Experimental Study and Analysis Of Temperature Variation in Multicylinder Motorized Engine Test-Rig Under Different Lubricants -A Case Study

Atul S. Shah, B. M. Sutaria, Dr. D.V. Bhatt,

Abstract—**Importance of lubricants is increasing day by day particurly in automotive sector due to rapid growth of automobile market. The cost and variety of lubricants vary for S.I. and C.I. single cylinder and multi cylinder automobile engines. Luricant plays an important role in minimizing the Friction and Wear (Tribological factors). @ 50% of total friction losses in PRA system is reported by literatures. To select a proper lubricant is also a challenge. Authors have put the efforts to compare the performance of different market avilable lubricants under diferent operating parameters on a developed multi cylinder I.C. engine test rig.**

A set of experiments were carried out on developed experimental setup at laboratory scale to measure the temperature at different locations of multi cylinder 800 cc engine system. The experimental results and observations are carried out under different operating parameters. Different standard make five lubricants (A-B-C-D-E) were experimented at 600 rpm to 3000 rpm range. The performance of engine varies under different lubricants.

Key wards: Friction, PRA, Tribological, Wear,

I INTRODUCTION

Global economic development has boosted up the automobile market in India for Two/Four wheelers vehicles in last decay with a growth rate of 15-18 %. At the same time fuel prices are also increased around 50% in last five years. This has resulted in demand of fuel efficient vehicles. Scientists have focused to apply upgraded technology to improve the efficiency and performance of an automotive I.C. engine by way of numbers of options. ie MPFI Fuel injection system, selection of light weight materials for vehicle components and Tribological application in design to reduced friction and wear through selection of appropriate lubricants etc. The knowledge of tribological factors is important to reduce friction losses, emission level & also to improve the fuel economy in an I.C. engine.

There are many different types of four stroke multi cylinder petrol automotive engine four wheelers are available in different capacity in the market with a fuel efficiency of 10 km/lt to 20 km/lt. 800 C.C. vehicle enjoy the market share more than 50% so it is preferable to select engine system of same vehicle for experimental study.

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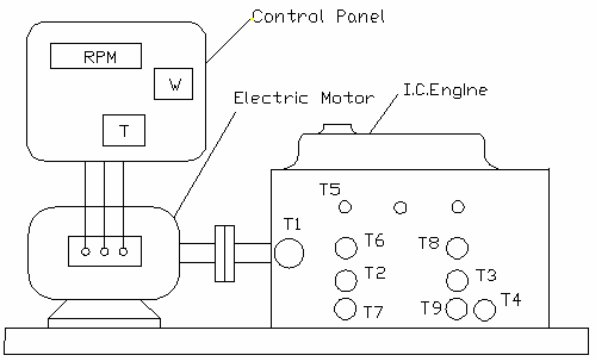
II SPECIFICATION OF TEST RIG

The fabricated test rig of 800-CC multi cylinder internal combustion engine system with crank mechanism, piston cylinder head, and engine lubrication system, with engine cooling system, without gear box is used. Crank shaft is coupled with induction motor to drive the engine. A.C. motor with variable frequency drive (VFD) is used to vary the engine speed. The performance variation is measured in terms of power consumption thr'o multi functional watt meter. Temperature (^{0}C) at different nine locations measured thro RTD temperature sensors. (Refer block diagram)



Block Diagram

Tables Location of Nine Temperature Sensors.

T_1 – Bearing temp	T_6 – Cylinder 1(TDC)
T_2 – Cylinder 1(centre)	T_7 – Cylinder 1(BDC)
T_3 – Cylinder 3 (centre)	T_8 – Cylinder 3(TDC)
T_4 – Oil temp.	T_9 – Cylinder 3(BDC)
T_5 – Spark Plug	

Tables Lubricants Used for Experiments.

Sr. No	Name of Lubricants	Viscosity (Cp)	Code
1	Castrol GTX	122.2	A
2	Valvoline	152.0	B
3	Gulf	153.5	C
4	Pennzoil	143.1	D
5	Maruti Genuine oil (Servo)	104.4	E

III STEPS OF EXPERIMENT

The test sequences to conduct the experiment on Multi Cylinder IC Engine Test Rig are as follows.

(1) Check all electrical connection of test rig including VFD & watt meter etc.
(2) Switch on the power supply & set the frequency on VFD to required rpm.
(3) Now switch on the VFD, as soon as the VFD is on, the motor will start to operate engine.
(4) Initially the system is to be run for at lest 5 to 10 minutes, so that the system get stabilize & the lubricating oil can reach properly up to the surface of piston ring & cylinder liner.
(5) After getting the stable condition of the system, record the rpm of the system and also the temperature of different nine locations of an engine
(6) Now for the next observation, change the frequency on VFD to change the rpm of the system and allow time to stabilize.
(7) Record the observations of rpm and temperatures as recorded earlier.

IV RESULTS AND OBSERVATIONS

The observations of temperature v/s engine speed at different nine locations under application of five test lubricants are plotted in graphical way i.e. T_1 to T_9.

Crank Bearing ($T_1{}^0C$)

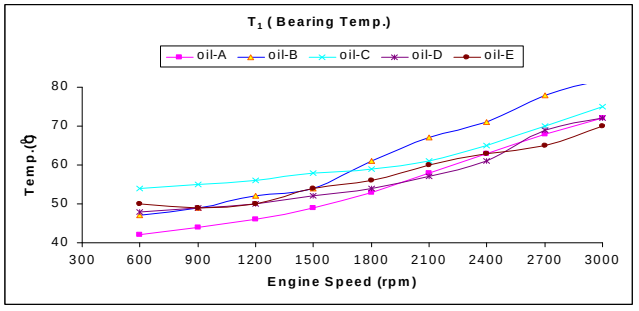


Fig. 1 Engine speed (RPM) V/s Bearing Temperature

From fig. 1 (T_1) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 2400 rpm but later on oil 'E' is found better till 3000 rpm.

Cylinder-1 Centre (T_2°C)

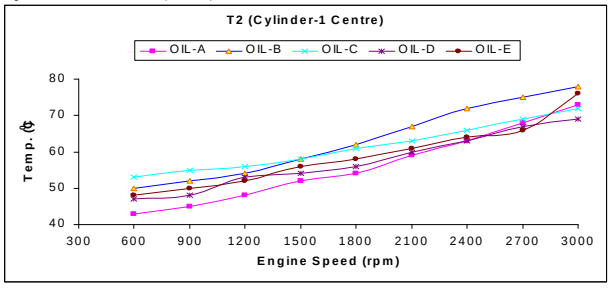


Fig:2 Engine speed (RPM) V/s Cylinder 1 Center Temperature

From fig. 2(T_2) it is observed that ,the average minimum temperature is offered by oil 'A' and maximum by oil 'C'.Oil 'A' performed the best till 2400 rpm but later on oil 'D' is found better till 3000 rpm.

Cylinder-3 Centre (T_3°C)

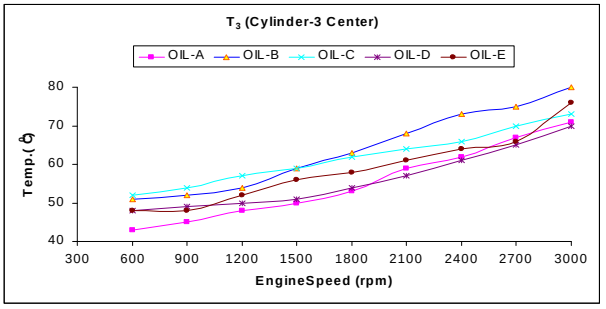


Fig:3 Engine speed (RPM) V/s Cylinder 3 Center Temperature

From fig. 3 (T_3) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 1800 rpm but later on oil 'D' is found better till 3000 rpm.

Oil Temperature (T_4°C)

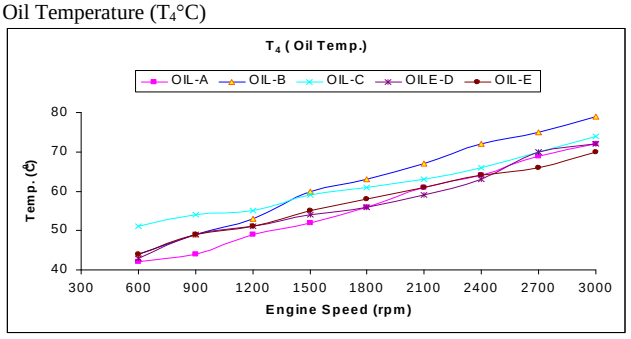


Fig:4 Engine speed (RPM) V/s oil Temperature

From fig. 4 (T_4) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 1800 rpm but later on oil 'D' is found better till 3000 rpm.

Spark Plug (T_5°C)

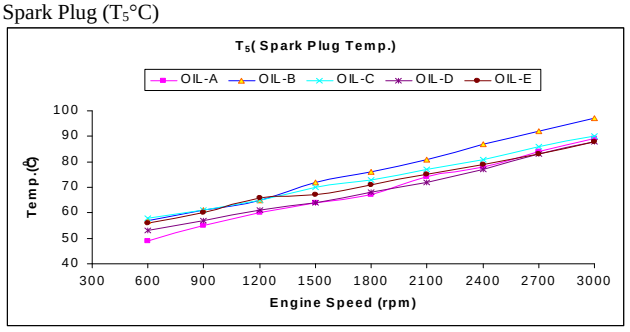


Fig:5 Engine speed (RPM) V/s Spark plug Temperature

From fig. 5(T_5) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 1800 rpm but later on oil 'D' is found better till 3000 rpm.

Cylinder-1 T DC (T_6°C)

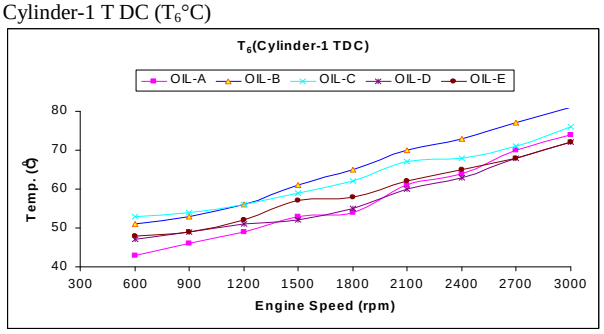


Fig:6 Engine speed (RPM) V/s Cylinder 1 Top dead Center Temperature

From fig. 6(T_6) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 1800 rpm but later on oil 'D' is found better till 3000 rpm.

Cylinder-1 BDC (T_7°C)

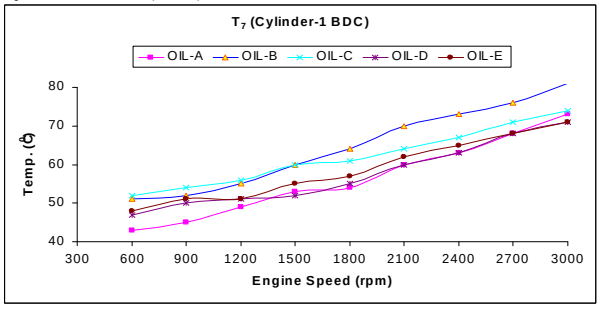


Fig:7 Engine speed (RPM) V/s Cylinder 3 Bottom dead Center Temperature

From fig. 7(T_7) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 2700 rpm but later on oil 'D' is found better till 3000 rpm.

Cylinder-3 TDC (T_8°C)

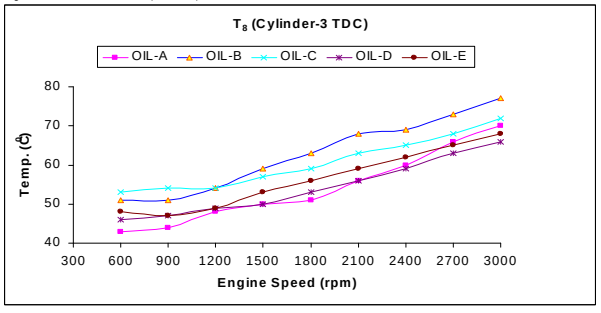


Fig: 8 Engine speed (RPM) V/s Cylinder 1 Top dead Center Temperature

From fig. 8(T_8), it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C'. Oil 'A' performed the best till 2100 rpm but later on oil 'D' is found better till 3000 rpm.

Cylinder-3 BDC (T_9°C)

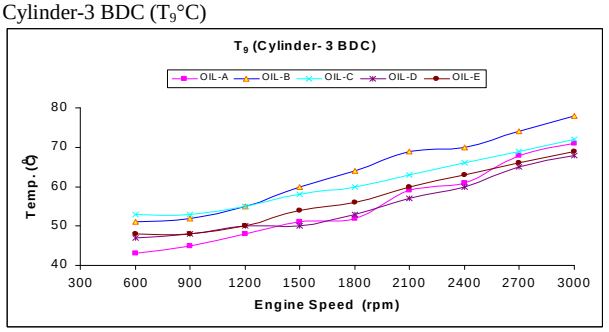


Fig:9 Engine speed (RPM) V/s Cylinder 3 Bottom dead Center Temperature

From fig. 9(T_9) it is observed that, the average minimum temperature is offered by oil 'A' and maximum by oil 'C' Oil 'A' performed the best till 1800 rpm but later on oil 'D' is found better till 3000 rpm.

V DISCUSSION

Oil 'A' has offered lowest temperature till 1800 rpm at all the observed temperature in comparison to other lubricants, while oil 'C' has offered highest temperature. Oil D is found better at higher speed. These may be due to variation in viscosity of oil in operating condition. It means that viscosity variation plays an important role in engine. Oil E has the lowest viscosity at room temperature while oil C has got highest. All oils are available in market for common application. Thus the engine performance may vary due to use of different branded oil. It means that engine performance with respect to Tribological parameter (Temperature) varies under different lubricants which prooves the importance of right selection of lubricant for a particular mechanism and potential of Tribological solution is yet to be exploited.

VI CONCLUSIONS

Following conclusions are made based on experimental results.

- Performance of engine can vary under different lubricating conditions.
- Performance varies in spite of same technical specification of lubricants if manufactured by different manufacturers.
- Further study can be made by adding different additives to check the improvements.
- It is rather difficult to establish the lubricant ranking under multi variables dynamic performance of PRA system.
- Performances ranking of lubricants A–C–D–E–B are observed.
- Potential of Tribological solution is yet to be exploited.

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