Unlocking premium hydraulic fluid potential with zinc-free additive

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Premium hydraulic fluids with the latest zinc-free additive technology can deliver exceptional, long-lasting protection for even the most demanding pumps and systems, validated by bench and pump testing as well as extended field trials.

Over the years, hydraulic fluid development has had to keep pace with increasingly demanding hardware operating conditions, driven largely by pump manufacturers. Traditionally zinc-based technology has been the go-to option used to achieve top tier OEM performance, defined by increased productivity. However, fast forward to recent years, end-users are not only looking to maximise productivity, they are also increasingly focused on the environmental impacts of their fluids. This creates lubricant formulation challenges that require additive expertise as well as strong technical insight.

Environmental benefits – beyond removing zinc

Although zinc-based fluids are still widely used due to their proven performance and relatively low cost, using zinc-based fluids in many applications can no longer be justified in the face of well-known environmental concerns. Severe-service and high-load mobile applications within the construction, mining and agriculture industries are particularly sensitive, given the potential impact that fluid leakage could have on the environment.

Premium zinc-free hydraulic fluids offer an opportunity for end-users to improve their environmental acceptability, while also reducing their product carbon footprint. Bringing down the carbon dioxide emissions that result from additive package by nearly a third is a significant improvement:

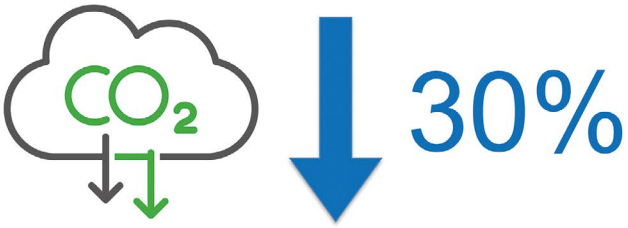

Figure 1: *The right impact: producing Afton's high-performing zinc-free additive package versus our zinc additive package results in over 30% lower CO_2 emissions. This is based on cradle to gate product carbon footprint calculated according to ISO14067.*

This lower-carbon footprint benefits not only environmentally sensitive mobile equipment but also stationary machinery, helping both oil marketers and end-users to reduce their impact and achieve their environmental product goals.

However, the benefits go beyond the product carbon footprint. As OEMs, such as Bosch Rexroth, focus on achieving greater power density by increasing pump speed and pressure, demands on hydraulic lubricants increase.

Around seven years ago, the Bosch-Rexroth hydraulic fluid rating process became even more demanding, with the introduction of the RDE 90235 process and requirement for the Bosch Rexroth RFT-AU-CL pump test. Its updated parameters reflected the OEM desire to improve equipment protection significantly and avoid costly servicing and warranty issues caused by component failures.

Considered a robust predictor of performance and the most stringent of all hydraulic fluid ratings, it examines a broad range of fluid properties: crucial antiwear and antioxidancy performance as well as hydrolytic stability, thermal stability, and filterability. The Bosch-Rexroth fluid rating is designed to ensure that approved fluids are suitably equipped to handle the harshest operating conditions, which in turn could support extended service intervals.

When formulated with the right additive chemistries, premium zinc-free hydraulic fluids are proven to deliver superior, longer-lasting performance versus zinc-based solutions – enabling longer drain and reducing maintenance costs. Overall, having a positive impact on reducing both end-users' environmental footprint, but also their total cost of ownership.

With fluids working under harsher operating conditions and spending less residual time in the sump, good separation from water and air and excellent oxidation prevention are essential for minimising sludge formation and extending fluid life.

Evaluation conducted by Afton on their zinc-free additive package showed that it performed strongly in all oxidation tests, including TOST Life exceeding 10,000 hours (beyond test limits) and RPVOT Life exceeding 700 minutes. It also showed superior wear protection and particulate prevention across multiple test procedures compared to zinc packages.

The zinc-free additive package can also be used with mono- or multi-grade mineral base oil formulations, demonstrating balanced performance across all key areas versus equivalent zinc technology (Figure 2).

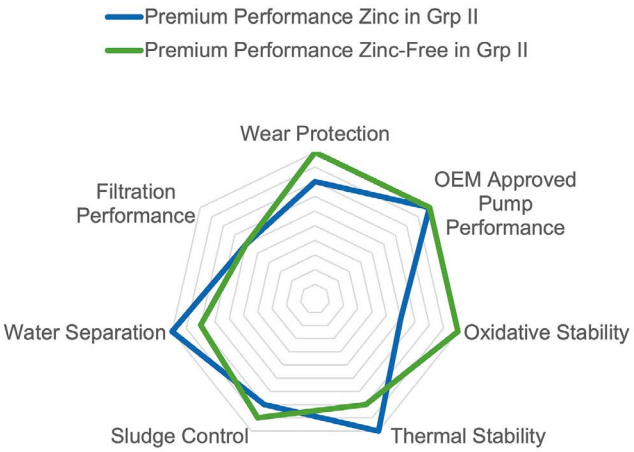

Figure 2: *The zinc-free advantage: fluids formulated with Afton's premium zinc-free package provide comparable or enhanced performance versus a premium zinc package.*

Value through additive advantages

The proven performance points to the considerable value that premium zinc-free fluids offer end-users, not least because their stronger antiwear performance ensures greater equipment reliability and therefore less unplanned downtime.

Fluid life is also prolonged thanks to the increased oxidative stability, representing a great opportunity for OEMs to extend service intervals without impacting reliability and for end-users to minimise planned maintenance downtime.

In addition, these fluids better handle common contaminants such as water, and the absence of zinc

also means that operators are less likely to experience power loss caused by filters becoming blocked with zinc salts.

The contribution that high performing hydraulic fluids make towards reducing the total cost of ownership outweighs any increased cost for these superior, zinc-free formulations.

Field trial standout

Findings from laboratory testing have also been validated in the field. A two-year trial of this premium zinc-free additive package – totalling 3908 operating hours, in temperatures ranging from -20°C in winter to 40°C in summer – has been carried out on a cement truck based in Missouri, USA.

Fluid properties remained stable with good performance during the entire two-year trial, with wear metal analysis showing that iron and copper levels remained low and stable. Minimal weight was lost from the pistons and visual inspection showed no significant differences in the appearance of parts at the start and end of the trial.

Throughout this lengthy trial, the zinc-free hydraulic package delivered standout all-round performance, as predicted by the lab testing – showcasing the potential benefits for real world performance.

A zinc-free future?

The hydraulic market is set to grow as it supports the busy construction, energy, steel, and automotive sectors; Afton foresees solid growth in performance fluids that replace traditional zinc with far more effective chemistries.

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