



Whitepaper

Why hydro lubrication is causing a revolution

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By using water as a functional component in specialty lubricants, Klüber Lubrication is creating opportunities for a whole new range of applications that can use the revolutionary properties of hydro lubricants to provide advances that include:

- **Enhancing operational excellence by reducing friction by a factor of 10 and significantly extending component service life**
- **Improving plant hygiene and occupational health and safety by reducing harmful solvents**
- **Providing an environmentally friendly formulation that reduces volatile-organic-compound (VOC) emissions, water pollution and CO2 emissions**
- **Saving energy by lowering operating temperature due to outstanding thermal conductivity**

Introduction

When considering the basic components of specialty lubricants, we almost automatically think of them as oils—primarily mineral oil. And in fact, as of 2017, most industrial lubricants are based on mineral oil. Despite the widespread use of conventional mineral oil-based lubricants, they have serious limitations in many applications. Moreover, their availability as a petroleum resource is finite, methods to handle them in a safe, environmentally responsible manner are complex, and proper usage and disposal are difficult and costly.

That's why machine designers and gear manufacturers who are looking for ways to deal with the variables of tribology—the science of friction, wear and lubrication—are continuously searching for lubricant formulations that provide new advantages. The product development approach used by the tribology specialists at Klüber Lubrication employs the element of water either as base fluid or as an additive to provide

How hydro lubricants meet increasing performance, energy and environmental demands

revolutionary performance benefits. The result is the whole new group of lubricants known as hydro lubricants. The benefits of hydro lubricants range from extremely low friction coefficients to improved occupational safety and sustainability throughout the whole life cycle. That's why Klüber Lubrication is developing an entire portfolio of hydro lubricants by 2025 in cooperation with customers interested in applying the advantages of hydro lubricants to decisively reshape the future of tribology.

In manufacturing industries, sustainability is increasingly important to differentiate a company from the competition and to communicate environmental leadership. Legal requirements and voluntary limits aimed at reducing resources, emissions and energy consumption drive the need for new and diverse solutions. Advanced industrial specialty lubricants can help meet sustainability initiatives—as defined, for example, in the UN Global Compact or the ISO 50001 standard.

In many demanding industries—such as food and beverage, automotive and mining applications—specialty lubricants are expected to do more than reduce friction and mechanical wear in. Regulations with regard to occupational health and safety are also becoming ever more stringent. And there is a growing demand for specialty lubricants that can be used worldwide to satisfy the diverse legal requirements of different countries and regions.

Water as a basis for a revolutionary formulation

To develop a new specialty lubricant formulation that can meet today's and tomorrow's challenges, the revolutionary and logical choice is water. It is a basic raw material: globally available, non-toxic, non-flammable. The benefits are clear—but, so are the tribological boundaries. These include not only water's low viscosity, but also its evaporation and freezing points, oxidation, corrosion and microbiological-growth potential.

After intensive research, Klüber Lubrication has succeeded in pushing these limits. With water as a functional component, there are crucial differences in the way the lubricant behaves. Benefits include a much lower operating temperature and significantly reduced friction coefficients.

Other benefits include excellent cooling capacity and tolerance for water intrusion, which is relevant, for example, in industries where equipment is exposed to water. In a conventional lubricant, even a low percentage of water intrusion can significantly compromise performance. This, of course, does not apply to hydro lubricants, which by nature already contain some water content.

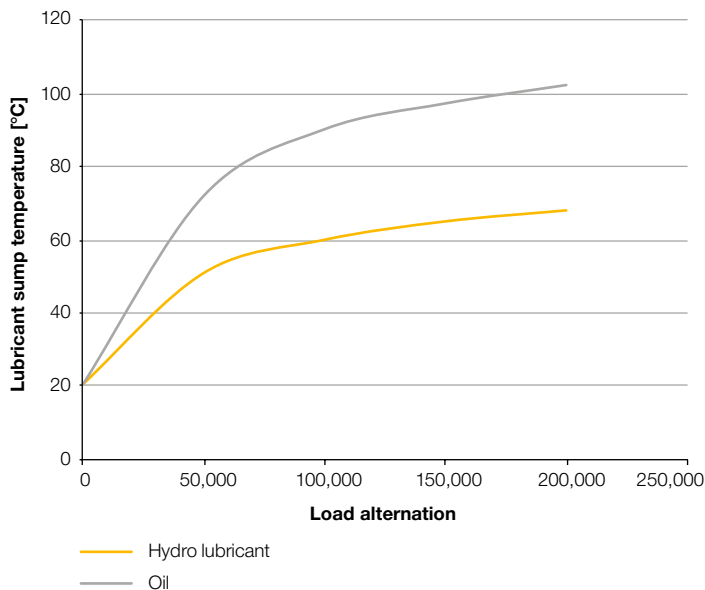
The future of friction reduction has arrived

The positive effects of water

Water is often used as a coolant in lubricants because it has high thermal conductivity compared to other liquids. Because of this property, lubricants with water as a functional component can reduce operating temperatures by up to 77°F (25°C) compared to oil-based lubricants (Figure 1). This reduction has been proven on various components in laboratory and field tests.

Moreover, water contributes to energy savings. On the one hand, reduced operating temperatures in the component translates into higher energy efficiency overall. Considering the viscosity of the lubricant for a particular application at a given operating temperature, this cooling effect may make it possible to select hydro lubricants with a lower ISO viscosity grade. Lowering viscosity has clear energy-saving potential. Energy reductions are also supported by the fact that hydro lubricants typically have a very good viscosity index and lower inner friction (Figure 2).

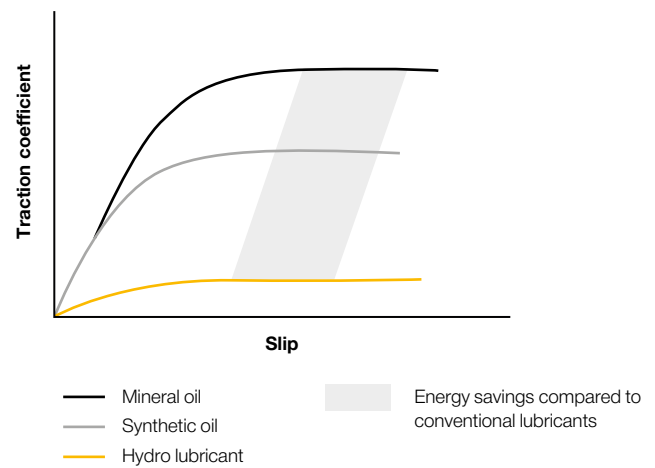
Figure 1:
Cooling effect of a hydro lubricant compared to standard oil with the same viscosity



Approaching “superlubricity” is now within reach

Hydro lubricants have unprecedented potential when it comes to friction. Friction can be reduced to such an extent that superlubricity—a state in which the friction and traction coefficient can drop to below 0.01—is within reach. Research is underway to further analyze the low coefficients of friction (COF) obtainable in various applications.

Figure 2:
Friction reduction of hydro lubricant



As shown in Figure 2, the traction coefficient corresponds to around one tenth of the value that can be achieved with the best available oil-based lubricants. This provides many positive effects, which range from energy savings and reduced emissions to longer component life cycles.

Interested in a test run?
Get in touch with us about next steps.

With many possible benefits and applications, the potential of hydro lubricants is only beginning to be harnessed. That's why Klüber Lubrication is looking for partners interested in exploring the potential of hydro lubricants to benefit their application. Relevant end industries may include food, marine, textile, mining, cement and forestry, but also applications in the fast-moving field of e-mobility. For companies with a strong focus on innovation and sustainability, hydro lubricants present a new opportunity to create a competitive advantage that moves business forward.

This white paper has been prepared by Klüber Lubrication as a general information resource. For opportunities to partner with us to conduct hydro lubricant trials, please visit lp.klueber.com/hydro-lubricants.

The benefits at a glance

With our hydro lubricants, you'll find the superlubricity and sustainability that puts you in front

Occupational Health and Safety

- No harmful solvents
- No slippery floors
- Easy and safe handling
- Improved fire protection
- Fewer harmful vapors
- Improved plant hygiene

Environmentally Friendly

- Reduced emission of Volatile Organic Compounds (VOCs)
- Reduced water pollution
- Reduced water consumption
- Reduced CO₂ emissions

Operational Excellence

- Reduced friction
- Longer service life of components
- Similar wear protection and Extreme Pressure properties to conventional lubricants
- Easier cleaning
- Reduced problems with water contamination

Energy Saving

- Lower operating temperature with outstanding thermal conductivity
- Reduced friction
- Support with meeting the requirements of ISO 50001

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