ENGINE LUBRICATION: A NECESSITY FOR AUTOMOBILE ENGINE DURABILITY

OLADEJI, KAYODE OLAYEMI
E-MAIL:olayem68@gmail.com
DEPARTMENT OF TECHNICAL EDUCATION
EMMANUEL ALAYANDE COLLEGE OF EDUCATION, OYO, LANLATE CAMPUS
DECEMBER, 2014

ABSTRACT

Engine lubrication is an essential part of automobile maintenance. Failure to do it correctly shortens the life of an automobile engine. This study highlights types of lubrication, systems of engine lubrication, types of lubricants, grade of lubricants, and lubrication system component parts. Also in the study five engine oil myths are critically examined.
In addition, the study x-rayed various sources of oil losses in the engine and proper steps in changing engine oil. It is recommended among others that genuine engine oil should be used, manufacturer recommendation should be followed and engine oil myth should be dispelled with.

Keywords:

Engine Lubrication, Hydrodynamics Lubrication, EXTREME PRESSURE LUBRICATION
INTRODUCTION

Meaning of Lubrication

According to Wikipedia (2000), lubrication is the process, or technique employed to reduce wear of one or both surfaces in close proximity, and moving relative to each other, by interposing a substance called lubricant between the surfaces to carry or to help carry the load (pressure generated) between the opposing surfaces.

Burlington (2012) says Lubrication circuit is one of the most important ones in the engine. The engine cannot run smoothly for more than a few minutes without lubricating oil. Lubrication is necessary in an automobile engine because the movement of two component parts of an engine entails an opposing force which tries to reduce the relative speed. This is known as frictional force. It depends upon the material of the two surfaces, surface finish and the load acting on them.

It is noticed that if the surfaces are dry, heat is generated and the rate of wear between surfaces increases. Both problems can be solved by interposing a layer of film of a suitable lubricant between the two components parts. The layer of oil reduces friction, dissipates heat, absorbs impulsive loads and cleans the surfaces Seth (2004).

Furthermore, all moving parts of an automobile require lubrication, without it, friction would increase power consumption and damage the parts.

There are four systems adopted for the lubrication of automobile engines. They are (i) Petrol system (ii) Splash system (iii) Pressure system (iv) Dry-sump system.

OBJECTIVES OF THE STUDY

(i) To highlight the importance of lubrication in automobile engine
(ii) To educate on the best way of changing engine oil.
(iii) To erase completely from peoples mind engine oil myths.
(iv) To x-ray factors responsible for excessive oil consumption.

TYPES OF LUBRICATION

Considering the nature of moving or sliding surfaces, there are different types of mechanisms by which the lubrication is done, according to Aggelili (2011) they are:

(i) Hydrodynamics lubrication
(ii) Hydrostatics lubrication
(iii) Boundary lubrication
(iv) Extreme pressure lubrication
Hydrodynamics Lubrication

Hydrodynamics lubrication is said to exist when the moving surface are separated by the pressure of a continuous unbroken film of layer of lubrication. In this type of lubrication the load is taken completely by the oil film. The basis of hydrodynamics lubrication is the formation of an oil wedge. When the journal rotates, it creates oil taper or wedge between two surfaces and pressure build up with the oil film support the load. Hydrodynamics lubrication depends on the relative speed between the surfaces, oil viscosity, load and clearance between the moving or sliding surfaces. In hydrodynamics lubrication the lube oil film thickness is greater than outlet, pressure at the inlet increases quickly, remains fairly steady having a maximum value little then outside of the bearing centre line, and then decrease quickly to zero at the outlet.

BOUNDARY LUBRICATION

Boundary lubrication exists when the operating condition are such that it is not possible to establish a full fluid condition, particularly at low relative speeds between moving or sliding surfaces.

The oil films thickness may be reduced to such a degree that metal to metal contact occurs between the moving surfaces. The oil film thickness is so small that oiliness becomes predominant for boundary lubrication. Aggeliki(2011).

Boundary lubrication happens when
(a) A shaft starts moving from rest
(b) The speed is very low
(c) The load is very high
(d) Viscosity of the lubrication is too low.

Examples of boundary lubrication:
(i) Guide and guide shoe in two stroke engine
(ii) Lubrication of the journal bearing in diesel engines
(iii) Piston rings and when cylinder liner is at TDC and BDC position. When the piston direction changes and is the relative speed is very low.

EXTREME PRESSURE LUBRICATION

When the moving or sliding surfaces are under very high pressure and speed, a high local temperature is attained. Under such condition, liquid lubricant fails to stick to the moving parts and may decompose and even vaporize. To meet this extreme pressure condition, special additives are added to the minerals oils. These are called extreme pressure lubrication. These additives form on the metal surfaces more durable films capable of withstanding high loads and high temperature. The additives are organic compound like chlorine, sulphur and phosphorus.
HYDROSTATIC LUBRICATION

Hydrostatics lubrication is essentially a form of hydrodynamics lubrication in which the metal surfaces are separated by a complete film of oil but instead of being self-generated, the separating pressure is supplied by an external oil pump. Hydrostatic lubrication depends on the inlet pressure and lube oil and clearance between the metal surfaces oil whereas in hydrodynamic lubrication it depends on the relatives speed between the surfaces, oil viscosity, load on the surfaces, and clearance between the moving surfaces. Examples: the cross head pin bearing or gudgeon pin bearing in two stroke engines employs this hydrostatics lubrication mechanism. In the cross head bearing the load is very high and the motion is not continuous as the bearing oscillations is fairly short. Thus hydrodynamic lubrication offers the advantages. The oil is supplied under pressure at the bottom of bearing. The lube oil pump pressure is related to the load, bearing clearance and thickness of the oil film required, but is usually in the order of 35-140kg/cm²

FUNCTIONS OF LUBRICANT OILS

The important functions of lubricant oils are as follows:
(i) **Lubrication**: The oil lubricates the two rubbing surfaces and in the process minimizes friction and the heat generated. Thus the main and big end bearing, piston rings and cylinder walls tappet and guides, rocker shaft and bushes, valve stems and guides and other rubbing surfaces are lubricated by the lubrication system.
(ii) **Heat Dissipation and cooling**: The presence of oil film reduces friction but does not fully eliminate it. The heat generated between moving parts is carried by the oil film.

(iii) **Load Carrying**: The impulsive thrust is carried by the thin film of oil between piston and cylinder, crankshaft journals and bearings. The load carrying capacity of this thin film of oil depends upon the viscosity rating of oil. Low viscosity oil shall be squeezed out resulting in wear, overheating and seizure.

(iv) **Internal Cleaning**: while lubricating the various parts, the oil cleans the parts internally of debris, dirt, metal particles and by products of combustion.

(v) **Sealing**: The oil must seal the combustion products in the combustion chamber piston blow by are greatly reduced and the piston floats over the thin film of oil between it and cylinder.

**GRADES OF LUBRICANTS**

The lubricants used in automobiles are usually termed on its main component oils. Engine oils are named according to two systems.

1. Americans petroleum Institute (API)
2. Society of Automotive Engineers (SAE)

The API system classifies oil according to their service (i) Regular type (ii) Premium type (iii) Heavy type.

**MEASUREMENT OF OIL QUALITY**

The most common and at the same time most accredited measure is the API rating from the American Petroleum Institute. This uses S for engines running on petrol and C for those of diesel.

Quality standards

Increases according

To the alphabet as Shown here

\[
\begin{align*}
SA & \rightarrow \text{low quality} \\
SB & \\
SC & \\
SD & \\
SE & \\
SF & \\
SG & \\
SH & \\
SJ & \\
SL & \\
SM & \rightarrow \text{High quality}
\end{align*}
\]
For diesel, the standards are

\[
\begin{align*}
&\text{CA} \rightarrow \text{Low quality} \\
&\text{CB} \\
&\text{CC} \\
&\text{CD} \\
&\text{CE} \\
&\text{CF} \\
&\text{CG} \\
&\text{CH} \\
&\text{CI} \rightarrow \text{High quality}
\end{align*}
\]

Ratings SA to SH are now obsolete. Those currently in use are SJ, SL and SM. The SM rating—the highest—is only available from leading manufacturer. Today the SJ/CF quality of oil can be used equally well in engines running on petrol or diesel. Lubcon(2014)

**VISCOSITY RATING**

The society of Automobile Engines (SAE) has classified the lubricating oils according to their viscosity and service rating, since September 1980, the viscosity rating are OW, 10W, 20W, 25W, 10, 15, 20, 30, 40, 50, 60, 80, 100, 150, 200. Encyclopedia (2002)

The oils with W are for winter use and then viscosity tests are made at 18°C while those without W. are for use in summer months and the viscosity tests in summer months and the viscosity tests in their cases are done at 99°C.

These days multigrade oils are also available. In this case change of viscosity with temperature is minimum for example SAE 10W/30 oil has viscosity as SAE 10W oil at 18°C and as SAE 30 oil at 99°C.

The advantage of such oils is that during cold starting there is reduced power loss on account of less friction than would be there if ordinary single grade oil suitable for engine operating temperatures is used. Further this also avoids the necessity of using different oils for winter and summer months.

![Viscosity behavior of multigrade oils](http://www.ijoar.org)
Lubricating oils available in the market fall under the following

**MINERAL OIL**

Mineral oils derived from petroleum are perhaps the most widely used in automobiles. The advantages they possess over the oils are:
(i) Greater chemical stability at higher temperature
(ii) Less tendency to form emulsions with water.
(iii) More plentiful and cheaper

Chiefly the mineral oils contain hydrocarbons. According to their molecular structures they may be further sub-classifiedinfo paraffin’s, naphthenes, aromatics and olefins. Paraffin’s are saturated hydrocarbon with straight or branched chains. Naphthenes with ring structure, aromatics are hydrocarbon with benzene nucleus and olefins are unsaturated hydrocarbon with double bonds. In practice the mineral lubricating oil is a mixture of paraffin’s, naphthenes and aromatics.

**SYNTHETIC LUBRICANTS**

According to Ade(1980) synthetic oil is chemically engineered for a certain molecular composition with a tailored and uniform structure. Such fine-tuned control over the final molecular composition of synthetic oils is the key to the superior performance properties of these fluids. Designing molecular structures in a planned and orderly fashion results in molecules and an end-product, that are far more stable than their refined petroleum counterparts. The examples of synthetic lubricants are poly organosiloxanes or silicon fluids, polyglycol ethers and aliphatic dieter oils.
Following advantages are claimed for synthetic lubricant over the mineral oils.
(i) Higher viscosity index
(ii) Reduced lacquer formation
(iii) Reduced loss due to evaporation
(iv) Considerably less oil consumption
(v) Less engine deposits
(vi) Less frequent changes of lubricating oil
(vii) Increase fuel economy.

However, their high cost limits their use.

ENGINE OIL MYTHS

Five engine oil myths according to Autocare (2000) are as follows:

MYTH 1

You should change your oil every 3,000 miles (4,826 kilometers) no matter what the manual says.

Once upon a time, almost every auto manufacturer recommended that the oil in the engine be changed every 3,000 miles (4,826 km). Use oil past that interval and the engine would begin to fill with sludge which would not only degrade performance but leave the moving parts at risk for damage. That is no longer true. Modern detergents oils improve oil viscosities and better auto engineering in general now allows cars to go about 7,500 miles (12,070km) between oil change yet you still hear the 4,826km figure quoted widely—especially by people trying to sell oil. The myth has been debunked unless you drive under unusually difficult condition especially if you always drive in stop and go traffic going 12,070km between oil change shouldn’t harm your engine in any way.

MYTH 2

When engine oil turns dark, it’s dirty and should be change.

If you’re conscientious about keeping your car in good running order. You will probably worry from time to time that your oil has gotten dirty and is causing sludge to build up in your engine. So you pull the dipstick out and check the colour of the oil at the tip. It’s starting to turn dark, no longer the high amber color that you sew on the stick when your oil was fresh. So now it’s too dirty to use. It is depositing sludge in your engine and needs to be changed.

It is wrong; in fact just the opposite is true. If you’re using detergent engine oil (most modern engine oils have detergent addition). The oil is working just the way it’s supposed to dispersing the tiny particles that can result in engine sludge and holding them in suspension in the oil itself so that they can’t build up. That is why the oil appears darker but thus in no way impedes the oil from performing its normal functions of lubricating and protecting the metal surface inside the engine. On the other hand, the oil is limited in how many of these suspended particles it can contain and will eventually needs to be changed when it becomes saturated but use the oil change interval recommended by your car manufacture to decide when to change the oil not the colour on the dipstick.
MYTH 3

**Synthetic engine oils can cause oil leaks.**

Backs in the 1970s, when synthetic engine oils first became popular they didn’t always play well with seals and gaskets in the car’s engine. They could cause the seals to shrink in ways that petroleum-based oils did not, resulting in those messy oils leaks that would mysteriously appear in your car’s parking space. Some people still fear that synthetic oil will cause leaks and so they continue to use petroleum based oils instead. These fears are largely unfounded oil manufacturers long ago learned to reformulate synthetic oil so that seal shrinkage doesn’t occur.

MYTH 4

**Engine oil additives will improve your engine’s performance**

This is true – except that these “additives” have already been added before you buy the oil. Any reputable brand of motor oil will come with additives that improves its viscosity index – the range of temperatures under which it flows properly through the engine – and that give it detergent properties that keep your engine free from sludgy. Most will also include rust retardants to prevent corrosion and chemicals to protect metallic surfaces. With all these additives already in the oil, putting in more may actually dilute what’s already there and reduces the oil’s effectiveness.

MYTH 5

**Changing oil in the morning**

Some believe that changing engine oil should be done in the morning when the engine is cold. Whereas oil must be drained when the engine is warm to ensure complete draining. The low viscosity of the warm oil facilitates the draining and brings the impurities out at the same time. So, if the engine is cold, run it to bring it up to the normal operating temperature Adegoke (2010).

**OIL ADDITIVES**

These are the chemical substances which are added to the lubricating oil either to reinforce some of its natural properties or to provide it with certain new properties which it does not possesses originally. Oil additives are classified according to the property of the oil which they reinforce or add. According to Adegoke (2002) and Dolan (2007) addictive include the following:

(i) Anti-wear agents
(ii) Antioxidants
(iii) Dispersants
(iv) Detergents
(v) Extreme Pressure additives
(vi) Foam Inhibitors
(vii) Friction Modifiers
(viii) Pour Point Depressants
(ix) Rust and Corrosion Inhibitors
(x) Viscosity Index Improves
AUTOMOTIVE ENGINE LUBRICATION COMPONENT

Lance Wright (2012) explains that the engine lubrication system includes the following.

1. Lubricating oil
2. Oil pump
3. Oil filter
4. Oil passages.

The engine oil system constantly filters and circulates engine oil to ensure that all components are protected.

EFFECT OF ENGINE CONDITIONS ON LUBRICATING OIL

The severe engine conditions of temperature and pressure to which the lubricating oil is subjected, cause it deterioration in many ways, which are:

1. Sludge formation
   Sludge is a mushy material composed of oil, water and other combustion products. It readily clogs the oil lines and galleries. It is caused by the condensation of water in the engine crankcase, which forms an emulsion with the oil, dirt and the other matter. This occurs in the case of an engine which seldom runs hot to drive away the water vapor out of the crankcase.

2. Lacquer formation
   Lacquer or varnish is formed when the oil gets oxidized due to high temperatures. The high speed, high load, high temperature driving increases varnish formation. Lacquer is often responsible for sticking valves and clogged piston rings. To avoid this, use suitable additives and change oil regularly.

3. Oil dilution
   Oil dilution is caused by the leakage of gasoline past piston into the crankcase, or by the condensation of water vapor in the crankcase. This happens often when the engine is cold, i.e., at the time of starting and warming up.
   Oil dilution may give sometimes a faulty dipstick reading. For example if the dipstick shows satisfactory oil level which put into the sump when just the engine has started the same will be misleading because the condensed water vapor is also present there in the sump. As the engine warms up and comes to normal conditions, the water will vaporize and the indicated oil level will therefore fall. And this will be the actual oil level, oil dilution reduces the lubricating property of the oil. Thus, if exceeded beyond limits, it will cause metal contact and hence very rapid wear of engine parts.

4. Carbon deposition
   Carbon formation occurs normally on the combustion chamber walls, pistons, valve stems and piston rings. It results due to incomplete combustion of fuel, particularly at the time of starting and idling when richer fuel is
supplied. Carbon is a bad conductor of heat and therefore dissipation of heat from the engine will be less. The result is higher combustion chamber temperatures which encourage oxidation of the oil and thicken out the deposits further. Moreover, the tendency to detonate is increased.

STARTING ENGINE

Christopher (2014) said it is a good habit to keep engine running at idle for few minutes after it is started. Allows the oil to flow all over the moving part before any load is placed on the engine. Remember, the maximum wear and tear of the engine takes place when it started for the first time of the day. Autocare (2000).

CONSUMPTION OF LUBRICATING OIL

The various sources of oil losses in the engine highlighted by Kirpai (1989) Include:

1. **Combustion** – The oil works up past the piston rings into the combustion chamber, where it is burnt up. This cannot be avoided completely since some of the oil has to go past the piston rings to lubricate the upper portion of the piston and the cylinder walls.

2. **Loss through leakage** – There may be some loss of oil through leakage at the faulty crankshaft bearing seals, at the defective joint between the cylinder block (or crankcase) and the oil pan, at the loose or faulty drain plug e.t.c. However, with proper care such losses can be reduced to negligible.

3. **Loss through crankcase ventilation** – Some of the oil is carried away from the crankcase as vapour or mist or along with the exhaust gases.

4. **Loss on account of wear of engine parts** – Such as cylinder bore, big and bearings, rocker shaft e.t.c.

5. **Loss due to excessive vehicle speed** - High speed leads to increase in consumption
Effect of speed on oil consumption.

CHANGING ENGINE OIL

There is need to change the oil in our engine when it has lost it quality. The steps to follow is as follows:

1. Make sure that the vehicle is on level surface while the oil is being drained.
2. Place container large enough to accommodate the drained oil under the engine.
3. Loosen the drain plug with a universal drain plug wrench or even better, use the correct socket with flexible handle.
4. Unscrew the drain plug.
5. Check the oil drain plug and the washer if the drain plug is of the magnetic type it must be clean properly. Replace washer with a new one to ensure proper sealing.
6. If the oil filter has to be changed replace it now while the oil is draining.
7. Let the oil drain out completely before installing the drain plug.
8. Before finally tightening to the recommended torque, the oil plug should be left in the threads until it reached the same temperature as the oil pan.
9. Remove oil cap.
10. Fill the slump with the required quantity of oil of the recommended type and grade.
11. Check the oil level with dip stick when the oil is full, the level reaches the upper mark on the dip stick.
12. Start the engine and run it for some minutes at fast idling speed.
13. Check carefully for leakage at the oil draining plug and the oil filter.
CONCLUSION AND RECOMMENDATION

Oil is the life blood of an engine keeping engine property lubricated reduces friction, heat buildup and wear. This means that good engine lubrication maintenance will help engine to run better and to last longer.

From the study I wish to make the following recommendation:

• Use the type of oil specified by the vehicle manufacturer in your owner’s manual.
• Proper storage is necessary for our lubricant because storage condition affect the life of oil. It should not be exposed to extreme temperature changes as well as moisture which reduces shelf life of lubricant.
• Genuine engine oil should be used always i.e oil produced by a reputable company should be use.
• Car owners should monitor the performance of lubricant put into their engine.
• Engine oil myths should be dispelled.
• Car owners should follow the recommended steps of changing engine oil.
REFERENCES


