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XL-9000

ECOLOGICALLY COMPATIBLE LUBRICANTS

Thermal-Lube's growing line of **XL-9000** series of **EcoSynthetic®, BioSynthetic®,** and **BioNatural®** lubricants are products fully formulated to exacting specifications with carefully selected components that are each categorized as "environmentally compatible", and conducive to definite applications.

The ecological impact analysis of the entire life cycle of each individual component has been addressed and applied to the overall effect that each formulated lubricant from this series will have on the environment.

The overall toxicological potential of the **XL-9000** series of lubricants is evaluated by addressing the intrinsic toxicity of the material itself and understanding the magnitude of **exposure to the ecosystem**. Only when these two parameters are evaluated together with the **final degradation** analysis, can the total ecological impact of the lubricant be ranked.

> **For example**: A toxic lubricant may not pose a threat to the environment if the exposure is minimized or eliminated. On the other hand, a lubricant that is relatively non-toxic may be an environmental concern if large amounts are exposed to a population.

Toxicity is related to exposure (or dose). This is generally determined by the amount of a material in air or water to kill 50% of an organism population within a pre-designated time period [LC_{50} (Lethal Concentration)]. With direct oral and/or dermal doses to a particular species, this value is referred to as the LD_{50} (Lethal Dose to kill 50% of the species).

LC_{50} values greater than 100 ppm, LD_{50} oral values greater than 2000 mg/Kg body weight, and LD_{50} dermal values greater than 5000 mg/Kg body weight are generally considered non-toxic.

Ecotoxicity is correlated to the bioaccumulation potential (concentration of chemicals from water or food into living organisms). This is determined by the degree of uptake, distribution, metabolism, and elimination of a substance within a living organism.

> **For example**: A material that is taken up and widely distributed, but metabolised and eliminated, will not bioaccumulate. Similarly, a material that is not taken up cannot bioaccumulate. However, bioaccumulation will occur when some highly lipid-soluble materials will be taken up and stored in fats (lipids).

In aquatic species, most bioaccumulation occurs via direct uptake from water rather than from food source. The ratio expressed by the concentration in an organism to the concentration in water is called the **BCF** or **bioconcentration factor**.

This BCF is linearly related to the lipophilicity in aquatic species. Its physicochemical parameter (log P) can be simulated without actual laboratory experimentation by measuring and calculating the ratio of a component as it partitions into and out of octanol and water. Generally, the higher the log P, the greater the likelihood of bioconcentration.

Until recently, regulatory bodies had categorized all materials with a log P < 3 as non-bioaccumulators. It is now realized that log P values > 6 are also non-bioaccumulators. This is due to the absorption of highly lipophillic substances onto the organic fractions of sediments, and lack of absorbtion of hydrophobic materials across fish gills because of their very low water solubility, and relatively high molecular weights.

Final **biodegradation** of a lubricant is the last criterion to be assessed. Degradation may override many harmful characteristics such as toxicity and bioaccumulation.

> **For example**: A lubricant that degrades may not be an ecological threat even though the material is toxic and/or bioaccumulates. Final degradation may occur by hydrolysis, photolysis, and biodegradation.

Determining biodegradation tendencies of a lubricant is difficult because of its hydrophobic nature. The test method being developed and used as of this writing is the CEC L-33-T-82 test. This measures the oxygen consumption or carbon dioxide production in a closed aqueous (inoculum) system for 28 days.

Materials analyzed by this test method can be categorized as readily, inherently, or relatively biodegradable as compared to mineral oils. Readily biodegradable lubricants will degrade a minimum of 60% in 28 days. Inherently and relatively biodegradable lubricants will degrade over 15% in 28 days. What this actually means is that inherently and readily biodegradable lubricant products will degrade, but over a longer period of time.

In many industrial applications where lubricants are subjected to harsh or outdoor conditions, and long lubricant life is expected, or where lubricant leakage, environmental contamination, and toxicity pose ecological problems, readily biodegradable lubricants would be the desirable choice. Thermal-Lube's **XL-9000 BioSynthetic®** and **BioNatural®** series of lubricant products are all non-toxic, non-bioaccumulator, and readily biodegradable.

For continuous real-time FTIR analytical monitoring and automatic additive dosing of lubrication systems, please inquire about Thermal-Lube's **COAT®** system.