**SYNTHETIC VS MINERAL OIL**

**Introduction**
Oil is the life blood of an engine and just like the blood in our bodies, it is required to fulfill a number of functions. Oil does not only lubricate, it also carries away heat, dissolves contaminants, carries away debris and provides a working medium for such things as hydraulic lifters.

All oils, whether mineral or synthetic, have additives mixed into the package which fortifies the oil to do its job. The majority of finished lubricants thus all consist of a base oil (or a mixture of different base oils) and a additive package. When we refer to the oil being either mineral or synthetic, we thus refer to its base oil component. The American Petroleum Institute (API) produces a chart that classifies the different base oil types. See Fig 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>Saturate wt %</th>
<th>Sulphur wt %</th>
<th>Viscosity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&lt; 90 and/or</td>
<td>&gt; 0.03</td>
<td>&gt; 80 to &lt; 120</td>
</tr>
<tr>
<td>II</td>
<td>≥ 90 and</td>
<td>≤ 0.03</td>
<td>≥ 80 to ≤ 120</td>
</tr>
<tr>
<td>III</td>
<td>≥ 90</td>
<td>≤ 0.03</td>
<td>≥ 120</td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td></td>
<td>All poly alpha olefins (PAOs)</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td></td>
<td>All base stocks not included in Groups I-IV</td>
</tr>
</tbody>
</table>

**Fig 1. API – Classification of base oils**

**Synthetic vs Mineral**
The differences between these types of oils are all in the molecular make-up. Groups I and II are typically classified as mineral base oils, are crude derived and consist mainly of hydrogen and carbon (hydrocarbon) molecules.

Group II and III type base stocks help to formulate more economic type semi-synthetic lubricants. These first three base oil groups are widely used in combination with additive packages, ester oils (Group V) and/or Group IV polyalphaolefins in order to formulate semi-synthetic based lubricants. Group III base oils are sometimes considered as synthetic when it is hydro-isomerized. Various petrochemical companies have developed processes involving catalytic conversion of feed stocks under pressure in the presence of hydrogen, into high quality mineral lubricating oil. This process was called hydro-cracking or hydro-isomerization. In 2005 production of gas-to-liquid (GTL) of Group III base stocks began. Even though they are considered a synthetic product, they are still mineral base stocks and counted as the mineral part of all semi-synthetic lubricants. Semi-synthetic oils are blends of mineral oil with no more than 30% synthetic oil. These oils are designed to have many of the benefits of synthetic oil without matching the cost of pure synthetic oil,

Mineral oil being a product of nature has lots of different sized molecules in its makeup. Synthetic oil on the other hand, has a very consistent molecule size which gives the synthetic material a controlled structure with predictable properties. Synthetic base stocks are man-made and sophisticated, unlike mineral base oils which are complex mixtures of naturally occurring hydrocarbons.
The history of synthetic oils
Synthetic oils are not new. As a matter of fact, the first real synthetic engine oils were used in aircraft engines in World War II concurrently by Germany and the United States. Easing engine starts in winter and avoiding soot deposits were the two main drivers for the US Air Force, while the motivation in Germany perhaps was primarily related to resource issues. The first synthetic oils for aircraft engines were based on blends of an acid ester and polyethylene oil.

In the early 1960s, Chevron USA integrated the first commercial utilization of hydro-cracking technology. By 1993 the company introduced iso-dewaxing technology making them one of the world's largest manufacturers of API Group II and III base oils. On 1 July 2000, Chevron Corp. combined efforts with Phillips Petroleum Co. now ConocoPhillips, to become Chevron Phillips Chemical Company, one of the top producers of poly-alpha olefin (PAO) Group IV base stocks.

The first synthetic oil developed for automotive combustion engines and fully recognized by the American Petroleum Institute (API) was produced in 1972. This first API-rated synthetic motor oil meeting API SE/CC specifications was based on a SAE 10W-40 grade Di-ester API Group V formulation.

The Pros and Cons of Synthetics
The advantage of synthetic oils is that it potentially has a more stable suite of properties that can be tailored to a wider range of applications. This is why one can now find oils that can cover huge viscosity ranges such as 15W60 and even OW30. There are definite advantages to this ability but careful consideration of application is necessary.

Advantages of synthetic motor oils:
- Better low and high temperature viscosity performance
- Decreased evaporative loss
- Resistance to oxidation, thermal breakdown and sludge deposits
- Better chemical & shear stability
- Better lubrication on cold starts
- Longer engine life
- Possible extended drain intervals with the environmental benefit of less oil waste
- Improved fuel economy in certain engine configurations

Disadvantages of synthetic motor oils include
- Lower friction characteristics may make them unsuitable for running-in applications
- Potential compatibility problems when mixed with mineral oils. Many modern cars now come with synthetic oil as a factory fill
- Potential decomposition problems in certain chemical environments
- Potential stress cracking of plastic components like poly-oxy-methylene in the presence of PAO
- Synthetics do not hold lead in suspension as well as mineral oil, caution is thus advised when running on leaded fuel

Conclusion
There is a popular belief that if high priced synthetic oil is used in an engine, oil changes can be extended exponentially and that there will be a huge increase in efficiency. No matter what the main constituent of the oil is (mineral or synthetic) a large proportion of the content are additives, research has shown that the lifetime of the additives (the time it takes to lose its useful properties) is primarily dependent on the service duty of the engine. It is in fact the depletion of these additives that dictates when an oil should be changed. Not all oils are created equal but all of them do wear out at approximately the same rate as the additives are depleted. The bottom line is that frequent oil changes are better for an engine.