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Reducing Energy Consumption with Multigrade Hydraulic Fluids

The high performance
multigrade hydraulic fluids
described in this document
are now known as
Maximum Efficiency
Hydraulic Fluids (MEHF)
For more info visit:
www.mehf.com

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January 2003

RohMax
OIL ADDITIVES

RohMax Oil Additives is a leading global supplier of high performance lubricant additives and refinery chemicals and forms part of the Specialty Polymers Division of Degussa AG, one of the world's largest specialty chemicals companies.

Our broad line of VISCOPLEX® Viscosity Index Improvers (VIIs) and Pour Point Depressants (PPDs), derived from proprietary polyalkyl methacrylate (PAMA) technology, helps formulators meet the challenges of extreme operating conditions. Our refinery chemicals boost process efficiency and optimise solvent extraction processes. We also produce and market VISCOBASE® synthetic base stocks.

Our global sales team, industry experts and technical service staff are backed by state-of-the-art Centers of Excellence and are committed to provide you with tailormade solutions to meet the latest industry standards.

World-wide manufacturing facilities, a global supply chain and sales representatives in more than 35 countries, enable us to provide customized products and services to our customers around the world.

Introduction

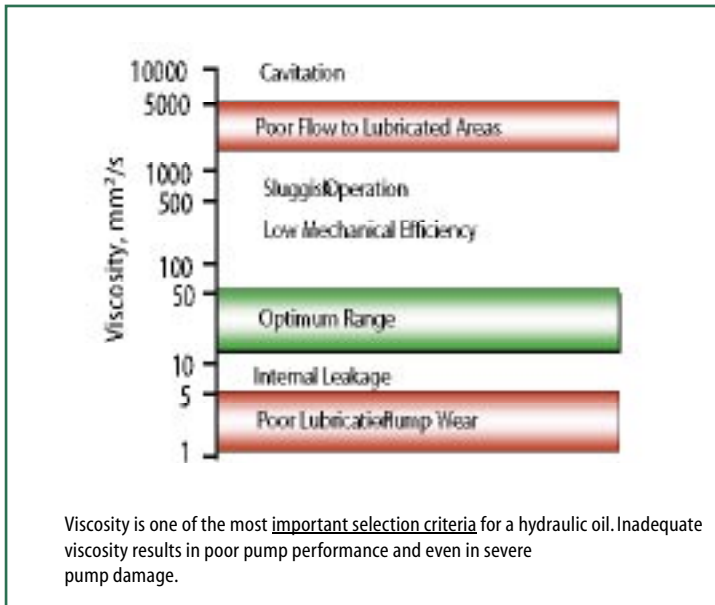
In a highly competitive environment, it is essential to maximize the efficiency of hydraulic equipment to lower operating costs, conserve resources, and increase productivity. To achieve these goals, it is necessary to minimize internal pump leakage at high operating temperatures, and reduce mechanical energy losses at low start-up temperatures.

Cost effective hydraulic systems are designed with the smallest possible pump and fluid reservoir in order to reduce size and weight. The fluid in these modern systems must function under ever increasing temperature and pressure demands. At peak operating conditions the fluid viscosity is often too low, resulting in poor pump efficiency, inadequate flow rates, reduced load carrying capacity, and system overheating. Models have been developed to determine the volumetric efficiency for a variety of gear and vane pumps as a function of pump speed, fluid pressure and viscosity. They can be used to estimate the impact of fluid viscosity on power requirement and response time at any given temperature, and thus can help optimize system design and fluid selection.

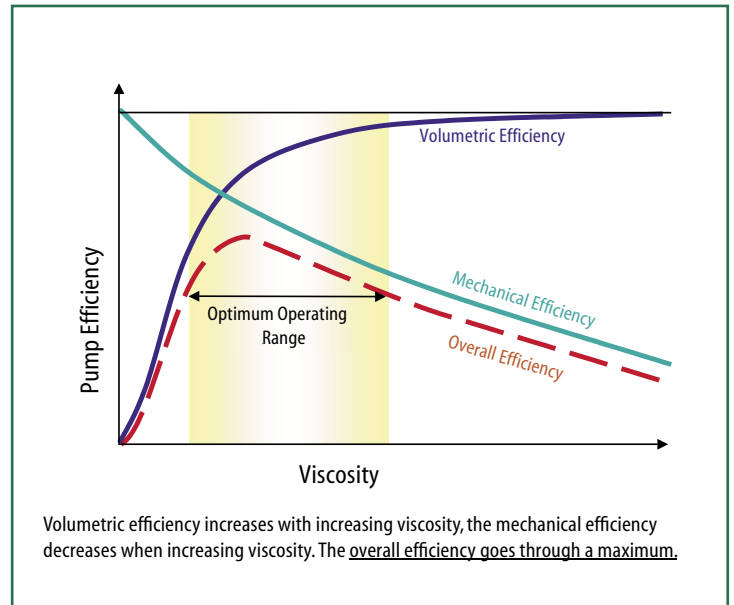
This paper highlights the benefits of multigrade (high VI) hydraulic fluids, in terms of temperature operating window (TOW), pump efficiency and energy savings.

Reducing Energy Consumption with Multigrade Hydraulic Fluids

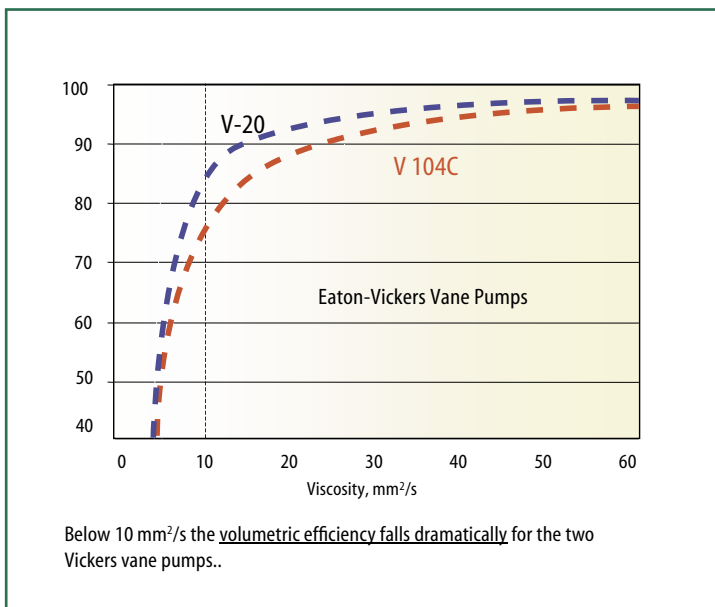
Viscosity vs. Pump Performance



Effects of Viscosity on System Efficiency



Volumetric Efficiency vs. Oil Viscosity



Time Savings: Multigrade vs. Monograde HF Oils

High VI oils: - Blended with a shear stable polymer to VI=200.
- The viscosity at 100 °C after the 40 minute Sonic test was used in time saving calculations.

Mobile Vane Pumps at 200 Bars, 2000 rpm, 100°C

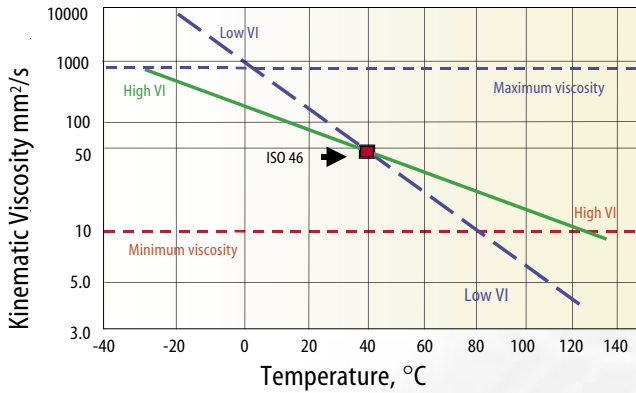
Cartridge Size	Nominal Flow Rate, liter/minute at 2000 rpm	Time Savings, % to fill a piston		
		ISO 32	ISO 46	ISO 68
A	43	*	*	30.4%
B	68	22.5%	17.9%	13.8%
C	92	13.2%	11.3%	9.2%
D	140	7.2%	6.4%	5.4%

The level of time savings for a given pump body depends on the ISO grade and on the cartridge size.

* Volumetric efficiency lower than 50% for the monograde oils.

High VI Fluids Expand the Temperature Operating Window (TOW)

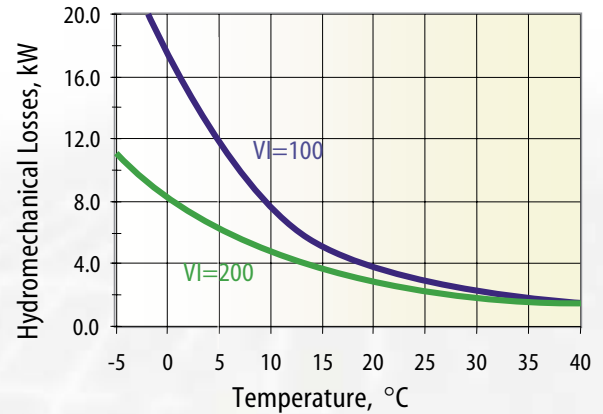
Two Oils Meeting the ISO VG 46 Viscosity Requirement



The high VI oil reaches the maximum start-up viscosity and the minimum operating viscosity at a much lower and higher temperature respectively than the monograde oil.

Hydromechanical Energy Losses

ISO 46 Oils in Vane Pump



Below 40°C, the multigrade oil has a lower viscosity than the monograde oil. This results in a significantly lower level of hydromechanical losses that can be as high as 50%.

Energy Savings: Multigrade vs. Monograde HF Oils

- High VI oils:
- Blended with a shear stable polymer to VI=200.
 - The viscosity at 80 °C after the 40 minute Sonic test was used in energy saving calculations.

Mobile Vane Pumps at 200 Bars, 2000 rpm, 80°C

Cartridge Size	Nominal Flow Rate, liter/minute at 2000 rpm	Energy Savings, % to deliver identical Hydraulic Power		
		ISO 32	ISO 46	ISO 68
A	43	20.0%	14.6%	9.0%
B	68	8.3%	6.8%	4.7%
C	92	5.7%	4.6%	3.2%
D	140	3.3%	2.7%	2.0%

PAMA or PAMA/α-decene reduce the EOTT of mineral oil. Compared to straight PAO, the addition of PAMA and PAMA/α-decene to PAO, leads to equal or lower EOTT.

Energy Savings: Multigrade vs. Monograde HF Oils

- High VI oils:
- Blended with a shear stable polymer to VI=200.
 - The viscosity at 100 °C after the 40 minute Sonic test was used in energy saving calculations.

Mobile Vane Pumps at 200 Bars, 2000 rpm, 100°C

Cartridge Size	Nominal Flow Rate, liter/minute at 2000 rpm	Energy Savings, % to deliver identical Hydraulic Power		
		ISO 32	ISO 46	ISO 68
A	43	*	*	27.9%
B	68	22.0%	17.4%	12.9%
C	92	12.8%	11.0%	8.5%
D	140	6.9%	6.2%	5.0%

For blends having the same viscosity at 100°C, the higher the VI the lower the EOTT. This explains the positive effect of PAMAs and PAOs and the poorer results obtained with the PIB.

Use RohMax VISCOPLEX® Viscosity Index Improvers (VIIs) to Formulate Cost-Effective High VI Oils

Product Benefits

Fluids formulated with VISCOPLEX® VIIs exhibit increased viscosity and film strength at peak operating temperature and good low temperature fluidity. The result is efficient, reliable equipment response over a wide temperature range.

The all-season use of high VI fluids can reduce maintenance costs and reduce waste oil disposal while delivering superior performance that help the operator operate more efficiently and more economically.

Product Line

8 Series:

PAMAs for mineral or synthetic base stocks including those with demanding filterability and demulsibility needs. Available in a wide range of shear stabilities. Some products are dispersant to help formulating tractor hydraulic fluids.

7 Series:

PAMAs for fluids with extremely demanding low temperature performance. Often used in naphthenic or synthetic stocks. Their high cleanliness make them suitable to formulate aircraft hydraulic oils.

10 Series:

PAMAs for use in biodegradable fluids. They improve the long term storage stability of vegetable oil based fluids. Available in a wide range of shear stabilities.

Conclusion

The comparison of the performance at low and high temperature of six hydraulic fluids with three different ISO grades (VG 32, 46 and 68) and two different Viscosity Indices (100 and 200) showed that:

The high VI oils can enable operations at lower temperature. The minimum start-up temperature at which the fluids reach a viscosity of 860 mm²/s was about 12°C lower for the high VI oils. This provides the operator with additional protection against cavitation, oil starvation, and wear in cold start-up conditions.

The high VI oils also contributed to much lower hydromechanical losses at temperatures lower than 40°C. The gain in hydromechanical efficiency can reach 50% at start-up temperature, resulting in lower energy consumption.

At temperatures of 80 and 100°C, calculations made for a series of vane pumps showed that the high VI oils deliver a higher flow rate and a better overall efficiency. This translates into higher operator productivity, and to significantly lower operating costs for the equipment user due to lower fuel consumption. Energy/fuel savings in the range up to 20% can be expected under standard operating conditions when high VI multigrade oils are used. Higher productivity gains and savings can be achieved at peak operating temperatures.



The high performance
multigrade hydraulic fluids
described in this document
are now known as
**Maximum Efficiency
Hydraulic Fluids (MEHF)**
For more info visit:
www.mehf.com

Additional Information

For additional information on product availability, performance data and Material Safety Data Sheets, please contact your RohMax Account Manager or Customer Service Representative.

For an overview of our entire VISCOPLEX® and VISCOBASE® product range and complete information on handling and storage, please visit the Products & Applications section on our website www.rohmax.com.



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