



Technical Topic

Hydraulic Fluids with Reduced Environmental Impact

To promote products with environmental benefits, many hydraulic manufacturers use terms such as “biodegradable”, “aquatic toxicity”, “energy efficient” and “no sheen”. Since manufacturers often define these terms differently, it is important to understand what they mean and how they can affect productivity goals and environmental initiatives.

By using this information as a guide, maintenance professionals will be able to make a better informed decision about which fluids will meet their performance and environmental needs.

Biodegradability

Biodegradability is the chemical breakdown of materials, such as petroleum products, by living organisms in the environment. The biodegradation process relies on certain microorganisms, such as bacteria, yeast and fungi that break down molecules for sustenance. Certain chemical structures are more susceptible to microbial breakdown than others, for example vegetable oils will biodegrade more rapidly than petroleum oils.

There are two main types of biodegradability, inherently and readily, as defined in the Organization for Economic Cooperation Development (OECD) Guideline for Testing of Chemistries - Annex.

- **Inherently biodegradable** – classification for a product that has a biodegradation better than 20 percent in 28 days or 12 weeks, which includes most, if not all mineral oil lubricants (up to ISO VG 320)
- **Readily biodegradable** – classification for a product that has a biodegradation of more than 60 percent within 28 days, which precludes most, if not all, mineral oils

There are numerous benefits a biodegradable hydraulic fluid can deliver, for example less environmental impact if the hydraulic fluid breaches containment. With that in mind, it should be noted that specific types of biodegradable fluids can impact the performance of hydraulic oil differently.

- **Vegetable-based fluids** – are generally more readily biodegradable, but may not provide comparable service life to that of a conventional mineral hydraulic fluid
- **Synthetic ester-based fluids** – deliver a more biodegradable formulation than conventional mineral oils, and can have an extended service life



Companies can select hydraulic fluids that not only meet environmental initiatives, but help exceed productivity goals.

Aquatic Toxicity

The response of water-based organisms to chemicals or physical agents is called aquatic toxicity. The negative effects of aquatic toxicity can range from mortality to impaired reproduction or growth abnormalities.

Hydraulic fluids with “low aquatic toxicity” generally are tested against OECD standards:

OECD 202 (daphnia water flea), or **OECD 203** (fish) testing, where greater than 50 percent (LC50) of test subjects survive at 1,000 parts per million hydraulic fluid dosage.

Additionally, there can be a misperception that any hydraulic fluid that does not contain zinc can be considered to have a low aquatic toxicity. While zinc content can influence aquatic toxicity test performance, claiming a product is “zinc-free” may not correlate directly to low aquatic toxicity if other harmful agents are present.

Energy Efficiency

All lubricants, including hydraulic fluids, are designed to minimize energy input by reducing the friction between moving, sliding or rotating parts. Efficiency gains in hydraulic fluid performance are obtained through excellent viscosity control, which includes shear stable, high viscosity index (VI) fluids and reduced traction coefficients.

Energy efficiency benefits are best tested and validated based on ASTM D7721 "Standard Practice for Determining the Effect of Fluid Selection on Hydraulic System or Component Efficiency." This protocol is a standardized method of testing that compares a lubricant's energy efficiency to a conventional mineral oil-based fluid.

CO₂ reductions can be achieved through fluids that reduce energy consumption. Hydraulic fluids with energy efficiency benefits can also reduce the energy used per work cycle, resulting in lower operating costs.

Sheen vs. No Sheen

The decision to select a sheen generating hydraulic fluid instead of a no- or limited-sheen hydraulic fluid should be based on the following:

- **Oil sheen** – allows for faster leak detection and aids in determining the source and severity of the oil spill
- **No or limited sheen** – are at greater risk of going undetected and may result in greater environmental harm

Though not visually appealing a sheen-generating hydraulic oil helps reduce environmental impact through detection.

When comparing the environmental impact of sheen to no sheen hydraulic fluid characteristics, there has been no discernible difference in toxicity to plants and animals.

Hydraulic System Performance over the Long Haul

The service life of a hydraulic fluid should also be considered when evaluating a product to help reduce environmental impact. Companies should use hydraulic lubricants that deliver strong keep-clean performance, wear protection and contamination control.



Using an oil that does not leave a sheen puts companies at greater risk of having a leak or spill go undetected, which may result in greater environmental harm and higher operating costs.

The performance and service life of hydraulic fluids is dependent on many factors, including the base oil, typically:

- **Conventional – mineral based** - three to five years is considered an acceptable hydraulic fluid lifespan
- **Synthetic – ester based** - higher performing hydraulic fluids, with proper oil analysis, have achieved service lives upwards of seven years
- **Vegetable – based** – hydraulic fluid service life may be less than a conventional mineral oil hydraulic fluid

Conclusion

Hydraulic fluids with reduced environmental impact can provide sustainable solutions that support both environmental and economic goals. Proper product selection starts with matching application needs with the right lubricant technology.

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