IMPROVING ENGINE OIL COOLING PERFROMANCE FOR FUTURE VEHICLE APPLICATIONS

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Abstract: Increasing market expectations of high engine power, low fuel consumption and high towing capabilities results in an ever rising pressure on the cooling system in modern engines, an important part was to clarify why the oil must not exceed a certain temperature limit. This gave answers to how the oil and engine components would be affected, if the oil did exceed the set temperature limit. Now I want to increase the oil cooling performance by the concept that showed to be the most promising in an oil cooling perspective, was to connect heat exchanger. This is a solution which will support the current engine oil cooling by handling the additional heat produced during certain driving scenarios. The concept that has been presented will implicate an alteration of the current oil cooling system design. The lack of available space in the engine will also result in some rearranging of components in order to make space for heat exchanger. This process is improving the engine oil cooling performance for future vehicle applications. By completion of this experimentation, we have observed that the efficiency increased by 1.42%.

Index Terms **–Oil Cooling, Heat exchanger, modern engines.**

I. INTRODUCTION

At a design and development stage an engineer would design an engine with certain aims in his mind. The aims may include the variables like indicated power, brake power, brake specific fuel consumption, exhaust emissions, cooling of engine, maintenance free operation etc. The other task of the development engineer is to reduce the cost and improve power output and reliability of an engine. In trying to achieve these goals he has to try various design concepts. After the design the parts of the engine are manufactured for the dimensions and surface finish and may be with certain tolerances. In order verify the designed and developed engine one has to go for testing and performance evaluation of the engines. Thus, in general, a development engineer will have to conduct a wide variety of engine. Test's starting from simple fuel and air-flow measurements to taking of complicated injector needle lift diagrams, swirl patterns and photographs of the burning process in the combustion chamber. The nature and the type of the tests to be conducted depend- upon various factors, some of which are: The degree of development of the particular design, the accuracy required, the funds available, the nature of the manufacturing company, and its design strategy.

II. LITERATURE REVIEW

Improving engine cooling performance requires sophisticated and intelligent engine cooling design especially when interactions of all engine parts are to be considered. The cooling system would highly influence engine thermal efficiency, durability and engine design criteria. Several attempts have been made by engine designers to improve the cooling design during the past decades, each with particular purpose considerations.

This method leads to an accurate prediction of the wall temperature and heat flux. It is observed that proper cooling design could improve wall temperature and thermal stress related phenomena significantly. The advantages and disadvantages of each concept are discussed and preferred design is demonstrated. Calculated results of original design are validated with test cell records. Payri et al (1990) discussed the processes of P-V diagram and T-S diagram of a diesel engine in detail. The experimental tests were conducted in a single cylinder, indirect injection Ricardo E6-MS/128/76 type diesel engine with variable loads and different engine speeds of 1000 rpm to 2200 rpm. Payri et al (1990) developed the methodologies for intake system design. Klein (1991) studied the effect of heat transfer through a cylinder wall on the work output of Otto and Diesel cycles. The maximum work or power and the corresponding efficiency bounds are derived. Chen (1996) derived the relations between net power output and the efficiency of the Diesel and Otto cycles with considerations of heat transfer through a cylinder wall. Tetsuya Nakayasu et al (2001) studied the intake and exhaust systems equipped with a variable valve control device for enhancing of engine Power. The variable intake and exhaust control valve system for the in-line four cylinder motor cycle engine was developed for realization of high engine power in all the engine speed ranges. The targets were set to realize the intake characteristics and the exhaust collecting pipes and engine performance by altering the way, the exhaust pipes were collected and connected to allow most efficient use of the exhaust pressure pulsation effects, and by adjusting the control valve. Shuhn-Shyurng Hou et al (2004) studied the heat transfer effects and importance to provide good guidance for the performance evaluations and improvement of practical diesel engines. Compression ignition engine operates with a much higher compression ratio than spark ignition engines and, thus have higher efficiencies. Tamil-porai et al (2003) have performed simulation and experimental investigation in a naturally aspirated multi-cylinder automotive diesel engine and as well as on the same engine with partially stabilized zirconium coating of thickness 0.5 mm and 1mm. The combustion was predicted using a two-zone combustion model. For gas phase heat transfer, different models were used among which only Annand's model is used to calculate both convective and radiation heat transfer. Wall heat transfer was calculated for both conventional and LHR engine. The overall effects of heat transfer on combustion and performance for conventional and LHR engines for different coating thickness of insulation at different operating conditions such as speed and load were evaluated. The authors have concluded that Low Heat Rejection (LHR) engine with 0.5 mm thickness insulation coating on cylinder components gives better performance than with 1 mm thickness insulation coating.

Miyairi (1988) have dealt about the computer simulation of low heat rejection direct injection diesel engine. It includes a gas flow model, a heat transfer model and a two zone combustion model. The combustion and heat transfer characteristics were studied in this literature by taking into account of the high temperature swing in the low heat rejection engines. Simulations were performed of various combustion chamber surface materials and various LHR levels.

III. EXPERIMENTATION SET UP

The main objective of our experimental investigation is to increase the oil cooling performance by the concept that showed to be the most promising in oil cooling perspective, performance and fuel consumption rate. For this Aim using single cylinder four stroke diesel engine setup of 436cc engine and heat exchanger

- Single cylinder four stroke Diesel engine   Heat exchanger   Rope brake drum setup

III.1 Engine specifications:

Engine Type: Single cylinder four stroke Diesel engine, Bore: 0.083m, Stroke: 0.078m Capacity: 436 cc,
Power: 7.6 H.P. at 3600 rpm, Torque: 18 N-m at 3600 rpm.

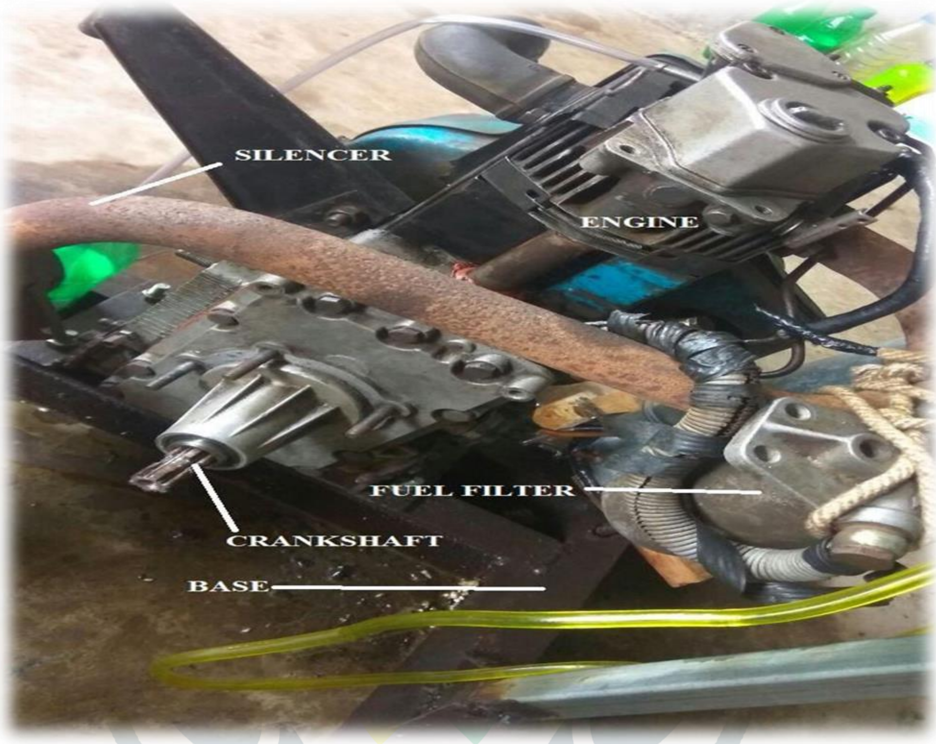
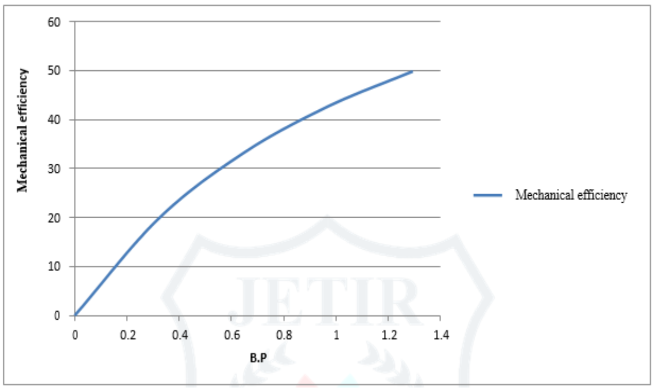


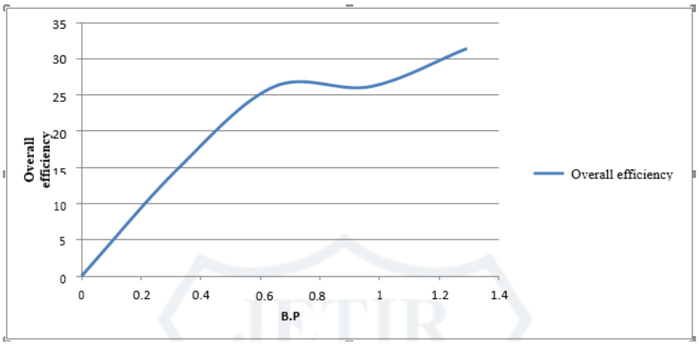
Fig.1 Testing and Observations without Heat Exchanger

We conducted the performance test on the engine without heat exchanger and we have taken required parameters like load, speed and time required for the mass of fuel consumed as tabulated below:

S. no	Load(Kg) (W)	Speed (rpm) (N)	Time taken for (1ml) of fuel consumption (seconds)(t)
1	0	1500	18.00
2	2	1500	17.00
3	4	1500	15.32
4	6	1500	10.00
5	8	1500	9.00



1. Graph between B.P and mechanical efficiency



2. Graph between B.P and overall efficiency

Tabulated all performance parameters

S.no	Load (Kg)	m_f (Kg/s)	T(N-m)	B.P (KW)	F.P(KW)	I.P (KW)	SFC (Kg/KW-H)	η_m %	η_o %	$\eta_{i.th}$ %	$\eta_{b.th}$ %
1	0	0.0459x 10^{-3}	0	0	1.3	1.3	0.12708	0	0	63.22	0
2	2	0.0486x 10^{-3}	2.0601	0.3235	1.3	1.6235	0.1076	19.92	14.84	74.5	14.82
3	4	0.0551x 10^{-3}	4.1202	0.6471	1.3	1.9471	0.1019	33.23	26.2	78.83	26.2
4	6	0.0827x 10^{-3}	6.1803	0.9707	1.3	2.2707	0.1311	42.74	26.2	61.28	26.2
5	8	0.0918x 10^{-3}	8.2404	1.2943	1.3	2.5493	0.1276	49.89	31.47	63.08	31.47

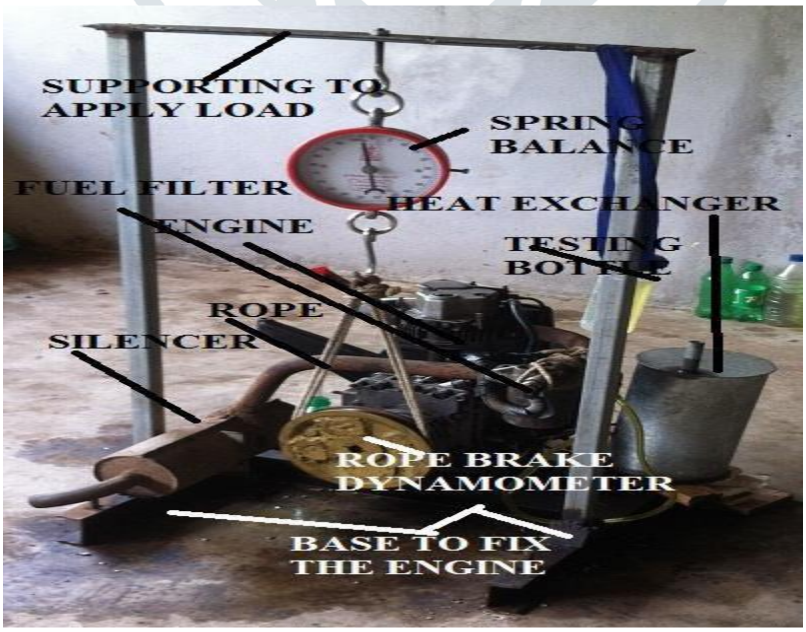
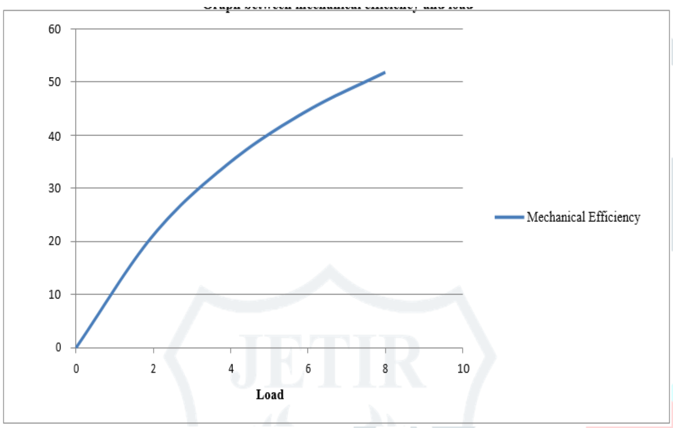


Fig 2. Testing & observations with H.E

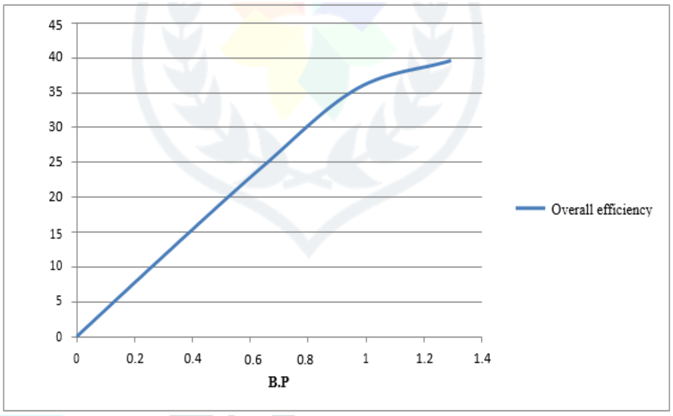
IV. Testing and observations with heat exchanger

Already conducted the performance test on the engine and mention the result above and again we have conducted performance test on the engine connect with heat exchanger. We have conducted this test and obtained the following values. We have taken required parameters like load, speed and time required for the mass of fuel consumed as tabulated below. Already conducted the performance test on the engine and mention the result above and again we have conducted performance test on the engine connect with heat exchanger. We have conducted this test and obtained the following values. We have taken required parameters like load, speed and time required for the mass of fuel consumed as tabulated below

S.no	Load (Kg) (W)	Speed (rpm) (N)	Time taken for(ml) of fuel consumption (seconds)
1	0	1500	16.75
2	2	1500	14.25
3	4	1500	14.05
4	6	1500	13.59
5	8	1500	11.34



3. Graph between mechanical efficiency and load



4. Graph between overall efficiency and BP

TABULATED ALL THE PARAMETERS WITH H.E

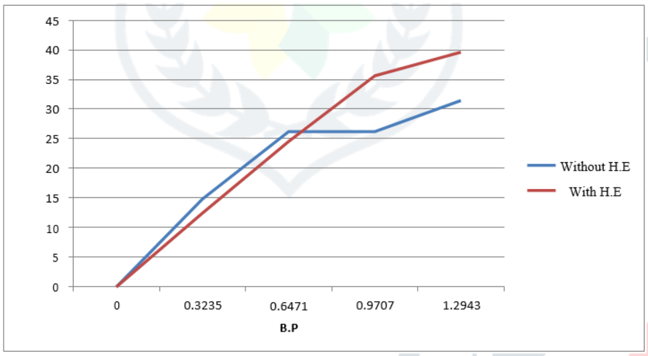
S. no	Load (Kg)	m_f (Kg/s)	T(N-m)	B.P (KW)	F.P (KW)	I.P (KW	SFC (Kg/KW-H)	η_m %	η_o %	$\eta_{i.th}$ %	$\eta_{b.th}$ %
1	0	0.0493×10^{-3}	0	0	1.2	1.2	0.1478	0	0	54.33	0
2	2	0.0580×10^{-3}	2.0601	0.3235	1.2	1.5235	0.1370	21.23	12.45	58.63	12.45
3	4	0.0588×10^{-3}	4.1202	0.6471	1.2	1.8471	0.1144	35.03	24.56	70.12	24.56
4	6	0.0608×10^{-3}	6.1803	0.9707	1.2	2.1707	0.1008	44.72	35.63	79.69	35.63
5	8	0.0729×10^{-3}	8.2404	1.2943	1.2	2.4943	0.1002	51.89	39.63	76.37	39.63

V. Results

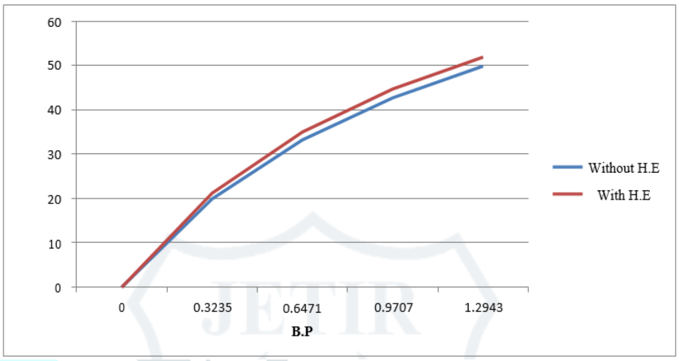
Comparison of efficiencies

S.no	Efficiencies	Test without H.E %	Test with H.E %	Increased/ decreased by %
1	η_m	29.15	30.57	Increased by 1.42
2	η_O	19.74	22.45	Increased by 2.71
3	$\eta_{i.th}$	68.18	67.82	Decreased by 0.36
4	$\eta_{b.th}$	19.74	22.45	Increased by 2.71

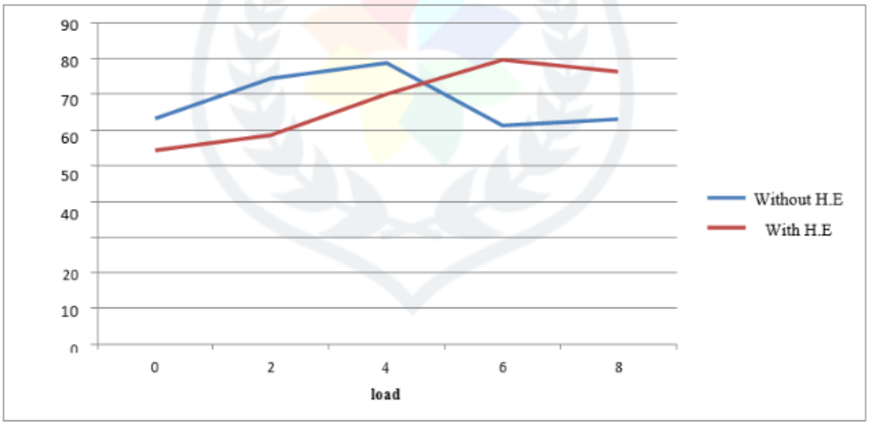
We observe that from above tabular form the following efficiencies compared and we observe that there is an increase of efficiencies i.e. the overall efficiency (η_O), mechanical efficiency (η_m) and the brake thermal efficiency ($\eta_{b.th}$) are increased and indicated thermal efficiency ($\eta_{i.th}$) is reduced.



Graph 5.Comparison graph of overall efficiencies



Graph 6. Comparison graph of mechanical efficiencies



Graph 7. Comparison graph between indicated thermal efficiencies

VI. CONCLUSION

Finally conclude that the efficiencies of engine are increased when we reduced the heat of the lubricating oil which enters from lubricating system. Initially we conducted test on the I.C engine (ape auto engine-BS2).obtained the following efficiencies as tabulated above.

Conducted the later performance test on the same engine by connecting heat exchanger for cooling lubricating oil. It's already mentioned that needed to remove 30% of combustion which is going absorbed by the engine components. Just removed certain temperature limit that is above the cold start condition of the engine.

Later again conducted a test after connecting the heat exchanger, obtained the following values for efficiencies as tabulated above. Hence finally conclude that the performance is increased by the modified part (connecting of heat exchanger) and made such modifications to increase performance and to decrease the heating effect on the engine components. By completion of this experimentation, have observed that the mechanical efficiency increased by 1.42%.

VII. FUTURE SCOPE

Providing oil cooling system to the engine with different ways and we can also use other coolant for this purpose. Also use other type of heat exchangers to increase the efficiency. Can also design it, based on connecting lubricating oil filter. Can also conduct emission test on this engine too.

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