Ethos Environmental, Inc.

MORE ABOUT ESTERS

In the simplest terms, esters can be defined as the reaction products of acids and alcohols. Thousands of different kinds of esters are commercially produced for a broad range of applications. Within the realm of synthetic lubrication, a relatively small substantial family of esters have been found to be very useful in severe environment applications.

Esters have been used successfully in lubrication for more than 50 years and are the preferred stock in many severe applications where their benefits solve problems or bring value. For example, esters have been used exclusively in jet engine lubricants worldwide for over 40 years due to their unique combination of low temperature flowability with clean high temperature operation. Esters are also the preferred stock in the new synthetic refrigeration lubricants used with CFC replacement refrigerants. Here the combination of branching and polarity make the esters miscible with the HFC refrigerants and improves both low and high temperature performance characteristics. In automotive applications, the first qualified synthetic crankcase motor oils were based entirely on esters and these products were quite successful when properly formulated. Esters have given way to Polyalphaolefins (PAOs) in this application due to PAOs lower cost and their formulating similarities to mineral oil. Nevertheless, esters are nearly always used in combination with PAOs in full synthetic motor oils in order to balance the effect on seals, solubilize additives, reduce volatility, and improve energy efficiency through higher lubricity. The percentage of ester used in motor oils can vary anywhere from 5 to 25% depending upon the desired properties and the type of ester employed.

Ester lubricants have already captured certain niches in the industrial market such as reciprocating air compressors and high temperature industrial oven chain lubricants. When one focuses on high temperature extremes and their telltale signs such as smoking, wear, and deposits, the potential applications for the problem solving ester lubricants are virtually endless.

In many ways esters are very similar to the more commonly known and used synthetic hydrocarbons or PAOs. Like PAOs, esters are synthesized form relatively pure and simple starting materials to produce predetermined molecular structures designed specifically for high performance lubrication. Both types of synthetic base stocks are primarily branched hydrocarbons which are thermally and oxidatively stable, have high viscosity indices, and lack the undesirable and unstable impurities found in conventional petroleum based oils. The primary structural difference between esters and PAOs is the presence of multiple ester linkages (COOR) in esters which impart polarity to the molecules. This polarity affects the way esters behave as lubricants in the following ways:

Volatility: The polarity of the ester molecules causes them to be attracted to one another and this intermolecular attraction requires more energy (heat) for the esters to transfer from a liquid to a gaseous state. Therefore, at a given molecular weight or viscosity, the esters will exhibit a lower vapor pressure which translates into a higher flash point and a lower rate of evaporation for the lubricant. Generally speaking, the more ester linkages in a specific ester the higher its flash point and the lower its volatility.

Lubricity: Polarity also causes the ester molecules to be attracted to positively charged metal surfaces. As a result, the molecules tend to line up on the metal surface creating a film which requires additional energy (load) to penetrate. The result is a stronger film which translates into higher lubricity and lower energy consumption on lubricant applications.

Detergency/Dispersency: The polar nature of esters also makes them good solvents and dispersants. This allows the esters to solubilize or disperse oil degradation by-products which might otherwise be deposited as varnish or sludge, and translates into cleaner operation and improved additive solubility in the final lubricant.

Biodegradability: While stable against oxidative and thermal breakdown, the ester linkage provides a vulnerable site for microbes to begin their work of biodegrading the ester molecule. This translates into very high biodegradability rates for ester lubricants and allows more environmentally friendly products to be formulated.

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