PERFORMANCE TEST ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE BY USING MAIN

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ABSTRACT

The core objective of the work is to compare the performance test on single cylinder four stroke diesel engines by the aid of convergent divergent inlet manifold then comparing it with the normal manifold. Experiments are done by using both the types of manifold and results are derived.

Consistent and dependable performances of latest diesel engines are ensured on the management of air supply into the combustion chamber. Management of air supply enhances all important properties like composition, temperature, pressure and the quality index of combusted air in heat exhaust time. Comparison is done before and after the nozzle insertion at the inlet manifold, to ensure the decrease in specific fuel consumption and increase in thermal efficiency and also reduction in the release of environmental hazardous gases from CI engines.

1. INTRODUCTION

Thermal or Heat energy is the oldest energy forms familiar to the world. This type of energy is generally exhausted from energies like Chemical and Electrical energy. Engine is the device used for conversion of one form of energy to the other form. In this process of conversion, efficiency has a dominant place and also decides the effective use of energy supplied. Heat engine, a device used to transform Chemical energy of a fuel to thermal or heat energy. The energy so converted is utilized for useful work.

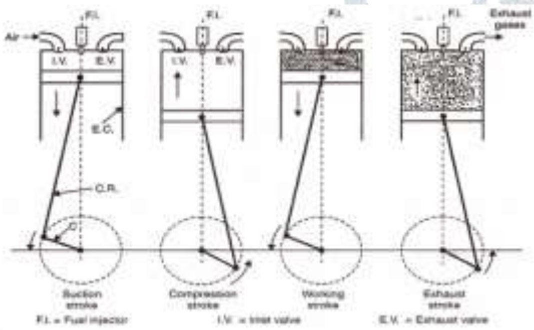
A 4-cycle engine also called as 4-stroke engine is an IC engine where the piston undergoes four strokes separately along with crankshaft turning. A stroke is the to and fro motion of the piston throughout the length of the cylinder. These strokes are coined as:

1. INTAKE: Intake stroke starts from the TDC (top dead center) and ends at BDC (bottom dead centre). During this stroke inlet valve is in open position so that the piston can pull the air-fuel mixture into the cylinder by providing vacuum pressure in the cylinder downwards.
2. COMPRESSION: Compression stroke starts at BDC or at the end of intake stroke and ends at TDC. Compression of air-fuel mixture is done by the piston in this stroke and preparing the mixture to ignite during the power stroke. Inlet as well as exhaust valves are closed in this stroke.
3. POWER: Power stroke marks the 2^{nd} revolution in this 4-stroke cycle. Crankshaft has undergone a 360^0 revolution. When the

piston is present at TDC that is where the compression stroke ends, the air-fuel mixture which is compressed is ignited by a spark plug in case of gas engine or by the generated heat due to high compression in case of diesel engine makes the piston to return to BDC. Power stroke provides the required mechanical work to rotate the crankshaft from an engine.

4. EXHAUST: In this stroke, piston comes back to TDC from BDC with exhaust valve is opened. Exhausted products out of combustion of air-fuel mixture are exhausted through this valve.

1.1 Working Of Four Stroke Compression Ignition Engine



Working Principle of 4-Stroke C.I Engine

2. LITERATURE REVIEW

In any injector, the geometry of the nozzle has an impact role in regulating atomization of diesel spray as well as combustion. Nozzle properties like diameter of hole, Dia-to-length ratio, nozzle inlet roundness have their effects on atomization of fuel as well as on combustion. These effects were put forward by Bergwerk. Aspects regarding internal flow like distribution of velocity inside the nozzle, cavity effect, turbulent factor determines the variation level in the jet near nozzle exit. Primary variations will affect the penetration, liquid divergence factor, and ignition as well as combustion. Large diametric nozzles are less efficient in fuel spray atomization when compared to small diametric nozzles. Moreover small diametric nozzles need to decrease combustion efficiency and duration of injection of small diametric nozzles by enhancing injection velocity. Size of the nozzle also has effect on performance and emissions of fuel. So nozzles of various diameters were checked in a process in which volume reduces with reduction in nozzle diameter. Pickett and Siebers observed and finalized the effect formation in diesel engine environments. Numerical modeling also used to derive the variation level in the jet near the nozzle exit relating to lift-off length. Large diametric nozzles are less efficient when compared to higher injection time in atomizing the fuel..

3. METHODOLOGY

An Engine is a mechanical operator that converts one form of energy to another form of energy. During this conversion, efficiency plays a crucial role in this process. Generally all the engines convert thermal or heat energy to mechanical energy or work, hence are termed as ‘heat engines’

3.1 Preparation of convergent – divergent nozzle

This type of manifold is made fixed in the lathe machine which has three jaw chucks so to drill a hole near the centre of desired diameter. Then boring is carried out on the already drilled hole with the help of boring tool from both the ends.

Preparation of Convergent- Divergent manifold flange

- Design and fabrication of CD Manifold
- CD manifold material and Properties

4. EXPERIMENTAL SETUP & PROCEDURE

The experimental set up containing an engine, an alternator, top load system, fuel tank with immersion heater, exhaust gas, and manometer

Engine:

The engine which is supplied by Kirloskar Company. The engine is a single cylinder vertical type four stroke, air cooled, CI Engine. The engine is self-governed type, which specifications are given below.

4.1 Experimental Procedure

Before starting the CI engine separate the fuel injector from the fuel system which is attached on the fuel injector Fuel injection pressure tested and operates the tester pump Notice the pressure reading from the dial at which the injector starts spraying In order to accomplish the required pressure by balancing the screw, which is at the top of the injector

Above process is repeated till obtaining various required pressures.

Diesel is allowed to run the CI engine for half an hour. So that it gets warmed up and required running conditions are obtained. First check the engine, lubricating oil in the engine and also observe all rotating and moving parts are whether lubricated or not.

Different steps are required in the setting of the experiment, which are explained below

1. The experiment was carried out after starting of the CI engine
2. Pressure is set constant over the experiment, which is 200 bar.
3. Precautions must be taken while doing the experiment.
4. Always should engine started with no load condition.
5. The engine was started at no load condition and continued it for at least 10 minutes.
6. The readings such as fuel consumption, spring balance reading, cooling water flow rate, manometer reading etc., were taken as per the observation table.
7. The load on the IC engine was increased by 15% of FULL Load by using the engine controllers and the readings were taken as

shown in the below tables.

8. Step 3 was repeated by varying different loads from no load to full load.

9. After completion of test, the load on the engine was completely removed and then the engine was stopped.

The results were taken and calculated by using formulas as follows.

5. Results and Discussion

Perfomance test Results on normal manifold at1400rpm

S.NO	Load	Speed	Time	BP	TFC	IP	F.P	Heat Input	BSFC	η_{bth}	η_{ith}	η_{mech}	η_{vol}	BMEP	IMEP	Exhaust temp
	kg	Rpm	Sec	kW	kg/s $*10^{-4}$	kW	kW	kW	Kg/ kW.h	%	%	%	%	kN/m^2	kN/m^2	°C
1	0	1400	97	0	1.308	3.2	3.2	13.67	0.7	0	20.5	0	58.8	64.32	165.2	93
2	5	1400	85	1.19	2.35	4.3	3.2	13.76	0.48	8.5	22.5	27.6	52.5	120	250.3	95
3	10	1400	72	2.38	3.41	5.5	3.2	19.95	0.38	12.5	22.2	43.2	50.8	200.3	303.2	97
4	15	1400	60	3.57	4.498	6.7	3.2	25.94	0.33	14.6	23.9	53.8	48.6	214.2	387.3	102
5	20	1400	53	4.76	5.563	7.9	3.2	30.72	0.29	16.3	20.4	60	45.8	300.6	435.7	105
6	25	1400	50	5.95	6.597	9.1	3.2	37.13	0.40	12.3	16.8	65.3	44.6	320.4	451.8	110

The above table observations are given below

1. With the increasing the load brake power also increases
2. Load and indicated power are directly proportional to each other.
3. BSFC decreases from 0Kg to 20Kg but whereas from 20Kg to 25Kg slightly it increases.
4. Brake thermal efficiency rises from 0Kg to 20Kg where as it decreases from 20kg to 25kg.
5. Indicated thermal efficiency Increases from 0Kg to15Kg and slightly decrease from 20Kg to 25Kg.
6. Load increases and Mechanical efficiency also increases and volumetric efficiency decreases.
7. Load increases and BMEP, IMEP and Exhaust temperature also increases

Performance test Results on normal manifold at1500rpm

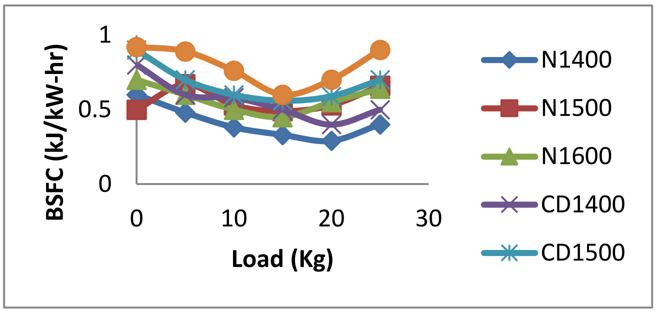
S No	Load	Speed	Time	B.P	TFC	I.P	F.P	Heat Input	BSFC	η_{bth}	η_{ith}	η_{mech}	η_{vol}	BMEP	IMEP	Exhaust temp
	kg	Rpm	Sec	kW	kg/s $*10^{-4}$	kW	kW	kW	Kg/ kW h	%	%	%	%	kN/m^2	kN/m^2	°C
1	0	1500	105	0	2.11	2.3	1.5	8.9	0.7	0	25.98	0	88.48	64.32	195.22	85
2	5	1500	93	1.4	2.73	3.0	1.5	11.4	0.67	12.76	26.27	48.67	66.23	124	254.84	89
3	10	1500	88	2.43	3.5	3.9	1.5	15.0	0.55	15.94	26.25	60.77	65.58	202.69	335.53	91
4	15	1500	70	3.11	[illegible]	[illegible]	1.5	17.99	0.49	17.32	25.93	66.78	61.96	265.23	394.1	92
5	20	1500	62	3.76	5.6	5.3	1.5	23.63	0.53	15.93	22.47	70.84	59.53	317.87	451.75	95
6	25	1500	55	4.06	7.5	5.8	1.5	31.54	0.66	12.54	17.8	72.44	56.25	343.39	474.25	103

The above table observations are given below

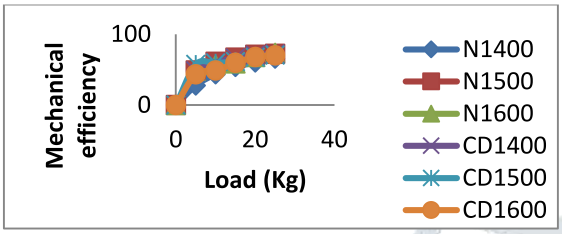
1. With the increasing the load brake power also increases
2. Load and indicated power are directly proportional to each other.
3. BSFC decreases from 0Kg to 20Kg but whereas from 20Kg to 25Kg slightly it increases.
4. Brake thermal efficiency rises from 0Kg to 20Kg where as it decreases from 20kg to 25kg.
5. Indicated thermal efficiency Increases from 0Kg to15Kg and slightly decrease from 20Kg to 25Kg.
6. Load increases and Mechanical efficiency also increases and volumetric efficiency decreases.
7. Load increases and BMEP, IMEP and Exhaust temperature also increases.

6. Efficiency

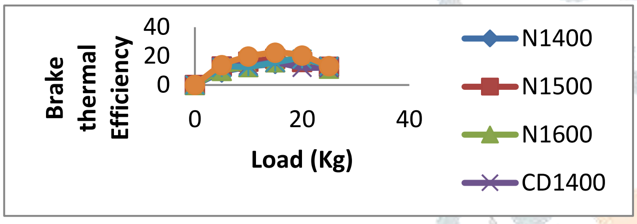
Mechanical efficiency indicates how good an engine is inverting the indicated power to useful power Fig5.2 shows the mechanical efficiency of normal manifold is less than CD manifold for the pure diesel at full load. Because higher fuel injection pressures increases the decrease of atomization. The fitness of atomization reduces ignition lag



Load against Mechanical efficiency



Load against Brake Thermal Efficiency



7. Conclusion

The performance characteristics of an IC engine without convergent divergent nozzle and with convergent divergent nozzle in the intake manifold were compared. A convergent divergent nozzle of various speeds N1400, N1500, N1500, CD1400, and CD1500 CD1600rpm

1. The result for the variations in the brake specific fuel consumption (BSFC) is dispensed. For all the fuels the BSFC decreases with increasing load. The variations of BSFC are very small when using various speeds. The highest BSFC values are 0.91kg/kw hr and for CD1500, 0.8 kg/kW hr. for CD1400 and 0.92kg/kW hr for CD 1600. Compare with normal nozzle values slightly give better results with convergent divergent nozzle.
2. Brake thermal efficiency gives an idea about output produced by the IC engine with respect to heat supplied in the form of fuel. Brake thermal efficiency increases with load at all the fuels. The brake thermal efficiency values at maximum loads are 11.2% for N1400, 12.54% for N1500 and 11.2% for N1600, 12.1% for CD 1400, 12.9% for 1500 and 12.6% for CD1600. Compare with normal manifold values, convergent divergent nozzle values are improves.

7.1 References

1. "File:Four stroke cycle intake.png," 2005. [Online]. Available: http://en.wikipedia.org/wiki/File:Four_stroke_cycle_intake.png. [Accessed June 2012].
2. M. Wan, "AutoZone Technical School," [Online]. Available: http://www.autozine.org/technical_school/engine/Intake_exhaust.html#Tuned-intake.
3. [Accessed June 2012].
4. Montgomery, D.T., et al., Effect of Injector Nozzle Hole size and Number of Spray Characteristics and the Performance of a Heavy-Duty D.I. Diesel Engine, in SAE Paper. 1996. p. 962002.137
5. Su, T.F., et al., Effects of Injection Pressure and Nozzle Geometry on Spray SMD and D.I .Diesel Emissions, in SAE Paper. 1995. p. 952360.
6. Bergwerk, W., Flow Pattern in Diesel Nozzle Spray Holes. Proc. Inst. Mech. Eng. , 1959. **173**: p. 655-660.
7. Arcoumanis, C. and M.Gavaises, Linking Nozzle Flow with Spray Characteristics in a Diesel Fuel Injection System, Atomization and Sprays. 1998. **8**: p. 307-347.
8. Tamaki, N., K. Nishida, and H. Hiroyasu, Promotion of the Atomization of a liquid Jet by Cavitation in a Nozzle Hole. Proc. ILASS, 1998. **98**: p. 218-223.
9. Challen, B. and R. Baranescu, Diesel engine reference book 2nd edition. 1999: Butterworth Heinemann.