Fear Factor

Synthetic Oil versus Petroleum Oil

Shyster, Slick, Smooth Operator. Do any of these words fit the picture you have in your head of sales people who are trying to sell products that may not be all they say they are?

Fake, Bogus, Concocted, Counterfeit, Phony, and Reproduction. Are these the words or ideas that you have of products that don't work at all the way they are advertised? Is this how you or your potential customers have viewed or are viewing synthetic lubrication products?

Be honest with me, or better yet with yourself. You probably had this mind set at one time or maybe even have it right now and that is why you are reading this. I know from personal experience that without a solid understanding of synthetics, it is easy to be fearful of them and the people who are selling them. Nobody wants to play the fool or be taken advantage of and that is why this document exists.

Let first look at several of the most common reasons "why" people are afraid of synthetic oil or the people who sell them:

- First, synthetics are relatively unknown and people fear what they don't know.
- Second, the name synthetic implies that it is some kind of "knock-off" of the original or lower quality than the original "high quality" natural substance.
- Third, the major petroleum companies have promoted their product and either hold the minds of the general consumer or have confused the issue to the point of gridlock where people won't change to something different.
- Fourth, there have been many unscrupulous companies selling questionable products that have tarnished the image of credible, high quality products like AMSOIL.

This document is intended to aid the Dealer and other interested parties in dispelling the fear and myths of synthetic oil in comparison to petroleum oil. The questions below provide an outline of the type of questions a Dealer may receive while discussing the AMSOIL business proposition and our synthetic products to individuals or business owners.

Where does it all come from?

There are two general places that lubricants come from. The first is from crude oil pumped from the ground. These are petroleum-based lubricants. The second is from man made compounds. These are synthetic lubricants. We will discuss the definitions and components or both.

Petroleum (from Latin *petra* – rock and *oleum* – oil), **crude oil**, sometimes colloquially called *black gold*, is a thick, dark brown or greenish flammable liquid, which exists in the upper strata of some areas of the earth's crust. It consists of a complex mixture of various hydrocarbons, largely of the alkane series, but may vary much in appearance, composition, and purity. It is an important "primary energy" source (IES Key World Energy Statistics). Petroleum is also the raw material for many chemical products, including solvents and fertilizers.

Synthetics –PAOs or Poly-Alpha-Olefins are **synthetic lubricant bases produced by a chemical polymerization process**. These bases exhibit exceptional properties even under demanding conditions. There is little variation in viscosity as a function of temperature, very good fluidity at low temperature, reliability under mechanical stress, and excellent chemical and thermal stability.

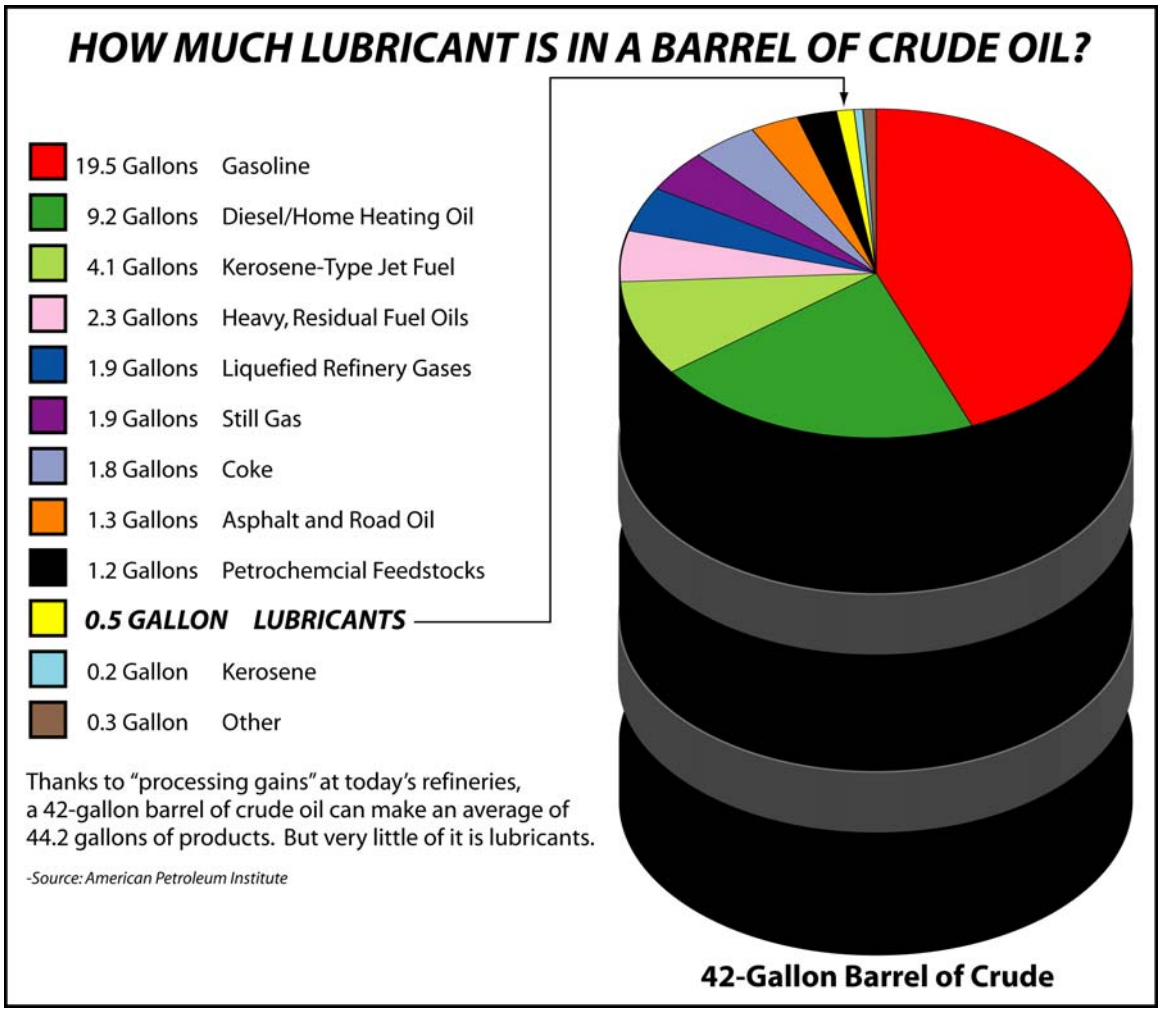
PAOs allow the formulation of synthetic lubricants capable of meeting extreme operating conditions for automotive (70%) and industrial use (25%). The poly-alpha-olefin unit consists of three main sections: polymerization, hydrogenation and distillation.

Polymerizering short chain hydrocarbon molecules into longer single chain hydrocarbons fabricate synthetic oils. Their lubrication characteristics can be adjusted by controlling the spectrum molecular weights that go into the finished formulation, which usually also includes thickeners.

Polymerization is a process of reacting monomer molecules together in a chemical reaction to form linear chains or a three-dimensional network of polymer chains

Hydrocarbon is any chemical compounds that consist only of carbon (C) and hydrogen (H). They all consist of a carbon backbone and atoms of hydrogen attached to that backbone.

What do you get from a barrel of crude?



What's in a Base Oil?

Base oils are categorized into Groups. Their relative viscosity and percent of saturates segment these groups (see table below.) The products that fall into these groups are listed below the table.

Why is the base oil so important? Because, lubricants contain 78-90% base oil (most often petroleum fractions, called mineral oils) and 10-22% of additives and the majority of their physical and chemical properties are derived from the base oil. Vegetable oils or synthetic liquids such as hydrogenated polyolefins, PAOs, esters, silicone, fluorocarbons and many others are sometimes used as base oils, as is the case for AMSOILs product which are based on PAOs. Additives can be combined with the base oil to deliver reduced friction and wear, increased viscosity, resistance to corrosion, aging or contamination, etc.

The table below shows the types of base oils grouped by their chemical makeup and viscosity index. This table is important to understand, because it helps demonstrate the dramatic differences between petroleum and synthetic products. This understanding also forms the basis of differences in product performance and cost.

Group	Description	Saturates Percent	Aromatics Percent	Sulfur Percent	Viscosity Index
I	Solvent-refined Mineral oil	<90	>10	>0.03	80 - <120
II	Hydroprocessed	>90	<10	<0.03	80 - <120
III	Hydrocracked	>90	<10	<0.03	120+
IV	Polyalphaolefins	(100)	(0)	(0)	
V	All others – other synthetics				

Group I – Petroleum based mineral oil and refined through the use of solvents.

Group II - Petroleum based mineral oil and refined through the use of Hydro processing.

Group III - Petroleum based mineral oil and refined through the use of Hydro cracking.

Group IV - Synthetic based and created through the use of chemical polymerization.

Group V - Petroleum based and refine through the use of solvents.

So, what does all the data mean? The following paragraphs describe the sections of the table and how they relate to AMSOIL and our products.

Saturates: The more saturated the oil the more carbon-hydrogen links the oil has. The more carbon-hydrogen links the oil has the more stable it is, the more resistance to oxidation it has and the longer its service life becomes. Clearly Group IV PAOs have the highest possible saturate percentage. That is one reason why AMSOIL uses PAOs. They simply outperform the other grades of base oil in every measurable category of performance.

Aromatics: The main aromatics are benzene, toluene and the xylenes. They are naturally occurring substances that are produced in the chemical refining process of crude oil. These substances are generally used in solvents and are not beneficial in lubrication products. In fact, they are detrimental to the performance of a product produced for the purpose of lubrication. Generally speaking, the more aromatics a product has the more hazardous it is to your health. The table clearly demonstrates the complete lack of these hazardous chemicals in PAOs. While this may not be the reason AMSOIL uses PAOs, it is definitely one of the great benefits of using PAOs in our products.

Sulfur: This is another naturally occurring element that also is detrimental to lubricants. In fact, people in the industry refer to the presence of sulfur as contamination and are always-seeking cost effective methods to remove it from the oil. A common phrase in the industry is “The lower the sulfur the sweeter the crude”. As you can see PAOs have NO, zero sulfur contamination. Once again, AMSOIL uses the best to produce and provide the best to you, the Dealer.

Viscosity Index: Most of you know and understand Viscosity Index and the relationship between the number and the performance of oil. However, to make sure everyone is on the same page in understanding this, and to educate new Dealers to the concept, we will review.

According to Brookfield Engineering Viscosity is defined as: Viscosity is the measure of the internal friction of a fluid. The greater the friction, the greater the amount of force required to cause this movement, which is called "shear." Shearing occurs whenever the fluid is physically moved or distributed, as in pouring, spreading, spraying, mixing, etc. Highly viscous fluids, therefore, require more force to move than less viscous materials.
Viscosity Index is defined as: The relationship of viscosity to temperature of a fluid.

When reviewing the Viscosity Index above you should note that high viscosity index fluids tend to display less change in viscosity with temperature than low viscosity index fluids. So generally speaking, oils with a viscosity index of better than 120, as shown in the above chart, are the most stable, or least susceptible to change with temperature. The oils with a viscosity index below 120 are the most unstable or most susceptible to change with temperature. AMSOILs use of PAOs gives our products some of the highest viscosity index numbers possible. This translates to our products being very stable under extreme temperature changes, i.e. gas or diesel engines.

As a summary to the above material it can be seen that AMSOIL, PAO based, products outperform all petroleum based oils from the moment of their “creation”. It isn’t magic, nor is it some kind of trickery, its just good chemistry!

For more in formation on the refining process and it’s parts go to: http://science.howstuffworks.com/oil-refining1.htm you can also follow the links to other websites, such as the OSHA site on refining.

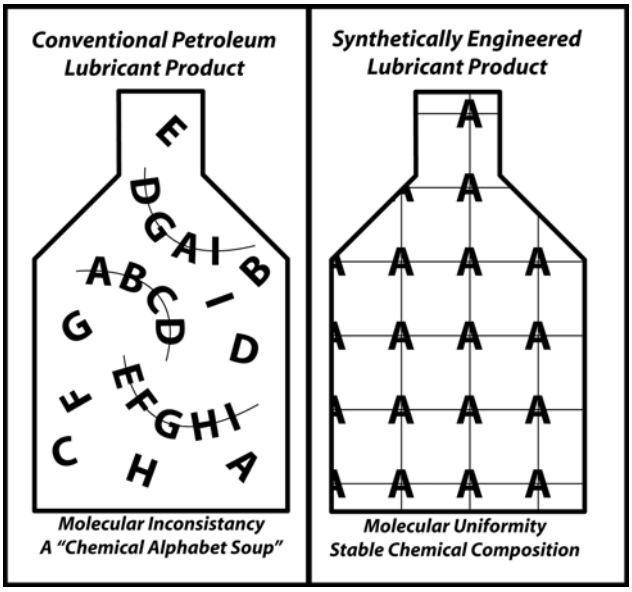
Chemistry is the key!

Because of where the base oils come from, and how they are processed or refined they have different chemistries. Without going into great detail, here are the basics, the differences and the benefits or drawbacks of each.

Petroleum oils, no matter how they have been refined, will always have some inherent flaws. First they will have non-uniform molecules and strings /bands of molecules. This reduces the film strength and makes it less sheer stable as well as lowers it’s lubricity. They will also have some amount of parafinic wax, which contributes to thickening in cold temperatures and thickening as a result of normal operation.

Synthetic oils have chemically engineered molecules, which are uniform in size and shape. They are bonded together in long straight strings, which make them strong, stable and increases their lubricity.

See the graphic below that visually represents some of the differences discussed above.



What are the core benefits of the Base Oil?

Because the base oil comprises 90% of the finished product it is extremely important that the very best, highest quality oil be used. The base oil provides the key core characteristics that the finished product needs. It defines the products viscosity, operating temperature range, sheer, chemical and thermal stability. These are the reasons that starting with the best base oil is so important. Synthetic PAOs are the best base oils and therefore products made with PAOs provide the best level of protection and capabilities for the equipment in which they are applied. The key benefits to the customer are:

- Better Wear Protection
- Increased Horsepower
- Keep Engines Cleaner
- Improved Fuel Economy
- Improved Cold Weather Starting
- Extended Drain Intervals

All of which save them money!

What's in an Additive?

Manufactures of every type of lubrication oil add other chemicals to their base oil in an effort to "add" certain benefits that will enhance the products ability to perform in the application for which it is intended. In an internal combustion engine, base stocks alone cannot meet all the requirements of a lubricant. Therefore, additives are used to improve performance and/or impart new characteristics or properties.

Typical concentrations of additives in engine oil range from 7.5 to 25%. As an example, typical 15w-40 petroleum oil breaks down as follows:

Base stock = 78.5%;
Viscosity Index Improver = 9%;
Dispersant = 8.1%;
Detergent = 2.6%;
Anti-wear = 1.2%;
Anti oxidant = 0.4%;
Pour point depressant = 0.1%;
Corrosion inhibitor = 0.1%;
Demulsifier = <0.1%;
Anti-foam = <0.1%.

Detergents are used to perform two key functions. One is to neutralize the acidity byproducts of lubricant oxidation and thermal decomposition and the other is to keep contaminants as sludge of oxidized oil soluble. The total base number (TBN) of the detergent reflects its ability to neutralize acids.

Dispersants control contamination from low temperature operation. Both detergents and dispersants attach themselves to contaminant particles, and hold them in suspension. The suspended particles are so finely divided that they pass harmlessly between mating surfaces and through oil filters. The contamination is removed from the engine when the oil is changed.

Oxidation Inhibitors reduce oxygen attack on the lubricating base oil.

Corrosion Inhibitors protect non-ferrous metals by coating them and forming a barrier between parts and their environment.

Rust Inhibitors protect iron/steel from oxygen attack, by forming a protection screen over the surface of the metals.

Friction Modifiers reduce friction by physical adsorption of polar materials on metal surfaces (fatty acids and esters, molybdenum compounds...).

Anti-Wear Agents form a protective layer by chemical reaction with the metal surface (normally a metal soap).

Extreme Pressure Additives also known as anti-seize additive, anti-scuffing additive, form a protective layer by chemical reaction with the metal surface, increasing the load at which scuffing or seizure occurs.

Foam Depressants controls the tendency for foaming. Detergent and dispersant additives can facilitate aeration of oil, which results in foaming. This can reduce the lubricating ability of the oil, and interfere with the pumping of the oil.

Viscosity Index (VI) Improvers control the viscosity of multi-grade oils. They are long-chain polymers that function by uncoiling or dissociating at elevated temperatures, increasing the oil's resistance to flow. At low temperatures, they are "tight-balls" which do not significantly increase the oils resistance to flow.

Pour Point Depressants give oil better low temperature fluidity.

Keep in mind that different application will require different additive chemistries. Gasoline engine oils for example, are initially formulated towards wear reduction, whereas diesel oils are more directed toward cleanliness. That does not mean however, that motor oil cannot be formulated to meet both sets of demands.

Quality is the key!

As in all things there are varying degrees of quality. You can buy a $300 computer or a $3,000 computer, a $3 bottle of wine or a $30 bottle of wine, a $5 bottle of vitamins or a $25 bottle of vitamins and you get exactly what you pay for. Both may “do the job” but how good of a job do they do, how long can they do the job and with what level of quality?

Additives are no different. You can use mediocre chemicals or high quality chemicals that meet rigid and exacting standards. It’s every manufactures choice. AMSOIL has always chose to buy the highest quality chemicals, base oils, filter components, etc… If AMSOIL can’t make it with top quality ingredients they don’t make it, period. You can guess what’s in everyone else’s products.

What are the core benefits of additives?

The benefits of each additive are unique. The benefits of additives in oil are substantial. Engine oils need to perform the following jobs:
Permit easy starting
Lubricate / Prevent wear
Reduce Friction
Protect against rust / corrosion
Keep the engine clean
Minimize the and the effect of engine combustion deposits
Cool the engine
Seal combustion chambers and other areas of the engine
Prevent foaming

Without additives even the best base oil would not hold up to the extreme lubricating environments they are forced to operate in. Intense heat, mechanical sheering forces, chemical dilution, water dilution, corrosion, dirt, metallic wear particles, all of these are attacking the oil and making it less able to do its job of lubrication, contaminant isolation and transport and heat removal. Additives in the right proportion and added correctly to the base oil are what enable the base oil to effectively and efficiently do its job.

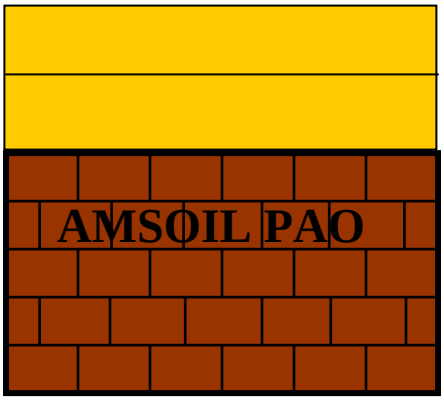
The Base Oil vs. Additive Paradox
A paradox exists in the oil industry, one that many consumers are completely unaware of. The paradox is; “When making a product, where should we invest the most money?” Should they invest in high quality base oil or in high quality additives with a poor to mediocre base oil?

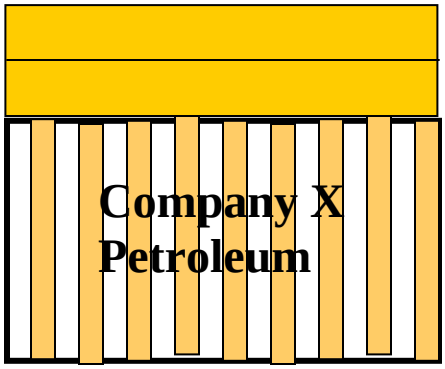
To better understand how to answer that question, let’s look at the following statement and try to fill in the blank. To help control the cost of a finished product you would control the amount of the _____ _____ ingredient. You would control the amount of the most expensive ingredient, right?

So, here is how it all plays out in the lubricants industry. First lets look at AMSOIL. AMSOIL products use PAOs as the base oil. PAOs are much more expensive than petroleum base oils. Because a base oil makes up more than 75% of a finished product, the majority of the cost of an AMSOIL product comes from the base oil contribution. When the time comes to choose and mix additives, AMSOIL can use the highest quality, most expensive additives because the amount of additive required is small due to the high performance of PAO. Simply put – the higher quality the base oil, the less additives required. In addition, AMSOIL can use the highest quality most expensive additives because the amount required has only a small effect on the final cost of the product.

Most companies selling petroleum-based oils have the exact opposite philosophy. They start with a cheap, low quality, marginal performance base oil. In order to bring the oil up in performance, they have to add more additives. However, they can't add too much, as the costs of the additives are much greater than that of their petroleum base oil. So, to keep the cost of their product down, and to meet the minimum performance requirements, they add the minimum amount of additives. What you the consumer are buying is marginal, "just getting by" product, with a very short lifespan.

Another way to look at it is, to pretend you are building a house. What is the most important part of a house? It's the foundation of course. So what kind of foundation would you build your house on? A wise person will build their house on a firm, long lasting foundation, like AMSOIL PAO. The less fortunate make unwise choices and build their houses on the shaky, short-lived foundation of petroleum.





Putting it all together – The finished product.

Have you ever mixed a drink? Have you ever followed a recipe to make something to eat? Then you know something about the process of making a finished product. Blending is the science of putting together the base oil and the additives so the finished product does what it is supposed to do. Make a mistake in the blending process and your finished product is garbage, nobody will want it.

In blending, like following a recipe, you need just the right amount of each ingredient, added at just the right time, in just the right form, in just the right way and sometimes at just the right temperature. Blending is kind of like making candy. AMSOIL manufactures its' products under close scrutiny to exacting standards, making sure to add the proper amount of each additive at just the right temperature, and mix it for the right amount of time, to blend it together so it stays together. This is the last step in the process before it is bottled and shipped. The blending team follows step by step instructions in the process and have even color coded many parts of the process to act as a second line of defense against improper mixing of chemicals. AMSOIL has blending down pat and our quality standards and testing ensures that only the best product makes it to the bottling stage, then out to you our customers.