

## Capability of Biolubricants as Alternative Lubricant in Industrial and Maintenance Applications

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### Abstract

*Petroleum based lubricants had a significant cost advantage over biolubricants and so petroleum has been the base oil of economic choice. Increase in crude oil prices, depletion of crude oil reserves and growing environmental concerns has brought in now more interest in biolubricants. Biolubricants have capability of being utilized in various industrial and maintenance applications like hydraulic fluids, metal working fluids, grease, two-stroke engine oil, concrete mould release agents, chainsaw oils and are mainly used in machinery and equipments operating in environmentally sensitive areas (e.g. agriculture and forestry machinery, jet-skis, snow mobiles etc.) Biolubricants for industrial and maintenance application, by contrast, may lead to a decrease in costs and to guarantee competitiveness. It is thus to be expected that environmentally sound applications of lubricants will be of great interest to all manufacturing companies. By the use of biolubricants, it is possible to reduce the use of petroleum based lubricants both in industrial and maintenance applications and also cut down the serious environmental problems caused.*

**Keywords:** *Biolubricants, Industrial & Maintenance Applications, Anti-Wear Character, Friction, Toxicity, Biodegradability, Environment.*

### 1. Introduction

Lubrication is essential in almost every aspect that has contributed to the development of our society to the present day (industry, transportation, construction, maintenance etc). The main property of a lubricant is friction reduction or avoiding the direct contact of two surfaces in different systems. Lubricant is also used for power transmission in hydraulic machinery. Biolubricants is being used throughout history.

A large majority of the bases of the lubricants used nowadays are from petroleum oils. However, the extensive use of petroleum based lubricants has caused serious environmental problems due to the fact that these oils are poorly biodegradable. So spills from machines or accidents cause damage to environment and are very dangerous. The increasing concern for environmental security, in addition to the regular increase in the price of petroleum oil have urged the development of newer bio based lubricants, which are much less contaminant and rapidly biodegradable. The latest advancement in oil seed provides new oil bases that overcome the problem of the low stability of vegetable oils (Joaquin J. Salas et. al., 2011). One of the main advantages of petroleum bases over vegetable oils is their higher versatility, which

involves producing bases with higher viscosities and lower pour points while maintaining high levels of stability. The production of fatty acid or triacylglycerol estolides allows for the production of biodegradable bases with improved properties and opens a promising field for the oleochemistry applied to biolubricant production.

### 2. Biolubricants

Substance made from vegetable based oils and additives are usually called as "biolubricants" (Wagner et. al., 2001). Vegetable oils are extracted from plants by placing the relevant part of the plant (Seeds, leaves, root etc.) under pressure, to squeeze the oil out. Traditionally vegetable oils have been applied in food uses, but recent courses of action suggest their economic usefulness in industrial and maintenance applications.

Vegetable oils are chemically triglycerides of fatty acids, and have excellent qualities like enhanced flash and fire points, higher viscosity and viscosity index, high biodegradability, high lubricity, and very less toxicity. Vegetable oils are of two types, Edible and Non edible. Edible vegetable oils: A liquid fat that is capable of being eaten as a food or food access, like Coconut, Olive, Soyabean, Sunflower, Palm, Peanut, Rapeseed, Corn etc. Various countries import edible oils for their food requirements. Non edible vegetable oils: As a substitute non edible vegetable oil can prove to be valuable. Non-edible vegetable oils like Neem, castor, Mahua, rice bran,

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karanja, Jatropha, and linseed oils (Sevim et. al., 2006, Ioan et. al., 2002).

### 3. Industrial and Maintenance Application of Biolubricants

Lubricants are used in various industrial and maintenance applications throughout the world. Some of the important applications are; Industrial Oils used for industrial purpose like machine oils, compressor oils, metalworking fluids and hydraulic oils etc. Automotive Oils used in automobile and transportation industry like engine oils, transmission fluids, gear box oils, brake and hydraulic fluids etc. Special Oils used for special purpose as per specified operations like process oils, white oils, instrumental oils etc (Amit Suhane et. al., 2012).

Biolubricants provide significant advantages as an alternative lubricant for industrial and maintenance applications due to their superior inherent qualities. Biolubricants due to their environmental benefits enable their use in sensitive environments and provide pollution prevention. Biolubricants have capability of being utilized in various industrial and maintenance applications. Some of the applications are listed below.

**Hydraulic fluids:** Hydraulic fluids or hydraulic liquids are used to transmit power in hydraulic machinery. Mainly hydraulic fluids are based on petroleum oil (Givens W et. al., 2003). Petroleum oil can pollute drinking water, with the agricultural and mining industries being major consumers of hydraulic fluid. Bio based hydraulic fluids are used in environmentally sensitive applications when there is the risk of an oil spill. Vegetable oils from Canola used as base stocks for fluids where biodegradability is considered important. (Placek et. al., 2006). Some of the significant advantages of using biodegradable hydraulic fluids are Viscosity for film maintenance, Low temperature fluidity, Cleanliness and filterability, Antiwear characteristics, Corrosion control, Adequate viscosity and viscosity index, Shear stability, Low volatility, Proper viscosity to minimize internal leakage, High viscosity index.

**Metalworking fluid:** Metalworking fluids reduce heat and friction and also remove metal particles in industrial machining and grinding operations. Metalworking fluids (bio based) have excellent lubricity and viscosity vs. temperature characteristics, better thin film strength, less smoke and risk of fire. The use of biolubricant can fulfil the aim of energy independency and a safe environment (Dwight Smith et. al., 2010).

**Metalforming:** Biolubricants are used in metalforming operations to separate workpiece and tool surfaces, reduce interface friction, ease metal flow in order to produce sound components and increase tool life.

**Cutting fluids:** Bio based cutting fluids are used for improving tool life, reduce thermal deformation, improving surface finish, reduce environmental impact

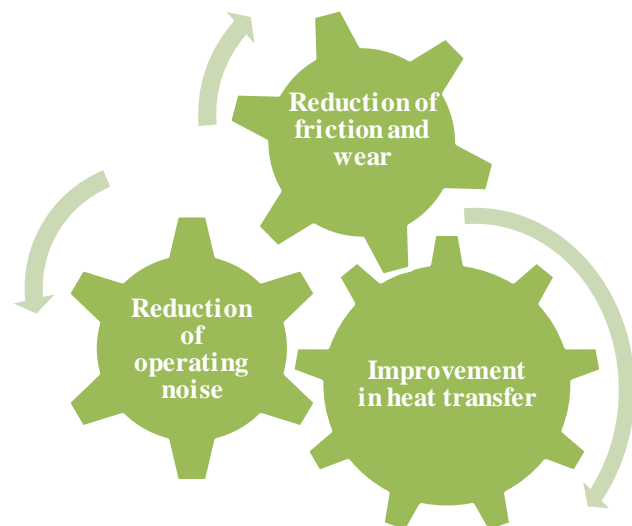
and are safe and convenient for use in a wide variety of manufacturing applications (Bob Frazier et. al., 2010).

**Grease:** Semisolid lubricants are applied to mechanisms that can only be lubricated infrequently and where lubricating oil would not stay in position. Grease also acts as sealants to prevent entry of water and incompressible materials. Bearings lubricated with grease have greater frictional characteristics due to their high viscosity. Rape seed oil based, rapidly biodegradable general grease containing a calcium soap for total-loss applications, -20Â°C to +70Â°C. (Fuchs).

**Concrete Mould Release Agents:** Biolubricant prevents freshly poured concrete from sticking to its mould or formwork and thereby facilitates removal of the formwork once it has cured. It can be used for environmentally sensitive areas.

**Chain Saw Oils:** Specially designed bar and chain combinations as a tool for use in chain saw art. Bio based chain saw oils have excellent lubricity and good ageing stability.

**Gear oils:** Biodegradable and environmentally friendly, high-performance gear oils provide excellent protection against micro-pitting, eliminate or reduce smoke, improve tool life, removal of foreign or wear particles (from critical contact areas of gear tooth surfaces) and corrosion prevention (Fuchs). Some of the other major benefits achieved by the use of biolubricants are shown in figure.



**Figure 1:** Major Benefits Achieved From Biolubricants.

**Gearing Applications:** Bio based oil in gearing applications increase tool life. At normal feeds and speeds tool life increases by up to 100 percent (Bob Frazier et. al., 2010). Faster machining processes and lesser tool change

can lead to productivity increases of 20 percent or even more. Better tool condition and improved surface finishes improves part quality. Processes like grinding, hobbing, shaving, shaping and broaching can be benefited by the inherent characteristics found in biolubricants.

**Gear grinding:** Biolubricants provide important meliorations in gear grinding like reduced friction which improves dressing efficiency and improves dresser life, the heat produced allows for faster grinding with lesser chance of burning the part, and it also provide improved surface finish, grinding wheels retain their size which extend wheel life, cutting edges is improved to prevent premature cratering which increase tool life.

**Grinding operations:** Bio based coolants can benefit greatly in grinding operations; reduce friction causing abrasive grains to stay sharp longer, allowing much longer time between wheel dresses so wheel life and accuracy is improved, reduction in heat generated in most grinding operations this allows feed rates to be increased without introduction of excessive heat into the part.

**Marine lubricants:** Lubricants that is used in various types of machinery situated on ships. A new technology that is increasing is biodegradable marine lubricants, because of the environmental advantages these lubricants can provide.

**Drilling Fluid:** Boreholes into the earth are assisted by drilling fluid, used while drilling oil and natural gas wells and on exploration drilling rigs, also used for simple boreholes (water wells). Drilling fluids keep the drill bit cool, provide hydrostatic pressure to prevent formation fluids from entering into the well bore, avoid formation damage and to limit corrosion (G. V. Chilingarian et. al., 1983). A drilling fluid produced from bio based ingredients that are able to withstand the harsh and challenging downhole environment conditions, outperforming the traditional fluids and the residual fluid and cuttings are able to meet all environmental standards to return to the environment, thus able to offer a much cleaner and safer approach.

**Slideway Oils:** Biodegradable and environmentally friendly slideway oils have very good friction coefficients, eliminate or reduce smoke, improve tool life, good EP and anti-wear performance.

**Chain lubricants:** Bio based tacky lubricant for chains and other total-loss applications.

**Machining process:** Machining processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process (Groover, Mikell P. 2007). Application of biolubricants on some of the common machining process is shown in the figure below.

**Water Soluble Coolants:** In machining biolubricant offer features that can lead to cost savings, quality improvements, improved lubricity for better tool life, better surface finish, reduce friction, reduce heat and increased productivity (OSHA 1999). Bio based coolants are easy to maintain due to excellent sump stability and reduced toxicity. No inflammation of the skin is experienced by operators.



**Figure 2:** Application of biolubricants on common machining process.

**Coolants:** Bio based coolants can be used on all metals like stainless steels, alloy, and tool steels (Bob Frazier et. al., 2010). Bio based coolants improve tool life, long sump life, and low maintenance.

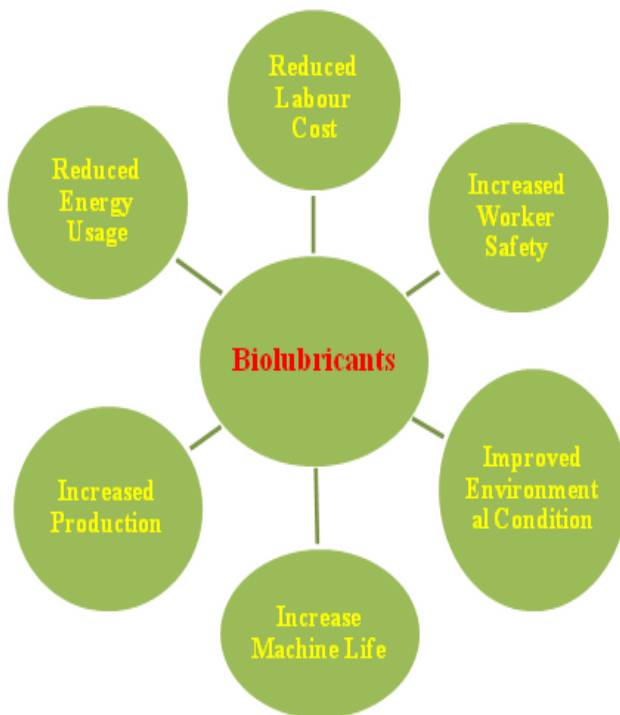
**Easy Cleanup:** Biolubricants and coolants are easily cleaned from parts and machines with soap and water. Residue left on steel parts acts as an effective in-process rust preventative non-staining on most metals, including brass and most aluminum alloys.

**Health & Safety:** Biolubricants are not ecologically hazardous; OSHA (Occupational Safety and Health Administration) limits for bio based vapors are much higher than for petroleum based vapors. No skin problem as the operator's skin doesn't dry out after contact with these oils. Vegetable oil is far less toxic than petroleum based lubricant, glycols and synthetic oils. Vegetable oil has much higher flash point (approximately 275-290 °C) which reduce the risk of accidental ignition, eliminating all injuries, unsafe practices, occupational illnesses and incidents of environmental pollution.

#### 4. Effect of Biolubricant on Industries and Environment

It is very clear that biolubricants are the best solution for the toxic effects that are caused by petroleum based lubricants on our ecosystem. No environmental problems will be caused from hydraulic leaks, no injuries at the job so no lost in work which will decrease maintenance between oil changes more production increases profits.

Employees no longer have to experience the inflammation of the skin caused by petroleum based lubricants. Furthermore biolubricants in industry provides significant advantages as shown in figure below due to their super high inherent characteristics.



**Figure 3:** Significant Advantages of Biolubricants.

#### Conclusion

Environmental factors are gaining importance in our society. Keeping in mind that environment is continuously contaminated with various kinds of pollutants; any slight reduction is acceptable gladly. A large amount of petroleum based lubricants pollute the environment during or after use, mostly from spills and industrial processes.

As environmental concerns gaining interest the biolubricant industry is growing and various countries are restricting the use of petroleum based lubricants in applications where lubricants can get in contact with soil and water.

Capability of biolubricants as alternative lubricant for industrial and maintenance applications include lower toxicity, good lubricating properties, high viscosity index, high ignition temperature, increased equipment service

life, high load carrying abilities, good anti-wear character, excellent coefficient of friction, natural multigrade properties, low evaporation rates – low emissions to atmosphere, and rapid biodegradability. Industries can reduce tool costs and improving product quality in a safer environment by switching to biolubricants. Biolubricant reduces costs and increases competitiveness.

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