

# Bio-based Lubricants Road to conserve and improve energy efficiency



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One of the prime objectives globally and particularly in India is to improve the energy efficiency and its conservation. BEE is in the process of establishing energy efficient equipments, products, processes and systems. Moreover, the next step will be to conserve the energy through re-generation using nature's cycle.

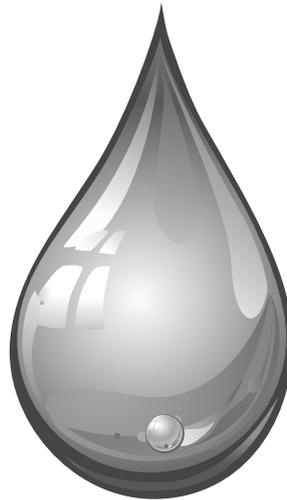
Naturally for improving the energy efficiency, one can target to reduce wastage of energy. In mechanical processes, large amount of energy is wasted due to frictional losses. We are so accustomed with present processes that, we do not realise that considerable amount of energy is being wasted because of friction.

It has been proved and accepted globally that, by changing mineral oil based or synthetic lubricants by bio-based lubricants, the power wastage can be saved upto 15 per cent or more, besides improving the other performance. Moreover, being bio-degradable and non toxic, biobased lubricants are environment friendly during use. They can be disposed off through composting so that, the entire energy can be renewed through cycle of the nature.

Bio-lubricants have the following exclusive properties:

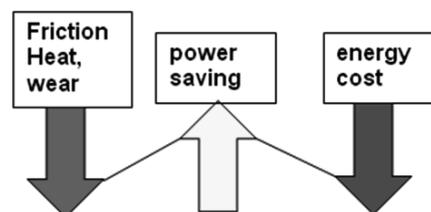
## Lubricity

Vegetable seed oil based lubricants are three to four times more lubricant than mineral oil based lubricants (tested in



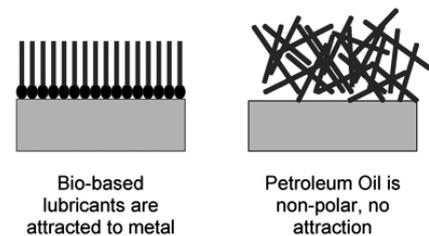
Iowa University) and two times more lubricant than synthetic. The base oils of petroleum based or synthetic are not lubricants, the lubricity is achieved by additives. But vegetable base oils are natural lubricants.

Lubricity reduces the friction between any two moving surfaces. With such higher lubricity, it was proved in case of gear boxes that their drive power or energy could be saved upto 15 per cent or more depending on type of gear box. Same is the case with reciprocating movements between flats



or during use of wire rope for material movement. Thus all vegetable seed oil based lubricants such as hydraulic fluid; spindle oil; chain oil; and greases of various types will provide energy saving in varying proportions.

## Polar Nature

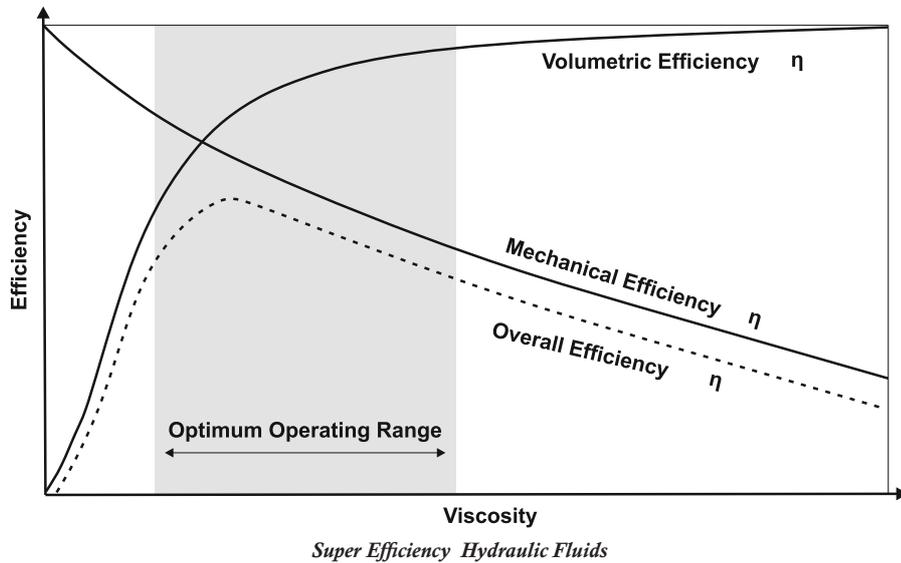


Unlike petroleum based or synthetic lubricants, all vegetable seed oil based lubricants are polar. The polar nature is shown here diagrammatically, they form thin strong film between contacting surfaces and induce better adhesion with substrate. This results in efficient transfer of power or energy.

## Higher Viscosity Index

Bio-based lubricants have two times higher viscosity index (210 cst) compared to petroleum based or synthetic lubricants (93 to 95 cst). Thus bio-based lubricants retain their viscosity in narrow band during the operations of the machines. Again considering the gear box operations, it can be observed that, due to frictional losses, there is always temperature rise of the gear oil in the sump upto 80

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deg.c. This will affect the viscosity of petroleum or synthetic based gear oils considerably. Hence normally high viscosity gear oils are used having viscosity ranging from 320 or 460 or more at room temperature. During operations, the temperature rises to 80 deg.c., and viscosity gets reduced to 40 to 50 cst. However, in case of vegetable oil based lubricants, even the 68 or 90 grade gear oils, temperature rises only up to 60 deg.c., (due to less frictional heating) and the viscosity is about 36 to 47 cst respectively due to high viscosity index of 210.

Bio-based hydraulic oils provide much better performance than petroleum or synthetic based oils due to its high viscosity index. It has been observed that pump efficiency is substantially improved by retaining the viscosity right from the starting to running. The over-all efficiency is product of hydro mechanical and volumetric efficiency. While starting at low operating temperature, high viscosity of petroleum based hydraulic fluids negatively affects the hydro mechanical efficiency of hydraulic systems resulting in reduced system performance, lubricant starvation and cavitations. But with bio-based lubricants having lower viscosity at starting, these problems are avoided.

With petroleum based hydraulic fluids

there is rise in temperature of the oil due to frictional losses during operations, resulting in reduced viscosity causing metal to metal contact in the pump, leading to wear and adding fluid heating. This creates loss of volumetric efficiency and also starts destructive cycle of rising temperature, accelerated wear and increased internal leakages. In case of bio-based hydraulic fluids, the temperature rise is low as frictional losses are reduced due to high lubricity during operations and viscosity does not drop due to higher viscosity index. This restricts metal to metal contact in the pump and avoids destructive cycle of rising temperature, accelerated wear and increased internal losses.

Considering much higher lubricity and polar nature along with higher viscosity index of bio-based hydraulic fluids, they could be called **Super Efficiency Hydraulic Fluids (SEHF)**. These hydraulic fluids can save more than 30 per cent energy, enhance the life of equipment and also reduce top-up requirements.

### High flash point and low evaporation loss

Compared to petroleum oil based lubricants, bio-based lubricants have high flash point and low evaporation rate. Thus they are safe to handle and top-up requirement for high temperature

applications like chain oil or high temperature grease is reduced. This property improves energy efficiency in high temperature applications.

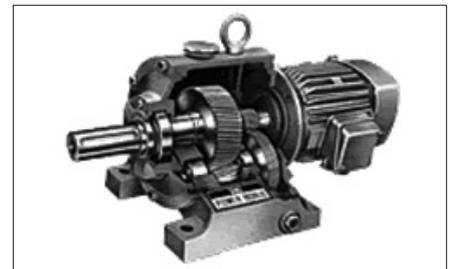
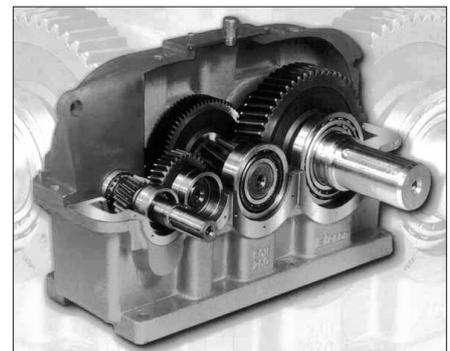
### Bio-degradable and non toxic

Unlike petroleum as well as some synthetic based lubricants, all vegetable seed oil based lubricants are bio-degradable and non toxic. Thus all applications under food grade and pharma grade can be conveniently covered by bio-based lubricants with the advantage of energy saving. Moreover, bio-based lubricants are environment friendly during operations and can provide renewable energy after disposal through composting and nature's cycle.

The use of bio-based lubricants in the following high energy consuming applications can lead to massive energy savings without any change in the construct or process of application.

### Gear Box: Gear oil

All machines require gear boxes to convert the speed of the driving unit such as electrical motor, steam turbine, oil engine, etc to speed required by machine. The efficiency of the gear box varies from 60 per cent (worm and worm wheel) to 95 per cent (planetary gear box) depending on the type and



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construction of gear box. All gear mechanisms operate in gear oil sump. The present gear oils with petroleum based or synthetic result in temperature rise upto 80 deg.c along with noise and vibrations.

It has been observed that, by simply replacing mineral oil based or synthetic gear oils with vegetable seed oil based lubricants, the efficiency improves, temperature rise comes down by 40 per cent with reduction in vibrations and noise levels. Moreover, the life of the gear box will increase substantially and suppress the top-up requirements of lubricants.

**Thus with this simple changeover, energy saving upto 15 per cent and more can be achieved for each drive.** This is tested and certified by major gear box manufacturers like Elecon Engineering Ltd, Premium Transmissions Ltd, Cyclo Ltd, etc.

During 2012-13, the above changeover was tried in three sugar units for their cane milling operations. The motors or steam turbines operating these machines have shown 10 per cent to 12 per cent energy saving for 750 HP motors or equivalent. The same results were obtained in distillery, passenger lift, conveyors and storage machines etc.

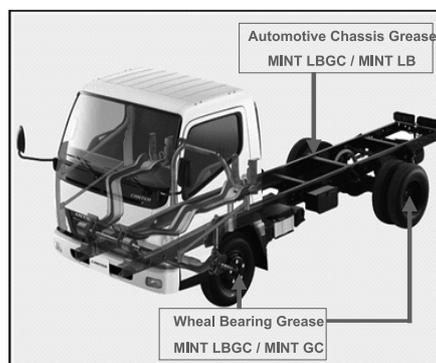
### Hydraulic systems: Hydraulic fluids

Elevators, industrial machines, hydraulic presses and plastic molding machines, material handling and earth moving equipments, are some of the cases where super efficiency hydraulic fluids can save more than 30 per cent energy, enhance the life of the



equipments and reduce top-ups.

### Wheels and bearings



Automotive wheel bearings as well as other bearings supporting rotating motions are filled with greases or oils specifically prepared for indicated applications. All automotives require special grease internationally known as LB/GC grease. This is for chassis and wheel bearings. Petroleum based or some synthetic based greases can be replaced with vegetable seed oil based greases to reduce the friction and provide energy saving. Considering huge quantity of four wheelers particularly trucks and buses and frequency of replacing the grease, the fuel savings even at low level will be massive. During testing at CIRT, Pune, it was observed that the lubricity of bio-based grease is much higher than specified by LB/GC standards (ASTM scar diam standards for LB-0.6mm max and for GC (wheel bearings) 0.9mm max) (CIRT test of 'Dirghayu' LB/GC-0.22mm).

Similarly, the high lubricity, polar nature of bio-based greases can provide energy saving for bearings in many applications including the drives like electrical motors. In case of heavy duty operations, sometimes the bearings use oil instead of grease. Bio-based oils can provide high rate of energy saving besides providing simpler ETP when it is discharged after duty.

In the sugar mills, the consumption of mill bearing grease or oil is high and they also cause friction. The use of bio-based mill bearing lubricants can change this

situation to less consumption and will also reduce load on drive because of the high lubricity provided by lubricant. This may further save five per cent to seven per cent energy.

### Wire rope lubricant



Wire ropes have two application requirements during dressing. One is to provide environmental protection to the complete rope and second is to penetrate the individual strands and provide high lubricity cover, so that, friction between strands and core during movement is minimised. The bio-based lubricants induce less friction and provide longer life for penetrating. Moreover, energy savings of about five per cent to seven per cent can be achieved. Wire ropes are used on cranes, earth moving machines, material handling, gantries etc. Ports, mines, industries are using wire ropes for various material handling jobs.

JNPT, Mumbai, has tested bio-based lubricant and found it effective. As a natural outcome of reducing friction between strands and core as well as rope and driving mechanisms, it was observed that, the life of wire rope increases.

### Chain oil

All conveyors and material handling equipments using chains require lubricating oil for wheels or bearings of the chain and the joints of the chain. In case of high temperature applications, there is consumption of oil due to evaporation. Poor lubrication causes higher energy consumption and reduces life of chain. By using bio-based chain

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oils, energy saving of about seven per cent to 10 per cent can be achieved along with much longer life for the chains. In case of high temperature applications, higher viscosity index of bio-based chain oils helps in proper application of chain oil, and maintaining similar viscosity during running resulting in energy saving. Top-up requirement is reduced.

### Spindle oil

In case of textile machinery, and CNC machines, spindle oil is required for smooth operations. Even in this case, bio-based spindle oils have proved energy saving upto seven per cent besides longer life for the lubricant.

### Steel rolling mills

In steel rolling mills, bio-based oils help

in reducing friction and cooling of the sheets between dyes resulting in energy saving and improved performance. Moreover, it is safe as bio-based oils doesn't cause any harm to humans while handling such machines.

In developed nations, many other bio-based lubricants are produced to replace the use of crankcase oils, two stroke engine oils, the rail road greases etc for energy saving and improved performance.

### Economic advantage

Biobased lubricants are two to three times expensive than petroleum based oils. However, energy saving alone is most important factor to justify the increased cost of bio-based lubricants. In almost all cases of gear oil, hydraulic oil, chain oils, wheel bearing grease, wire rope lubricants etc it has been proved that, the energy saving will set off total cost of bio-based lubricants within one or two months of their use. Thereafter, the energy saving provides excellent economic advantage.

Thus changing petroleum based or synthetic based lubricants by equivalent bio-based lubricants will result in significant energy savings, improved performance and longer life of the machines. Moreover, being biodegradable and non-toxic, this changeover will help in establishing conservation and renewal of this energy through nature's cycle.

Bio-based lubricants under the trade name 'Dirghayu' is being produced and marketed by Mint Biofuels Ltd and Intech Energy Systems Pvt Ltd (the licensee) since 2011.

### International References

- Biobased Lubricants: A Viability Study- Adam Ing.
- Energy Savings Through Use of Advanced Biodegradable Lubricants.
- Fuchs Lubricants (UK), Efficiency Tests of A Transfer Gearbox: Biodegradable Non-Toxic Ester Vs. Mineral Oil, The Research Paper Financed by European Union.
- The Benefits of Maximum Efficiency Hydraulic Fluids, Steven Herzog, Rohmax Christian Neveu, Rohmax Douglas Placek, Rohmax.

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## Peak Load Management

"When I think of peak load management of power, I am reminded of 1980s when I was working as Director - DRDL. In 1983-84, there was severe shortage of power in AP. The defence labs had a peak load constraint of 3 MW power, whereas the connected power was over 10 MW. This situation led to inefficient working of all the three labs located in the complex. To overcome the situation, the three Directors of the laboratories at Hyderabad devised an innovative plan to stagger the working hours in such a way that one set of laboratories used to work for a four day week (from Monday to Thursday) of 10-1/2 hour duration per day. The other

set worked on a different four days (Thursday to Sunday) with one common working day available among all labs to facilitate inter laboratory communication. This system ensured conservation of energy and maintained efficiency within the peak load constraint imposed by the state electricity board. This is one way of practical energy conservation. Similarly, I would suggest implementation of staggered working hours for the whole country based on the determination of the existing peak demand period in various parts of the country".

- *Dr APJ Abdul Kalam, former President of India*  
*Address at National EC Awards Function 2005*