Abstract

Petroleum oils are insufficient in lubricating our engines since they are made of refined substance, since some of the chemicals present in conventional petroleum oil break down at temperatures within the normal range usually around 325 to 250 degree Fahrenheit. Synthetic Oil outperforms all brands of petroleum oil in every aspect, but the best benefit we can derived from continuous use of synthetic oil is the extended life of your vehicle. Synthetic oil will make your engine last longer that petroleum oil through its continuous use. Throughout its history, the diesel has been the subject of a great deal of research and development. This work has focused on comparative study of physical properties Synthetic Oil and Mineral Oil.
1. INTRODUCTION

The ready availability of inexpensive middle-distillate petroleum fuels provided little incentive for experimenting with alternative, renewable fuels for diesel engines. However, since the oil crisis of the 1970s, research interest has expanded in the area of alternative fuels which are capable to give the high efficiency. So these needs are make our attention towards invention and analysis of best use of alternative fuel blends and switching synthetic lubricating oil for higher efficiency of diesel engine. The perfect lubricant would have no friction, allow no wear and be able to operate at any temperature for any length of time without any change in its properties. The place for synthetics is somewhere between the finite limitations of mineral oils and perfection. To be commercially viable a synthetic product must:

- Meet a need which a mineral oil cannot,
- Show an economic benefit in operation.

Early developments in synthetic lubricants primarily addressed the need to provide some performance characteristic unattainable with mineral oils. In the last decade or so, field experience has shown that certain types of synthetics can give Economic benefits when used in place of mineral oils which were working satisfactorily. Organic esters were developed in the 1940's in response to a military need for lubricants which would perform satisfactorily at high temperatures and still remain fluid at low temperatures. Much current research is aimed at lubricants that can function at temperatures far higher than either mineral oils or most current synthetics can survive. Our research is improving our understanding of the relationship between these benefits and the physical and chemical properties of the synthetics leading to an optimization of the synthetic.

2. WHAT IS SYNTHETIC OIL?

The term 'synthetic fuel' has several different meanings and it may include different types of fuels. More traditional definitions, e.g. definition given by the International Energy Agency, define ‘synthetic fuel’ as any liquid fuel obtained from coal or natural gas. The Energy Information Administration defines synthetic fuels in its Annual Energy Outlook 2006, as fuels produced from coal, natural gas, or biomass feedstock’s through chemical conversion into synthetic crude and/or synthetic liquid products.[5] A number of synthetic fuel's definitions include also fuels produced from biomass, and industrial and municipal waste. The definition of synthetic fuel also allows oil sands and oil shale as synthetic fuel sources, and in addition to liquid fuels, synthesized gaseous fuels are also considered to be synthetic fuels. Conventional motor oil as we have known it for the last 100 years or so is derived from crude oil that is taken from the earth with oil wells. Through a complex distillation process the crude oil is refined into many different liquids or fractions each having its own characteristics. Some are very light and are used as fuel (Gasoline, Kerosene, & Diesel Fuel). And some are heavier and are used as lubricants (Motor Oil, Gear Tube, and Grease). There are many
molecular compounds present in crude oil and many of those compounds are still present in the refined product. Detracting from the physical properties of that product. For instance, paraffinic waxes are present in crude based oil, but contribute nothing to lubricant properties of the oil. Also, the size of the hydrocarbon molecules themselves is nonuniform in crude-based oils. Synthetic oil contains none of these contaminants and the hydrocarbon molecules are very uniform. Giving the synthetic oil base better mechanical properties at extreme high and low temperature (see the sections below on physical properties). By contrast, synthetic oil is not distilled from crude oil. It is made through a chemical process known as the Fischer-Tropic process, starting with raw materials like methane, carbon monoxide, and carbon dioxide. This process was developed by Germany in WWII. When that country's access to crude oil was very limited.

3. NEED FOR SYNTHETIC ENGINE OILS

There are only three reasons for a consumer to use synthetic or partial synthetic engine oil:

i.) It solves a technical problem.

ii.) Its use results in improved economics.

iii.) Governmental regulations

Technical requirements 'may involve using synthetics to satisfy high or low temperature proper- lies, to improve oil durability, or to improve engine test performance. In Europe, the addition of PAO and ester base stocks has allowed oil formulators to increased thermal oxidative stability requirements and to achieve improved volatility specifications and better low temperature start- in. In North America, OEMs are requiring more stringent lubricant performance in engine clean- lines, as well as improved volatility and low temperature pumping-starting. OEMs are starting to specify synthetic engine oils for some high performance applications (e.g., GM's Chevrolet Corvette).Full synthetic arctic engine oils have been used by the U.S. military, NATO, and civilian companies since the early 1970s for equipment serving in extreme cold weather conditions MIL-L-46167B). The use of synthetics in engine oils has just started to show economic justification in the mar- replace. The consumer--whether an individual with a passenger car, a lease company with return vehicles, or a business with a fleet of trucks is beginning to recognize the economic advantage of increased engine life that is associated with the use of high performance oils. This advantage can be shown for extended vehicle service or residuals on resale.

High performance, heavy-duty diesel engine oils are under development and testing to extend the oil drain interval and to lower maintenance costs, while maintaining or increasing engine operating life. Synthetic components (PAO, digester, polygon esters) are being evaluated in conjunction with high performance additive systems for this "next generation" HDDO. These components are being added at 530 with petroleum base stock for' enhanced additive and by product solubility which improved engine cleanliness, good isometric properties and lower oil volatility. Worldwide, government
regulations are starting to reflect concerns with vehicle fuel usage and the environmental impact of the products of the internal combustion engine. These regulations are affecting vehicle and engine design and formulations for the lubricants used in these vehicles. Fuel economy has been subject to government guidelines since the 1970s (CAFE in the United States). Heavy-duty diesel emissions guidelines in 1978, 1994, and 1998 in North America and corresponding requirements in Europe and the Far East are changing the engines and oils. All these requirements are designed to promote more efficient energy usage and to diminish the environmental impact of these engines.

4. PERFORMANCE BENEFITS WITH SYNTHETICS
In order to be commercially viable as a mineral oil replacement, a synthetic must be able to give a reasonable return for the additional investment. Principal benefits cited in the review were labor and material savings, reduction in power requirements, reduced failure rates and elimination of cold weather starting problems. The benefits of various types of synthetics in industrial applications were also recently reviewed by Miller (1984). In the introduction to the current paper, five general areas of performance benefit for synthetics were listed. These areas will be discussed in more detail in the following subsections, with emphasis on the property differences which give the benefit. The advantages of using synthetic motor oils include:

i.) Better low- and high-temperature viscosity performance at service temperature extremes;
ii.) Better (higher) Viscosity Index;
iii.) Better chemical and shear stability;
iv.) Decreased evaporative loss;
v.) Resistance to oxidation, thermal breakdown, and oil sludge problems[citation needed]
vi.) Improved fuel economy in certain engine configurations;
vii.) Better lubrication during extreme cold weather starts;
viii.) Possibly a longer engine life;
ix.) Superior protection against "ash" and other deposit formation in engine hot spots (in particular in turbochargers and superchargers) for less oil burn off and reduced chances of damaging oil passageway clogging;
xi.) Increased horsepower and torque due to less initial drag on engine;
xii.) Improved fuel efficiency - from 1.8% to up to 5% has been documented in fleet tests.

5. PHYSICAL CHARACTERISTIC TESTS
For Comparative analysis of the physical properties of the synthetic and petroleum oil. We are going to conduct some tests that deal with the characterics and physical properties of the oil. This test conclude about the reliability, friction reducing tendency cold working ability, alkali level, wide temperature range, flow ability of oil, higher load stability of the both oils. So we come out to know about worst condition the oil can be used and able to perform satisfactorily. For that purpose we collected four samples of
oil with the 10W40 grade as follow:
Fresh Pure petroleum oil
3000 km used petroleum oil
Fresh pure synthetic oil
15000 km used synthetic oil

Figure 1- Samples
The used oil samples are collected because as the oil is used for certain kilometers it loses its ability to lubricate an engine and the performance reduces. Our aim is to show that 15000 KM used synthetic oil shows better results than 3000 KM used petroleum oil so the comparative data will analyses through following tests which carried out others four samples:

i.) Flash Point test.
ii.) Pour point test.
iii.) Knock volatility test.
iv.) Total Base Number test

5.1 Flash and Fire Point Test
Aim: To determine the Flash and Fire point of Four oil samples of oil.
Scope: Many times the flash point and fire point of an ignitable liquid (like oil) is a key consideration in fire case litigations, I.C. engine. Litigation in fire or explosion incident cases is often a matter of the relative flammability of the oils involved. When oil flammability characteristics become the main issue at the heart of litigation, the subject of "material science" comes into play. Materials science deals with the various properties and characteristics of substances, particularly with those characteristics which have an impact on their use by a consumer.

Result: The Result table and comparative graphs are as below.

Table 1: The Result table

|-----|-------------------------------------------------|----------------------|---------------------|
Remark: From the above test results we are concluded that the Synthetic oil has large flash and fire point than conventional petroleum oil which proof that synthetic oil can be chemically stable up to 300 degree cell and the rate of vaporization of this oil is very low. As well as we compare flash point and fire point of used oil which also indicate that 15000 kilometres used synthetic oil have still more flash point then 3000 km used petroleum oil. This test is ultimately conclude about rate of ignition of 15000 km used synthetic oil is even higher and will not contributes to any_ hazards and fire condition of I.C. engine. So the synthetic oil can be used at worst engine condition and higher engine temperature and synthetic oil will not lose its chemical properties up to 15000.

5.2 Pour point test

Aim: To determine the pouring capacity of oil at lower temperatures

Scope: Pour point: In petroleum products, the lowest temperature at which movement of the test specimen is observed under prescribed conditions of test. The Pour Point is the lowest temperature at which the oil can still be poured out of a container.

Pour point is important in order to find out the properties of oil at lower temperature and chemical behavior oil at certain low temperature. These properties will ensure the worst lower working condition of I.C. engine like faster cranking for easy start up, stain on battery & faster flow for engine start up etc.

Apparatus: We use deep freezer having the capacity produce -35°c temperature which is used to produce step reduction of temperature.

Result: The 100ml each sample is taking for the examination after 2hr of frizzling at different temperature.
Table 2(i, ii, iii): The Pour Point Results

(i) At the $0^\circ$ temperature.

<table>
<thead>
<tr>
<th>No.</th>
<th>Sample</th>
<th>ml of oil flow out after 6 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Synthetic Oil</td>
<td>100</td>
</tr>
<tr>
<td>2.</td>
<td>Synthetic Oil (15000 kilo meters used)</td>
<td>98</td>
</tr>
<tr>
<td>3.</td>
<td>Petroleum Oil</td>
<td>98</td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil (3000 kilo meters used)</td>
<td>98</td>
</tr>
</tbody>
</table>

(ii) At the $-20^\circ$ temperature

<table>
<thead>
<tr>
<th>No.</th>
<th>Sample</th>
<th>ml of oil flow out after 6 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Synthetic Oil</td>
<td>90</td>
</tr>
<tr>
<td>2.</td>
<td>Synthetic Oil (15000 kilo meters used)</td>
<td>84</td>
</tr>
<tr>
<td>3.</td>
<td>Petroleum Oil</td>
<td>52</td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil (3000 kilo meters used)</td>
<td>47</td>
</tr>
</tbody>
</table>

(iii) At the $-35^\circ$ temperature

<table>
<thead>
<tr>
<th>No.</th>
<th>Sample</th>
<th>ml of oil flow out after 6 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Synthetic Oil</td>
<td>70</td>
</tr>
<tr>
<td>2.</td>
<td>Synthetic Oil (15000 kilo meters used)</td>
<td>60</td>
</tr>
<tr>
<td>3.</td>
<td>Petroleum Oil</td>
<td>23</td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil (3000 kilo meters used)</td>
<td>15</td>
</tr>
</tbody>
</table>

Figure 3: Sample vs ml of oil flow out
Figure 4: Samples

Remark: This test will concluded that at very lower temp like 0°C-20°C,-35°C the synthetic oil still pour and convectional oil can't keep down. This will alternately conclude that synthetic oil can perform better at extreme low temp condition, this will also improve, faster cranking for easier start up 2, faster flow for faster engine warm up 3.less strain on battery.

5.3 Knock volatility test

Aim
To determine the knock volatility of oil samples.

Scope
The evaporation loss is of particular importance in engine lubrication. Where high temperatures occur, portions of oil can evaporate. Evaporation may contribute to oil consumption in an engine and can lead to a change in the properties of an oil. Many engine manufacturers specify a maximum allowable evaporation loss. Some engine manufacturers, when specifying a maximum allowable evaporation loss, quote this test method along with the specifications. Procedure C, using the Selby-Knock apparatus, also permits collection of the volatile oil vapours for determination of their physical and chemical properties. Elemental analysis of the collected volatiles may be helpful in identifying components such as phosphorous, which has been linked to premature degradation of the emissions system catalyst.

Result:

Table 3: The result table

<table>
<thead>
<tr>
<th>No.</th>
<th>Sample</th>
<th>Weight lost in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Synthetic Oil</td>
<td>70</td>
</tr>
<tr>
<td>2.</td>
<td>Synthetic Oil (15000 Kilometres used)</td>
<td>60</td>
</tr>
<tr>
<td>3.</td>
<td>Petroleum Oil</td>
<td>23</td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil (3000 kilometres used)</td>
<td>15</td>
</tr>
</tbody>
</table>
The test is concluded about oils volatility. And synthetic oil has less volatility so we can use this oil till 15000 km with very less loss of oil. It ensures the chemical stability of synthetic oil at 250°C. In the case of petroleum oil it vaporizes very faster the synthetic oil so it give lower performance at very high temperature condition.

5.4 Total base number test (TBN test)

Aim: To determine the total Base Number of Four Oil samples of Oil.

Scope: TBN stands for Total Base Number. TBN is a measure of the oil's alkalinity. Alkalinity in oil is important because the combustion process produces acids which can attack metals and other materials in an engine, increasing wear. When oil is now the TBN is highest. Over time, TBN decreases until finally the oil reaches a point where it cannot absorb any more acids and the acidity of the oil in the engine will start to rise. Most often, it is this depletion of TBN which signals that an oil is 'worn out' and due to be changed. TBN is measured in milligrams of Potassium Hydroxide per grain (mg KOH g).

In other words when we buy new engine oil, it has a 'base reserve' built into the additive package. This is designed to neutralize the acids as they are produced with all acid base reactions. The 'base reserve' is used up in the process of neutralizing these acids.

This Base reserve is called the Total Base Number which is a measure of the level of BASE in the oil and is determined by measuring the amount of Potassium Hydroxide in mg taken to neutralize the base reserve in 1 gram of oil (mg KOH-gin). TBN is measured in milligrams of Potassium Hydroxide per grain (mg KOH/g).

Results:
The result table and comparative graphs are as below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Sample</th>
<th>mg KOH/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Synthetic Oil</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Synthetic Oil (15000 kilo meters used)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Petroleum Oil</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil (3000 kilometres’ used)</td>
<td></td>
</tr>
</tbody>
</table>

Remark:

Figure 5: Comparative graphs
Remark

From the above test results we are concluded that the Synthetic oil has large Total Base Number then Petroleum Oil. The Fresh synthetic oil has Total Base Number of 12 and pure Petroleum oil has Total Base Number of 10 as well as we compare both used oils and conclude that the capacity of 15000 KM used synthetic oil to neutralize the acid is more than Mineral oil. Ultimately the test results are proved that the Synthetic oil is giving better maintainability of engine, as Synthetic oil has more capacity to absorb acids produced from combustion process of engine. So 15000 KM used synthetic oil having Total Base Number 9 will no effect on the internal metal structure of engine. On the other hand 3000 KM used Petroleum oil having Total Base Number is 5 which show that the capacity of Petroleum oil to neutralize acid is lower so the acid may attack on internal metal structure of IC engine.

6. CONCLUSION

It is beneficial to use synthetic oil then conventional petroleum oil. The advantage of synthetics over mineral oils comes from the ability to synthesize selected molecular structures which are beneficial in lubrication. This usually is only possible at some cost penalty and a synthetic product is only of value if it can more than repay the additional investment or provide some critical performance need which a mineral oil cannot. Performance factors which can lead to overall cost savings are improved energy efficiency, reduced maintenance costs, increased design ratings, improved reliability and safer operation. In addition, Performance beyond the capability of mineral oils can be obtained through a wider operating temperature range and the ability to operate in hostile environments. The introduction of teratology as a scientific discipline has helped make
these benefits more readily recognizable. The lubricant is an important engineering component, not an unfortunate afterthought, and its performance characteristics contribute to the overall economics of any design. Synthetics in widest use as mineral oil replacements due to better performance are synthetic hydrocarbons, polyglycols and esters. Synthetics which offer special properties at higher cost are phosphate esters, silicones, halogenated fluids and polyphenyl ethers. Ultimately we can use synthetic oil till 15000 km with minor loss of its physical properties which does not impact performance of engine lubrication.

7. REFERENCES