Zinc Dialkyldithiophosphates (ZDTPs)

Introduction

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

For engines 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. The products we produce help fuels and lubricants push the boundaries of speed, strength, cleanliness and durability.

Zinc Dialkyldithiophosphates, or ZDTPs, are oil soluble chemicals which are used as additives in lubricating oils for internal combustion engines and transmissions. ZDTPs are a key component of modern engine oils, and while they represent only a small fraction of the total engine oil, they play a vital role providing wear protection of key metal-metal contact points in engines and transmissions. This results in extended engine and transmission life. Because they contain sulfur, ZDTPs also provide oxidation protection which extends the life of the engine oil. With this dual protection role, ZDTPs are sometimes referred to as “multifunctional” additives.

Figure 1 below shows a representative chemical structure of a ZDTP. ZDTPs are manufactured by reacting various types of alcohols with phosphorus pentasulfide, then neutralizing the resultant intermediate with zinc oxide. The phosphorus – sulfur – zinc linkage is key to understanding how a ZDTP protects engines from wear.

Figure 1. Chemical Structure of a ZDTP

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Figure 2 shows a photograph of the valve train of a typical four cylinder engine with the valve cover removed. The shaft running across the head of the engine is called a camshaft. It has off centered lobes that press on springs as the camshaft rotates, opening the valves to the engine to allow fuel to enter and exhaust to escape. Figure 2 also shows a close-up photo of severe wear on one of the individual lobes of the engine camshaft.

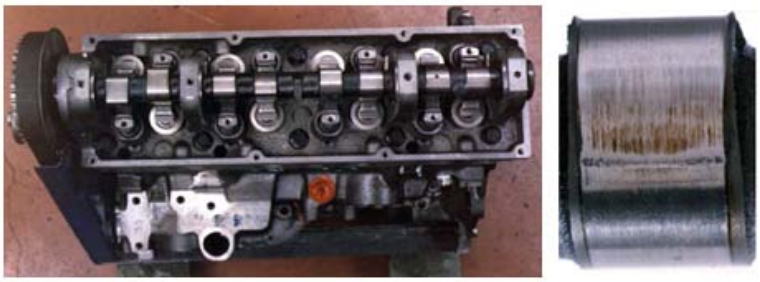

Figure 2. Example of valve train and close-up of wear on a camshaft lobe.

ZDTPs react with metal oxides on the metal surface to create a protective metal sulfide film (for most engines the film is iron sulfide).

ZDTPs prevent this wear by reacting with metal oxides on the metal surface to create a protective metal sulfide film (for most engines the film is iron sulfide). This soft sulfide film protects engine parts by sacrificing itself in lieu of wearing the harder metal surface. This process is described in Figure 3 below.

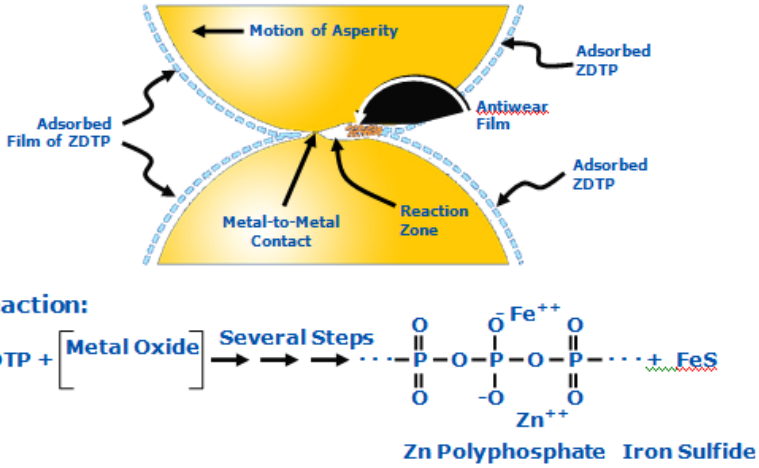

Figure 3. Creation of the protective wear film.

Description and Properties

ZDTPs appear as gold colored liquids with a thickness or viscosity similar to heavy syrup. They are not soluble in water, and because they are denser than water, they will sink in a water environment. They are readily soluble in oil and lighter weight hydrocarbons such as gasoline. ZDTPs have very low vapor pressure and little noticeable odor at ambient temperatures. When heated however, they have a sulfurous odor, similar to that of burning rubber. Since ZDTPs are present in a small amount in lubricating oils, this odor is not noticeable during normal operation.

ZDTPs are not soluble in water, and because they are denser than water, they will sink in a water environment.

Health Information

Studies of ZDTPs by the dermal and oral routes of exposure indicate that these substances are low in acute toxicity by both routes of exposure. Clinical signs of toxicity were relatively minor, and in many cases the effects disappeared after exposure was stopped.

Signs of systemic toxicity occur only at very high dose levels that are much greater than typical human exposures. Studies indicate that ZDTPs are strong skin, eye and mucosal irritants, and have demonstrated that ZDTPs can cause irreversible eye damage. Repeated exposures to high doses of ZDTPs via oral or dermal routes of exposure results in toxic effects that are related to the strong irritancy of the ZDTPs.

Repeated dermal exposure can cause dermatitis, body weight loss, and affect the blood. Repeated oral exposures can cause gastrointestinal irritation, inflammation, body weight loss, and diarrhea. Evidence of these toxicological effects is observed at very high doses that are much greater than typical human exposures.

Studies demonstrate that these substances have low potential to be toxic to genetic material in cells and do not present a significant risk for mutagenicity or carcinogenicity in humans. Studies, as well as human epidemiological evaluations, provide no evidence of direct effects of repeated doses of ZDTPs on reproductive systems or indices.

Environmental Information

Zinc dialkyldithiophosphates (ZDTPs) are not expected to undergo hydrolysis, photolysis, or microbial degradation based on their chemistry, available test data or predictive modeling. Additionally, due to their low vapor pressure and low water solubility, modeling has indicated that ZDTPs are more likely to partition into soil and sediment rather than into air and water. Based on current data, ZDTPs are unlikely to bioaccumulate in the environment.

ZDTPs exhibit aquatic toxicity. Smaller ZDTPs (with side chains less than 8 carbons) are toxic to aquatic species. In the event of a spill of a product containing ZDTPs, stop the source of the release if you can do it without risk. The Material Safety Data Sheets (MSDS) provided with these products contain 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 ZDTPs or products containing them. These requirements may vary by jurisdiction. For more

Zinc dialkyldithiophosphates are important chemicals used to create products that are proven to increase engine life.

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

Information, consult the relevant Material Safety Data Sheet (MSDS) or contact us.

Exposure Potential

The low volatility and low water solubility of ZDTPs limits the potential for exposure, and therefore risk, to people in the workplace, as well as 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. Furthermore, these materials are designed to undergo thermal decomposition in the crankcase, resulting in the production of a lubricant film on critical engine parts to minimize engine wear and oxidation.

Manufacturing of ZDTPs generally occurs in dedicated closed systems with proper engineering controls, thereby minimizing exposure. Solid waste is either incinerated or recycled.

Waste water from the manufacture of ZDTPs 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 protective 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 ZDTPs.

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Responsible Care Contact Information

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This summary is based on information as of January 2009.