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Heat Balance Sheet of Single Cylinder Diesel Engine by Introducing Oxygen in the Air Intake

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Abstract: *The objective of research is to determine efficiency of single cylinder diesel engine by introducing oxygen through air intake and preparing heat balance sheet. Presently setup having single cylinder diesel engine with rope brake dynamometer with spring mass measurement system. Whole setup is used to study the performance of engine by providing oxygen during combustion or enhancement of charge by oxygen. Because of which loss of heat through the exhaust gases will be reduced. It is observed that percentage increase of oxygen in intake air reduce exhaust emission and efficiency of engine increase satisfactorily.*

Keyword: *Heat balance sheet, Thermal efficiency, Exhaust emission, Rope brake Brake power, and Heat loss in cooling, exhaust SFC, bsfc, Oxygen enrichment, air intake etc.*

I.INTRODUCTION:

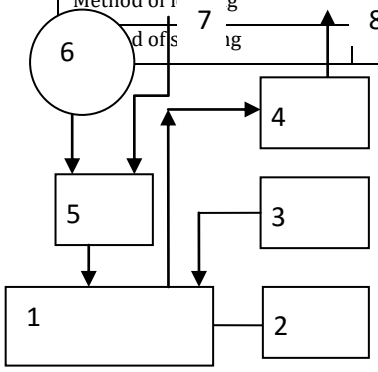
To increase thermal efficiency and reduce fuel consumption is a big challenge in front of engine manufacturer. Fuel and air mixture should burn satisfactorily to reduce fuel consumption so that to active this, new technology has adopted by manufacturer. i.e. microprocessor controlled fuel system which provides the quantity of fuel according to the load and speed condition also lot of research work is going on to active less pollution. Presently diesel engine applications are too broad as compare to petrol engines. The use of oxygen at intake air is beneficial according to the consumption point view. In the experimental setup oxygen cylinder is used with flow meter and pressure gauge. The mixing of oxygen in the air is carried out before intake manifold in the mixing chamber. The variety of observations and reading are noted with different levels of oxygen enrichment and mathematical calculations are carried out for a proper heat balance sheet & other aspect like Brake power, sfc, Break mean effective pressure, Break thermal efficiency, Indicated thermal efficiency, Mechanical and Volumetric thermal efficiency are included in this study.

II.EXPERIMENTAL SETUP

The test engine used a single cylinder water cooled kirloskar diesel engine with rope brake dynamometer.

The schematic diagram of engine Experimental setup is shown in the figure.1 and technical specification engine also given below

Make	Kirloskar
BHP	5HP
Speed	1500-2000 rpm
No. of cycle	One
Compression ratio	0.750694444
Bore	87.5mm
Stroke	110mm
Type of ignition	Compression
Method of l g	e brake dynamometer
d of s ıg	ual crank start



1. Engine 2.Rope break dynamometer 3. Fuel tank 4. Calorimeter 5.Mixing Chamber
6. Oxygen Cylinder with flow meter7.Atmospheric air 8. Exhaust gas to the atmosphere

III.MEASUREMENT OF AIR CONSUMPTION:

The method commonly used in laboratory for measuring combustion of air, it consist of a air tight chamber fitted with sharp edged orifice. The orifice located away from the suction connection to engine. Due to suction of engine there is pressure difference in cubical air box which cause the flow through orifice. The volume of chamber should be large as compare to swept volume of cylinder. It is assumed that the intermittent suction of the engine will not affect the air pressure in the air box. As the volume of the box is sufficiently large and pressure in box remain constant.

IV.MEASUREMENT OF FUEL CONSUMPTION:

The measurement of the fuel supplied to the engine is carried out as below. The fuel from the tank is connected a glass burette and same is connected to engine through a manual ball valve

The tank will remain open until the burette is filled to high level during this time the fuel is flowing to the engine directly from fuel tank and also fills the burette. Now the fuel in the burette gets discharged to the engine. Time is noted to empty the burette for 50ml and the cycle is repeated here injection is direct with multi hole nozzle.

V.OXYGEN SUPPLY SYSTEM:

For the purpose of test conducted here compressed oxygen stored in the cylinder was used. The oxygen and atmospheric air was mixed in the mixing chamber provided before entering to the intake manifold of the engine the amount of oxygen supplied from the cylinder varies from 1 LPM to 3 LPM

For intake air low levels of oxygen enrichment were used it did not exceed 3LPM of intake air in order to protect engine. Higher oxygen enrichment levels need special engine modification and oxygen concentration was measured properly using gas flow meter.

VI.CRANK ANGLE AND METHOD OF LOADING:

Crank angle encoder was mounted on the camshaft to measure engine crank angle. The engine was instrumented with the piezoelectric transducer to measure the combustion process. The pressure transducer is connected to the battery powered signal conditioner via an inline charge amplifier/converter. The charge amplifier converts the low level charge to a high level voltage output, which again conditioned in the signal conditioner and fed to the data acquisition card as a differential connection. The engine and the air cooled eddy current dynamometer are coupled using a tire coupling, the output shaft of the Eddy current dynamometer is fixed to a strain gauge type load cell for measuring applied load to the engine. The engine is loaded using the potentiometer provided on the panel. Data acquisition is the sampling of the real world to generate data that can be manipulated by the computer, typically involves acquisition of signals and waveforms and processing the signals to obtain desired information. The components of data acquisition systems include appropriate sensors that convert any instrument parameter to an electrical signal, which is acquired by data acquisition hardware. Acquired data is displaced, analyzed and stored in computer. Data acquisition begins with physical phenomenon or physical property of an object to be measured. This property may be the temperature or temperature change of a room, the intensity or intensity change of a light source, the pressure inside a chamber, the force applied to an object or many other things. An effective data acquisition system can measure all of these different properties or phenomena. For intake air low levels of oxygen enrichment were used, it did not exceed 4 LPM of the intake air in order to protect the engine. Higher oxygen enrichment levels need special engine modifications because of the expected higher output temperature which is expected to be produced. The intake air oxygen concentration was increased by injecting pure oxygen from a cylinder to the mixing chamber. To ensure effective oxygen enrichment, the pure oxygen was injected directly through mixing chamber in its inlet and the intake air oxygen concentration was measured properly using gas flow meter.

VII.RESULT & DISCUSSION:

While performing this experiment lot of thing we observed these are when increases load on the engine same time specific fuel consumption and speed gradually decreases. In the varying speed and load condition brake power developed and brake thermal efficiency is very low. Reason behind that is combustion of charge are not satisfactorily

so that formation of pollutants take place. We know that co forms due to deficiency of oxygen during combustion due to design of engine lot of charge goes as it is through exhaust known as UHBN, temperature of engine leads to Nox formation particular matter in the exhaust are also more.

On other hand phenomenon after introducing oxygen in the air intake in mixing chamber is amazing like when load on engine is going to increase gradually there is slight reduction in speed and time required for 50ml of consumption of diesel is increased by 30 to 50 sec per 50ml.this is very interesting from mileage point of view and it is made possible. After all there is rise in brake power and brake thermal efficiency of same engine. Last we drawn heat balance sheet of both situations means before and after introducing oxygen in the intake air. According to the mathematical calculation heat utilization in the brake power increased and in the exhaust emission is drastically reduced its proper meaning is that approaches towards the complete combustion. After all mathematical calculation all values are tabulated below with proper charting and graphs

BFORE INTRODUCING OXYGEN

Sl.No	Speed	Load	Manometer Difference	Time for 50 Ml	Break power	Efficiency
	RPM	KG	M	SEC	KW	η_{bt} %
1	1480	1	0.0254	380	0.49	9.31
2	970	5		350	1.61	22
3	740	9		335	2.18	32
4	550	12		300	2.16	24

Mass of air	Mass of Fuel	Temperatures OC			
Kg/S	Kg/S	T1	T2	T3	T4
$6.33*10^{-3}$	$1.19*10^{-4}$	22	43	151	41
	$1.30*10^{-4}$	22	45	158	43
	$1.35*10^{-4}$	22	47	160	43
	$1.51*10^{-4}$	22	48	162	42

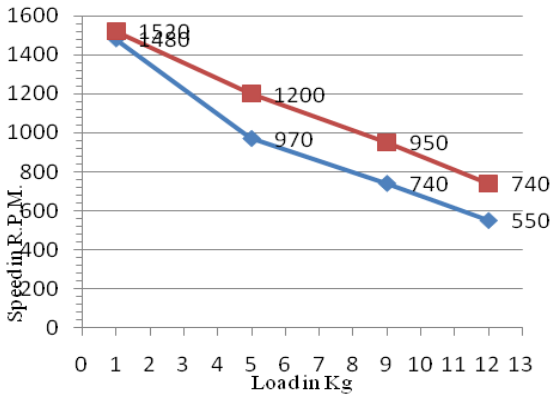
AFTER INTRODUCING OXYGEN

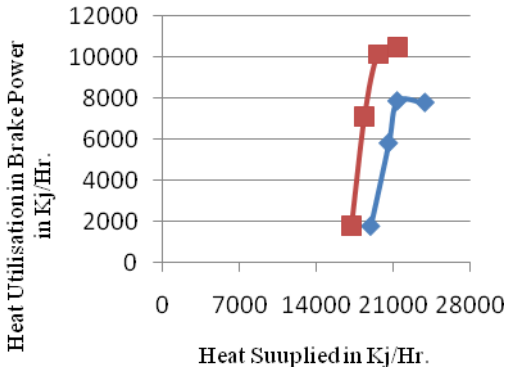
Sl.No	Sped	Load	Manometer Difference	Time for 50 Ml	Break power	Efficiency
	RPM	KG	M	SEC	KW	ηbt %
1	1520	1	0.0254	420	0.5	10.5
2	1200	5		395	1.97	38.7
3	950	9		368	2.81	51
4	740	12		335	2.91	49

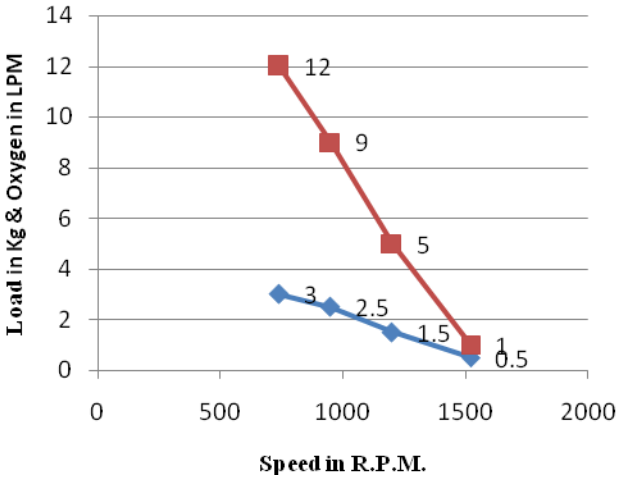
Oxygen Enrichment	Mass of air	Mass of Fuel	Temperatures OC			
LPM	Kg/S	Kg/S	T1	T2	T3	T4
0.5	$6.33*10^{-3}$	$1.083*10^{-4}$	22	45	157	58
1.5		$1.1578*10^{-4}$	22	46	161	56
2.5		$1.2364*10^{-4}$	22	48	163	61
3		$1.35*10^{-4}$	22	48	163	55

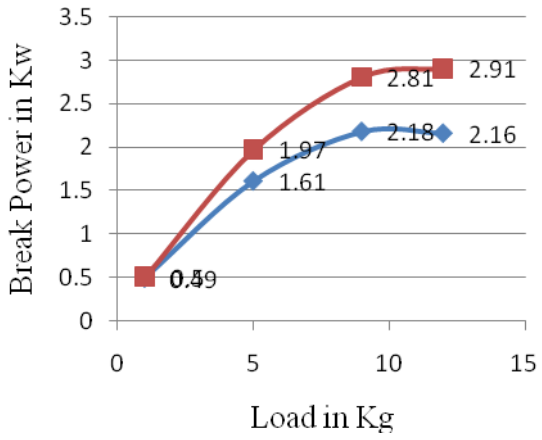
Heat Supplied	Utilization of heat in KJ/Hr			
KJ/HR	Brake power	Cooling	Exhaust	Unaccounted
18946	1752	5264	2558	9380
20571	5796	5766	2686	6323
21363	7848	6267	2758	4490
23895	7776	6518	2798	6804

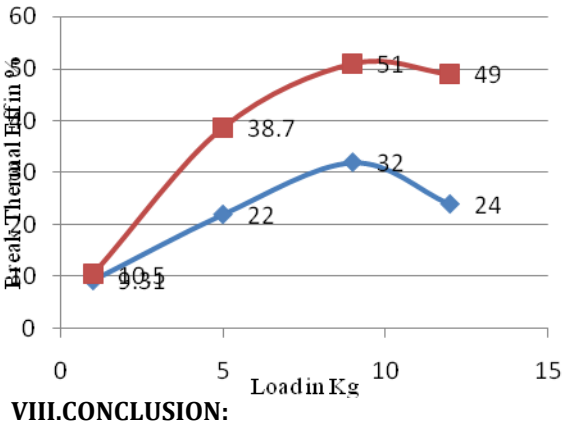
Heat Supplied	Utilization of heat in KJ/Hr			
KJ/HR	Brake power	Cooling	Exhaust	Unaccounted
17137	1800	5771	2294	7272
18321	7092	6000.8	2436	2792
19565	10116	6001	2370	1077
21363	10476	6500	2515	1872

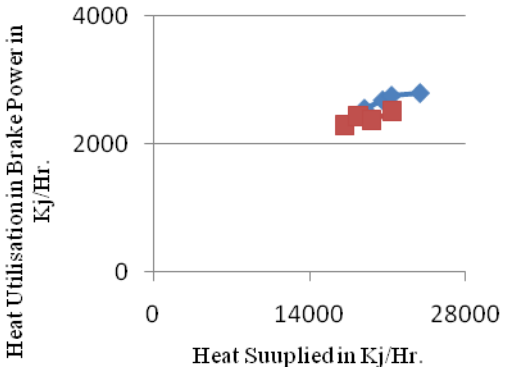












VIII.CONCLUSION:

Based on experimental results the following conclusion are made

1. The speed of engine increases with load because of enriching air intake by oxygen &. Specific fuel consumption is reduce at different load sped condition.

2. Brake power and brake thermal efficiency satisfactorily increase at varying speed and load condition as compare to normal combustion process.

3. lastly according to the heat balance sheet of before and after introducing oxygen in the intake air the utilization of heat in the brake power satisfactorily increased also heat loss in the exhaust gases is reduced so this is the major achievement of this research work.

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REFERENCES

1. The book by V. Ganesan, (2007), "Internal Combustion Engines", Tata McGraw hill publications, pp. 527-528,573-579.
2. The book by John B Heywood (2013), "Internal Combustion Engines fundamentals", McGraw hill education privet limited, pp. 493-507.
3. The book by M L Mathur & R P Sharma (2012), "Internal Combustion Engines", Dhananpat rai publication pp. 214-249.

4. Stork, K.C., and R.B. Poola (1998), "Membrane-Based Air Composition Control for Light-Duty Diesel Vehicles: A Benefit and Cost Assessment", Argonne National Laboratory, Technical Report.

5. D.N., R.B. Poola, R. Sekar and G.R. Cataldi, Study of using oxygen-enriched combustion air for locomotive diesel engines. J. Eng. Gas Turbine Power, 123: 157-166.2001.

6. Cahyono, B. and R.A. Bakar, Effect of Ethanol Addition in the Combustion Process during Warm-UPS and half open throttle on port-injection gasoline engine. Am. J. Eng. Applied Sci., 4: 66-9. DOI: 10.3844/ajeassp.2011.66.69.

7. Momani, W., 2009. The effects of excess oxygen to mixture on the gasses emissions of a gasoline engine. Am. J. Applied Sci., 6: 1122-1125. DOI:10.3844/ajassp.2009.1122.1125.

8. Momani, W., S. Abu-Ein, M. Momani and S.M. Fayyad, 2009. Effects of oxygenated gasoline on fuel and air mass flow rates and air-fuel ratio. Am. J. Applied Sci., 6: 974-977. DOI:10.3844/ajassp.2009.974.977

9. Najafi, G., B. Ghobadian, T.F. Yusaf and H. Rahimi, Combustion analysis of a CI engineperformance using waste cooking Biodiesel fuel with an artificial neural network aid. Am. J.Applied Sci., 4: 759-767. DOI:10.3844/ajassp.2007.759.767

10. Rajkumar, K. and P. Govindarajan, 2010. Experimental investigation of oxygen enriched air intake on combustion parameters of a single cylinder diesel engine. Int. J. Eng. Sci. Technol., 2: 3621-3627.

11 Rakopoulos, C.D., D.T. Hountalas, T.C. Zannis and Y.A. Levendis, 2004. Operational and environmental evaluation of diesel engines burning oxygen-enriched intake air or oxygen-enriched fuels: A Review. SAE International, DOI:10.4271/2004-01-2924.