

## Dynavis® Hydraulic Fluid Additive System Increases Fuel Economy and Equipment Productivity

Operating hydraulic equipment efficiently involves doing the most work in the least time for the lowest cost, while maintaining safety and performance. Hydraulic equipment manufacturers are developing innovative approaches to increasing efficiency and fuel economy in off-road vehicles, driven in part by concerns over air pollution and CO<sub>2</sub> emissions. Lubricant manufacturers are playing a key role, by offering products designed to boost performance and efficiency while reducing operating costs.

In 2007, ICIS recognized a groundbreaking new concept called Maximum Efficiency Hydraulic Fluid (MEHF) as an "Innovation with the Greatest Beneficial Environmental Impact." RohMax Oil Additives has spent the past several years developing MEHF and researching its potential applications. The process began with mathematical modeling of the thermodynamics of hydraulic circuits. RohMax then tested MEHF's potential in experiments with a variety of gear, vane and piston pumps in the lab,<sup>1</sup> and demonstrated its benefits during full-scale tests on off-road equipment.

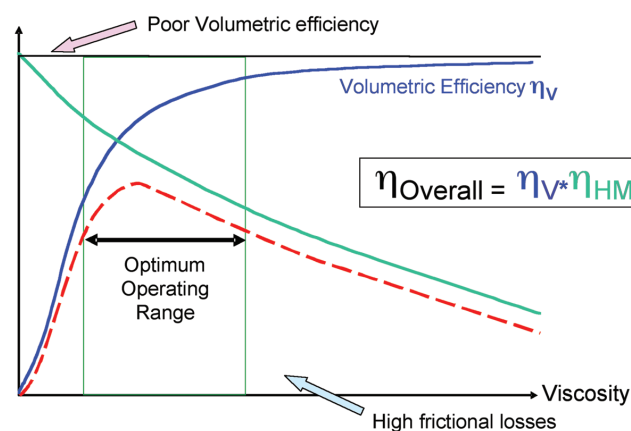
The end result of these tests is RohMax's Dynavis®, a complete additive solution that lets hydraulic fluid formulators deliver MEHF-level performance to their customers and end users. What follows is a brief description of the technology behind Dynavis®, followed by a review of a field test of the product.

### The MEHF Concept

Two factors determine the overall efficiency of a hydraulic pump or motor: its mechanical efficiency and its volumetric efficiency.<sup>2</sup> Each factor is a function of the viscosity of the hydraulic fluid, but they react oppositely to changes in viscosity. Figure 1 illustrates this difference. When viscosity (or resistance to flow) is higher, mechanical efficiency decreases, because the pump has to work harder simply to move the fluid through the system. But higher viscosity actually increases volumetric efficiency, since thicker oil reduces wasteful leakage in the recycle pathways inside pumps and motors, where excess fluid lubricates the sliding surfaces of pumps. When less viscous fluid flows through these recycle pathways, the increase in leakage decreases volumetric efficiency and, as a result, the output of the pump.<sup>3</sup>

Figure 1

### Effects of Viscosity on Overall Pump Efficiency



The most effective hydraulic fluids are thin enough to allow the most efficient flow, and thick enough to pump with the greatest efficiency. Viscosity changes with temperature, so an efficient hydraulic fluid must maintain optimal performance at a wide range of temperatures, from cold equipment start-up to the heat that builds up during extended periods of operation.<sup>4</sup>

MEHF fluids are designed to increase efficiency regardless of temperature. Like conventional multi-grade hydraulic fluids, MEHF fluids at cold temperatures allow equipment to start at lower temperatures, which can eliminate the need for heaters and ensure smoother operation in the cold. But MEHF fluids can also reduce the loss of viscosity at higher temperatures that can occur with conventional hydraulic fluids. Well-designed, multi-grade MEHF fluids can therefore increase efficiency throughout the range of operating temperatures.

### What Are Dynavis® Additives?

The Dynavis® additive system has been specifically designed to formulate Maximum Efficiency Hydraulic Fluids (MEHFs). Dynavis® incorporates anti-wear, antioxidant, and corrosion inhibition (AW/AO/CI) packages, along with shear stable Viscosity Index Improvers (VIIs). These ingredients are optimized to work together to deliver increased fuel efficiency and produc-

tivity when used in hydraulic equipment. For hydraulic fluid formulators, Dynavis® improves upon traditional additive technology by providing a complete system for creating MEHFs.

## Field Testing Dynavis®

A recent field test compared the performance of a Dynavis® hydraulic fluid versus an OEM-recommended hydraulic fluid. A Caterpillar® excavator ran through a repeated work cycle using each fluid, and the amounts of work completed and fuel consumed were measured at regular intervals. When using Dynavis®, productivity (measured in work cycles completed per hour) increased between 6% and 24% relative to the OEM-recommended fluid. Fuel consumption per work cycle when using Dynavis® was between 18% and 24% less than when the OEM-recommended fluid was used.

The fluids evaluated were a Dynavis® Maximum Efficiency Hydraulic Fluid (L32-100) and an OEM-branded and recommended 10W (L46-46) hydraulic oil.<sup>5</sup> Fresh OEM-branded oil was used as a reference in the initial test. Testing lasted for

six hours under each tested condition, including engine throttle settings of 90% and 100%. After running a six-hour test with the reference oil for each throttle setting, the oil was changed to the Dynavis® fluid. The test was repeated once at each throttle setting using Dynavis®. Then, the test was run again with the reference oil to confirm the initial baseline measurements.

The fluids were tested in the Caterpillar® 318CL tracked excavator pictured in Figure 2. The excavator was powered by a 125HP diesel engine that drove two hydraulic piston pumps and three piston motors to move and turn the vehicle. The test work cycle took place on a 100-foot long course with a pile of loose dirt at one end. Each cycle consisted of the following steps: (1) the excavator took as large a scoop of dirt as possible from the pile; (2) the cab was rotated 180°; (3) the excavator traveled forward at full speed for 100 feet; (4) the scoop of dirt was dropped; (5) the cab was again rotated 180°; and (6) the excavator returned 100 feet at full speed to the start of the course.

Figure 2





Test Conditions	Fuel Consumed per work cycle, kg/cycle	Fuel Consumption Improvement, Percent	Fuel Consumed per Hour, kg/hour	Fuel Consumption Improvement, Percent	Work Cycles per Hour, Cycles/hour	Percent Improvement
Cat HYDO 10W (L46-46) Full Throttle	0.364	---	19.5	---	53.5	---
Cat HYDO 10W (L46-46) 90% Throttle	0.380	---	15.2	---	40.0	---
DYNAVIS MEHF (L32-100) Full Throttle	0.297	+ 18.4%	16.8	+ 13.8%	56.6	+ 5.8%
DYNAVIS MEHF (L32-100) 90% Throttle	0.280	+ 26.3%	13.9	+ 8.6%	49.7	+ 24.3%

Figure 3

Figure 3 charts the results of the testing. Using the Dynavis® hydraulic fluid, the excavator completed more work cycles in the allotted time, at each of the throttle settings. The MEHF Dynavis® fluid offered increased in-service viscosity, which increased the flow rate out of the pumps and through the motors, and thus, the system's volumetric efficiency. When compared against the OEM-recommended oil at the same throttle setting, using Dynavis® fluid allowed the excavator's diesel engine to consume less fuel. This occurred because the hydraulic system was operating more efficiently, requiring less power to accomplish an equal amount of work. When the decreased fuel consumption measured in the Dynavis® portion of the test is combined with the increased productivity demonstrated, the result is an 18% to 24% reduction in fuel consumed per work cycle.

During the field test, the operating and ambient conditions were moderate, with outdoor temperatures ranging between 45°F and 65°F (7°C and 18°C). Temperatures measured in the hydraulic fluid reservoir averaged between 90°F and 142°F (32°C to 61°C). The efficiency advantages of MEHF fluids increase at higher operating temperatures, so the field test indicates that increased equipment efficiency is likely under harsher temperature conditions as well.

## Dynavis® Benefits the Environment and the Bottom Line

The fuel savings measured when Dynavis® was used in the field test are significant. Extrapolating these results over the expected life of hydraulic fluid demonstrates even greater potential savings. For example, the recommended operating time for the test equipment between hydraulic fluid replacements is 4,000 hours. Multiplying the field test results to reflect this fluid lifetime, the excavator would use 3,300 fewer gallons (13,000 fewer liters) of fuel using Dynavis®. At the price levels common in the United States at the time of the test, this would translate

into a savings of around \$8,000 – with even greater savings expected in countries where fuel prices are significantly higher.

This amount does not reflect the additional savings which could result from the increased productivity demonstrated when Dynavis® is used. Nor does it include the potential benefits to the environment. When a hydraulic excavator burns 3,300 fewer gallons of diesel fuel, the pollutants emitted and CO2 produced might decrease as much as 33.3 metric tons (using the United States Environmental Protection Agency's standard for CO2 production of 10.08kg/gallon diesel; see <http://www.epa.gov/otaq/climate/420f05001.htm#calculating>).

## Conclusion

RohMax Oil Additives has tested its Dynavis® additive system extensively to demonstrate the concrete benefits it can offer to lubricant manufacturers and their customers, including increased efficiency and productivity. Dynavis® can help lower operating costs, and the fuel savings that result from using Dynavis® can benefit the environment as well.

For additional information on Dynavis®, including online calculators to estimate the benefits of using an MEHF for an entire fleet of equipment, visit [www.dynavis.net](http://www.dynavis.net), or contact RohMax Oil Additives directly through their website, [www.rohmax.com](http://www.rohmax.com).

<sup>1</sup> Albert, Goerlitzer, Herzog, Neveu, "Efficiency Advantages in Vane, Piston and Gear Pumps", Proceeding of IFK, Aachen, Germany, 2006.

<sup>2</sup> Tessmann, Melief, Bishop, Basic Hydraulic Pump and Circuit Design in Handbook of Hydraulic Fluid Technology, p. 27, G.E. Totten (Ed.), Marcel Dekker New York 2000

<sup>3</sup> Herzog, Neveu, Placek, Simko "Predicting the Pump Efficiency of Hydraulic Fluids to Maximize System Performance", NCFP I02-10.8/SAE OH 2002-01-1430, IFPE April, 2002, Las Vegas, NV, USA.

<sup>4</sup> Place, Hyndman, "Cost and Performance Advantages of Multigrade Hydraulic Fluids," Proceedings of 7th Fuels and Lubes Asia Conference, Bangkok, 2001.

<sup>5</sup> For more information on the "L-grade" nomenclature for hydraulic fluids see the National Fluid Power Association Recommended Practice for Viscosity Selection T2.13.13

## REACH fees are 'out of control'

### Massive fee increases

The base fee for a joint submission to register a substance in the 1-10 tonnes category was originally budgeted by the Commission to be 400 euros. In July 2006, this figure was revised to 804 euros. In the latest Commission proposal, the fee has increased to 1,200 euros. Overall, these fees have increased by 200% on the original budget.

Similar increases apply at the other end of the tonnage scale. The base fee for a joint submission for a substance manufactured or imported in volumes of more than 1,000 tonnes per year was initially budgeted at 8,000 euros. In July 2006, this figure was more than doubled to 16,080 euros. In the latest Commission proposal, the fee has risen to 23,250 euros - an increase of 191 % on the original budget.

New research by CBA has revealed massive increases in the fees to be charged by the European Chemicals Agency. The Chairman CBA's REACH Task Force, Melvyn Whyte, said that they were 'out of control'.

"This is the second time that proposed REACH fees have escalated and they have now achieved a level where they are completely unacceptable and will inflict significant damage to the competitiveness of the industry. CBA's research shows that there are many fees which represent increases of well over 500% on the original budget," said Melvyn Whyte.

"There are only two possible explanations for these figures. Either they represent an unacceptable level of incompetence in framing the initial budget or, which is more likely, the level of the original budget was deliberately manipulated as a means of deflecting industry's concerns about the costs of the REACH system. In any case, the Commission is now behaving like a state monopoly by forcing industry to fund its grandiose regulatory ambitions," he said.

The new budget for REACH fees contains some concessions for Medium, Small and Micro-sized companies. Even allowing for these reductions in fees for the smallest firms, the Commission's proposals represent an overall increase of more than 40% on the revised proposals of July 2006 and well over 100% on its original budget. The European Chemicals Agency is also introducing new fees for small administrative changes. For example, it will now cost 1,500 euros to change simple information on the Agency's database, such as a company address.

CBA is also concerned about the terms of trading which the Agency is unilaterally seeking to impose.

"The proposals say that the Agency expects its invoices for fees to be paid within either seven or 14 days," explained Melvyn Whyte. "The standard terms of trade throughout Europe are 30 days - which is also the figure in the European Union's Late Payment Directive. But the reality in most European countries is that the average payment period for invoices is 50 days. CBA believe that the Agency should accept a 30-day payment period. Commercially, this places it in exactly the same position as the businesses which it is seeking to regulate. Industry does not accept that the Agency should have the right to grant itself more favourable trading terms," he added.

The CBA is also opposing the Agency's proposals that its fees will increase each year in line with inflation. "Industry is not in a position to issue a blank cheque to the Agency for year-on-year fee increases. We expect it to have to justify any increases and also be obliged to make annual efficiency savings to hold its fees at an acceptable level. Industry is concerned about the absence of transparent budget and the apparent lack of accountability to its major stakeholder," he said.

*Article reproduced from 'Outlook' November 2007,  
The magazine of the Chemical Business Association*

LINK

[www.chemical.org.uk](http://www.chemical.org.uk)