

Technical Note

Compatibility of Polymers and Base Oils

Functional Products Inc.

Polymer additives are widely used in lubricant and lubrication grease formulations. Typical examples are viscosity modifiers, pour point depressants, thickeners and water resistance enhancing agents. In most applications, polymer additives must be soluble in the base oil. The solubility of polymer in the base oil is essential to its performance in the finished lubricant. There are several factors that determine the solubility of a polymer in a particular base oil. A certain degree of the chemical similarity between the polymer and base oil is necessary to achieve good solubility.

Major lubricant base stocks include mineral oils, polyalphaolefins (PAOs), synthetic esters, vegetable oils and polyalkylene glycols (PAGs). The chemical structure and polarity of each category oils varies significantly. Figure 1 shows the order of the polarity of different base oil types. Mineral oils and PAOs are hydrocarbons (See Figure 2 for examples). The polymers used as viscosity modifiers are generally high molecular weight hydrocarbons including polyolefins, olefin copolymers (OCPs) or EPDM types.

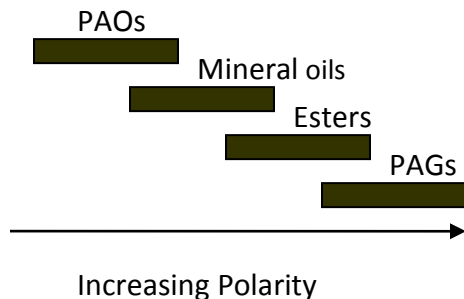


Figure 1: Polarity ranking of base oils

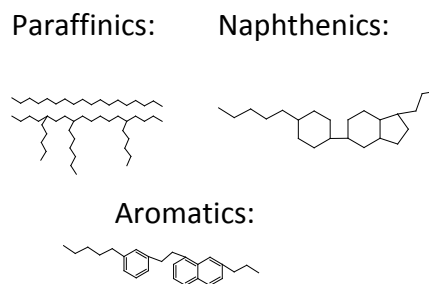


Figure 2: Types of mineral oils

Synthetic and natural esters, including vegetable oils, are more polar than mineral oils and PAOs due to the oxygen containing ester groups. Typical synthetic esters are monoesters, adipate esters, phthalate esters, trimellitate esters, polyol esters and TMP

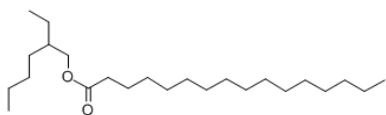
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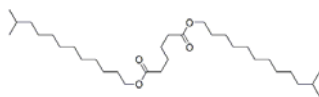
esters (see Figure 3 for examples). Vegetables oils are mainly composed of triglycerides. The degree of unsaturation and length of the fatty chain in the triglycerides varies depending on the type of vegetable oil. The compatibility of these esters with polymers depends on the types of the esters and the length of the fatty chains. Most of these oils are not compatible with OCPs and are compatible with more polar polymers such as ethylene/vinyl acetate copolymers (EVA) or polymers with π bonds including polybutadiene. Most PAGs have high polarity. High molecular weight polyethers are compatible with PAGs.

Example Synthetic Esters:

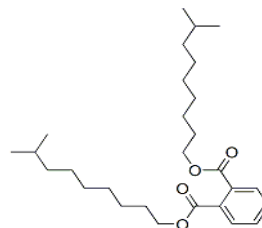
Monoester:



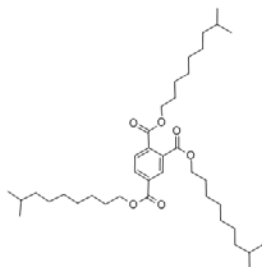
Adipate Di-ester:



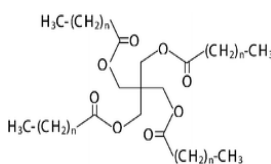
Phthalate Di-ester:



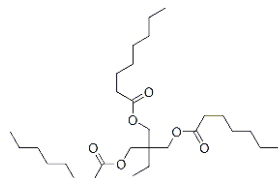
Timellitate Ester:



Polyol ester:



TMP ester:



Example Vegetable Oil Triglyceride:

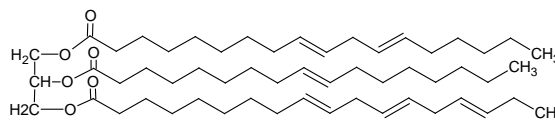


Figure 3: Examples of synthetic esters and triglycerides