LUBE-TECH

NO.43

# MULTIGRADE OIL & VISCOSITY INDEX IMPROVERS

This is an extremely important concept which, to my experience, most maintenance personnel either are not aware of or not bothered to understand. However, these concepts must be understood very thoroughly in order to implement effective maintenance practices.

In view of this, an attempt has been made to highlight these concepts as clearly as possible with a view to providing a deep insight into the topic.

## VISCOSITY

A detailed discussion of viscosity is beyond the scope of this topic. However, we must recall that viscosity is the resistance to flow at certain temperature. It is simply a measure of the thickness of the oil. Generally, thin oil has a low viscosity and thick oil has a high viscosity. This definition of viscosity is normally referred to as Kinematic Viscosity. The CGS unit of viscosity is $1cm^2sec^{-1}$. This is also called 1 stoke (st). The SI unit of kinematic viscosity is $1m^2sec^{-1}$. Normally the unit centistokes - cSt is used for practical purposes. This means that 1cSt = $10^{-2}$ st = $1mm^2sec^{-1}$.

## GRADES OF OIL

Grade of oil is defined either in terms of performance category (performance of the oil inside the engine) or in terms of viscosity classification (viscosity of the oil).

**American Petroleum Institute (API)** is the authority who does this certification. Let us consider following grades of oil: CE, CF4, CG4, CH4 and CI4. Here, 'C' stands for commercial, F, G, H etc. in alphabetical order indicates superiority in performance of the oil in four (4) stroke engine. API CE was in the market till 1980. Then it was superceded by CF4 which continued upto early 1990. Subsequently, CG4 and CH4 became the major players up to 2001 or so which were finally superceded by CI4. CI4 is currently the highest grade oil in the market. This continuous thrive for improvement in the performance of the oil is absolutely necessary to cater to the needs of more and more stringent performance of the engine.

**Society of Automotive engineers (SAE)** is the agency who does the classification in terms of viscosity. So SAE only performs viscosity classification.

Let us consider the two oils: SAE 20W40 & SAE 30. SAE 20W40 has two parts: 20W & 40, whereas, SAE 30 has only one part, 30. So, SAE 20W40 is generally termed as a multigrade oil and SAE 30 as a monograde oil.

Multigrade oils are designed to function under wide temperature variations. Here, 'W' stands for winter. There are two numbers on the left and right side of 'W'. The number at left with suffix 'W' indicates the performance of the oil at low temperature and the number at the right side of 'W' indicates the performance at higher temperature. The rule is smaller the number lower the viscosity and greater the number higher the viscosity. Now, it is clear that SAE 5W oil has a lower viscosity than SAE 10W oil and so on.

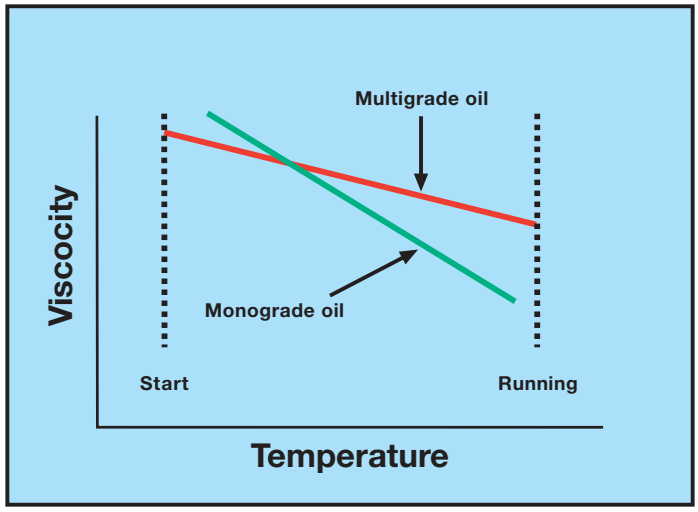
At this stage can we assess the feasibility of using SAE 10W30 in summer season? Yes, we can. The oil tends to be thin in summer because of high ambient temperature. If this thinning effect is not properly taken care of, then adequate film thickness will not be provided and there is every possibility of metal-to-metal contact between the components heading towards premature failure. Therefore, a more viscous oil like SAE 10W40 or SAE 15W40 should be preferred. Better component protection can be offered because of higher viscosity of these oils. However, in spite of the above discussion, lubricant selection must be done very scrupulously and original equipment manufacture must be ardently involved in this matter.

But how do these multigrade oils function? To understand this we must understand the following terms: Viscosity Index & Viscosity Index Improvers

## VISCOSITY INDEX

Viscosity Index (VI) is an empirical parameter. It denotes the extent of change in viscosity of the oil over a given temperature range. Viscosity @40$^0$C & viscosity @ 100$^0$C must be determined to calculate the VI of any oil. A low VI means the change in viscosity of the oil with temperature is high. A high VI number indicates a relatively small change in viscosity with temperature. This rate of change of viscosity with temperature also depends on the base oil. This change for paraffin base oils is relatively less than that for napthenic base stock. Some synthetic base oils are even more superior to paraffin base oils in this respect.

**Figure.1**




From Figure.1, it is obvious that the red line is the viscosity-temperature graph for a monograde oil, whereas, the blue line is that for a multigrade oil.

So, if one looks at the VI numbers of different oils, he must observe that VI numbers are larger for multigrade oils than those for monograde oils.

## VISCOSITY INDEX IMPROVERS

The VI parameter is improved by deliberately adding some chemicals known as additives. Many additives are used in any lubricating oil. One of these additives is VI improvers (VII). These additives are basically organic polymers precisely blended with the base oil to improve the viscosity-temperature characteristics of the lubricant. These polymers are soluble in the base oil. Their molecular weight varies from $10^3$ to $10^6$. These polymer molecules swell in the oil.The increase in viscosity of the polymer is directly dependent on extent of swelling of the polymer by the oil. This swelling increases with the increase in molecular weight of the polymer. These polymers are in the form of a long chain and remain tightly coiled and suspended in the oil at low temperature. As the temperature increases the coil unfolds, volume increases as a result of expansion and the oil gradually becomes thick. This means that thinning effect of the oil is nullified at higher temperature by the addition of VI improvers. Some of these polymers are shown in Figure 2.

These polymers basically tend to improve the viscosity-temperature property of the lubricant as shown in FIG.1. The loss of viscosity with temperature is less pronounced compared to a monograde oil. These polymers are found to be more effective with the increase in molecular weight. However, it is also true that these high molecular weight polymers breakdown under high shear stress. Hence, a performance balance must be very carefully sought out in

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selecting these polymers. A very high or very low molecular weight polymer may not be the most suitable candidate.

## MULTIGRADE OILS

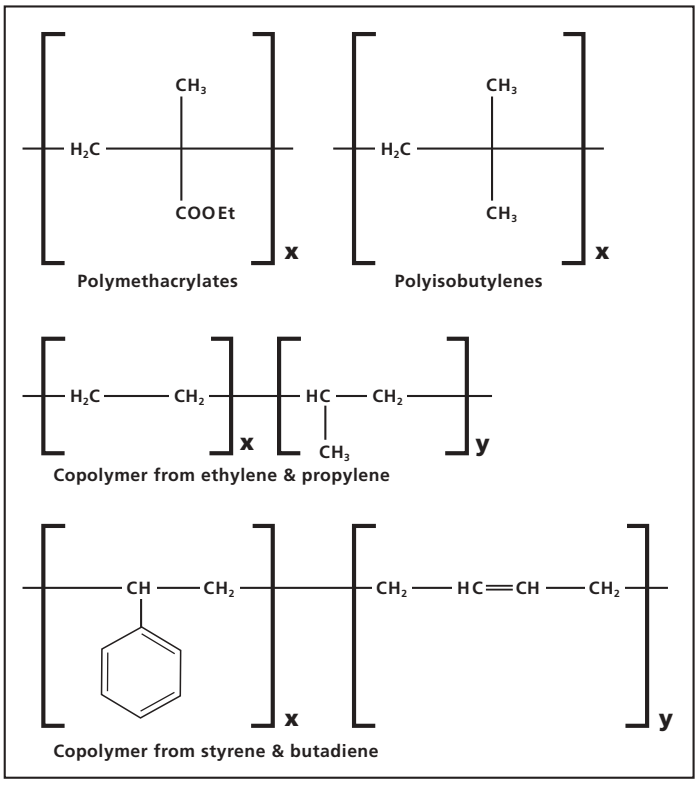
Let us assume that we have a SAE10W oil. The polymer additives discussed above are very precisely and carefully blended with the oil. At low temperature the viscosity of the oil will remain unchanged (because the polymer remains coiled), whereas, at high temperature it flows like a 30W (or a 40W) oil. Now we have made a 10W30 (or a 10W40) multigrade oil. This means that this oil will offer protection over an extended temperature range.

## CONCLUSION

Viscosity is one of the most important concepts (perhaps most important) with respect to lubrication and its diverse applications. Unfortunately, maintenance people normally are reluctant to go deep into this slippery subject. This is one of the reasons that root cause failure analysis or applied failure analysis is not adequately carried out in most organisations. When a machine fails, it is very easy to say that the machine failed due to bad oil. But does it really make any sense? What exactly has happened? Is it due to contaminated oil? Is it due to degradation of fluid's physical properties? Is it due to viscosity loss? Nobody bothers to go into such detail. And the result is repetitive failures occur affecting the bottom line of the organisation.

The author, therefore, makes an attempt to explain these concepts as clearly as possible. People working in this area detect the problem quickly and easily once the understanding is clear. Once the cause of failure is properly diagnosed, repetitive failures might be avoided.

**Figure 2**

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***Dr D Mukherjee***

**Biographical Profile**

Dr. Debasish Mukherjee
Date of birth: 27/08/1955

Education:

- Graduation with Chemistry Honours in 1976 from Burdwan University.
- Post graduation in pure Chemistry from IIT (Indian Institute of Technology), Kharagpur in 1978.
- Doctorate from IIT Kharagpur in 1985.

Service:

- Worked as a post doctoral fellow in University of Salford, Manchester in 1986-87.
- Worked as a Senior Research Fellow in IIT Kharagpur in sponsored projects from 1987-91.
- Worked in British Oxygen India (BOC India Ltd.) from 1991-98.
- From 1999 to present date working in TIL (Tractors India Ltd, Caterpillar dealer in India) as a manager of oil analysis lab.

Publications:

27 papers have been published. 22 papers are in international journals of repute which include research papers, review articles, teaching modules, articles in international conferences and magazines.

# ROHMAX MAXIMUM EFFICIENCY HYDRAULIC FLUID TECHNOLOGY

RohMax have announced the launch of a new high performance level in hydraulic fluid formulation technology that provides significant improvements in hydraulic pump efficiency.

Maximum Efficiency Hydraulic Fluid, or MEHF, is the result of extensive research by the oil additive experts at RohMax. It was developed in response to requests from equipment builders, oil blenders and hydraulic equipment owners and operators for increased levels of performance, fuel and operations efficiency.

MEHF products are formulated to minimise mechanical energy losses at low temperatures and to reduce internal pump leakage under high pressure/high temperature operating conditions. The resulting improvement provides many advantages to the equipment operator, including reduced need for auxiliary cooling and improved productivity. The primary advantage of MEHF is significant energy savings per unit of work, with a corresponding reduction in energy costs. For equipment manufacturers, MEHF delivers improved pump efficiency, meaning that smaller pumps can be used to supply equivalent amounts of power when compared with larger pumps using a standard fluid.

"This new level of product performance will deliver improved energy efficiency, which is especially relevant in mobile equipment," explained Doug Placek of RohMax. Placek said, "this new high performance fluid level will not only reduce downtime, but also maximise productivity and cut operating costs."

**Technology Details**

A wide variety of hydraulic fluid product options are commercially available. Low performance, low technology options can be provided to the market at a low price, if the customer is focused on the purchase price of the oil and will accept minimum performance levels. Educated and sophisticated customers will want to consider the total cost of operation, which includes the purchase price of the oil, life of their equipment, maintenance costs, and productivity. Optimising the quality, volume, and pace of production while reducing the total cost of operation requires the use of the latest technology, and MEHF has been designed to help.

The hydraulic fluid manufacturer, marketer, and distributor promote a number of different fluids to satisfy the requirements established by the pump manufacturer and equipment builder. The list of product options includes:

- Straight mineral base oils
- HM monograde oil
- Engine oils used as hydraulic fluids
- HV multigrade oil
- Specialty oils - synthetic, fire resistant, insulating
- Multipurpose oils for combined use in hydraulics, gears, metalworking, etc.
- Automatic transmission fluids used as hydraulic fluids
- *MEHF – Maximum Efficiency Hydraulic Fluid*

All of these fluids can "work", but do they enable the operator to reduce the overall cost of operations while improving performance and productivity? Hydraulic fluids must endure the burden of increasing temperature and pressures in current system designs. The operator must select a fluid that suits the needs of both new and old equipment from multiple OEMs.

MEHF technology represents a new option for the hydraulic fluid marketer to meet these challenges, and also a clear mechanism to differentiate these specialty fluids in the marketplace. Fluids formulated to meet the MEHF performance level will deliver value to everyone in the industry. Equipment operators get improved productivity and cost savings, equipment builders can improve performance and reduce vehicle emissions, and oil marketers will find increased demand in the valuable specialty fluids segment.

MEHF products are formulated to minimize mechanical energy losses at low temperature, and also reduce internal pump leakage under high pressure/high temperature operating conditions. The resulting improvement in pump efficiency over the entire temperature operating range provides many productivity benefits to the equipment operator, including:

- Energy savings per unit work of 5% or more, with a corresponding reduction in energy costs.
- Increased hydraulic power and reproducible equipment performance over a wider temperature range.
- Improved start-up performance at lower temperatures
- Reduced need for auxiliary cooling.
- Reduced risk of overheating and consequent equipment shutdown
- Elimination of seasonal oil change-outs.

Selecting a hydraulic fluid with the proper viscosity is critical in order to obtain optimum system response and guarantee long-term performance. A fluid with too high a viscosity at low temperature will not provide the necessary flow to avoid pump cavitation. A fluid with a low viscosity at the highest operating temperature will result in poor volumetric efficiency and, in some cases, in pump seizure.

To learn more about MEHF specifications, development and other performance data, visit the link below

MAXIMUM EFFICIENCY mehf HYDRAULIC FLUID

LINK
www.mehf.com

# UEIL HEALTH AND ENVIRONMENT COMMITTEE MEETS AT FEDERCHIMICA, MILAN

The second meeting of 2005 for the UEIL Health and Environment Committee took place at Federchimica, Milan, Italy in early October. Federchimica have taken a very active role in this UEIL group over recent years as they have a particularly close association with the Italian Metalworking Fluid Industry. Matteo Aglio hosted the meeting on behalf of Federchimica in his first meeting since replacing the recently promoted Giuseppe Abello from the same organisation.

Chairman of the Committee, Robert Stubbs of Polartech Ltd, welcomed the members of the committee and was particularly pleased to also welcome guest visitors from the UKLA Metalworking Fluid Product Stewardship Group and from the German organisation, VSI.

There was another strong attendance at the meeting with the main topics including:

REACh - Following on from the extensive lobbying activities of UEIL with respect to this issue, the H and E committee are now examining ways in which the Group can assist member companies to eventually implement the legislation.

Formaldehyde - Consideration of the potential effects that might arise within the biocides industry should the carcinogen classification of formaldehyde increase in severity. It is likely that a joint position paper will be created in conjunction with the UKLA Stewardship Group.

ILMA issues - Significant concern was expressed with respect to the NTP testing programme on watermix metalworking fluids currently being initiated in North America. A number of International UEIL / ILMA members have an involvement in this programme which is also being observed by the UK's Health and Safety Executive.

Boric Acid - The Committee agreed to take a consistent stance to this issue joining with the UKLA Stewardship Group in a 'no label' approach. VSI will discuss with their members to determine if they will join this approach or lobby for a minimising effect.

The Committee also agreed to set up its first group task force to consider how it might obviate specific aspects of REACh that could affect member companies particularly those manufacturing metalworking fluids.

The meeting concluded with a discussion of the approach that the UEIL Committee will take through into 2006. This included an increased usage of the UEIL web site to provide member companies with appropriate information, a stronger and closer relationship with UKLA Stewardship Group and the VSI and closer links to the current issues in North America, through ILMA. It was agreed that Chairman, Stubbs, would present the detail of the issues and the overall strategy at the UEIL General Assembly in Rome at the end of October.

The next meeting of the UEIL Health and Environment Committee will take place in January 2006 in the UK. If you would like more information about the UEIL Health and Environment Committee, please visit the web site at www.ueil.org. Alternatively if you would like to join the next meeting, please contact Robert Stubbs.

***R.Stubbs***
Chairman, UEIL Health and Environment Committee,
10th November 2005.

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# THE DIFFERENCE BETWEEN GOOD LUBRICATION AND GOOD LUBRICANTS

## Jim Fitch, Noria Corporation

I have learned that excellence in lubrication is just as difficult to realise as it is rare to find. The reasons for this are many. One simple explanation is the field of lubrication is a specialty that takes education and years of experience to master - like most professions. Companies employ professionals with specialised skills indeed (computer science, finance, marketing, etc.), but how often have you heard of a recruiter going to a college campus to interview and hire lubrication professionals? I've never heard of this. Likewise, I know of no colleges or universities in North America with degree programmes in lubrication. No wonder excellence in lubrication is so rare. Do you sense an opportunity here?

Lacking real knowledge in lubrication, companies must still make lubrication decisions. Decisions often seem straightforward on the surface, but below this surface, they are plagued with pitfalls that can cost companies dearly. Many are lured into making bad decisions due to pressures imposed by overzealous vendors or by management's cost-cutting directives. For instance, those with lubrication knowledge know that saving money by buying cheap oil is almost always a false economy. On the other extreme, buying quality oil to remedy bad lubrication is also a false economy. Sadly, many companies fail to make the important distinction between good lubricants and good lubrication. Yet, it is this distinction that defines whether or not we are on a trajectory to lubrication excellence.

Good lubrication requires knowledge, initiative and persistence. It's proactive, not reactive and certainly not passive. You cannot buy your way into good lubrication - just like you can't use money to tame unruly maintenance culture. Lubricants of high science and quality, at any price, cannot forgive the maintenance practitioner for not knowing how much, how often and by what method. No one is born with such insight.

Purchasing good lubricants requires only money. Best-fitting the type and quality of lubricants to the reliability needs of machinery is a science, not a purchasing function. But the science of good lubrication goes way beyond the optimum selection of lubricants. It's also a mantra of vigilance. It's tending to the details perpetually. It's constant improvement and constant learning. Its currency is reliability at the lowest cost. It optimises not maximises. It is measurement-driven and deploys oil analysis to make risk-informed decisions.

Bad lubrication cuts deep into business operating profits. It risks lost production, ties up valuable resources and, in some cases, imperils human life. Those who don't understand the causes of bad lubrication are condemned to repeat them. Instead, develop a culture that fosters learning and an unwavering drive to achieve excellence in lubrication.

Although rare… it is achievable.

NORIA

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