Sulfonates

Introduction

The metallic salts of alkaryl sulfonic acids, commonly referred to as "sulfonates", 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 are insoluble in water.

Detergents are critical components of an engine's lubricating oil, providing protection whether it's a lawn mower, car, or massive two story marine diesel engine.

First, 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 toengine failure.

Second, detergents 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

Sulfonates appear as viscous amber liquids, and are insoluble in water. They are denser than water, and as a consequence would sink if oured into water. They have no appreciable odor. Per OSHA (Occupational Safety and Health Administration – US) guidelines they are not considered flammable or combustible.

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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.

Making the things that go, go better.™

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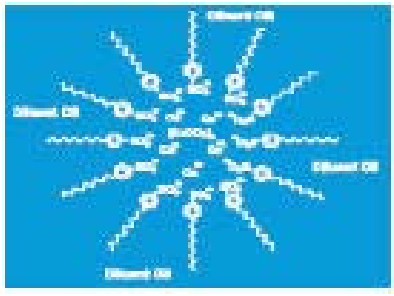

Figure 1. Chemical structure of a sulfonate contains critical parts.

Chemically sulfonates are made up of three parts – a long hydrocarbon tail which is responsible for their being soluble in lubricating oil; a polar sulfonic acid head, which serves as a linking group to the third part, the calcium carbonate base which is sequestered in the center of the molecule. The amount of carbonate base present in the molecule is tailored to the specific application for which the sulfonate is intended.

Figure 2. The heavy duty diesel piston is showing severe deposits due to lack of sulfonates.

The detergent, or "soap" portion of the molecule (the long tail and polar head) helps to clean engine deposits, especially on the piston ring and lands. In the photograph above is depicted a piston showing how carbonaceous deposits can build up without the correct selection of detergent. To prevent this deposit build up, lubricating oils are formulated with sulfonates that are high in soap content and relatively low in metallic base. However there is still a need to neutralize harmful combustion acids, so the solution is to use several different types of sulfonates, those that are rich in soap to protect against engine deposits, and those that are rich in metallic base to protect against corrosive wear from combustion acids.

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Health Information

Studies of sulfonates by the dermal, oral, and inhalation routes of exposure indicate that these substances are low in acute toxicity by all three routes of exposure. Signs of systemic toxicity occurred only at very high dose levels that are much greater than typical human exposure. Exposure via inhalation to the highest vapor concentration attainable did not cause any deaths or signs of systemic toxicity.

Studies indicated that sulfonates generally have the potential to cause only minimal irritation, and are not considered a potential irritant to the skin or eyes according to current regulatory guidelines. Studies have shown that sulfonates are skin sensitizers but when tested in human patch tests, overbased sulfonates are not potential skin sensitizers.

In studies, repeated exposures to sulfonates by the oral, dermal, and inhalation routes of exposure caused reversible and non-life- threatening systemic toxicity, low incidence of local skin injury at the site of application, and local injury to the lungs, respectively. Evaluation of all the data indicates that repeated-dose exposure to sulfonates demonstrates low toxicity.

In vitro and *in vivo* studies have demonstrated that these substances lack the potential to be genotoxic.

The low volatility and low water solubility of sulfonates limits the potential for exposure, and therefore risk, to people in the workplace and consumers.

Environmental Information

At Chevron Oronite, we foster a culture grounded in operational excellence and are conscientiously committed to protecting people and the environment.

Sulfonates are not expected to undergo hydrolysis, photolysis, or microbial degradation based on their chemistry, test data and predictive modeling. Additionally due to their low vapor pressure and low water solubility, they are more likely to partition into soil and sediment than into air and water. Based on current data, sulfonates are unlikely to bioaccumulate in the environment.

Sulfonates are not toxic to aquatic organisms based on a number of studies.

In the event of a spill of a product containing sulfonates, stop the source of the release if you can do it without risk. The Material Safety Data Sheet for 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 and Chemtrec at 1-800-424-9300.

Regulatory Information

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

Sulfonates are not expected to undergo hydrolysis, photolysis, or microbial degradation based on their chemistry, test data and predictive modeling.

Exposure Potential

The low volatility and low water solubility of sulfonates 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 during normal lubricant use is low because they comprise only a fraction of the final lubricant oil product.

Manufacturing of sulfonates generally occurs in dedicated closed systems with proper engineering controls, thereby minimizing potential 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 and those involved in transportation 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 potential 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 sulfonates.

Sulfonates have no appreciable odor.

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This summary is based on information as of January 2009.