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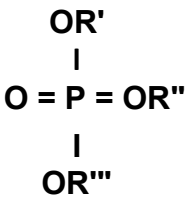
'Providing Tribological Solutions'

What Are Phosphate Esters?

There are many types of ester-based fluids and several are widely as used as lubricants, as hydraulic fluids and/or as lubricant additives. Examples include phosphate esters, diesters and polyol esters. These are used because they have performance and/or safety advantages over just mineral oil-based fluids.

More details later but first, esters themselves have been described as compounds formed by replacing the hydrogen of an acid by a hydrocarbon radical of the ethyl type. The name was coined by the German chemist Gmelin and was some time ago because he died in 1853. Without getting to much into the chemistry, esters can be produced by the reaction of an organic or inorganic acid with an alcohol or with another organic compound containing the hydroxyl (-OH) radical.

Chemically, phosphate esters can be called organic salts of orthophosphoric acid $O=P(OH)_3$. They are also organophosphorous compounds, of which there are thousands. However, only one relatively small group has found significant use as basestocks for synthetic fluids. These are the trisubstituted, or tertiary (t), phosphate esters with the general structure as follows;



Typically all three R groups are organic groups containing four or more carbon atoms. Consequently, the important phosphate esters are either triaryl, trialkyl or aryl alkyl phosphates. The triaryl phosphates are the most significant which can have all three organic groups the same as in tricresyl or trixylenyl phosphate or they might be different as in isopropylphenyl diphenyl phosphate.

Originally the raw materials used included cresylic acids derived from coal tar and coking operations. While still synthetic fluids, they have become known as "natural" phosphate esters. Examples include tricresyl or trixylenyl phosphate such as Fyrquel® EHC-N and Reolube® Turbofluid 46XC. Those made from phenolics derived from other processes are known as "synthetic phosphate esters. Examples of these are isopropylphenyl diphenyl phosphate and tertiary butylphenyl phenyl phosphate. The latter can be Fyrquel EHC-S and Reolube Turbofluid 32B GT and Turbofluid 46B (Durad). The products with GT are for gas turbine driven equipment and are a lower viscosity while the others are for hydraulic and/or electrohydraulic control applications. The different fluids are required because the various fluids have pros and cons. However, they all share the characteristics of being fire resistant and having high flash and fire points as well as high autoignition temperatures and low heats of combustion. Plus, having good oxidative stability and EP wear characteristics.

Fyrquel is a trademark of ICL and Reolube a Trademark of Lanxess.