Ester-Based Exended Life Compressor Lubricant

SA Performance

Extended life lubricants, referred across the industry as "POE's", were originally introduced for rotary screw compressor applications where high operating temperatures are naturally experienced, and in high pressure systems where temperatures can exceed 250°F. These fluids are also used by request from customers who strive to maximize a lubricant's useful life through a condition-based oil analysis program.

A lubricant formulated with ester and synthetic hydrocarbon base fluid components can provide several benefits to the operation of a rotary screw compressor, including:

- Superior thermal and oxidative stability
  - Allows for a wider range of operating temperatures without the risk of premature fluid failure, varnish or sludge formation.
- Improved thermal stability
  - Allows for higher operating temperatures where the additives can no longer prevent fluid failure.
- Quick separation from water
  - Ensures condensate generated from the compression process can be easily eliminated from the machine, providing pure lubricant to reach the bearings for enhanced protection.

Ester Types

Synthetic esters used for lubrication, are classified as Group V bases under API Base Oil Categories. Further references to the types of esters are commonly over-simplified. Esters are made from various types of carboxylic acids and alcohols, with water being an additional byproduct as part of the manufacturing process. The desired finished product results in an ester that can be easily modified to meet a lubricant manufacturer's performance expectation for the environment and application, leveraging the fluids hydrolytic stability, oxidative stability, biodegradability, lubricity, high viscosity index, and/or low temperature performance. The raw materials used to achieve these characteristics can be linear, branched, saturated, unsaturated, monofunctional, difunctional or polyfunctional. With so many chemistries available to choose from, there are many possible finished ester combinations.

As it's related to rotary screw air compressor lubricants, two subcategories of esters are commonly used. Pentaerythritol esters, also known as true polyol esters or POE's. These are found in high quality PAG formulations such as Sullair's Sullube, Ingersoll Rand's Ultra Coolant and Simple Air Performance's SAP 8000. Benzenedicarboxylic acid branched alkyl

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esters, commonly referred to as diesters, are blended with a polyalphaolefin (PAO) or synthetic hydrocarbon for finished fluids. The branched alkyl esters used in these extended life finished fluids, while commonly referred to as "POE's" are in most cases diesters and may also be referred as multi-functional synthetic esters.

Fluid Life Ratings

Many OEM and aftermarket lubricant suppliers state a fluid's expected operating hours under normal conditions, which can prove to be both vague and misleading. Most all lubricants follow the same basic temperature/operating life longevity curve, with every 18.5°F increase in temperature, the fluids operating life is cut in half. This curve remains the same regardless of fluid chemistry including PAO, PAG, POE and diester based fluids. While most OEM and aftermarket suppliers of compressor lubricants will outline the typical operating hours for their lubricant, few communicate the temperature at which the lubricant is rated for to achieve 100% fluid life.

Lubricant Comparison

The below comparison of common OEM and aftermarket ester-based extended life rotary screw compressor lubricants exhibit the many differences in formulation theory for these products. While specifications can vary greatly, the fluid longevity in challenging conditions have been proven for many years.

Properties	Test Method	GD's Aeon 9000TH	Quincy QuinSyn+	Summit Ultima-46	SAP 6000-46
Base Fluid Type	-	PAO/MFSE	PAO/Ester	PAO/POE	PAO/Ester
Color	-	Natural	Natural	Natural	Natural
Density @ 15°C	ASTM D1298	0.926	0.909	0.921	0.897
Viscosity @ 40°C (cst)	ASTM D445	60.01	46.0	50.0	45.7
Viscosity @ 100°C (cst)	ASTM D445	8.6	7.5	7.35	6.79
Viscosity Index	ASTM D2270	116	127	108	102
Flash Point °C (°F)	ASTM D92	261 (500)	266 (511)	254 (490)	243 (470)
Foam Tendency (Sequence I, II, III)	ASTM D892	0/0, 0/0, 0/0	0/0, 0/0, 0/0	0/0, 0/0, 0/0	0/0, 0/0, 0/0
Demulsibility	ASTM D1401	40/40/0	40/40/0	40/40/0	40/40/0

Conclusion

The compressor industries use of these ester-based fluids show continual growth year over year, with finished fluid formulations varying widely. Despite these chemistry differences, ester-based fluids excel when used in compressors placed in demanding conditions, where coolers are undersized, and when PAO-based fluids fail prematurely.