Phenates (Alkyl Phenate Sulfides)

Introduction

At Chevron Oronite, we foster a culture grounded in operational excellence and are conscientiously committed to protecting people and the environment. This Product Stewardship Summary is an example of that commitment.

The metallic salts of alkyl phenol sulfides, commonly referred to as “phenates”, belong to the class of lubricating oil additives known as detergents. Unlike household detergents, these detergents are specifically designed to be soluble in oil, and insoluble in water.

Detergents are critical components of an engine’s lubricating oil, providing protection. Whether it is a lawn mower, car, or a massive two story marine diesel, engines and other machines do not run by themselves. To perform their everyday functions as well as expected, all their moving parts must be powered and protected with fuels and lubricants enhanced by some of the most technologically advanced additives.

Detergents provide a means for dissolving otherwise insoluble metallic salts, like calcium or magnesium carbonate, in lubricating oil (see manufacturing description below). As such they function like an “antacid” for the engine, neutralizing corrosive combustion acids that would otherwise dissolve key metal parts and eventually lead to engine failure.

Detergents also prevent the buildup of harmful deposits on the rings and in the grooves of the engine pistons. These deposits can cause the rings of the piston to stick, causing potentially catastrophic liner wear, which leads to loss of engine compression (power), poor

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emissions quality and fuel economy, and eventually engine failure. Phenates contain sulfur. Sulfur provides oxidation protection to the oil, preventing oil viscosity increase which can impede the oil's ability to lubricate. Oronite's family of Viscosity Index Improvers combines excellent viscometric effectiveness with the high oxidative stability engines need.

Description and Properties

The chemical structure of a phenate contains four critical parts (see Figure 1).

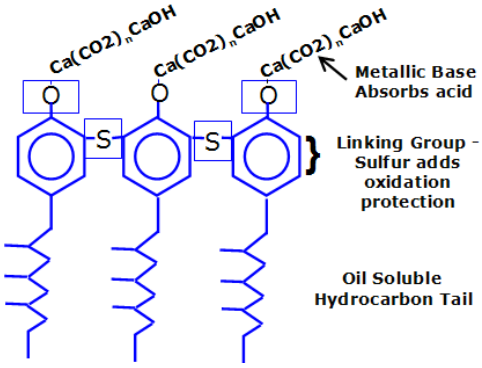

Figure 1. The chemical structure of a phenate contains four critical parts. 1) Hydrocarbon tail, 2) Linking group, 3) Metallic carbonate, 4) Sulfur

The first part is the long hydrocarbon tail that allows the phenate to dissolve in lubricating oil (and not water). This tail is typically a polymer of a low molecular weight hydrocarbon like propylene, usually 12 to 15 carbons long or longer.

The second critical part is what is called the linking group, which links the long hydrocarbon tail to the metallic salt or carbonate. For phenates the linking group is phenol from which the generic name phenate is derived. Typically the linking group and the hydrocarbon tail are reacted together, and then the product (called an alkylphenol) is reacted with sulfur and the metallic oxide and carbon dioxide (to make the carbonate) in the presence of a glycol catalyst.

The third part is the metallic carbonate itself, and the fourth part is the sulfur that links phenates together into a larger polymeric molecule (and further aids oil solubility).

At ambient temperature, phenates appear as a highly viscous, water insoluble, almost black liquid with no appreciable odor. Phenates are denser than water, so they would sink if poured into water. Upon heating, they may give off the faint odor reminiscent of burning tires, but this is generally not detected in the applications for which they are intended.

Tetrapropenyl phenol (TPP) and its calcium salt, the raw material that is

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Detergents help prevent the buildup of harmful deposits on the rings and in the grooves of the engine pistons.

The chemical structure of a phenate contains four critical parts.

1) Hydrocarbon tail
2) Linking group
3) Metallic carbonate
4) Sulfur

used to make phenates, remain in varying residual quantities in the final product.

Health Information

Studies of phenates by the dermal, oral, and inhalation routes of exposure indicate that these substances are relatively low in acute toxicity by all three routes of exposure. Exposure via inhalation to the highest vapor concentration attainable did not cause any deaths or signs of systemic toxicity.

Studies indicate that these substances are not irritating to the skin or to the eyes. Studies have not shown any evidence of skin sensitization.

Repeated-dose toxicity studies with phenates demonstrated that none of the tested substances caused systemic toxicity. Toxicity studies conducted by oral exposure demonstrate that phenates do not cause developmental malformations. Signs of systemic toxicity occur only at very high dose levels that are much greater than typical human exposure.

In studies, tetrapropenyl phenol (TPP) and its calcium salt caused a reduction in fertility, a reduction in number of offspring, and a reduction in the size of reproductive organs. Whether these effects were observed in studies depended upon the concentration of residual TPP and its calcium salt in the material tested. Studies conducted with alkyl phenate sulfides diluted to the concentrations used by consumers did not show any adverse effects on reproduction.

Studies demonstrate that these substances lack the potential to be toxic to the genetic material of the cell. Based on these studies, there is low concern that these substances are carcinogenic.

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Environmental Information

Phenates are not expected to be degraded by hydrolysis, photolysis, or oxidation, based on their chemistry, computational modeling and test data. They are expected to have limited biodegradation. Additional modeling predicts that these chemicals are likely to partition into soil and sediment. Based on both modeling and actual testing, phenates are unlikely to bioaccumulate in the environment.

Phenates are not toxic to aquatic organisms. These substances are not expected to inhibit wastewater treatment plant microorganisms at typical discharge rates.

In the event a product containing phenates spills, stop the source of the release if you can do it without risk. The Material Safety Data Sheet provided with the product contains suggested spill response and clean-up procedures. As appropriate (or required) report spills to local authorities. In the USA the US Coast Guard can be reached at 1-800-424-8802.

Based on both modeling and actual testing, phenates are unlikely to bioaccumulate in the environment.

Regulatory Information

Requirements may exist that govern the manufacture, importation, sale, transportation, use, and/or disposal of phenates or products containing them. These requirements may vary by jurisdiction. For more information, consult the relevant Material Safety Data Sheet (MSDS) or contact us.

Exposure Potential

The low volatility and low water solubility of phenates limits the potential for exposure, and therefore risk, to people in the workplace and consumers. Indirect exposure to these chemicals via the environment is likely to be negligible. Also, exposure to these substances is low because they comprise only a fraction of the final lubricant oil product.

Manufacturing of phenates generally occurs in dedicated closed systems with proper engineering controls, thereby minimizing exposure. Solid waste is either incinerated or recycled and therefore there is no significant release to the environment. Waste water is treated before release to a sewer or other appropriate system. Workers in manufacturing plants, including those in sample analysis, blending, maintenance, and cleaning are well trained in their particular operations and wear appropriate personal protection equipment, e.g. safety glasses, chemical resistant gloves, etc.

Professional mechanics, service station attendants, and other skilled workers that are frequently involved with oil changes use personal protective equipment and hygiene practices that reduce exposure to lubricant oils. Consumers have potential for exposure to small amounts of these substances due to the possibility of skin contact with fresh lubricant oils that can occur during crankcase oil changes or periodic oil "top off". There may also be infrequent, trivial inhalation exposure to aerosols/vapor if "top-off" is conducted before the engine has cooled. However, "do-it-yourself" consumer exposure is likely to be relatively infrequent. In summary, there is minimal potential for exposure of the consumer to phenates.

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Responsible Care Contact Information

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This summary is based on information as of January 2009.