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Optimization of Engine oil Pressure after Overhauling in HINO 6DTI Engine

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ABSTRACT
Reliability and performance of modern engines are directly dependent on the effectiveness of lubricating systems. To be effective, an engine lubricating system must successfully perform the functions of minimizing friction between the bearing surfaces of moving parts, dissipating heat, and keeping the engine parts clean by removing carbon and other foreign matter. In almost all modern internal-combustion engines, the system that provides the lube for these functions is the forced lubrication system. Although there are many variations in lubricating systems for internal-combustion engines, the components and method of operation are basically the same. Steady state thermal analysis is carried out for the thermal fluid flow in the engine. In a tribological study which involves the contact between the two surfaces in relative motion, a lubricating oil plays a vital role in reducing friction and helps in protecting materials from wear. For conclusion, the quality of engine lubrication depends upon how much oil is supplied and how the lubricant is fed under thermal load of the components. This state of lubrication is closely related to the safe operation of an engine and its lifetime. Therefore, a practically optimized analytical method has been required by engine designers.
KEYWORDS: *Low Oil Pressure, Main bearing, Oil Pump, Oil Temperature, Oil filter, Pressure relief valve, Viscosity,*

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I. INTRODUCTION

An engine is the machine that converts any energy into mechanical energy. It can convert different energies, but the most common is the heat, which then creates force. These engines are almost all the time combustion engines, either with internal orexternal combustion. Internal combustion engines (ICE) are engines where the combustion of the fuel occurs with an oxidizer, in a combustion chamber, that is part ofworking fluid flow circuit. In ICE, the force comes from the expansion of high-pressureand high-temperature gases, produced by combustion. This force is applied to component of the engines, typically to pistons, turbine blades or a nozzle. This chemicalenergy is transformed into mechanical energy by the movement of a component over a distance.

Oil pressure is an important factor for the long life of any internal combustion engine. In general lubrication system oil is picked up by variable flow or positive displacement pump and forced through the oil galleries into main bearing, big end bearing and camshaft bearing. Sufficient oil pressure ensures that the metal of all rotating shaft and bearing shell can never touch. There are many variables that affect the oil pressure of engine like oil temperature, viscosity of oil, engine speed, area of oil gallery. Engine oils have many functions in the engines, besides tribological tasks. The oils contribute to the sealing of the cylinder, transport particles (the sludge, soot and other particles) to the oil filter, etc. Some of the points inside the engine where lubricant influences the work are shown. There are different movement, different lubrication regimes, different speeds, wide range of temperatures, micron tolerances in between contacting surfaces, and other parameters that have to be covered from lubricant from the tribological aspect.

A. The function of Lubrication**:**

- To minimize wear and friction.
- To prevent metal to metal contact of moving part.
- To remove the heat of the engine parts by acting as a cooling agent.
- To absorb shock between the bearing and other engine parts thus reducing noise and improves life.

- To form an effective seal between the piston ring and cylinders walls.
- To keep the engine parts, clean by carrying way parts.
- To prevent oxidation of engine parts.

B. **Parts to be lubricated**:

- The following parts of I.C. Engine are to be lubricated:
- Main bearing of the crankshaft.
- Big end bearing of the connecting rod,
- Cylinder wall.
- Small end bearing.
- Valves guides.
- Camshaft bearing.
- Camshaft driving gears.

C. **Properties of lubricating oil**:

- Viscosity
- Physical stability.
- Chemical stability.
- Corrosion resistance.
- Pour point.
- Flashpoint.

II. PROBLEM IDENTIFICATION

- From the previous study of the lubrication oil system in the four strokes CI engine, it is noticed that reliability and performance of the engines are directly dependent on the effectiveness of their lubricating systems. To be effective, an engine lubricating system must successfully perform the functions.
- It is found that the engine oil pressure found to be 1 bar at temperature of 40 C and 0.5 bar at 80 C temperature, the safe value is should be in between 2 bar to 4 bar at respective temperatures.
- This study will be helpful for investigating the various causes of low oil pressure and the remedies for them.
- In order to investigate the low oil pressure problem the overhauling of HINO 6 DTI engine, the image of the engine is shown in the figure bellow:
- Gammon Engineers and contractors Private Limited facing the same problem in this particular type of engine in their workshop premises.

III.OBJECTIVES

- The lubrication system in IC engine and significance of oil pressure in the performance of IC engines and the various parameters which influences the engine oil pressure.
- Study the standard assembly process of IC engines.
- Understand operational characteristics and maintenance requirements of lubricationsystems.
- Study of parts used for the assembly, dimensions, torque values of different bolts andthe tools used for the assembly of IC engine.
- Experimentally study of assembly of 2-3 engines and testing no load and the loadconditions.
- To find the actual cause of low oil pressure in particular type of engine (HINO 6 DTI).
- To study the different properties of lubrication oils and their effect on the performance of internal combustion engine.
- To increase the oil pressure of the lubrication system to safe operating value.

IV. METHODOLOGY

Characterizing lubricating oil viscosity to describe effects on engine friction and investigation into the benefits of reduced oil flows in internal combustion engines. Identify the flow rates, degradations, and local lubricant/additive species concentrations, and impact on friction, wear and emissions. Investigating the potential to reduce crankshaft main bearing friction during engine warm-up by raising oil feed temperature.

Typically lubricants contain 90% base oil (most often petroleum fractions, called mineral oils) and less than 10% additives. Vegetable oils or synthetic liquids such as hydrogenated polyolefins, esters, silicones, fluorocarbons and many others are sometimes used as base oils. Additives deliver reduced friction and wear, increased viscosity, improved viscosity index, resistance to corrosion and oxidation, aging or contamination, etc.Non-liquid lubricants include powders (dry graphite, PTFE, molybdenum disulphide, tungsten disulphide, etc.), PTFE tape used in plumbing, air cushion and others. Dry lubricants such as graphite, molybdenum disulphide and tungsten disulphide also offer lubrication at temperatures (up to 350 °C) higher than liquid and oil-based lubricants are able to operate. Limited interest has been shown in low friction properties of compacted oxide glaze layers formed at several hundred degrees Celsius in metallic sliding systems, however, practical use is still many years away due to their physically unstable nature.

A. Description of oils

In this thesis ten different engine oils are investigate for their ant wear performance and frictional behavior. The tested lubricant are from five different suppliers and are all stated to meet relevant approvals and to be suitable for use in modern diesel engines. Oil number 1-3 content and performance is reviewed in detail, oil 4-9 is approved against the stated standards. Oil ten is most likely a false claim, due to inappropriate additivities.

1. OEM CJ-4, 15W-40, VDS-4. Group II Base fluid
2. OEM CI-4, 15W-40, VDS-3. Group I Base fluid
3. OEM CI-4, 15W-40, VDS-3. Group II Base fluid
4. Supplier 1, Top tier synthetic, CJ-4 5W-30
5. Supplier 2, Standard tier, ACEA E7 15W-40
6. Supplier 2, Standard tier, ACEA E7 15W-40 used for 500h
7. Supplier 3, Standard tier, CI-4, 15W-40, VDS-3
8. Supplier 4, Standard tier, CJ-4, 15W-40, VDS-4
9. Supplier 4, Standard tier, CI-4, 15W-40, VDS-3
10. Supplier 5, uncertain quality stated to be ”CI-4

Investigate the assembly process, lubrication oil used, specifications of lubricating oil. Investigate composite lubricant formulations that retain most of the frictional benefits for the subsystems identified in Phase 1 and then identify the tradeoffs and compromises necessary for an optimal composite lubricant formulation for the combined subsystems. Identify the tradeoffs and compromises in composite lubricant formulations that provide the best combined effects in friction and wear for all components. Demonstrate the mechanical efficiency improvement for the best optimized lubricant formulation in an actual full-size engine over a range of operating conditions that both reflect those in standardized industry protocols and other driving conditions.

V. RESULT AND DISCUSSION

Engine oils are generally formulated oils. They consist of mineral, semi- or fully synthetic base oil (base stocks) plus a varying number and amount of additives. The quality of an engine oil depends on the base stock and its properties as well as on the additives.The main requirements for an engine oil are defined temperature-viscosity properties, protection against wear and corrosion, keeping the engine clean, holding particles like soot or abrasives in suspension, yield strength under compression and many more. Temperature impacts the flow properties of engine oil. Engine oil is available in different SAE grades to suit the climate where it is used and the purpose of the user.

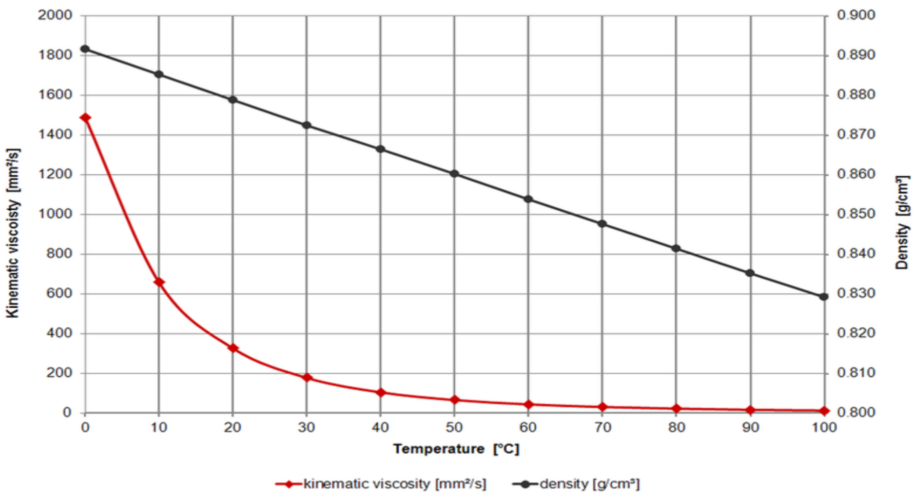

Fig: Variation of viscosity and density with temperature

A. Variation of viscosity of 15W40 oil with temperature:

Temp. [°C]	Dyn. Viscosity [mPa.s]	Kin. Viscosity [mm²/s]	Density [g/cm³]
0	1328.0	1489.4	0.8916
10	582.95	658.60	0.8851
20	287.23	326.87	0.8787
30	155.31	178.01	0.8725
40	91.057	105.10	0.8663
50	57.172	66.464	0.8602
60	38.071	44.585	0.8539
70	26.576	31.350	0.8477
80	19.358	23.006	0.8414
90	14.588	17.467	0.8352

B. Variation of oil pressure with temperature:

Temperature in ℃	Idle speed (700 rpm)	Full load condition (2300 rpm)
30	4 bar	5 bar
40	3.9 bar	4.8 bar
50	3.5 bar	4.5 bar
60	3.2 bar	4.2 bar
70	2.8 bar	4 bar
80	2.3 bar	3.8 bar
90	2 bar	3.5 bar

VI. CONCLUSIONS

The functions, properties and various components of lubrication system are explained and well-studied in this project. The lubrication can be done properly and with right type of lubricant and other specific required components. This project deals with basic lubrication system, basic selection criteria for components required for lubrication system. Also from the Automatic Lubrication system it is concluded that the man power required for the lubricating the various oil points can be eliminated. The lubricant consumption will considerably reduce by control system optimization i.e. right quantity of lubricant at right part. The project study gives there are different movement, different lubrication regimes, different speeds, wide range of temperatures, micron tolerances in between contacting surfaces, and other parameters that have to be covered from lubricant from the tribological aspect. The various factors which affects the engine oil pressure and the effects of low oil pressure on the performance of internal combustion engine.

The objective of this research was to evaluate the influence of lubricating oil temperature and pressure on engine performance at low speed. In spite of the use of a specific test bench, the study has demonstrated the difficulty of assessing engine performance at low speed. First of all, it is important to stress the influence of the heat given by the lubricating oil, which in the case of low speeds leads to serious errors when trying to estimate the compressor isentropic efficiency. Given that the experiments were conducted on a "cold" test rig, it is certainly unrealistic manuscript accepted accepted manuscript to hope for correct results at low speeds on hot test rigs. Thus, starting from the experimental results, only those tests performed in quasi-adiabatic conditions were selected in order to draw the engine characteristics.

- The engine life may be increased up to 50 percent by complete overhauling og engine and increasing the oil pressure above safe limit.
- The cost of overhauling the engine is about 20 to 30 percent of the cost of engine this gives the more scope and motivation towards the engine overhauling.
- Engine oil pressure increases from 0.5 bar to 2 bar at idle speed and room temperature and 2 bar to 4.5 at working rpm and high temperature.

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