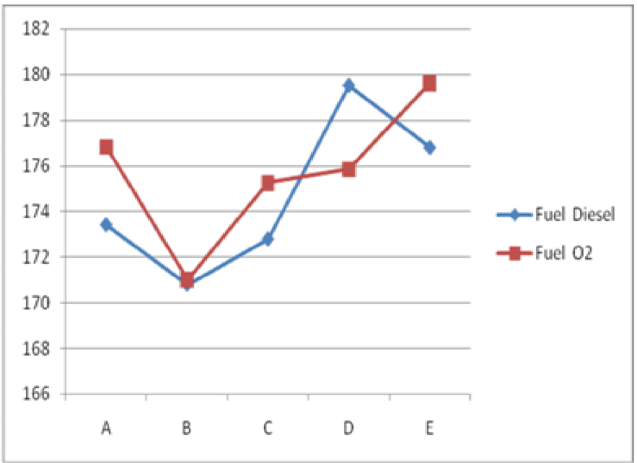

Fig. 2: A measurement of fuel consumption (g/CV*h).

We can clearly see that there is an increase in fuel consumption of about 2%.

Particulate measurements

The measure was performed according to the following procedure:

For both the fuels the exhaust were analyzed by dilutions on Teflon filters. The filters were weighted before and after the exhaust fluxes. Mode Measurement point B and C have the same engine speed (rpm = 1,800), but with different power conditions (for Diesel, B at HP = 195.9 and C at HP = 148.9, and for O2Diesel, B at HP = 191.5 and C at HP = 145.4). Mode B is at "maximum" power and under stressing conditions for the engine and Mode C (the same rpm of Mode B) is at more "sustainable" conditions for the engine.

Table: 5: Particulate measurements.

PARTICULATE (mg/nl)				
Measurement point		**Fuel**		**% O_2Diesel /Diesel**
	rpm	Diesel	O_2Diesel	
A	2,000	0.03066	0.02629	85.75
B	1,800	0.02957	0.02233	75.52
C	1,800	0.02994	0.02197	73.38
D	1,600	0.01731	0.01945	112.36
E	1,400	0.01587	0.01008	63.52
F	640	0.00793	0.00558	70.37
Average	80.15			

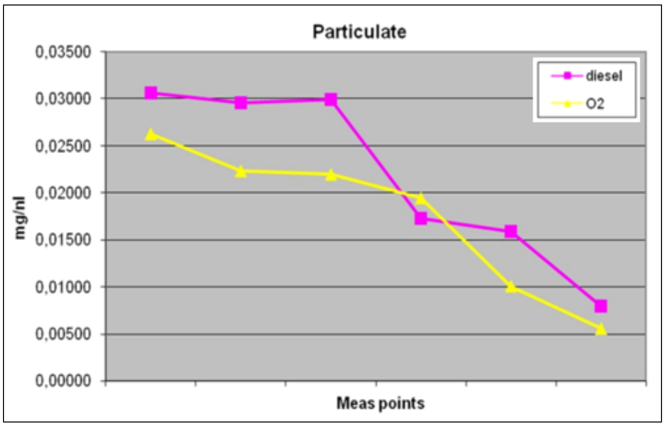

Fig. 3: Particulate measurements.

Table 6: Pollutants measurements (Diesel)

	RPM	HP	kg/h	g/CV*h	T1	T2	T3
A	*2,000*	200.2	33.21	173.40	588.4	652.5	149.6
B	*1,800*	195.9	31.92	170.80	602.8	661.2	145.4
C	*1,800*	148.9	24.56	172.78	514.0	556.7	109.6
D	*1,600*	98.4	16.66	179.50	427.8	454.5	84.9
E	*1,400*	69.5	11.66	176.78	368.5	376.4	70.6
F	*640*	0.0	1.20	968.00	180.0	159.2	54.8

Table 7: Pollutants measurements (O_2 Diesel)

	RPM	HP	kg/h	g/CV*h	T1	T2	T3
A	*2,000*	193.3	32.51	176.83	573.9	608.8	139.5
B	*1,800*	191.5	31.12	171.00	593.8	623.2	136.0
C	*1,800*	145.4	24.32	175.25	518.5	547.3	108.3
D	*1,600*	93.9	15.93	175.86	431.5	452.2	83.3
E	*1,400*	66.1	11.35	179.63	373.8	374.7	69.8
F	*640*	0.0	1.33	838.33	151.2	137.4	46.4

Table 8: Pollutants measurements (NO_X) ppm

Measurement point		Fuel		%O_2Diesel/ Diesel
	rpm	Diesel	O_2Diesel	
A	2,000	1,260	1,145	90.87
B	1,800	1,393	1,278	91.74
C	1,800	1,126	922	81.88
D	1,600	1,030	720	69.90
E	1,400	1,052	713	67.78
F	640	436	459	105.28
Average	84.58			

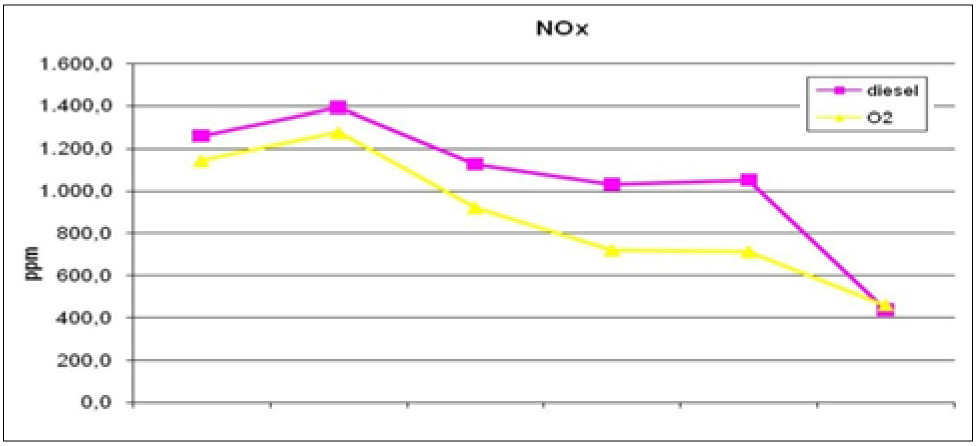

Fig.4: Pollutants measurements NOx

Table 9: Pollutants measurements CO ppm

Measurement point		Fuel		%O_2Diesel/ Diesel
	rpm	Diesel	O_2Diesel	
A	2.000	420	320	76.19
B	1.800	540	392	72.59
C	1.800	210	158	75.24
D	1.600	129	118	91.47
E	1.400	285	115	40.35
F	640	285	237	83.16
Average	73.17			

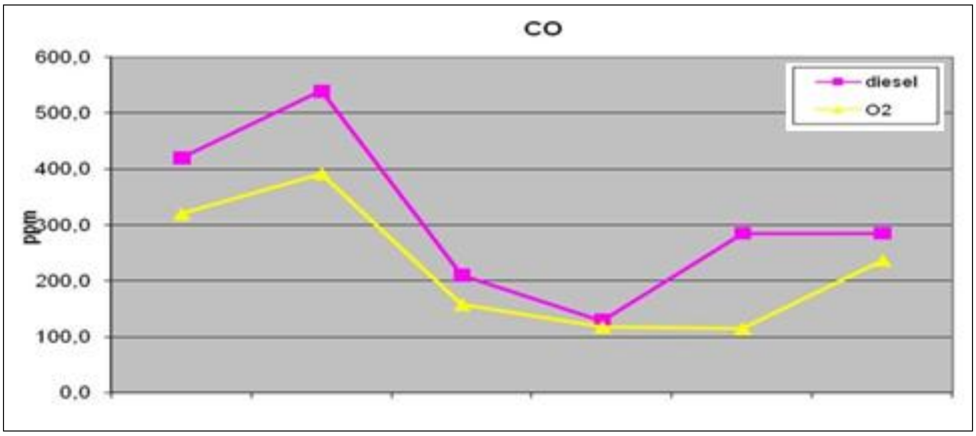

Fig.5: Pollutants measurements CO ppm

Table 9: Pollutants measurements (CO_2) ppm

Measurement point		**Fuel**		**%O_2Diesel/ Diesel**
	rpm	Diesel	O_2Diesel	
A	2,000	7.7	7.4	95.84
B	1,800	8.0	7.7	96.36
C	1,800	7.1	6.8	97.02
D	1,600	6.0	5.9	98.83
E	1,400	5.3	5.0	93.97
F	640	1.3	1.4	110.94
Average	98.83			

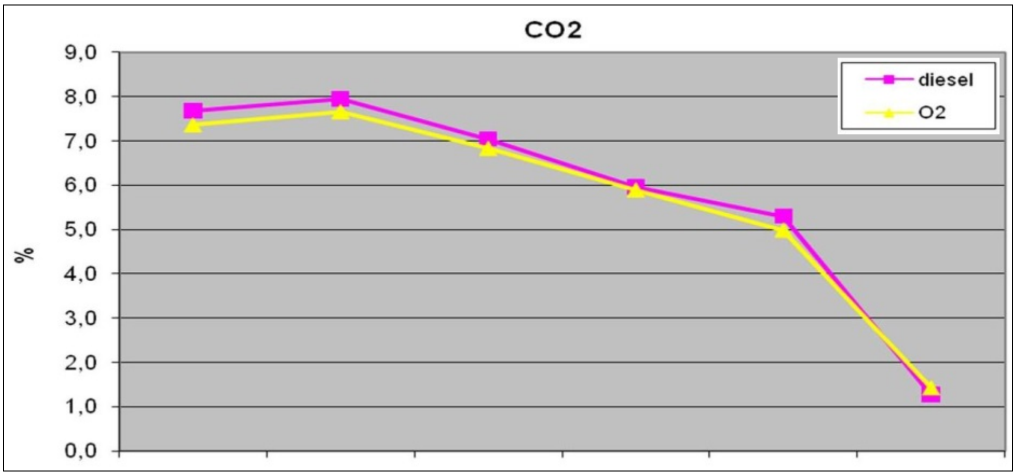

Fig.6: Pollutants measurements CO_2 ppm

Table 9: Pollutants measurements (HTC) ppm

Measurement point		**Fuel**		**%O_2Diesel/ Diesel**
	rpm	Diesel	O_2Diesel	
A	2,000	28.01	5.15	18.39
B	1,800	30.85	5.00	16.21
C	1,800	37.52	10.93	29.13
D	1,600	36.55	10.92	29.88
E	1,400	44.29	11.63	26.26
F	640	45.09	20.90	46.35
Average	27.70			

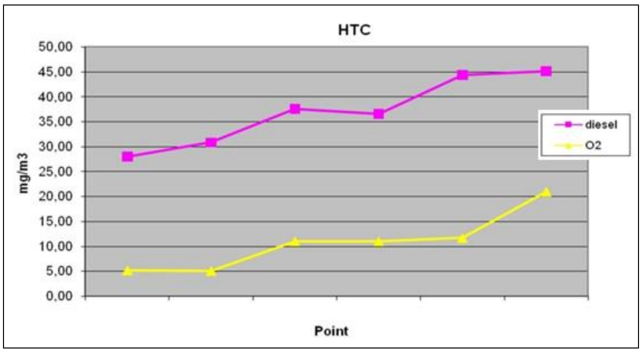

Fig.7: Pollutants measurements HTC

With the exception of at 1,400 rpm the table shows a significant decrease in particulate emissions. These encourage the possibility to operate in standard (on road) conditions.

Other pollutants measurements

All other exhausts were measured using the following procedure: reliefs of the exhaust were made at several regimes of the engine.

Samples test cycle

- A preheated nose test probe was utilized;
- Exhausts were refrigerated and dehydrated;
- Relief pump;
- Multigas analyzer (MARPOL 73/78 standards);
- Magnetic registrations of the data.

Significant reductions in NO_x, CO, SO_2 and in HTC were registered. In the following tables all the results are reported.

CONCLUSION

The test has been necessary to evaluate the possibility to use E-DIESEL fuel to feed "old" engines and saving pollution in order to increase the sustainable developement

The results of the test seem to strengthen this possibility, in fact: even if a small reduction in power is showed (4% average) there is a significant reduction in all the exhaust emissions measured during the tests:

- 20% less in Particulate,
- 15% less in NO_x,
- 27% less in CO,
- 18% less in SO_2,
- 73% less in HTC.

It can thus be safely concluded that E-DIESEL though generates lesser power at the same RMP, can be used as a viable alternative to conventional DIESEL. The engine requires no modification to run on E-DIESEL. Further as it is a Carbon NEUTRAL fuel we are eliminating no carbon into the atmosphere under any forms. During the process of production of the fuel we are using the CO2 from the atmosphere thus also slowly using up the pollutant. The widespread use of this fuel will not only relinquish us from the dependency of fossil fuel but also will help us in developing a greener future.

REFERENCES

1. Oxygenated Diesel: Emissions and Performance Characteristics of Ethanol-Diesel Blends in CI Engines Irshad Ahmed Pure Energy Corporation.
2. Jothithirumal B and James Gunasekaran E, Combined impact of biodiesel (meno) and exhaust gas recirculation on nox emissions in di diesel engines, *International Journal of Advances in Engineering & Technology*, Sept 2012.
3. Short report from emission test using E-diesel Fuel,Issued by: ETA-Renewable Energies, Piazza Savonarola 10 Florence-Italy.
4. Matti Happonen , Juha Heikkilä, Timo Murtonen, Kalle Lehto, Teemu Sarjovaara, Martti Larmi, Jorma Keskinen, and Annele Virtanen. Reductions in Particulate and NO_x Emissions by Diesel Engine Parameter Adjustments with HVO Fuel, *Environ. Sci. Technol.*, 2012, *46* (11):6198-204. DOI: 10.1021/es300447t.
5. http://reneweconomy.com.au/2015/blue-crude-audi-pilot-produces-diesel-fuel-from-co2-and-water-66638.