

Lubrication Fundamentals

There's something synthetic about synthetics



By Dr. Robert M. Gresham
Contributing Editor

Synthetic oils have been around for a long time, about 50 years. They began to gain popularity for use in industrial applications in the 1970s and were often mischaracterized, giving synthetics an excessively good and bad reputation at the same time.

Part of the problem came from those individuals we love to call snake oil salesmen. I encountered folks some years ago who represented their products as “all synthetic.” I guess what they meant is that their oils are produced by man. Their products were common (Group I or less) mineral oil and additives. I guess they couldn't figure out how to make a sale without some kind of hook besides performance and price, but more on that later.

According to the dictionary one of several definitions of synthetic is: *Not natural or genuine; artificial or contrived; prepared or made artificially.* I suppose that could be a fit. As a chemist, I tend to be a purist, and so, based on the Gospel According to Gresham, I still found these folks to be, at best, charlatans.

'Double, double toil and trouble...'

With apologies to MacBeth's famous trio of witches and their cauldron skills, there are a number of different types of synthetic base oils. To me, they tend to fall into two main groupings: those based on hydrocarbon chemistry, primarily Group IV, and everything else—the silicones, phosphate esters, perfluoroalkylpolyethers, etc.

To my way of thinking all synthetic base oils are generally specific polymers produced from controlled polymerization. These polymerization reactions begin with specific small pieces called monomers. The

hydrocarbon monomers come from crude oil (or perhaps gas-to-liquid technology), which has been broken down to very small basic building blocks like ethylene, propylene and their oxides. The resultant base oils are polymers of carbon, hydrogen and oxygen, most commonly the polyalphaolefins, dibasic acid esters, polyol esters and polyalkylene glycols.

Synthetics have the added advantage that they, by their very nature, can be tailored to fit specific market needs leveraging their specific attributes—but not without significant cost. When you think that they result mostly commonly from crude oil that has been broken down to these small monomers and recombined through polymerization, they have to be more expensive. These materials generally extend the useable temperature range, both high and low, and have a very high viscosity index. They don't have wax as a contaminant. Thus, if we really do our jobs correctly, it is relatively straightforward to determine the value-in-use of a synthetic in a given application.

But here comes the rub. Now we have the emergence of the Group II, Group II+ and Group III mineral oils. These are the result of increasingly more sophisticated refining of crude oil, also resulting in progressively higher cost. Group III oils now begin to approach the performance of synthetics. In fact, in 1999 the National Advertising Division ruled that Group III base oils could be called synthetics. But, again, the dictionary has another meaning to the word synthetic: *produced by synthesis, especially not of natural origin.* Kind of makes you think there might be a problem here. So let's try to put all this into perspective.

You may recall that I once characterized the refining of crude oil as being analogous to a refining mixture of every kind of cooked pasta you have ever seen: spaghetti, lasagna, ziti, shells, rotini, noodles, linguini, stars, etc. It is all flour but in many different forms. We have learned that long straight pasta, like eight-inch-long spaghetti, generally, makes the best lubricant pasta (or, rather, lubricant).

In the refining process, we separate the different kinds of pasta into the different types through processes of distillation (kind of like removing the very big and the very little pieces), cracking (like breaking the very long pieces of pasta like linguini and spaghetti into the shorter eight-inch pieces), hydrogenation (converting some pieces into others), dewaxing (removing certain large types like lasagna) and so forth. Without going too far with this analogy, we can think of Group I, II, II+ and III as increasing degrees of rigorousness in sorting out our pasta to make the coveted eight-inch spaghetti.

The true synthetics, according to the Gospel of Gresham, are synthesized from basic semolina to make the eight-inch spaghetti. The position of true synthetic producers is that these highly refined oils still have some level of wax and some level of this or that, which results in lowered performance on some level. The analogy might be that we take the linguini and slice it down the middle to make it about the same thinness as spaghetti and cut it off to the desired eight inches, but it still is flat with edges rather than round.

From my perspective, the term synthetic was co-opted by the marketing side of the house from manufacturing and R&D in 1999. My sales friends from the first paragraph have, in effect, won or at least been shown not to be so bad.

But the marketplace always rules: That grumpy, recalcitrant so-and-so, the customer, will have his say, usually loudly. He wants performance and price—more of the first and less of the second, and don't forget

consistent, high-quality and on-time delivery, as givens. As our customers become more and more sophisticated, and they are, they will specify the level of performance they need for a given application. They will not pay a premium for performance they don't need, or compromise on performance for price. Thus, suppliers are going to have to figure out how to meet these needs.

One could envision custom blending of a PAO and Group III or even Group II to meet a specific cost/performance relationship. This is not trivial, as the needed additives do not always behave the same way in the different oils. Thus, the custom blend of oils is also going to involve a custom blend of compatible additives. This is not easy, but computers can help make some of this happen.

The customer also will have to contend with how he will approve these blends—will he want field-testing for each custom blend? All that starts to become expensive, but the decision will be the customer's. Our job will be to give him what he wants—if we want to grow our market share.

What we call these modern products is a problem for the sales and marketing departments, and in the end it really won't matter. It all will be sound and fury signifying nothing—including to the Gospel According to Gresham. <<

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Crude Oil



Synthetic oil



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