

Vegetable oil as lubricant essay sample



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Environmental concern and regulation has increase the need of renewable and biodegradable lubricants such as oil lubricant, grease or solid lubricants. Thickener and base oil determine the greases' biodegradable properties and lubricating ability. Recent environmental awareness has put mineral oils; as the most widely used lubricant base fluid into consideration by the use of biodegradable fluid like vegetable oils and other synthetic fluids into new grease formulation. The lubricant made of vegetable oil already is used by human since ancient time. For example olive oil was used as lubricant since 1650BC. In this world many type of vegetable oils are produced commercially as it is being used in many applications especially in industry. Nowadays mineral oil which is derived from petroleum and synthetic oil from petrochemical are mainly used as base oil in lubricant.

In recent years there has been serious concern of the remaining of the world petroleum resources. For over 100 years mineral oils have dominated lubrication and nowadays the environmental issues start to arise as the mineral oil and synthetic oil is not readily biodegradable. Today vegetable oil are gaining popularity because of the significant advantages to environment as the vegetable oil is a renewability resource, biodegradability, and posse's adequate performance in a variety of applications. The suitability of vegetable oils as lubricant is mainly influenced of its composition and stabilization towards oxidation. The addition of suitable anti-oxidant is believed significantly enhanced the stability of vegetables oil. Therefore the modification of vegetable oil structure is necessary to enhance its performance as a better lubricant. They are the promising candidates as

base fluid for eco-friendly lubricants because of their excellent lubricity, biodegradability, viscosity-temperature characteristics and low volatility.

INTRODUCTION A lubricant is a substance introduced to reduce friction between moving surfaces. It is used to reduce wear, prevent overheating and corrosion. It may also have the function of transporting foreign particles. The major component in lubricant are the base stock (usually 80-100%) and additives . The property of reducing friction is known as lubricity. Lubricants perform the following key functions.

- * Keep moving parts apart
- * Reduce friction
- * Transfer heat
- * Carry away contaminants & debris
- * Transmit power
- * Protect against wear
- * Prevent corrosion
- * Seal for gases
- * Stop the risk of smoke and fire of objects

Vegetable oils were the primary lubricants for machinery and transportation vehicles for thousands of years until the discovery of petroleum. Petroleum, primarily on the bases of lower cost and improved performance, quickly replaced vegetable oils as the lubricant. Now with increased petroleum costs, decreased petroleum reserves, and environmental concerns as major factors, vegetable-based oils for lubricants are making a slow but steady comeback. Continued growing environmental concerns are providing the

impetus for increased demand and usage of vegetable oil utilization in lubricants for many applications. Of the 5-10 million tons of Petroleum based oleo chemicals entering the biosphere every year, about 40% comes from spills, industrial and municipal waste, urban runoff, refinery processes, and condensation from marine engine exhaust. Oleo chemical pollutants are derived from the food industry, petroleum products, and by products such as lubricating hydraulic and cutting oils. Vegetable oil can offer significant environmental advantages with respect to;

- * Resource renewability,

- * Biodegradability,

- * Adequate performance in a variety of applications.

- * Low temperature properties that are innate characteristics of the triglyceride molecule. Vegetable oils are perceived to be alternatives to mineral oils as base oils for industrial lubricants due to growing environmental concerns. Vegetable oil based lubricants offer significant environmental benefits with respect to resource renewability,

- biodegradability, low toxicity, and provide satisfactory performance in a wide array of applications. Vegetable oils in general have excellent properties such as high viscosity index, high lubricity, high flash point, and low evaporative loss with regard to their use as base oils for lubricants. On the negative side, they are known to possess low thermal, oxidative and hydrolytic stabilities and poor low temperature characteristics.

Vegetable oils are also found to be temperature sensitive in the case of tribological properties especially at high temperatures. Some of the important base oil properties of industrial lubricants are viscometric, physico-chemical, tribological, oxidative, thermal, hydrolytic, corrosion and low

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temperature properties. The present day mineral oil lubricants consist of a base oil (> 90%) and an additive package (<10%) to enhance its lubricant properties. Recent literature reports development of novel additives and chemical modification processes to improve the oxidative and hydrolytic stabilities of vegetable oils to make them suitable as base oils. Literature survey also reveals many chemical modification processes suitable for vegetable oils to improve their base oil properties including cold flow characteristics.

The poor cold flow properties of vegetable oils can be attributed to their unique molecular structure, namely, triacylglycerol structure. Vegetable oils have a tendency to form macro crystalline structures at low temperature through uniform stacking of ' bend' triacylglycerol backbone. Such macro crystals restrict the easy flow of the system due to loss of kinetic energy of individual molecules during self stacking. The predominantly saturated fatty acid content of certain tropical oils like coconut oil compounds the problem further. This is attributed to close packing of the saturated fatty acid chains in triacylglycerols during cooling forming crystals which entrap the low melting constituents leading the formation of gels (congelation). Attachment of side chains at double bond positions by chemical modification procedures like oligomerization (synthesis of dimers, estolides etc.) and alkoxylation is suggested as possible methods to improve cold flow behaviour of vegetable oils. Conventional method for determining pour point is ASTM D97 method. ASTM D97 method is time consuming and reproducibility of pour point temperatures is poor between laboratories. Differential Scanning Calorimetry

(DSC) is a fast, accurate and reproducible method to analyze the thermal activities during cooling/heating of an oil.

REVIEW OF LITRATURE

3. 1 Definition of some important words

Vegetable oil - Any of various oils obtained from plants and used in food products and industrially. eg-corn oil from the germs of corn grains, palm oil from nuts of oil palm etc. Synthetic oil-The synthetic oil is a lubricant consisting of chemical compounds that are artificially made (synthesized).

Viscosity index-It is an arbitrary measure for the change of kinematics viscosity with temperature. It is used to characteristics lubricating oil in the automotive industry. Mineral oil- A distilled product of petroleum especially one used as a lubricant, moisturizer, or laxative. Pour point-The pour point of a liquid is the lowest temperature at which it will pour or flow under prescribed condition. It is a rough indication of the lowest temperature at which oil is readily pump able. Oxidation stability - Ability of a lubricant to resist natural degradation upon contact with oxygen. Kinematics viscosity- The coefficient of viscosity of fluid divided by the density is called kinematics viscosity and usually measured in stokes. Cloud point-The cloud point of a fluid is the temperature at which dissolved solid a are n longer completely soluble, precipitating as a second phase giving the fluid a cloudy apperence.

3. 2 Objective of the term paper

The purpose of this term paper is to know about the uses of vegetable oil as a lubricant and to be eco-friendly with the environment. In this term paper, I will focus on the use of vegetable oil. I am going to explain the composition, properties, some test which can show that how can we use vegetable oil with

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decreasing its disadvantages. Some modifications for vegetable oil and additives which can increase its efficiency. History of vegetable oil that how it is introduced in industry and machinery purpose as lubricant. The main part of this paper is its national and international status of the topic, that how it is used by the people in different countries.

3. 3 Composition of vegetable oil

Basically vegetable oil is made of two simple building blocks which are glycerol and fatty acids. Based on the Handbook of Vegetable Oils and Fats there is only one type of glycerol but the fatty acids can vary widely in their structure. Glycerol consists of three alcohol groups where fatty acids can be attached and the resulting products are termed monoglycerides (one fatty acid), diglycerides (two fatty acids) or triglycerides (three fatty acids).

Quality and the stability of vegetables oil is a main factor to be accepted in market. Vegetable oils in general have excellent properties such as high viscosity index, high lubricity, high flash point, low evaporative loss, high biodegradability and low toxicity with regard to their use as base oil for lubricants. In contra, vegetable oil also infamous of its low thermal, oxidative, and hydrolytic stabilities and poor low-temperature characteristics.

3. 4 Properties of vegetable oil

3. 4. 1 Oxidation

Fundamental knowledge of the oxidative properties of lubricants is necessary to predict the long-term thermal stability of vegetable oil as it is critically important for lubricant property . Generally the oxidation stability of vegetable oil is determined by the degree if unsaturation, the presence of natural and synthetics antioxidants, the presence of pro-oxidants such as

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metal and availability of oxygen. Triacylglycerols oxidation normally takes place at the double bond proceeding via a formation of hydroxides to ketones and aldehyde . Fox and Stachowiak mentioned that the fatty acids in vegetable oil triglycerides are all of similar length, between 14 and 22 carbons long, with varying level of unsaturation.

The triglyceride structure of vegetable oils provides qualities desirable in a lubricant since the long, polar fatty acid chains provide high strength lubricant films that interact strongly with metallic surfaces and reduce friction and wear. Indeed the strong intermolecular interactions are resilient to changes in temperature that providing a more stable viscosity. Low oxidation stability contributes to major factors that hinder the industry to accept vegetable oil based as lubricants. However the oxidation stability of vegetable oil can be improved through selective breeding programs and genetic modification, and also by chemical modification of oil structure by techniques such as blending, interesterification, hydrogenation and epoxidation. Oxidation properties evaluated experimentally are often used to predict actual lubricant service life in high temperature and other extreme applications. The more resistant a lubricant is to oxidation, the fewer tendencies for the lubricant to form deposits, sludge, and corrosive byproducts in grease, engine oil and industrial application. 3. 4. 2

Antioxidant

A study made by Merrill et al. (2008) measure the oxidative stability of conventional and high-oleic varieties of commercial vegetable oils, with and without added antioxidant. The variety study of vegetable oil is soybean, partially-hydrogenated soybean, corn, sunflower, canola, high-oleic canola,

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very high-oleic canola, oleic safflower and high-oleic sunflower. One or more anti-oxidant was added to the selected vegetable oils at recommended level supplier. Among the antioxidants use such as rosemary extract, ascorbyl palmitate, tert-butylhydroquinone and mixed tocopherols. The anti-oxidant effect is evaluated use oil stability index. Oxidation determines the service life of a lubricant. Oxidation resistance and operating temperature will measure the oxidation resistance of the oil (Landsdown, 2004). It is also stated by Landsdown that certain metals increased the oxidation. The rate of oxidation can be reduce with the presence of anti-oxidants either natural or additives.

3. 5 Performance Test Review

Unlike the use of vegetable oils in the food industry, the lubrication industry has its own testing protocols for products, and the following are some of the tests are carried out to evaluate the performance and effectiveness of a formulation or key component.

- * Pour Point (ASTM D 97)
- * Brookfield Viscosity (ASTM D2983)
- * Oxidative Stability
- * Industrial Gear Oil High Temperature Test (ASTM D2893)
- * Turbine Oil Oxidation Test (ASTM D943)
- * Hydrolytic Stability (D2619)
- * Corrosion Testing (D665&D130)
- * Rotary Bomb Oxidation (RBOT) ASTM D2272
- * Biodegradability

Pour Point (ASTM D 97): The pour point of a formulation is the temperature below which it stops flowing. For most low temperature performance requirements, pour point depressants are used. They are not as effective in vegetable oils.

Brookfield Viscosity (ASTM D2983): The technique is used to determine the low temperature viscosity of lubricants such as automotive gear oils, tractor fluids, etc. Normally high oleic oils show poor Brookfield viscosity, but this behavior can be helped with the addition of pour point depressants.

Oxidative Stability: Because vegetable oils are unsaturated, they tend to be less oxidatively stable than mineral oils. Small amounts of antioxidants (0.1-0.2%) are effective for mineral oil formulations. For vegetable oils, larger dosages are required (1-5%) to inhibit oxidative destruction. A number of screen tests are used in the lubrication industry to evaluate oxidative stability of lubricant formulations.

Hydrolytic Stability (D2619): Exposure to moisture of lubricant during use is expected and must be measured since hydrolytic stability is a factor and consistent lubricating properties are maintained. It depends upon the catalytic effect of copper at elevated temperatures in the presence of water to accelerate the rate of hydrolysis. Hydrolytic stability further tends to correlate with hydrophobicity. Fatty acids with chain length in the range of 12 - 14 carbon atoms are usually hydrolytically stable, whereas medium chain triglycerides in the chain length of 2 - 11 carbon atoms are not so stable.

Rotary Bomb Oxidation (RBOT) ASTM D2272: With certain high oleic vegetable oils and certain antioxidants, RBOT's comparable to combination of mineral oils and antioxidants are achievable. Oxidation tests we are familiar are the AOM and OSI test procedures. There are many examples and data supporting this property.

Biodegradability: Most vegetable oils and synthetic esters are inherently biodegradable. For certain applications, environmentally acceptable lubricants should be readily biodegradable. Several tests have been developed to measure biodegradability. The CEC L-33-T-82 and the modified STURM test are the two of the most widely used tests to measure biodegradability. Vegetable oil systems give the best biodegradability for all lubricant base fluids.

3. 5. 1 Test equipment and method

A lot of methods and equipments have been developed throughout the year to study and to measure the chemicals interaction and their influence on the physical properties of vegetable oils. A study done by Jayades and Nair (2006) make use of thermo-gravimetric analysis (TGA) under nitrogen and oxygen environment to vegetables oil thermal and oxidative degradation and the use of differential scanning calorimetry (DSC) to analyze the low temperature properties of vegetable oils.

They also use a molecular dynamics simulation software to study the effect of different saturated and unsaturated fatty acid such as lauric, oleic, linoleic chain and the effect on pour point. DSC also is an excellent method to measure wax appearance and crystallization temperature of vegetable oils

(Adhvaryu et al. 2003). In their study they observe the turning fork conformation of fatty acid chains of a triacylglycerols molecule and undergo molecular stacking during the cooling process. Various chemical reaction mechanism based on free radicals are thought to be involved in the oxidative degradation of engine oils (Igarashi, 1990). ASTM D943 test method is very widely used in industry to assess storage and long term service oxidation stability of oils in the presence of oxygen, water, copper and iron at an elevated temperature (95°C).

Pressurized differential scanning calorimetry (PDSC) and FT-IR us used to measure oxidation performance of oils containing selective anti-oxidants such as Zinc dithiocarbamate (ZnDTC), zinc dialkyldithiopghosphatw (ZDDP) and the mixture of both. The oils containing the same additives at different concentrations and oils containing a single or mixture of additives were quite different from data obtained use PDSC. In the 3rd Global Oils and Fats Business Forum USA by Gawrilow (2003), stated that vegetable oils used for lubrication industry has its own testing protocols.

It is included pour point test (ASTM 97), Brookfield Viscosity (ASTM D2983), Oxidative stability, Industrial Gear Oil High Temperature Test (ASTM D2893), Turbine Oil Oxidation Test (ASTM D943), Hydrolytic Stability □D2619, Corrosion Testing, and Rotary Bomb Oxidation (RBOT) ASTM D2272.

Abdulkarim et al. (2007) conducted a test to high-oleic *Moringa oleifera* seed oil frying quality and stability and compare the result to other type of conventional frying vegetable oils such as canola oil, soybean oil and palm olein oil. Standard methods for determination of used frying oil deterioration such as changes in color, viscosity, free fatty acids, peroxide value, p-

anisidine value, iodine value, specific extinction and total polar compounds were used to evaluate the oils. At the end of the frying period which is 6 hours per day for 5 day the change in percent of free fatty acids from initial to final day is observed.

3. 5. 2 Example of coconut oil

Coconut oil is chosen as representative vegetable oil for the analysis and improvement of cold flow properties since it is abundantly available in the tropics and has a very high pour point of 24 °C. Differential scanning calorimetry (DSC) is used for the analysis of unmodified and modified vegetable oil. To modify cold flow properties different techniques like additive addition and chemical modifications were carried out. The modified oils were analyzed by DSC to ascertain the effectiveness of the procedures adopted. Since poor pour point (high) was the major hurdle in the use of vegetable oils as lubricants, the first task was to bring down the pour point to desired level. The modified oils (with acceptable pour points) were then subjected to different tests for the valuation important lubricant properties like viscometric, tribological (friction and wear properties), oxidative and corrosion properties.

3. 6 Modification of vegetable oil

There are many study made by several researchers of how to improve the quality of vegetable oil to be used in as lubricant base. In a study made by Campanella et al. (2009) explain that even though vegetable oil possess most of the desirable lubricity properties such as good contact lubrication, high viscosity index, high flash point and low volatility vegetable oil also have some drawbacks that must be overcome. Gawrilow (2003) suggested few solutions of improving low temperature and pour points. These include

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interesterification with other potential vegetable oils such as high oleic canola oil, blending with synthetic esters to improve low temperature properties such trimethylol propane trioleate or trimethylolethane tetraoleate, transesterification with various polyols and genetic engineering to reduce saturates and increase monounsaturates. A study on vegetable oil blends was conducted by Chu and Kung (1997). They used the oil stability index (OSI) and peroxide value (PV) to determine the quality of oil blends. Soybean oil was blended with other refined, bleached and deodorized (RBD) oils where the quality of mixture oil was between of soybean oil and the RBD oils used. By blending the high quality oils with lower quality of oils in term of anti-oxidants can improve the quality of anti-oxidants of the lower quality oils.

3. 7 Issues in lubricant market

Besides the performance issues of vegetable oils utilization versus mineral oil based systems, relative cost of the base fluids is always of concern. It is believed that the approximate relative costs of the various base fluids are:

- * Refined mineral oils - 1
- * Vegetable oils - 1.5 - 2
- * Synthetic esters - 4 - 12

The advantages of vegetable oils as base fluids in lubricants are perceived to be the following:

- * Non-toxicity
- * Biodegradability
- * Resource renewable
- * Affordable application cost

- * Good lubricity
- * High viscosity index

One of the key needed oil property or characteristics that vegetable oils lack in general are the following:

- * Oxidative instability
- * Poor low temperature properties
- * Perceived poor hydrolytic stability

Fluidity of oil is mainly determined by the efficiency of molecular packing, intermolecular interactions, and molecular weight. Saturates have too high a level of crystalline symmetry, which facilitates interlocking of the sharp needle-like triacylglycerol crystals as temperature decreases. Vegetable oils and their double bonds influence low temperature behavior. The FAC of most of the vegetable oils that are readily available and inexpensive are not suitable for lubrication due their high saturates or polyunsaturates fatty acid content. Monounsaturated fatty acid oil present optimum oxidative stability and lower temperature properties. As a consequence, vegetable oils that have high stability and low pour points can be produced by converting all the fatty acids into a monounsaturated fatty acid.

Thus, base fluids for lubricants must have a balance of fatty acids, preferably a high level of monounsaturated, minimal polyunsaturates, and ideally no saturates at all for cold climates. The following data below gives an example of the aforementioned properties of vegetable oils as compared to mineral oils. Unlike most mineral oils, vegetable oils display very high viscosity indices (VI). This is a relative measurement in change of base fluid viscosity between 40°C and 100°C and indicates the change in viscosity over

an extended temperature range. Vegetable oils afford higher flash points as compared to mineral oils. In terms of pour point, vegetable oils are comparable to mineral oils except for one point. Mineral oils are more responsive to pour point depressants additives and give pour points of -30°C to -50°C . Vegetable oils are not as responsive to conventional pour point depressants since the conventional pour point depressant have been developed for the paraffin waxes found in mineral oils versus the traditional waxes found in most vegetable oils.

Oil	viscosity	viscosity	Viscosity	Pour Point	Flash Point	40°C	100°C	Index	$^{\circ}\text{C}$	$^{\circ}\text{C}$
Coconut oil	27.7	6.1	175	-	-Neutral	65.6	8.4	97	-18	252
Low erucic rapeseed oil	36.2	8.2	211	-18	346	High oleic	39.9	8.6	206	-12
252 Conventional soya oil	28.9	7.6	246	-9	325	However, one should not need to worry about the shortcomings of vegetable oils for lubrication.				

Mineral oil fluids, like vegetable oils, cannot meet most lubrication performance needs without additives. Available additives that enhance base fluids are:

- * Antioxidants

- * Detergents

- * Dispersants

- * Viscosity Modifiers

- * Pour Point depressant

- * Antiwear agents

- * Rust and corrosion inhibitors

- * Demulsifiers

- * Foam inhibitors

- * Thickeners

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- * Friction Modifiers
- * Other additive e. g., dyes, biocides, etc.

3. 7 International and national status

Currently, over 100 MM MTs of vegetable oils are produced worldwide. This is doubling every 20 to 25 years and will surpass 175 MM MTs by 2020. Of this, 16 million MTs tons are produced in the United States. It is estimated that around 60 thousand metric tons of vegetable oils are currently used in the United States. Synthetic esters and other non-mineral oil base fluids are currently available and being used in lubricants designated for agricultural, forestry, food processing, mining, construction, and recreation equipment.

Specific market applications are:

- * Two-stroke oils
- * Chain Bar oils
- * Hydraulic fluids
- * Cutting oils
- * Concrete mould release agents
- * Transformer oils
- * Refrigeration oils
- * Farm tractor oils

The world market for environmentally friendly lubricants, those based on synthetic esters and vegetable oils, is forecasted to grow to over 100 millions tons in the years 2002-2005. The majority of demand will be in Europe and Canada, where environmental awareness and regulations are highest.

In United States of America, the major source of in house vegetable oil for lubricant application is soybean oil . The total estimated supply of soybeans in 2004 was 2. 9 billion bushes; of these, 1. 6 billion on bushes were crushed to supply 1 billion pounds of oil. WORLD VIEW

From a global perspective, total lubricant demand is expected to be about 41. 8 million metric tons, or about 13 billion gallons, according to a 2007 Freedonia report. Growth is expected to be about 2%/yr through 2010. The fastest growth will be in the Asia/Pacific region, with China being the major gainer.

In the world market, the segmentation by application area is:

- * Engine oils - 48%
- * Process oils - 15. 3%
- * Hydraulic oils - 10. 2%
- * All other - 26. 5%

The geographical segmentation is:

- * Asia/Pacific - 36. 7
- * North America - 28%
- * Western Europe - 12. 5%
- * Rest of world - 22. 8%

U. S. MARKETS

Sales of all lubricants in the US were in the range of 2. 5 billion gallons in 2006, according to the latest National Petroleum Refiners Association report. This number is lower than the 3. 6 billion gallons estimated by the above Freedonia study. The NPRA numbers are likely to be more accurate. The

market is segmented according to the NPRA 2006 data as: * Automotive - 56. 1%

* Industrial - 21. 2%

* Process oils - 18. 1%

* Metal working - 2. 1%

* Greases - 2. 4%

The overall growth rate was about 1%/yr. Industrial oils were flat while automotive oils and metal working fluids were down, although some parts of these segments grew. The low growth has been attributed to the lengthening of oil change intervals and the higher performance oils being developed, in spite of the increase in vehicles and other machinery requiring lubricants.

3. 6 History of vegetable oil as lubricant

Olive oil was used as a lubricant as long ago as 1650 BC. Various oils obtained from olive, rapeseed, castor beans, palm oil and the fats from sperm whale, animal lard, and wool grease were used from the time of 50 AD until the early 19th century. These natural oils had limited stability. The Industrial revolution of the late 18th century and its expansion into the 19th century stimulated the need for inexpensive, thermally and oxidative stable lubricants. Serious efforts were initiated in the 1930s to develop synthetic lubricants for operation over wide temperature ranges. These synthetic hydrocarbons, organic esters and others. Today, vegetable oils are drawing attention as biodegradable alternates for synthetic esters because they are less expensive and are available from renewable sources. Historically speaking, recent vegetable oils have been used in applications where

leakage of equipment is inevitable, or where a system is designed to function by loss lubrications. They are :

- * Two stroke engine oil
- * Chain saw oils
- * Hydraulic oils
- * Mold release oils
- * Farming, mining, and forestry equipment
- * Open gear lubricants
- * Greases

DESIRED VEGETABLE OIL CHARACTERISTICS

The lubricant industry could be poised to take advantage of oilseed biotechnology to produce high performance base oils that are compatible with the current stable of additives used in the lubrication industry. The drivers that will influence the vegetable base oil composition and market penetrations are:

- * Regulatory initiatives
- * Public perception of need
- * OEM acceptance and continued support
- * Cost/benefits

Selection of vegetable oils for this industry will heavily rely on relatively low cost, acceptable low temperature properties, and acceptable oxidative and thermal stability. Compatibility of certain additives for particular applications will be essential to complete the product package. Vegetable oils with iodine values (IV) between 50 and 130 are ideal for hydraulic fluids. Below 50, fluids

have high pour points due to lack of unsaturation, and above 130, oils tend to be oxidatively unstable. Fatty acids contained in some vegetable oils are polar in nature and tend to cling to metal surfaces more effectively than mineral oils and therefore provide improved lubricity.

Requirements for high performance compatible vegetable oils are: * High biodegradability; Low toxicity

* Excellent Oxidative Stability

* Good low temperature properties

* Lower cost than synthetic esters

* Performance comparable to mineral and synthetic esters Some guidelines for properties of a vegetable oil designed for lubrication base oils are: *

Viscosity, at 40°C 35-30

* Viscosity Index, VI greater than 200

* Iodine Value 94-126

* Saponification Number 186-198

* Specific Gravity 0. 91-0. 92

* Pour Point, °C -20

* Flash Point, °C 259

ADVANTAGES AND DISADVANTAGES

Vegetable oil can be used as lubricant in their natural form. They have several advantages and disadvantages when considered for industrial and machinery lubricant. Advantages of vegetable oil

* Very high viscosity indexes

* Good thermal stability

* Low volatility

- * High flash points
- * Good miscibility with other lubricant base fluids and solvents * Good additive compatibility
- * Excellent lubricity
- * Biodegradable
- * Low toxic
- * Renewable and reduce dependency on imported petroleum

Disadvantages of vegetable oil

- * Poor oxidative stability
- * Questionable hydrolytic stability
- * Poor low temperature characteristics
- * Poor response to pour point depressants

Some modifications are there to overcome the disadvantages of vegetable oil. Poor oxidative stability can be modified by blending vegetable oil with synthetic esters to improve low temperature properties such as trimethylol propane trioleate or trimethylolethane tetraoleate, transesterification with various polyols and genetic engineering to reduce saturates and increase monounsaturates. It can also be modified by the involving partial hydrogenation of vegetable oil and shifting of its fatty acids. The challenges with hydrogenation is determining at what point the process should cease. Poor response to pour point can be modified problem too can be addressed by winterization, addition of chemical additives (pour point suppressants) and/or blending with other fluids possessing lower pour points. Various synthetic oils can be used for this purpose. With a combination of these techniques, UNI-ABIL has developed hydraulic fluids with pour points of -32.

8°F (-36°C) for use in snow blowers used by the Iowa Department of Transportation.

METHODOLOGY OF TERM PAPER

The method that I have used in this term paper is very simple. I have used simple way to show all the details of vegetable oil and how it can be used as lubricant in proper way. I have focused that how vegetable oil can perform well by doing some basic changes on them which is eco-friendly with nature and cheap in cost. I took an example of palm oil from the group of vegetable oil to show how it works. The following topics are in this term paper to show the detailing of my paper. 1. Introduction of whole topic

2. Review of the literature related to this topic

2(a). Definition of the common term which are used in this term paper 2(b).

Main objective

2(c). Composition of vegetable oil

2(d). Properties of vegetable oil

2(e). Modification of vegetable oil so that we can modify the vegetable oil to it easily 2(f). History of vegetable oil

2(g). International and national status

2(h). Issues in lubricant market

2(i). Performance test review of vegetable oil

3. Desired vegetable oil characteristics

4. Advantages and disadvantages of vegetable oil

5. Conclusion that what we have find out through this term paper 6.

Reference

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CONCLUSION

Vegetable oils naturally suitable to be used as lubricant base oils. With the co-operative of chemical modification methods to enhance its physical properties the vegetable oils are functioning as good as the mineral and synthetic oils or better. Selective addition of additives is crucial to increase its stability and provide the vegetable oils to work under wider range of temperature and pressure. With the outstanding performance, non toxic, and biodegradability advantages vegetable oil will be a better choice to be use yet it is still offer space for improvement and usefulness.

The test methods such DSC, TGA and FT-IR provided alternative and multi-selection of vegetable oils properties instead of ASTM methods of how the chemical structures especially the unsaturated fatty acid component and its influence to the quality of a particular vegetables oil and the selective modification required. It is desirable to incorporated vegetable oil as greases' base oil where thickener will be added for non-Newtonian application

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