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Biodegradable Lubricants

Introduction

Environmental compatibility is usually viewed in respect to biodegradability and toxicity. While the first issue is reached by using a suitable biodegradable base fluid, low toxicity requires additives that are also environmentally friendly. However, lubricant performance (friction, wear, lifetime, load bearing, efficiency etc.) has a major impact on its overall environmental compatibility.

The replacement of mineral oils by biodegradable products is one of the ways to reduce adverse effects on the ecosystem. At the same time, products eco-labelled in the EU scheme can give you the guarantee that their compliance with established ecological criteria has been tested by independent third parties, the national and regional Eco-label Competent Bodies. Providing information about the environmental effects of a product during its whole life-cycle will be essential in order to support sustainable consumption.

1. Regulations and policies about biolubricant

Several national eco-labels/schemes and one international standard have been developed in the recent years setting requirements for the ecological and technical characteristics of lubricants: Nordic White Swan (Nordic Countries), Swedish Standard SS 15 54 34 (Sweden), EU Llincwa, Blue Angel, Eco-label RAL-UZ (Germany), German positive list, VAMIL regulation (The Netherlands), ISO 15380 (International Standard), European Ecolabel EEL 1005/360/CE etc.

2. Biolubricants requirements

There are other requirements that a biolubricant has to fulfil if they are also considered as environmentally friendly products:

- High biodegradability (rapid removal from environment)
- Low ecotoxicity (impact on the environment).
- Technical specifications (adequate performance as a lubricant)
- Contains a significant level of renewable raw material (sustainability)

The fact is that no universal agreement exists concerning the chemical composition of a biolubricant.

Primary biodegradation is the measure of conversion by biological system of the original organic into different products. This is the first step in biodegradation.

Readily biodegradation occurs when biodegradation performance is greater than a certain relative fixed percentage of ultimate biodegradation.

Ultimate biodegradation is the complete conversion of the original substance into carbon dioxide, water, and new microbial biomass. This process is also referred to as mineralisation.

2.1. Biodegradation requirements

The biodegradability of a biolubricant is best assessed using a "ready biodegradability test as published by OECD and adopted by the European Union. In view of the low solubility of biolubricants in water, only respirometric methods are suitable for testing. The two recommended methods are OECD 301 B and OECD 301 F.

A substance is considered **ultimately biodegradable** (aerobic) if: -

- in a 28-day biodegradation study according to OECD 301 A-F or equivalent tests the following levels of biodegradation are achieved;
- in OECD 301 tests based upon dissolved organic carbon > 70%;
- it can be rapidly and extensively biodegraded in the environment, and
- it can be used in a "biodegradable" or "environmentally acceptable" product.

A substance is considered **inherently biodegradable** if it shows: -

- biodegradation > 20% but < 60% after 28 days in the OECD 301 tests.
- Based on oxygen depletion or carbon dioxide generation;
- Has only the potential to be biodegraded in the environment

2.2. Aquatic toxicity requirements

Toxicity to the environment is usually assessed using short term aquatic toxicity tests as published by the OECD (Test Guidelines 201, 202 and 203). The OECD methods are: -

Figure 1