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Seminar

On

Synthetic Oil Technology



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What are motor oils ?

**Motor oil**, or **engine oil**, is an oil used for lubrication of various internal combustion engines. While the main function is to lubricate moving parts, motor oil also cleans, inhibits corrosion, improves sealing and cools the engine by carrying heat away from moving parts. Motor oils are derived from petroleum and non-petroleum synthesized chemical compounds used to make synthetic oils. Motor oils are today mainly blended by using base oils composed of hydrocarbons, poly alpha olefins (PAO), poly internal olefins (PIO), thus organic compounds consisting entirely of carbon and hydrogen. The base oils of some high-performance motor oils contain up to 20 wt% of esters .Lubricating oil creates a separating film between surfaces of adjacent moving parts to minimize direct contact between them, decreasing heat caused by friction and reducing wear, thus protecting the engine. In use, motor oil transfers heat through convection as it flows through the engine by means of air flow over the surface of the oil pan, an oil cooler and through the build up of oil gases evacuated by the Positive Crankcase Ventilation (PCV) system.

Functions of Motor Oil

* Lubricate
  + Increases efficiency, slows wear
* Cool
  + Antifreeze only cools the upper engine
* Corrosion Protection
  + Stop/hinder oxidation & acid build up
* Clean
  + Stop deposit formation & hold particles in suspension

History of motor oils

* Lubrication dates back to Egyptian times
* The first motor oils arrived around 1900
* In 1972 Amsoil started selling the first API rated 100% synthetic motor oil for internal combustion engines

Grades and viscosity

* The Society of Automobile Engineers in the USA took on the task of setting the standards for engine oil. They made the decision to compare and define lubricating oils by viscosity. Viscosity, in lay terms, is how easily a liquid pours
* Single grade
* Multi grade
* Turbine grade
* Viscosity is measured by the remarkably accurate method of pouring oil through a known size hole and measuring how long it takes to come out. The result of this is known as kinematic viscosity.

Oil terminology

**Viscosity Index:** This measures the effect of temperature on oil [viscosity](http://auto.howstuffworks.com/question164.htm), or the oil's thickness and ability to protect the engine. When oil is heated, it becomes thinner; when it's cooled, it becomes thicker. If the oil is too thin or too thick, the oil can't do its job properly. A high viscosity index means the oil doesn't change too much, no matter what the temperature inside the engine may be. In a perfect world, the viscosity of the oil wouldn't change at all and would provide optimum protection under any conditions.  
**Total Base Number:** The "base" in this context is the opposite of "acid." The total base number measures the oil's ability to withstand acid buildup in the engine.  
**NOACK Volatility Number:** Volatile compounds are unstable and tend to vaporize when exposed to heat, and this test measures that tendency. As temperatures rise, smaller molecules vaporize, leaving behind larger molecules that can make oil more sluggish and less viscous. The lower the NOACK volatility number, the better; it means there are fewer molecules being lost, which means fewer top-offs at the local lube shop.

**SAE Kinematic Viscosity of Engine Oil**

|  |  |
| --- | --- |
| **Centistokes** | **SAE Rating** |
| 16.3 - 21.9 | 50 |
| 12.5 - 16.3 | 40 |
| 9.3 - 12.5 | 30 |
| 5.6 - 9.3 | 20 |
| less than 5.6 | 10 |

**SAE Winter Rating of Engine Oil**

|  |  |
| --- | --- |
| **Notation** | **Useability** |
| 25w | -5 |
| 20w | -10 |
| 15w | -15 |
| 10w | -20 |
| 5w | -25 |
| 0w | -30 & above |

Motor oil standards

* American Petroleum Institute
* The International Lubricant Standardization and Approval Committee (ILSAC)
* The ACEA (Association des Constructeurs Européens d'Automobiles)
* Japanese Automotive Standards Organization (JASO)
* The Society of Automobile Engineers (SAE) 1950s and 60s
* Long chain viscosity modifiers and detergents are soon destroyed in high load conditions
* Requirement for as light an oil as possible to cut down friction losses, making the vehicle both quicker and more fuel efficient
* Advances in the 1950s and 60s in the petro-chemical industry also led to comprehensive synthetic detergent packages for oil, and very efficient anti-wear and anti-scuff additives. Combined with advances in filtration technology
* Gas turbine engines had developed to the stage where the immense pressures and temperatures involved would fry mineral oils on contact. The stage was set for totally synthetic lubricants to enter the automobile market.
* By the early 1970s, the use of the PAO synthetic lubricants in competition engines was allowing reduction of the amount of oil carried on board race cars, combined with smaller de-aeration systems and reduction in cooler size.
* In the 1950s and 1960s, synthetic oil took off to meet the high-performance needs of fighter jets. Then, just as the fuel crisis of the 1970s took hold, Mobil1 synthetic oils that promised to increase fuel economy hit the passenger car market.
* Auto manufacturers started to understand the benefits of synthetics -- such as fewer emissions and longer stretches between oil changes -- and recommended their use in newly built cars.

**The Science of Synthetic Oils**

The main difference between synthetic motor oil and conventional motor oil is found in their molecular structure. In a mineral oil, the molecules come from organic, natural materials. Synthetic oils, on the other hand, were created by scientists in a lab which have uniform molecules.

There are three basic parts to synthetic motor oil

* The base oil
* The carrier oil that disperses those powdered performance additives throughout the base oil
* Performance additives, which come in powder form
* Pour Point Depressants
* Viscosity Index (VI) Improvers
* Detergents & Dispersants
* Anti-Foam & Anti-Wear Agents
* Oxidation & Corrosion Inhibitors

Polyolefin

Synthetic oil disadvantages

* Synthetic oils cost around 6 to 10 times the price of conventional motor oils.
* Synthetic oils will clean out the deposits that may be holding a weak seal together. This could lead to an engine oil leak that may cause myriad safety problems and cost you a lot of money to fix as well.
* Synthetic oils are not recommended in automotive rotary engines.
* Synthetics do not hold lead in suspension as well as mineral oil, thus caution is advised when the engine is run on leaded fuel. As an example, leaded fuel is still commonly used in aviation

Future of synthetic technology

* A process to break down polyethylene, a common plastic product found in many consumer containers, is used to make wax with the correct molecular properties for conversion into a lubricant, bypassing the expensive Fischer-Tropsch process. The plastic is melted and then pumped into a furnace. The heat of the furnace breaks down the molecular chains of polyethylene into wax. Finally, the wax is subjected to a catalytic process that alters the wax's molecular structure, leaving a clear oil. (Miller, *et al.*, 2005)
* Biodegradable Motor Oils based on esters (ELF HTX 822, Castrol Greentec LS 5W-30) or hydrocarbon-ester blends (BP Vistra 7000)
* (FUCHS Titan GT1 0W-20), which respond to the bio-no-tox-criteria of the European preparations directive (EC/1999/45). This means, that they not only are biodegradable according to OECD 301x test methods, but also the aquatic toxicities (fish, algae, daphnia) are each below 100 mg/L.
* U.S. were presented motor oils based on vegetable esters, like AMG Bio 10W-30.

Conclusion

The benefit of these new formulations is its ability to get back into soil with fewer negative consequences. Typical motor oil needs to go through special treatment facilities, whereas biodegradable motor oil has less impact on the environment if spilled on the ground. All used motor oils can contain toxic heavy metals, however, and even biodegradable oils should be recycled properly and not spilled into the environment!

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