Synthetic Oil Secrets; High Tech Hydrocarbons

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It came up on us over our left shoulder. There it was. A brand new '69 Cobra-jet Mustang, and I had a feeling me and my GTO were now going to pay the price for all those "milk runs" against 390 Fairlanes. Yes, sport fans, good old FOMOCO was back in business on the street and was coming back with a vengance. These big-block Cobra-jets were serious business, and on that hot summer night in the late 60's, my brother with me, I knew we had trouble on our hands.

The 428 beastie and my nice innocent Goat slowed to a crawl, side by side, and then all heck broke loose on a nearby highway that you could land a Space Shuttle on. My '67 Poncho gave me all it had until the top of third gear when the Mustang punched me out. We did it again, and another time. Same result. We had the lead, broke up, and then that Ford 428 CJ just poured it on.

Well, those were fun days, and we always were careful on the street back then. Now, with our rekindled love affair with the late 60's supercars you may have suddenly found yourself a shocked owner of a care demanding Ford big block from that great muscle car era. Sure, engine parts are aplenty for your Mustang GT of the '80's, but not everyone's garage looks like Bob Gliddens. If that's the case, maybe it's time to re-think the basic engine needs of your Motown mauler.

Most of us choose motor oil by the low sale price, the rebate coupon, or the fancy color of the can. Maybe, it's the decal of your favorite race car blasting down the quarter mile. Well, this is 1987. Has anyone told you what's inside that plastic container or have you sent a sample of your motor oil to a lab to analize it's condition after 1000 miles? Most of us just take it for granted that petroleum oil is the cats meow when it comes to engine protection. Click on your Ford seatbelt, we're going to spill some slippery information here!

After spending many long nights at college, I was accepted into pilot training at Pensacola, Florida for the U.S. Navy. It was in engineering class where I heard of synthetic oil for the first time. This is the only oil used in military jet aircraft engines. Yup, this is the stuff used on the fastest interceptors entrusted with the defense of our homeland.

The history of synthetic oil goes back to the 1930's when Standard Oil Co. of Indiana apparently became the first to synthesize hydrocarbon and alpha olefin lubricants. The process of synthesizing hydrocarbons (bonding long chains of hydrogen and carbon molecules) was also discovered independently by German scientists at I.G. Farbenindustrie in an attempt to make up for shortages during WWII caused by allied bombing. The Luftwaffe's high output aviation engines had been compromised by the short supply of modified conventional oils and the high command expressed the need for a superior lubricant.

It could be stated that synthetic lubes for the jet age of the 1980's were born in the snows of Stalingrad in 1942. During the Soviet invasion, reports from the bitter cold Eastern Front told of trucks and tanks made useless by jelly-thick conventional oils that turned good equipment into dead heaps of iron. German scientists responded by accelerating its development into all types of synthetic polymeric oils that would remain fluid even at these low temperatures.

Post war production of synthetic oils is almost entirely a result of the U.S. Air Force's search for a lubricant for their Mach 2 and Mach 3 high performance jet gas turbine engines. Light mineral lubricating oils could not withstand the high temperature and pressures common with the 35,000 (+) turbine rpm's, and the search continued for a better lubricant. Subsequently, all jet airplanes and space vehicles have been lubricated with synthetic fluids. It's safe to say that if it was not for synthetic oils, the modern jet engines would still be experimental. It is of interest to note that only in 1958 did production of sythetic lubes reach the level attained by the German oil industry in 1943, 15 years earlier.

Manufacturing of synthetic oil has very little in common with it's petroleum counterpart. Compounds with names like di-basic acid esters, polyol esters, and polyalphaolifins (PAO's) are constructed molecule by molecule in the laboratory sometimes by using chemicals that are not lubricants in themselves, but when combined, these molecules form a technologically advanced lubricant that can out perform conventional lubes. By the way, let's not confuse synthetic oils with petroleum oils fortified with teflon, graphite or moly additives. Not the same thing. Something that is synthetic is a man-made substitute for a natural item, i.e., rubber. Because a synthetic is built from the ground up, it has predictable characteristics; desirable attributes can be enhanced while leaving out the deficiencies. Thus, the synthetic version is nothing less than an idealized version of the original item. Automobile tires are an excellent example of synthetic engineering.

The earliest lubricants go back to deposits of beef tallow found on the axles of Egyptian chariots (1400 BC). Apparently, most lubricants from antiquity until early in the 19th century were comprised of animal fats, whale and porpoise oils, oils from olives, castor bean, wool grease and shallow oil drilling. After the famous Lucas Gusher in 1901, refining petroleum lubricating oils from thick crude became a fine art that met the needs of the new automobile craze, and fill the crankcases of ol' Henry's Model T.

The motor oils used in the majority of cars today have to meet or exceed a class of American Petroleum Institute (API) service designation, regardless whether it is petroleum or synthetic in chemical form. Fifty years ago most oils had a rating of 'ML' - Motor light. Just a simple oil that may have contained a foam dispersant, currently equivalent to SA. These oils had no detergent and were primitive by today's API standards. Oh, the oil stayed clean, but your engine got dirty. Strictly the stuff Freddie Flintstone used. The 1940's saw an added rating of MM (now SB), which included a rust and oxidation inhibitor.

By 1964, the new API rating was MS (now, SC). No real improvements as evidenced by the high failure rate with the HP 409 engines. In 1968 we saw a more severe MS equivalent to SD which included low temperature, anti-sludge and anti-rust properties. 1972 began a new rating of SE. Things were getting interesting because the oil had to offer anti-oxidation along with SD properties. Today we use an SF oil that was introduced in 1980. This called for improved anti-wear additives and protection against engine deposits. What's next? I'm sure we will see SG in the next year or so as car manufacturers now demand more out of smaller displacement engines with less oil in the pan. I did not mention the CC and CD API designation because these oils are for diesel use. (C stands for compressor ignition, S stands for spark ignition) An SF/CE (latest API) is a must for max protection.

In Europe where API is not the gold standard, oils have to meet the CMCC (Comte' des Constructeurs d'Automobiles du march'Commun) performance standards. These standards are much more rigid than our American API requirements and many conventional oils fail to meet them. Synthetic lubes are well ahead of the CMCC and API.

The First 100% Synthetic 10W-40

During 1972, Air Force jet pilot A.J. Amatuzio started a company called AMSOIL. He was an innovator for land vehicle lubricants due to his knowledge of synthetics for jet turbine engines. AMSOIL introduced the 1st API service rated SE 100% ester-based synthetic 10W-40 oil for the modern automobile engine. In fact, this oil was able to meet the API 1980 SF rating, 8 years ahead of its time. Actually, synthetics offer many benefits not included in the API service rating: greatly extended drain intervals and increased fuel economy are among them.

Moisture

Cars driven few miles in a year such as classic cars used for show or summertime cars never driven in winter need a lubricant that also protects against condensation and consequent rust. Moisture can be a real problem for engines in storage or limited use. First, moisture (caused by thermal cycling) in an engine can mix with combustion by-products in the oil to form acids which will corrode engine interiors and form rust. The effect over a prolonged period means trouble for an engine, including premature engine failure. Synthetic oils help combat the moisture caused by condensation and prevents the formation of rust thanks to their special chemistry and high total base number (TBN). The higher the TBN, the greater capacity of an oil to fight off acidic compounds.

Seals

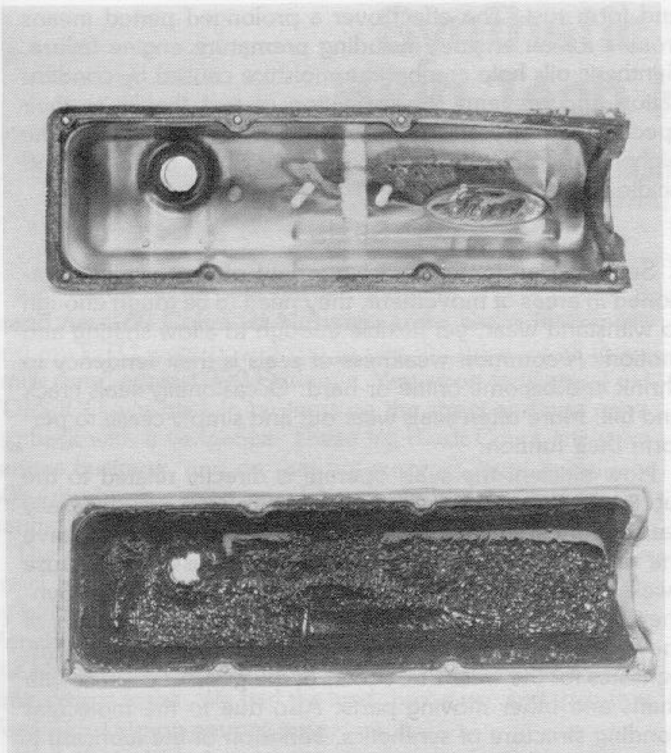
Seals are an important component of any engine. Stationed in areas of movement, they need to be tough enough to withstand wear, yet flexible enough to allow shifting and motion. A common weakness of seals is their tendency to shrink and become brittle or hard. Occasionally seals crack and fail. More often seals wear out and simply cease to perform their funtion.

How efficient the seals operate is directly related to the lubricant chosen for your engine. Petroleum oils generally cause more shrinkage than swelling. Some synthetics leave the seal unchanged while other synthetic base stocks cause swelling of varying degrees based on lab formulations. Synthetics are generally formulated to allow a slight swelling of the seals. This minor swelling is excellent because it compensates for the wear that occurs at the point of contact with shafts and other moving parts. Also due to the molecular bonding structure of synthetics, adhesion of the lubricant is improved and prevents seals from drying out.

High And Low Volatility

High volatility is a characteristic of petroleum lubricants trying to be fuel efficient. Volatility occurs when lubricant manufacturers use "only" petroleum base stocks to produce low viscosity engine oils, 10W-30 for example. But petroleum base stocks light enough to deliver the low viscosity side of a 10W are highly volatile or changeable. Thus, when conventional oils are subjected to the high heat found in modern engines, they begin to evaporate or volatilize. As a result, what was originally a 10W-30 quickly becomes a 20W-30 or a straight 30 as a result of the loss of the light (low viscosity) ends.

The meaning of this phenomenon is that the lubricant marketed as a fuel efficient 10W-30 soon becomes a fuel inefficient 20W-30, often within weeks of introduction into your crankcase, causing engine drag, and displaying poor low temperature characteristics such as poor low temperature fluidity. If you inspect under your valve cover, or PCV valve, you will notice a greasy oil film or thick sludge which is a direct result of the petroleum evaporate condensing on the cooler surfaces. That same evaporate (unburnt hydrocarbons) is added into your intake manifold vacuum and burnt along with fuel, adding to exhaust pollution and intake valve deposits. The NOACK volatility test measures the evaporation or weight loss of a test oil. A popular synthetic 10W-30 designed for turbo charged cars had a weight loss of 8% compared to almost 30% for a very popular petroleum 10W-30.



Top: Engine was run twice the length of the Sequence III-D to earn SF rating with a popular synthetic 15w-50. Bottom: Engine cover from conventionally refined premium petroleum 20w-50 oil.

Shear Stability And Viscosity Improvers

Viscosity change is another important ability of any oil. In other words, what goes in as a 10W-40 should still be a 10W-40 after many miles. Petroleum oils rely on additives known as viscosity index (VI) improvers. A petroleum 10W-40 is basically a thin SAE 10 weight oil with a good amount of VI improvers and detergent dispersant. VI improvers behave differently at high temperatures than at low temps giving a change in viscosity. VI improvers DO NOT add to the lubricity of the oil and tend to shear apart as the motor oil is squeezed and slashed with whirling, scraping frictional losses caused by internal combusion monkey motions.

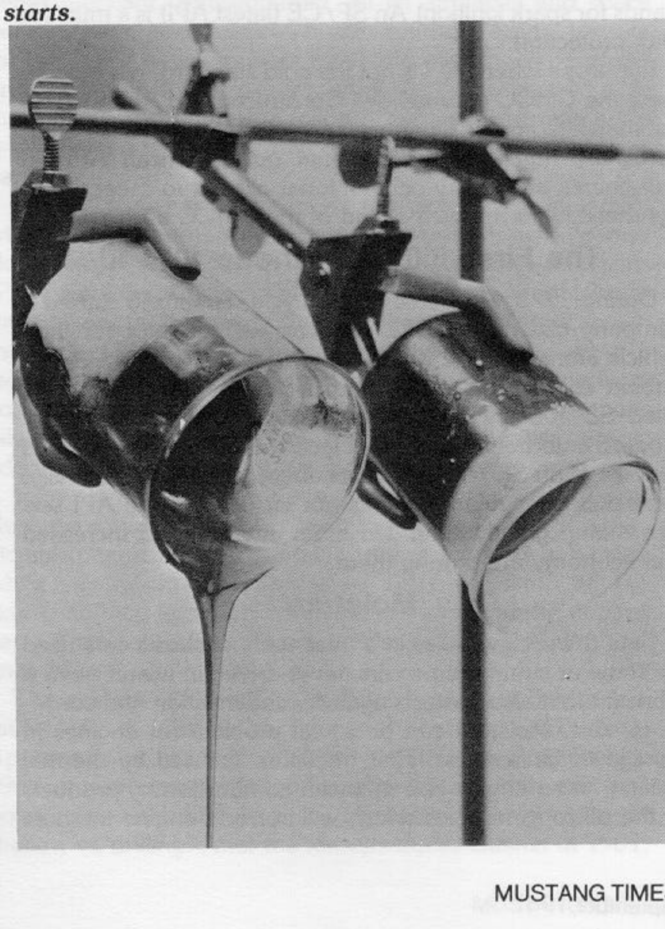
The long molecule VI chains that are found in petroleum oil are subject to rapid deterioration and the oil shears back to a 10W-20 or lower viscosity. As the VI improver's deteriorate, the oil's viscosity not only becomes unstable, but the used additive reacts chemically to form harmful engine deposits. Combine this mess with high volatility! Many synthetics are formulated without VI improvers and are noted as being "shear stable". Syn-lubes can maintain their original viscosity throughout the entire period of use. Most synthetic oils can perform better after 10,000 miles than brand new petroleum oils. Your favorite drag racer changes his petroleum oil every quarter mile and never see's this problem. Do you change your oil that often?

In a standard test for viscosity change called the OLDS III-D test, Amsoil 100% synthetic 10W-40 changed a mere 9% in 64 hours compared to 102-400% for petroleum. Mobil 1 doubled the III-D test (128 hours) and yielded only a 32% viscosity increase. Some petroleum oils tend to solidify after the 64 hour test.

Low Temperature Fluidity

Low temperature fluidity becomes an important consideration when winter chill pushes the thermometer below zero. Borderline pumping temperature (BPT) is the lowest temperature an oil can be adequately circulated throughout an engine. This is a critical factor in cold weather operation since poor oil circulation not only inhibits starts, it also causes excessive engine wear. Cold room tests have shown that up to 40% of all engine wear occurs because of oil starvation during winter starts. In cranking test conducted by Mobil Corp. with Mobil 1, at -30°F a test engine turned at an average speed of 152 RPM, and started. Using 10W-30 and 10W-40 primium petroleum oils, the same engine cranked at 45 and 32 RPM respectively and did not start. In fact, Mobile Delvac, Conoco DN, and Chevron Sub Zero synthetic oils were supplied to the large diesel engines during oil drilling on Alaska's freezing North Slope. A true testimony to their effectiveness in severe climates.

Left beaker containing AMSOIL 10w-30 synthetic oil still flows at -60 F. Petroleum 10w-30 on right was solid. This is why there is so much engine wear during cold weather starts.



Film Strength

This refers to the amount of pressure required to force out a film of oil from between two pieces of flat metal. The higher the film strength, the more protection is provided to such parts as piston rings, timing chain, cam lifters and rocker arms . . . wherever the lubricant is NOT under oil system pressure. Synthetics routinely exhibit a nominal film strength of well over 3,000 psi, while petroleum oils average somewhat less than 500 psi. The result is more lubricant protection between moving parts with synthetics. Based on their superior film strength, synthetics were used in the Atlas rocket engine turbo-pumps for the U.S. Apollo Space programs. Synthetic hydraulic fluids have also played a major role in air and spacecraft where performance and safety are the primary goals. NEO Oil Company offers special metal coatings (NEO SEAL) to work with their line of synthetic lubes to enhance boundary lubrication.

Camshaft and bearings still within factory spec's after 90,000 miles using a popular turbo-charge synthetic 10w-30 oil.

Part II in next month's issue will further explore the benefits of synthetic oils such as reduced oil temperatures and extended drain intervals. — Ed.