Carboxylates

Introduction

The metallic salts of carboxylates 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 against deposits, corrosive wear, and oxidation. Whether it is a lawn mower, car, or massive two story marine diesel engine, the engines and machinery of life 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. 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 are critical components of an engine's lubricating oil.

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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 emissions quality and fuel economy, and eventually engine failure.

Description and Properties

Carboxylates appear as viscous brown liquids, and are insoluble in water. They have no appreciable odor. Per OSHA (Occupational Safety and Health Administration – US) guidelines, these materials are not considered flammable or combustible.

Carboxylates are made up of three parts – a long hydrocarbon tail which is responsible for their solubility in lubricating oil; a polar acidic head, which serves as a linking group to the third part; the calcium carbonate base which is sequestered in the center of the molecule. Much like sulfonates (another class of detergents described in a separate product stewardship summary), the balance of calcium carbonate base vs. the actual carboxylate detergent present in the molecule is tailored to the specific application for which the carboxylate is intended.

The detergent, or “soap” portion of the molecule (the long tail and polar head), as shown in Figure 1, helps to clean engine deposits, especially on the piston ring and lands. However, there is still a need to neutralize harmful combustion acids, so the solution is to use several different types of detergent, both those that are rich in soap to protect against engine deposits, and those that are rich in metallic carbonate base to protect against corrosive wear from combustion acids.

Figure 1: Generic Detergent Structure

Health Information

Studies of carboxylates by the dermal and oral routes of exposure indicate that these substances are relatively low in acute toxicity. They are not expected to be harmful if inhaled. Signs of systemic toxicity occur only at very high dose levels that are much greater than typical human exposure.

Studies indicate that some carboxylates are irritating to the skin and can be skin sensitizers. There is no evidence that these chemicals are significant eye irritants. Toxicity studies conducted by oral gavage demonstrate that carboxylates do not cause developmental malformations.

Some carboxylates contain a material that may cause adverse reproductive effects upon repeated swallowing. These adverse reproductive effects included reductions in fertility, reduction in number of offspring, and a reduction in the size of reproductive organs.

In-vitro and *in-vivo* studies demonstrate that these substances lack the potential to be genotoxic. Based on these studies, there is low concern that these substances are carcinogenic.

Environmental Information

Based on test data, carboxylates are not readily biodegradable and may cause long-term adverse effects in the aquatic environment. Carboxylates are not toxic to aquatic organisms. When used as recommended with proper controls, exposure of the aquatic environment to these chemicals is not likely. These substances are also not expected to affect or inhibit wastewater treatment plant microorganisms at typical discharge rates.

In the event a product containing carboxylates 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.

Regulatory Information

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

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Carboxylates are sometimes used in Marine Lubricants

Exposure Potential

The low volatility and low water solubility of carboxylates 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 small fraction of the final lubricant oil product.

Manufacturing of carboxylates 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. Wastewater 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 should 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 to carboxylates to the consumer in commercial settings

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