# MEHF-A New High Performance Level for Hydraulic Fluids providing Energy Saving and Emissions Reductions

**Dr. Hitoshi Hamaguchi**

(RohMax Additives GmbH)

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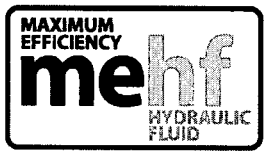
Introducing:




# A New High Performance Level for Hydraulic Fluids providing Energy Savings and Emissions Reductions

**Dr. Hitoshi Hamaguchi**
Degussa-RohMax Oil Additives Japan

KSTLE Lubricant Symposium
October 6 - 7, 2005
Damyang, Korea

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## Contents

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## Hydraulic Fluid Trends

- Higher Pressures
  - ➢ Mobile equipment now at 300 bar, moving to 450 bar
- Smaller, Lighter Equipment
  - ➢ Reduced fluid volumes
  - ➢ Less residence time for cooling
- Higher Fluid Operating Temperatures
  - ➢ 80 ° C common for mobile equipment
  - ➢ 100+ ° C peak temperatures

**Improved Fluids are Required**

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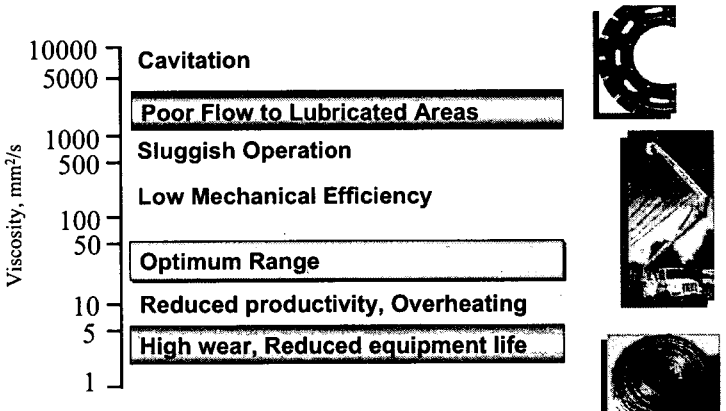
## Viscosity Impact on Performance




Viscosity grade is a major selection criteria for a hydraulic oil

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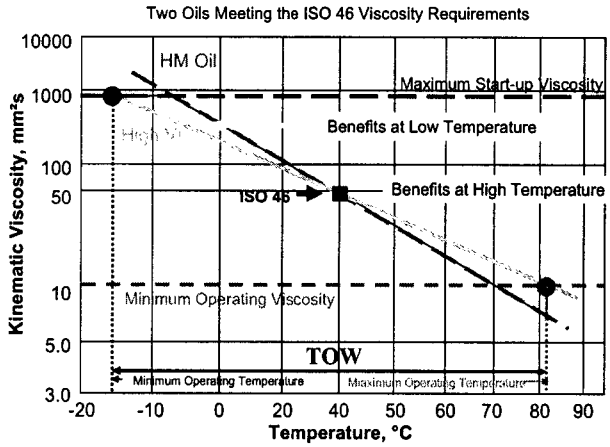
## Benefits of High VI Oils Are a Consequence of their Improved Viscosity Temperature Relationship

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## Current Performance Claims for HV Oils

| Low Temperature | High Temperature |
|---|---|
| ▪ Features:<br>➢ Low pour point<br>➢ Lower viscosity than HM oils | Features:<br>➢ Higher viscosity than HM oils |
| ▪ Benefits:<br>➢ Equipment can start at lower ambient temperatures<br>• Enlarged TOW on the low temperature side<br>➢ Better protection of pump | ▪ Benefits:<br>➢ Equipment can operate at higher ambient temperatures<br>• Enlarged TOW on the high temperature side<br>➢ Better protection of pump |

No need for seasonal oil changes

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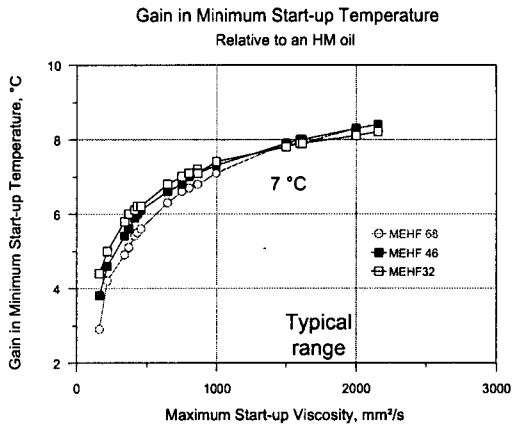
## Average Gain In Minimum Start-up Temperature
### MEHF Oils vs. Maximum Start-up Viscosity

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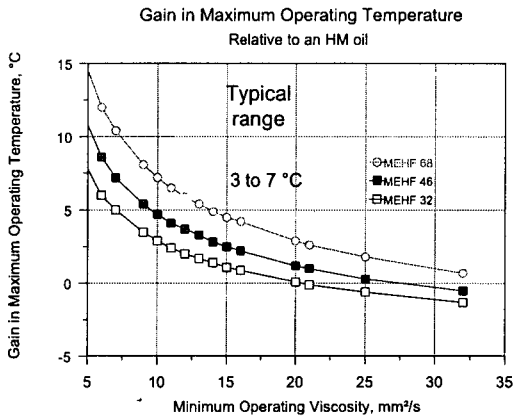
## Gain In Maximum Operating Temperature
### MEHF Oils after Sonic 40' Shear (ASTM D 5621)

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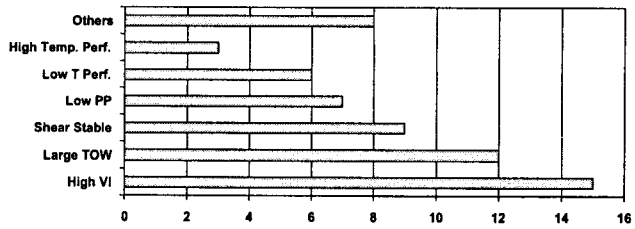
## Current Promotional Platform of High VI Oils

- Analysis of the claims associated to Viscosity for 89 oils from major suppliers.
- Of the 170 performance claims 60 are related to viscosity

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## New Performance Claims for MEHF Oils

Low Temperature

- Features:
  - ➢ Reduction of friction at low temperature
- Benefits:
  - ➢ Reduced energy losses from start-up to equilibrium temperature
  - ➢ Faster and larger flow at pump inlet
    - Improved volumetric efficiency

High Temperature

Features:
- ➢ Higher viscosity than HM oils

- Benefits:
  - ➢ Improved volumetric efficiency
    - Less time to fill a piston
    - Less energy required to produce a desired level of hydraulic power
    - Lower rate of temperature increase
    - More energy delivered to the motor(s) before reaching the minimum viscosity

Fuel savings & reduced $CO_2$ emissions

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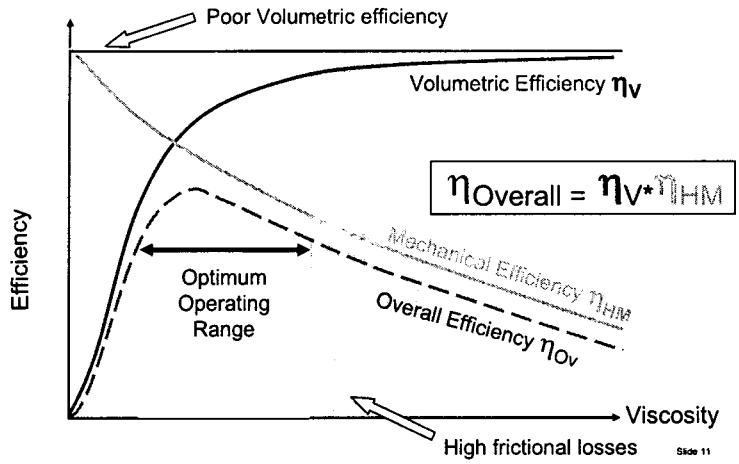
## Effects of Viscosity on Overall Efficiency

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## How Can we Obtain these New MEHF Benefits?

- For a given ISO grade, base stock slate and DI there are 2 formulation parameters
  - ➢ The VI of the fresh oil
    - VI is a complex function of viscosity at 40 and 100 °C
      - Gains achieved by increasing VI from 130 to 140 will be different than those obtain by raising VI from 170 to 180

      **Is there an optimum VI?**
  - ➢ The shear stability of the polymer used
    - The more shear stable the VI Improver:
      - The higher the treat rate needed to obtain a given VI and ISO grade
      - The higher the after shear viscosity and VI

      **Is there an optimum shear stability?**
- Since viscosity is changing in service due to permanent and temporary viscosity losses

  **How much of the initial benefits will be left after extensive service?**

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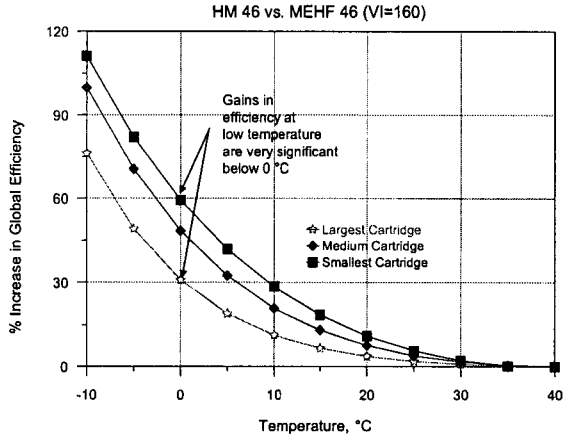
## Performance Claims at Low Temperature

**% Increase in Efficiency in Denison T6C Mobile Vane Pump**

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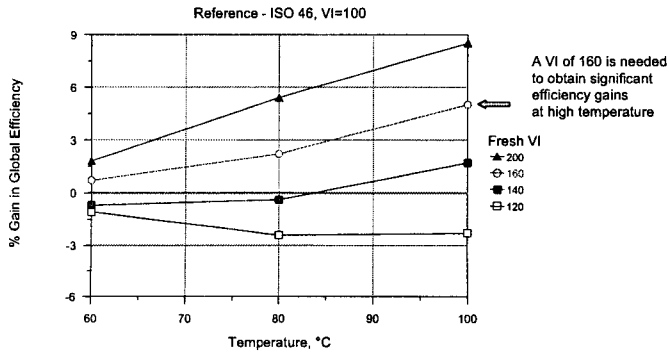
## Performance Claims at High Temperature – VI Effect

**Effect of Temperature on Efficiency at 350 bars in Komatsu Piston Pump**

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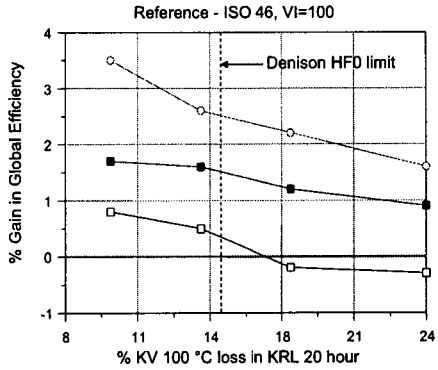
## Performance Claims at High Temperature – SSI Effect

**Effect of Shear Stability on Global Efficiency at 280 bars**
**ISO 46 VI=160 in Komatsu Piston Pump**




The better the shear stability, the higher the gains in efficiency

VIIs meeting Denison HF0 provide benefit over a wide range of temperature

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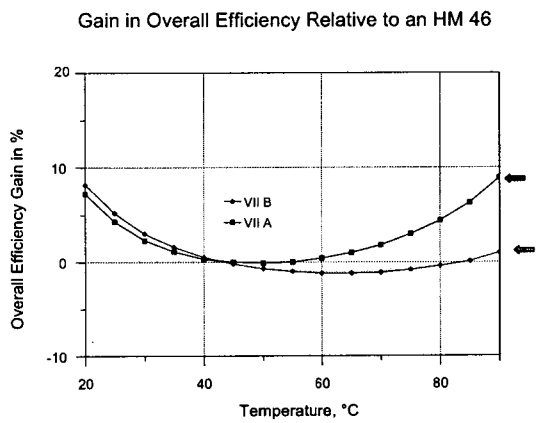
## Performance Claims at Low and High Temperature – SSI Effect

**ISO 46 VI=150 in Denison T6C Mobile Vane Pump at 250 bars**




HV 46 oil (VI=150) based on VII A provides benefits at both low & high temperature compared to an HM 46.

HV 46 oil (VI=150) based on VII B provides benefits only at low temperature

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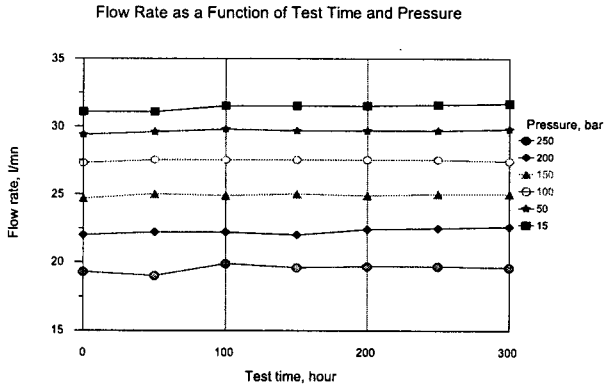
## Retaining Performance after Extended Service – Time Effect

**MEHF 46 oil in Denison T6CM Vane Pump at 80 °C**




We observe no significant decrease in flow rate with time even at the highest pressure.

The pump sees a constant viscosity in service that is equal to:
the fresh oil viscosity less the sum of permanent and temporary viscosity losses which is constant

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## Promoting a New Tier of HV Oils, MEHF Fluids

- We believe that the promotional platform for HV oils can be significantly expanded by using claims based on the improved efficiency of mobile equipment at both low and high temperature.

  - Benefits for the end users are:
    - Reduced $CO_2$ emissions
    - Fuel savings
    - Increased efficiency
      - More power available in less time

  - The level of benefits will depend on the formulation strategy (VI and Shear Stability)

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# What Is MAXIMUM EFFICIENCY mehf HYDRAULIC FLUID Performance ?

- MEHF delivers improved viscometric properties that provide:

➢ **High system efficiency over a wide range of temperature**
  - MEHF oils minimize frictional losses at low temperature
  - MEHF fluids reduce internal pump leakage and maximize Efficiency under high pressure and high temperature conditions

➢ **Benefits allowing fast pay-back on slightly higher oil costs**
  - Lowers energy consumption for same amount of work
  - Allows use of smaller pumps for same performance
  - Reduced need for auxiliary cooling in mobile equipment
  - Widens effective Temperature Operating Window (TOW)
  - Reduced overheating and risk of equipment shut down
  - Reduced costs for equipment builders and end users

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# MEHF Performance Definition

| Performance Requirement | Comments | Units | Method | Limit | Limit | Limit |
|---|---|---|---|---|---|---|
| Viscosity Grade | New Oil | ISO VG | ISO 3448 or ASTM D 2422 | 32 | 46 | 68 |
| Viscosity Index | New Oil | | ISO 2909 or ASTM D 2270 | >150 | >150 | >150 |
| Total Energy Savings* - Denison T6C Vane Pump | vs. HM fluid, same ISO VG, VI=100 | % | 80° C, 250 bar, 1500 rpm | *NA*** | >5 | >3.5 |
| Low Temperature Viscosity | "L" grade must be at least one grade lower than the ISO VG | mPa·s (cP) | Brookfield viscosity requirements according to ASTM D 6080 | <750 @ -22° C "L22" | <750 @ -14° C "L32" | <750 @ -7° C "L46" |
| Shear Stability | Minimum KV100 after shear in bench tests, predicts operating viscosity in the pump | $mm^2/s$ (cSt) | Kinematic Viscosity @ 100° C (ASTM D 445) after 40 minute Sonic Shear (ASTM D 5621) | >5.9 | >7.5 | >10.0 |

*Relative difference in the amount of energy input to the pump to generate the same amount of hydraulic work.
**_Not Applicable_- ISO 32 HM fluids have insufficient viscosity at 80° C to meet OEM minimum requirements. Therefore it is not possible to generate a reference baseline for comparison with MEHF 32.

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## Additional MEHF 46 Performance Information

- Fluids that meet the MEHF Performance Definition will show similar advantages in all types of hydraulic pumps
  - ➢ Fluids have been compared at typical mobile equipment operating conditions
    - High pressure external gear pump at 207 bar and 80° C
    - High pressure vane pump at 250 bar and 80° C
    - Variable displacement piston pump at 350 bar and 100° C

| Typical Performance Advantage | Comments | Conditions | % Energy Savings |
|---|---|---|---|
| Total Energy Savings* Eaton L2 Series, 25503 **Gear Pump** | vs. ISO 46 HM, VI=100<br>vs. 10W engine oil | 80° C, 207 bar, 2750 rpm<br>80° C, 207 bar, 2750 rpm | **>4**<br>**>7** |
| Total Energy Savings* Denison T6C **Vane Pump** | vs. ISO 46 HM, VI=100<br>vs. 10W engine oil | 80° C, 250 bar, 1500 rpm<br>80° C, 250 bar, 1500 rpm | **>5**<br>**>7** |
| Total Energy Savings* Komatsu HPV 35+35 **Piston Pump** | vs. ISO 46 HM, VI=100<br>vs. 10W engine oil | 100° C, 350 bar, 2100 rpm<br>100° C, 350 bar, 2100 rpm | **>15**<br>**>20** |

*Relative difference in the amount of energy input to the pump to generate the same amount of hydraulic work

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## Energy Savings- MEHF 46 vs. HM 46 Hydraulic Fluid

Denison T6C Mobile Vane Pump at 200 bar, 2000 rpm, 80° C

| | | Energy Savings to Deliver Same amount of Work | | |
|---|---|---|---|---|
| Pump Cartridge Size | Nominal Flow Rate, liters/minute | MEHF 46 VI = 150 | MEHF 46 VI = 175 | MEHF 46 VI = 200 |
| **B06** | **43** | **5.0%** | **6.7%** | **9.2%** |

All fluids formulated with RohMax VISCOPLEX® 8-200

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## Energy Savings- MEHF 46 vs. HM 46 Hydraulic Fluid

Denison T6C Mobile Vane Pump at 200 bar, 2000 rpm, 80° C

| | HM 46 VI = 100 | MEHF 46 VI = 150 | MEHF 46 VI = 175 | MEHF 46 VI = 200 |
|---|---|---|---|---|
| **Liters of Diesel Used** | **8,116** | **7,710** | **7,572** | **7,369** |
| **Liters of Diesel Saved by MEHF 46** | **0** | **406** | **544** | **747** |
| **Annual Savings** (Korea) (Japan) | **0** | 487,200 Won<br>42,630 Yen | 652,800 Won<br>57,120 Yen | 896,400 Won<br>78,435 Yen |

Assumptions: 8 Hours/day, 250 Days/year,
Diesel Fuel in Korea @ 1200 Won/liter
Diesel Fuel in Japan @ 105 Yen/liter

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## Conclusions

- **MEHF fluids offer Improved Performance and Energy Savings**
  - In all pump types (Gear, Vane, Piston)
  - At low temperature start-up (<0° C)
  - At high temperature operation (>60° C oil temperature)
  - Allow the operator to meet the fluid viscosity requirements of multiple OEM's
  - Can reduce peak oil operating temperatures and overheating
  - Reduced fuel consumption and exhaust emissions
  - Significant energy savings provide fast-pay-back of slightly higher oil cost.

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