

VEGETABLE OIL LUBRICANT COMPRISING ALL-HYDROPROCESSED SYNTHETIC OILS

BACKGROUND OF THE INVENTION

This application claims priority to a provisional application, Serial No. 60/502,669, filed September 12, 2003.

The present invention is directed to lubricant compositions. Specifically, it relates to vegetable oil based lubricants that comprise synthetic oils made by all-hydroprocessing routes. More specifically, it relates to lubricants that provide enhanced properties including viscosity index, pour points, low temperature pumpability, low volatility, oxidation stability, electrical insulating value, the ability to formulate different viscosities, and microbial biodegradability.

It is generally known that vegetable oil based lubricants can be formed using additives including the non-lube portion of natural vacuum gas oil feedstock. Historically, base oil manufacturers have often used traditional chemical-solvent refining processes to remove the undesirable non-lube molecules from the gas oil portion of the crude oil. Such refining is considered a subtraction process in that the solvents do not change the molecular structure of the desired product. To further enhance the characteristics of the solvent refined base oil, hydrogenation (i.e., hydrofinishing) is sometimes used to saturate the molecules making them less susceptible to oxidative degradation when used as a lubricant. It is generally recognized that hydrofinishing associated with solvent processes, although useful, is typically very mild, resulting in minimal change to the primary, secondary, and tertiary structure of the finished product.

Viscosity Index (VI) measures the resistance of an oil to viscosity change as temperature changes. The higher the VI, the more stable the viscosity over a wide temperature range. In other words, the higher the VI, the less an oil will thicken as it gets cold and the less it will thin out at higher temperatures—providing better lubricant performance at both temperature extremes.

Hydrocracking and hydroisomerization are refining processes that use catalyst and hydrogen at high pressure to make high-quality lubricant base oils. Hydrocracking is

used to improve VI and remove impurities, while hydroisomerization converts wax molecules into high quality lubricant components.

Groups I, II, and III are broad categories of base stocks developed by the American Petroleum Institute for the purpose of creating guidelines for licensing engine oils. Typically, solvent-refined base oils fall into Group I, while hydroprocessed base stocks fall into Group II. Unconventional Base Oils (UCBOs) or Very-High VI stocks are normally categorized as Group III.

Group II+, though not an official API designation is a term used increasingly to describe Group II stocks of higher VI (110-119) and lower volatility than typical group II stocks.

Group I oils contain high levels of sulfur and aromatics, which are compounds that can diminish performance. Hydroprocessed Group II and III oils have lower levels of these impurities, which result in enhanced oxidation performance for fully-formulated lubricants.

Recent refining processes have formed a new class of synthetic oils. For example, a technical paper by the Chevron Products Company entitled: "The Synthetic Nature Of Group III Base Oils", Presented at the 1999 Lubricants & Waxes Meeting, November 11-12, Houston TX (National Petrochemical & Refiners Association) discloses an all-hydroprocessing manufacturing route that combines three catalytic processes to significantly and selectively change the size, shape, and heteroatom content of the molecules to improve their lubricating properties. Hydrogen is added at high temperature and pressure in all three steps to make oil of exceptional stability. Impurities such as sulfur and nitrogen are essentially completely removed. In Group III manufacturing, feedstock is converted to saturates, which are enriched in isoparaffins. Reactive species, such as those containing aromatics, sulfur, and nitrogen are virtually gone and species that create problems with low temperature performance, such as normal paraffins, are also eliminated. Finally, the paper concludes the analysis of the feed and product from a commercial Group III production run, which shows that a vast majority of feed molecules are synthetically altered by the three catalytic processes used to make modern all-hydroprocessed Group III base oils. These results support the claim that

modern Group III base oils, made utilizing an all-hydroprocessing route, are essentially man-made or synthetic and have advantages over old technology hydrocracked base oils. In addition, their high performance in lubricant applications allows them to be used in high performance products often formulated with traditional synthetics such as polyalphaolefin (PAO). The reference did not teach the use of all-hydroprocessed group III base oils as a raw material for the preparation of biodegradable vegetable oil based lubricants.

Patents that generally disclose lubricants that can be formed using vegetable oil and group III oils include U.S. Pat. No. 6,103,673; U.S. Pat. No. 6,251,840; U.S. Pat. No. 6,451,745; and U.S. Pat. No. 6,528,458 all of which are from the Lubrizol Corporation (Wickliffe, OH). Additional patents include U.S. Pat. No. 6,303,547 and U.S. Pat. No. 6,444,622 both from the Ethyl Corporation (Richmond, VA).

U.S. Patent No. 6,528,458 discloses that compositions comprising (a) an oil of lubricating viscosity; (b) 2,5-dimercapto-1,3,4-thiadiazole (DMTD), a derivative of DMTD, or mixtures thereof; (c) a friction modifier; and (d) a dispersant, are useful for lubricating a transmission having a plurality of wet clutches and a plurality of partial power transmission shafts, wherein shifting of gears occurs by a process comprising synchronization of an engaged and a non-engaged partial transmission shaft and engagement of a wet clutch.

U.S. Patent No. 6,451,745 discloses that a continuously variable transmission can be lubricated by supplying to them a composition of (a) an oil of lubricating viscosity; (b) a dispersant; and (c) a detergent. At least one of the dispersant (b) and the detergent (c) is a borated species, and the amount of boron present in the composition is sufficient to impart improved friction and anti-seizure properties to the composition when employed in said transmission.

U.S. Patent No. 6,444,622 discloses mixtures of the reaction product of at least one C₅-C₆₀ carboxylic acid and at least one amine selected from the group comprising: guanidine, aminoguanidine, urea, thioruea and salts thereof and a phosphorus-containing dispersant are useful as gear oil additives.

U.S. Patent No. 6,303,547 discloses that the reaction product of at least one C₅-C₆₀ carboxylic acid and at least one amine selected from the group comprising:

guanidine, aminoguanidine, urea, thioruea and salts thereof is useful as a gear oil additive.

U.S. Patent No. 6,251,840 discloses a lubricating/functional fluid composition which exhibits in use improved antiwear and antifoaming properties. The improvements result from use of 2,5-dimercapto-1,3,4-thiadiazole and derivatives thereof together with silicone and/or fluorosilicone antifoam agents.

U.S. Patent No. 6,103,673 discloses a composition comprising of an oil of lubricating viscosity; a shear stable viscosity modifier; at least 0.1 percent by weight of an overbased metal salt; at least 0.1 percent by weight of at least one phosphorus compound; and 0.1 to 0.25 percent by weight of a combination of at least two friction modifiers provides an improved fluid for continuously variable transmissions. At least one of the friction modifiers is selected from the group comprising: zinc salts of fatty acids having at least 10 carbon atoms, hydrocarbyl imidazolines containing at least 12 carbon atoms in the hydrocarbyl group, and borated epoxides. The total amount of the friction modifiers is limited to those amounts which provide a metal-to-metal coefficient of friction of at least about 0.120 as measured at 110°C by ASTM-G-77.

The references do not disclose enabling lubricant formulations containing a combination of vegetable oil and hydroprocessed base oils (group III) and thus fail to teach or suggest the advantages associated with such formulations. Because all-hydroprocessed Group III stocks are manufactured with no solvent refining steps, when it comes to purity, they far surpass Group II or III base oils made in "hybrid" plants that maintain some solvent processing. In fact, they contain the lowest levels of impurities currently available in mineral-based oils, which, in turn gives them a significant performance advantage.

All-hydroprocessing includes three steps as follows: hydrocracking, hydroisomerization, and hydrofinishing. In the first step, hydrocracking, the majority of sulfur, nitrogen, and essentially all other non-hydrocarbon impurities are removed and most aromatics are saturated via hydrogen addition. Molecular reshaping of remaining saturated species occurs as rings are opened and paraffin isomers are redistributed, driven by thermodynamics with reaction rates facilitated by catalysts. Clean fuels are by-products of this and subsequent steps of the process. In the second step,

hydroisomerization, n-paraffins and other molecules with waxy side chains are isomerized into branched molecules with much lower pour points. The majority of remaining aromatics are saturated and the majority of remaining sulfur and nitrogen species are removed. In the final step, hydrofinishing, any remaining non-isoparaffin impurities (sulfur species, nitrogen species, aromatics, and olefins) are removed to trace levels.

Environmental issues related to discarded and/or spent lubricants are also concerns that need to be addressed. For example, biodegradable resistant lubricants can stress an ecosystem when improperly discarded or accidentally discharged into the environment. The invasive and persistent nature of such materials continues to be a health concern in aquatic and landfill environments. To overcome these issues, research efforts continue to explore new raw materials and/or new combinations of raw materials to provide improved lubricants having a higher degree of microbial biodegradability.

Patents that teach biodegradable lubricants include U.S. Pat. No. 5,736,493; U.S. Pat. No. 6,383,992; U.S. Pat. No. 5,863,872; U.S. Pat. No. 5,990,055; U.S. Pat. No. 6,624,124; U.S. Pat. No. 6,620,772; and U.S. Pat. No. 6,534,454 all of which are from Renewable Lubricants, Inc. (Hartville, OH), and the contents of which are herein incorporated by reference. The patents describe a combination of natural oils, synthetic oils, and antioxidants to provide effective lubricant compositions. Other related patents that teach the importance of vegetable oil based compositions and their biodegradability includes U.S. Pat. No. 6,300,292 granted to Nippon Mitsubishi Oil Corporation. Although the lubricants described above have effective lubricating and biodegradable properties, in the spirit of continuous improvement, alternative compositions and the improvements there from are needed.

Therefore, there remains a need for vegetable oil based lubricants, comprising synthetic oils made by all-hydroprocessing routes, which provide enhanced properties including viscosity index, pour points, low temperature pumpability, low volatility, oxidation stability, electrical insulating value, the ability to formulate different viscosities, and microbial biodegradability.

SUMMARY OF THE INVENTION

The present invention is directed to vegetable oil based lubricants using all-hydroprocessed synthetic based oils. The lubricants are shown to provide enhanced properties including viscosity index, pour point, low temperature pumpability, low volatility, oxidation stability, electrical insulating value, and microbial biodegradability.

The lubricants of the present invention comprise:

- 1) at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof;
- 2) at least one all-hydroprocessed synthetic base oil having a sulfur content equal to or less than 0.03 percent, saturates equal to or greater than 90 percent, and a viscosity index equal to or greater than 120; and
- 3) at least one antioxidant.

The lubricants are characterized as having enhanced microbial biodegradability making them environmentally friendly. Surprisingly, some compositions can have an all-hydroprocessed based oil content greater than about 60% and pass ultimate biodegradability test method ASTM D-5864 Pw1. Ultimate biodegradability Pw1 is the fastest and most complete type of biodegradation as defined by ASTM D-5864. Furthermore, the inventive compositions have excellent rheological properties and a super high viscosity index of about 120 to 200, making them particularly useful as hydraulic oils, transmission fluids, engine oils, gear oil, rock drill oils, circulating oils, drip oils, spindle oils, compressor oils, grease base oils, corrosion inhibitor oils, heat transfer oils, cable oils, chain oils, general purpose oils, metal working oils, and electrical insulating oils.

In another aspect, the present invention discloses a method for the preparation of vegetable oil based lubricants comprising the steps of:

- 1) providing at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof;
- 2) providing at least one all-hydroprocessed synthetic base oil having a sulfur content equal to or less than 0.03 percent, saturates equal to or greater than 90 percent, and a viscosity index equal to or greater than 120;

- 3) providing at least one antioxidant; then

blending 1), 2), and 3) to form said lubricant.

Another aspect of the invention relates to a method of enhancing the lubrication of mechanical equipment comprising the steps of:

- a) providing at least one lubricant comprising:
 - 1) at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof;
 - 2) at least one all-hydroprocessed synthetic base oil having a sulfur content equal to or less than 0.03 percent, saturates equal to or greater than 90 percent, and a viscosity index equal to or greater than 120;
 - 3) at least one antioxidant; then
- b) adding an effective amount of said lubricant into said equipment.

In accordance with one aspect of the present invention, a lubricant composition includes at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof, at least one synthetic base oil having a sulfur content equal to or less than about 0.03 percent and saturates equal to or greater than about 90 percent, and at least one antioxidant.

In accordance with another aspect of the present invention, the vegetable oil is selected from the group comprising: sunflower oil, canola oil, soybean oil, corn oil, peanut oil, palm oil, castor bean oil, cotton oil, lesquerella oil, crambe oil, safflower oil, high oleic sunflower oil, high oleic canola oil, high oleic soybean oil, high oleic corn oil, high oleic peanut oil, high oleic cotton oil, high oleic safflower oil, and mixtures thereof.

In accordance with another aspect of the present invention, the vegetable oil is present in an amount greater than about 10%, based on total weight.

In accordance with another aspect of the present invention, the vegetable oil is present in an amount less than about 90%, based on total weight.

In accordance with another aspect of the present invention, the vegetable oil is present in a range from about 10% to about 90%, based on total weight.

In accordance with another aspect of the present invention, the vegetable oil is present in a range from about 30% to about 70%, based on total weight.

In accordance with another aspect of the present invention, the vegetable oil is present in a range from about 40% to about 60%, based on total weight.

In accordance with another aspect of the present invention, the base oil is an all-hydroprocessed synthetic base oil.

In accordance with another aspect of the present invention, the base oil is present in an amount greater than about 10%, based on total weight.

In accordance with another aspect of the present invention, the base oil is present in an amount less than about 90%, based on total weight.

In accordance with another aspect of the present invention, the base oil is present in a range from about 10% to about 90%, based on total weight.

In accordance with another aspect of the present invention, the base oil is present in a range from about 30% to about 70%, based on total weight.

In accordance with another aspect of the present invention, the base oil is present in a range from about 40% to about 60%, based on total weight.

In accordance with another aspect of the present invention, the antioxidant is selected from the group comprising: amines, phenols, and mixtures thereof.

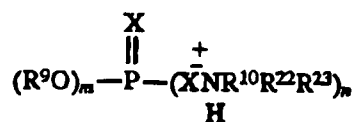
In accordance with another aspect of the present invention, the antioxidant is present in a range from about 0.01% to about 5.0%, based on total weight.

In accordance with another aspect of the present invention, the antioxidant is present in a range from about 0.25% to about 1.5%, based on total weight.

In accordance with another aspect of the present invention, the antioxidant is present in a range from about 0.5% to about 1.0%, based on total weight.

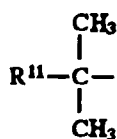
In accordance with another aspect of the present invention, the composition further includes at least one additive, the additive chosen from the group comprising: anti-wear inhibitor, extreme pressure additive, friction modifier, rust inhibitor, corrosion inhibitor, pour point depressant, tackifier, viscosity modifier, metal deactivator, foam inhibitor, emulsifier, and demulsifier.

In accordance with another aspect of the present invention, the at least one additive is a phosphorous amine salt of the formula:



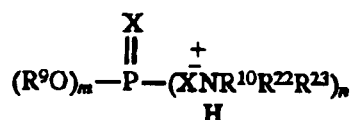
wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3 and X is oxygen or sulfur.

In accordance with another aspect of the present invention, the phosphorous amine salt includes R^9 contains from about 8 up to 18 carbon atoms, R^{10} is

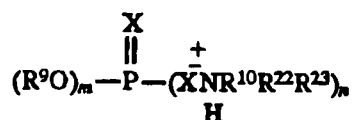


wherein R^{11} is an aliphatic group containing from about 6 up to about 12 carbon atoms, R^{22} and R^{23} are hydrogen, m is 2, n is 1 and X is oxygen.

In accordance with another aspect of the present invention, the at least one additive is chosen from the group comprising (in the following list, the different additives are separated by semicolons): phosphorous amine salt having the formula:

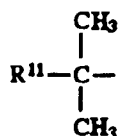


wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3 and X is oxygen or sulfur; phosphorous amine salt having the formula:

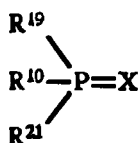


wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3

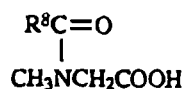
and X is oxygen or sulfur, wherein R⁹ contains from about 8 up to 18 carbon atoms, R¹⁰ is



wherein R¹¹ is an aliphatic group containing from about 6 up to about 12 carbon atoms, R²² and R²³ are hydrogen, m is 2, n is 1 and X is oxygen; phosphorous compound having the formula:



wherein R¹⁹, R²⁰, and R²¹ are independent hydrogen, an aliphatic or alkoxy group containing from 1 up to about 12 carbon atoms, or an aryl or aryloxy group wherein the aryl group is phenyl or naphthyl and the aryloxy group is phenoxy or naphthoxy and X is oxygen or sulfur; N-acyl derivative of sarcosine having the formula:



wherein R⁸ is an aliphatic group containing from 1 up to about 24 carbon atoms. In one embodiment, R⁸ contains from 6 to 24 carbon atoms, and in one embodiment from 12 to 18 carbon atoms. An example of an additive of N-acyl derivative of sarcosine is N-methyl-N-(1-oxo-9-octadecenyl) glycine wherein R⁸ is a heptadecenyl group; imidazoline; triazole; substituted triazole; tolu-triazole; alkylated polystyrene; polyalkyl methacrylate; ethylene vinyl acetate; polyisobutylenes; polymethacrylates; olefin copolymer; ester of styrene maleic anhydride copolymer; hydrogenated styrene-diene copolymer; hydrogenated radial polyisoprene; alkylated polystyrene; fumed silica; complex ester; and food grade tackifier.

In accordance with another aspect of the present invention, the anti-wear inhibitor is from about 0.1% to about 4% by total weight, the corrosion inhibitor is from about 0.01% to about 4% by total weight, the metal deactivator is from about 0.05% to about

0.3% by total weight, the pour point depressant is from about 0.2% to about 4% by total weight, and the viscosity modifier is from about 0.5% to about 30% by total weight.

In accordance with another aspect of the present invention, the corrosion inhibitor is from about 0.05% to about 2% by total weight, the metal deactivator is from about 0.05% to about 0.2% by total weight, and the viscosity modifier is from about 1% to about 20% by total weight.

In accordance with another aspect of the present invention, the synthetic base oil has a viscosity index equal to or greater than about 120.

In accordance with another aspect of the present invention, the composition has an oxidation characteristic in a range from about 60 to about 600 minutes.

In accordance with another aspect of the present invention, the oxidation characteristic is in a range from about 200 to about 400 minutes.

In accordance with another aspect of the present invention, the base oil is at least one oil chosen from the group comprising: synthetic ester base oil, polyalphaolefin, unrefined oil, refined oil, re-refined oil, and mixtures thereof.

In accordance with another aspect of the present invention, a method of making a lubricant composition includes the steps of providing at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof, providing at least one synthetic base oil having a sulfur content equal to or less than about 0.03 percent and saturates equal to or greater than about 90 percent, providing at least one antioxidant, and blending together the vegetable oil, the base oil, and the at least one antioxidant.

In accordance with another aspect of the present invention, a lubricant composition includes at least one vegetable oil selected from the group comprising: sunflower oil, canola oil, soybean oil, corn oil, peanut oil, palm oil, castor bean oil, cotton oil, lesquerella oil, crambe oil, safflower oil, high oleic sunflower oil, high oleic canola oil, high oleic soybean oil, high oleic corn oil, high oleic peanut oil, high oleic cotton oil, high oleic safflower oil, and mixtures thereof, wherein the at least one vegetable oil is present in a range from about 40% to about 60%, at least one synthetic base oil having a sulfur content equal to or less than about 0.03 percent, saturates equal to or greater than about 90 percent, and a viscosity index equal to or greater than about 120, wherein the

base oil is present in a range from about 40% to about 60%, at least one antioxidant selected from the group comprising amines, phenols, and mixtures thereof, wherein the antioxidant is present in a range from about 0.5% to about 1.0%, and at least one additive, the additive chosen from the group comprising: anti-wear inhibitor, extreme pressure additive, friction modifier, rust inhibitor, corrosion inhibitor, pour point depressant, tackifier, viscosity modifier, metal deactivator, foam inhibitor, emulsifier, and demulsifier, wherein the corrosion inhibitor is about 0.05% to about 2% by total weight, the metal deactivator is about 0.05% to about 0.2% by total weight, the pour point depressant is about 0.2% to about 4% by total weight, and the viscosity modifier is about 1% to about 20% by total weight.

In accordance with another aspect of the present invention, a mechanical device containing at least one lubricant, the at least one lubricant includes at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof, at least one synthetic base oil having a sulfur content equal to or less than 0.03 percent, saturates equal to or greater than 90 percent, and a viscosity index equal to or greater than 120, and at least one antioxidant, wherein the lubricant has a viscosity index greater than 120 and passes biodegradability test method ASTM D-5864 (Pw1).

Other aspects, objects, features, and advantages of the present invention would be apparent to one ordinarily skilled in the art from the following detailed description illustrating the embodiments.

DETAILED DESCRIPTION OF THE INVENTION

The compositions of the present invention comprise at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof. In one embodiment of the invention, the vegetable oils include safflower, canola, peanut, corn, rapeseed, sunflower, cottonseed, lesquerella, palm, castor, meadow foam, and soybean. Suitable vegetable oils are further described in U.S. Pat. No. 6,534,454 B1, incorporated herein by reference. In another embodiment of the present invention, the vegetable oils are high oleic sunflower and high oleic canola, primarily because of availability. In one embodiment of the present invention, the vegetable oil is present in the composition in a range of from about

10 percent to about 90 percent, in another embodiment the vegetable oil is from about 30 percent to about 70 percent, and in another embodiment, the vegetable oil is from about 40 percent to about 60 percent. A vegetable content greater than 90, although still contemplated within the present invention, is less desirable in that there is a reduction in oxidation and cold temperature stability.

The composition of the present invention comprises at least one all-hydroprocessed synthetic base oil (group III). All-hydroprocessed synthetic base oils are available in the industry from base oil producers like Chevron and can be produced in different viscosity ranges but are normally in 2, 4, and 7 centistokes (cSt) @ 100° C. The all-hydroprocessed base oil is present in the composition in a range of from about 10 percent to about 90 percent, and in one embodiment, from about 30 percent to about 70 percent, and in another embodiment, from about 40 percent to about 60 percent. A Group III base oil content greater than 80 percent is less desirable in that there is a reduction in biodegradability.

The composition of the present invention comprises at least one antioxidant. In one embodiment of the present invention, the antioxidants include amine and/or phenol, but other antioxidants may be used. Antioxidants are described in more detail in U.S. patents incorporated herein by reference. The antioxidant is present in the composition in a range of from about .01 percent to about 5.0 percent, and in one embodiment, from about 0.25 percent to about 1.5 percent, and in another embodiment from about 0.5 percent to about 1.0 percent. The lubricant has an oxidation characteristic using ASTM D-2272 in a range of from about 60 to about 600 minutes, and in one embodiment from about 200 minutes to about 400 minutes. This test method uses an oxygen pressured bomb to evaluate the oxidation stability of new and in service turbine oils having the same composition (base stock and additives) in the presence of water and a copper catalyst coil at 150°C or according to the selected standard

Other Base Oils

If desired, the inventive lubricant may contain other oils comprising (1) synthetic ester base oil, (2) a polyalphaolefin, or (3) unrefined, refined, or re-refined oils, and mixtures of (1), (2), and (3). These base oils are further described in U.S. patents incorporated herein by reference. The base oils can be present in the composition in a

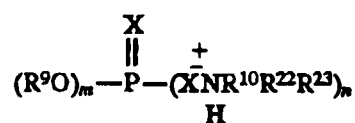
range of from about 10 percent to about 80 percent, and in one embodiment, from about 30 percent to about 70 percent, and in another embodiment, from about 40 percent to about 60 percent.

If desired, the inventive lubricant may contain other ingredients/additives including antiwear inhibitors, rust/corrosion inhibitors, pour point depressants, tackifiers, viscosity improvers, metal deactivators, extreme pressure (EP) additives, friction modifiers, foam inhibitors, emulsifiers, or demulsifiers. Other ingredients and additives are further described in more detail in U.S. patents incorporated herein by reference.

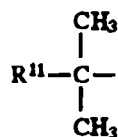
The additives in this invention include:

The Anti-wear Inhibitor, Extreme Pressure Additive and Friction Modifier

To prevent wear on the metal surface, the present invention utilizes an anti-wear inhibitor/EP additive and friction modifier. Anti-wear inhibitors, EP additives, and friction modifiers are available off the shelf from a variety of vendors and manufacturers. Some of these additives can perform more than one task and any may be utilized in the present invention that is food grade. One food grade product that can provide anti-wear, EP, reduced friction and corrosion inhibition is phosphorous amine salt of the formula:



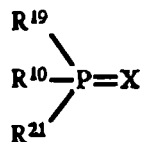
wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3 and X is oxygen or sulfur. In one embodiment, R^9 contains from about 8 up to 18 carbon atoms, R^{10} is



wherein R^{11} is an aliphatic group containing from about 6 up to about 12 carbon atoms, R^{22} and R^{23} are hydrogen, m is 2, n is 1 and X is oxygen. An example of one such

phosphorous amine salt is Irgalube® 349, which is commercially available from Ciba-Geigy.

Another food grade anti-wear/EP inhibitor/friction modifier is phosphorous compound of the formula:



wherein R^{19} , R^{20} , and R^{21} are independent hydrogen, an aliphatic or alkoxy group containing from 1 up to about 12 carbon atoms, or an aryl or aryloxy group wherein the aryl group is phenyl or naphthyl and the aryloxy group is phenoxy or naphthoxy and X is oxygen or sulfur. An example of one such phosphorus compound is triphenyl phosphothionate (TPPT), which is commercially available from Ciba-Geigy under the trade name Irgalube® TPPT.

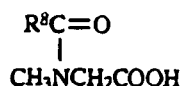
The anti-wear inhibitors, EP, and friction modifiers are typically about 0.1 to about 4 weight percent of the lubricant composition and may be used separately or in combination.

The Corrosion Inhibitor

To prevent corrosion of the metal surfaces, the present invention utilizes a corrosion inhibitor. Corrosion inhibitors are available off the shelf from a variety of vendors and manufacturers. Any corrosion inhibitor may be utilized in the present invention that is food grade.

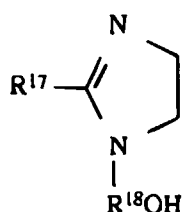
The corrosion inhibitor is typically about 0.01 to about 4 weight percent of the lubricant composition.

In one embodiment, the corrosion inhibitor is comprised of a corrosion additive and a metal deactivator. The corrosion inhibitor and the metal deactivator can be food grade and comply with FDA regulations. One additive is the N-acyl derivative of sarcosine, which has the formula:

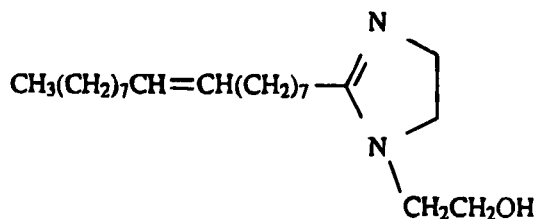


wherein R^8 is an aliphatic group containing from 1 up to about 24 carbon atoms. In one embodiment, R^8 contains from 6 to 24 carbon atoms and in another embodiment, from 12 to 18 carbon atoms. An example of an additive of N-acyl derivative of sarcosine is N-methyl-N-(1-oxo-9-octadecenyl) glycine wherein R^8 is a heptadecenyl group. This derivative is available from Ciba-Geigy under the trade name Sarkosyl® O.

Another additive is imidazoline of the formula:



wherein R^{17} is an aliphatic group containing from 1 up to about 24 carbon atoms and R^{18} is an alkylene group containing from 1 up to about 24 carbon atoms. In one embodiment, R^{17} is an alkenyl group containing from 12 to 18 carbon atoms. In one embodiment, R^{18} contains from 1 to 4 carbon atoms and in another embodiment, R^{18} is an ethylene group. An example of one such imadazoline has the formula:



and is commercially available from Ciba-Geigy under the trade name Amine O.

Typically, the corrosion additive is about 0.01 to about 4 weight percent of the lubricant composition. If the additive is the N-acyl derivative of sarcosine, then, in one embodiment, it is about 0.1 to about 1 weight percent of the lubricant composition. If the additive is imidazoline, then, in one embodiment, it is about 0.05 to about 2 weight percent of the lubricant composition. The lubricant can include more than one corrosion additive. For example, the lubricant can include both the N-acyl derivative of sarcosine and imidazoline.

The Metal Deactivator

One metal deactivator is triazole or substituted triazole. For example, toly-triazole or tolu-triazole may be utilized in the present invention. However, in one

embodiment the triazole is tolu-triazole sold commercially by Ciba-Geigy under the trade name Irgamet® 39, which is a food grade triazole.

Typically, the metal deactivator is about 0.05 to about 0.3 weight percent of the lubricant composition. If the metal activator is Irgamet 39, then it is about 0.05 to about 0.2 weight percent of the lubricant composition.

Although the anti-wear inhibitor and the corrosion inhibitor have been described separately, they can be included in a single chemical additive. For example, both the anti-wear inhibitor and the corrosion inhibitor are included in the non-food grade additive Lubrizol® 5186B, which is available from Lubrizol Corporation. In one embodiment, Lubrizol® 5186B is about 0.5 to about 2 weight percent of the lubricant composition and, in another embodiment, about 1.25 weight percent of the lubricant. Another example where both the anti-wear inhibitor and the corrosion inhibitor are included in the non-food grade additive is Ciba-Geigy 3050A. In one embodiment, Ciba-Geigy 3050A is about 0.4 to about 1.75 weight percent of the lubricant composition and, in another embodiment, about 0.95 weight percent of the lubricant.

The Pour Point Depressant

There is a natural stiffening at low temperatures of vegetable oils, especially vegetable oils with a high monounsaturated content. This is analogous to the stiffening of honey or molasses at a reduced temperature. To maintain the “pour” or “flow” of a vegetable oil at reduced temperatures, it becomes necessary to add a pour point depressant.

Pour point depressants are available off the shelf from a variety of vendors and manufacturers. Any pour point depressant may be utilized in the present invention. In one embodiment, however, the pour point depressant is an alkylated polystyrene or a polyalkyl methacrylate.

Two different reaction routes are envisioned in preparing the alkylated polystyrenes. The first route involves reacting either an alkyl chloride or an alkene with styrene to form an alkylated styrene. The alkylated styrene is then polymerized to form an alkylated polystyrene. In the second route styrene is polymerized to form polystyrene, and propylene, or butylenes, or mixtures thereof are polymerized to form polypropylene, polybutylenes, or mixtures of polypropylenes and polybutylenes, also known as

polyalkylenes. The polystyrene is then alkylated with the polyalkylenes to form the alkylated polystyrenes.

One pour point depressant in the class of alkylated polystyrene is Keil-Flo™ 150, available from Ferro Corporation – Petroleum Additives, 3000 Sheffield Avenue, Hammond, Indiana 46327.

The polyalkyl methacrylates suitable for use in the present invention are prepared by the polymerization of C₁ - C₃₀ methacrylates. Preparation of these polymers may further include the use of acrylic monomers having nitrogen-containing functional groups, hydroxy groups, and/or alkoxy groups which provide additional properties to the polyalkyl methacrylates such as improved dispersancy. The polyalkyl methacrylates, in one embodiment, have a number average molecular weight of from about 10,000 to about 250,000 and in one embodiment, 20,000 to 200,000. The polyalkyl methacrylates may be prepared by conventional methods of free-radical or anionic polymerization. One pour point depressant in the class of polyalkyl methacrylates is 10-310 available from RohMax, USA, Delran, NJ 08075.

The pour point depressant is typically about 0.2 to about 4 weight percent of the lubricant composition.

Viscosity Modifier, Thickener and Tackifier

Optionally, the lubricant may further include an additive from the group comprising viscosity modifiers, which includes, but is not limited to, ethylene vinyl acetate, polyisobutylenes, polybutenes, polymethacrylates, olefin copolymers, esters of styrene maleic anhydride copolymers, hydrogenated styrene-diene copolymers, hydrogenated radial polyisoprene, alkylated polystyrene, fumed silicas, complex esters, and food grade tackifiers like natural rubber solubilized in food grade oils.

The addition of a food grade viscosity modifier, thickener, and/or tackifier provides adhesiveness and improves the viscosity and viscosity index of the lubricant. Some applications and environmental conditions may require an additional tacky surface film that protects equipment from corrosion and wear. In this embodiment, the viscosity modifier, thickener/tackifier is about 1 to about 20 weight percent of the lubricant. However, the viscosity modifier, thickener/tackifier can be from about 0.5 to about 30 weight percent. An example of a food grade material that can be used in this invention is

Functional V-584, a natural rubber viscosity modifier/tackifier, which is available from Functional Products, Inc., Macedonia, Ohio and Indopol H-1500, a polybutene viscosity modifier from PB North American, Naperville, Illinois. Another example is a complex ester CG 5000 that is also a multifunctional product, viscosity modifier, pour point depressant, and friction modifier from Inolex Chemical Co. Philadelphia, PA.

The lubricants described in the present invention are useful in applications including hydraulic oils, transmission fluids, engine oils, gear oil, rock drill oil, circulating oils, drip oils, spindle oils, compressor oils, grease base oils, corrosion inhibitor oils, heat transfer oils, cable oils, chain oils, general purpose oils, metal working oils, and electrical insulating oils.

The lubricants described in the present invention can be made using a simple blend procedure wherein the components are mixed together using mechanical agitation. Prior to the blending process, the components may be heated to enhance the blending and/or mixing process.

Test Methods

The following test methods were used to characterize the lubricant compositions of the present invention:

Formulation Number 1 ISO 32 Hydraulic Fluid

Viscosity @40°C	ASTM D-445 ³	29.65 cSt
Viscosity @100°C	ASTM D-445 ³	6.43 cSt
Viscosity index	ASTM D-2270 ⁷	178
4-ball wear	ASTM D-4172 ⁹	.37
Rust	ASTM D-665 ⁴	Pass Clean
Oxidation	ASTM D-2272 ⁸	550 to 600
Low temperature pumpability	ASTM D-4684 ¹⁰	1,900 cP @ -25°C 3,200 cP @ -30°C
Demulsification	ASTM D-1401 ⁶	40/40/0
Flash point	ASTM D-92 ¹	226°C
Pour point	ASTM D-97 ²	-36
Electrical insulating value	ASTM D-877 ⁵	16 kv
Biodegradability	ASTM D-5864 ¹¹	65%

1. Flash and Fire Points by Cleveland Open Cup Tester - This test method describes the determination of the flash and fire point of petroleum products by a manual Cleveland open cup apparatus or an automated Cleveland open cup apparatus. This test method is applicable to all petroleum products with flash points above 79° C (175° F) and below 400° C (752° F) except fuel oils.

2. Pour Point of Petroleum Products - This test method is intended for use on any petroleum product. A procedure suitable for black specimens, cylinder stock, and nondistillate fuel oil is described in.
3. Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity) - This test method specifies a procedure for the determination of the kinematic viscosity, ν , of liquid petroleum products, both transparent and opaque, by measuring the time for a volume of liquid to flow under gravity through a calibrated glass capillary viscometer. The dynamic viscosity, η , can be obtained by multiplying the kinematic viscosity, ν , by the density, ρ , of the liquid. The result obtained from this test method is dependent upon the behavior of the sample and is intended for application to liquids for which primarily the shear stress and shear rates are proportional (Newtonian flow behavior). If, however, the viscosity varies significantly with the rate of shear, different results may be obtained from viscometers of different capillary diameters. The procedure and precision values for residual fuel oils, which under some conditions exhibit non-Newtonian behavior, have been included. The range of kinematic viscosities covered by this test method is from 0.2 to 300 000 mm²/s at all temperatures.
4. Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water - This test method covers the evaluation of the ability of inhibited mineral oils, particularly steam-turbine oils, to aid in preventing the rusting of ferrous parts should water become mixed with the oil. This test method is also used for testing other oils, such as hydraulic oils and circulating oils. Provision is made in the procedure for testing heavier-than-water fluids. For synthetic fluids, such as phosphate ester types, the plastic holder and beaker cover should be made of a chemically resistant material, such as polytetrafluoroethylene (PTFE).
5. Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes - This test method is for determining the electrical breakdown voltage of insulating liquid specimens. The breakdown test uses ac voltage in the power-frequency range from 45 to 65 Hz. This test method is used to judge if the disk electrode breakdown voltage requirements are met for insulating liquids, as delivered from the manufacturer, that have never been filtered or dried. This procedure is used to determine

the breakdown voltage of liquids in which any insoluble breakdown products easily settle during the interval between the required repeated breakdown tests. These liquids include petroleum oils, hydrocarbons, and askarels (PCB) used as insulating and cooling liquids in transformers, cables, and similar apparatus. The procedure may be used to obtain the dielectric breakdown of silicone fluid as specified in Test Methods D 2225, provided the discharge energy into the sample is less than 20 mJ (milli joule) per breakdown for five consecutive breakdowns.

6. Water Separability of Petroleum Oils and Synthetic Fluid - This test method covers measurement of the ability of petroleum oils or synthetic fluids to separate from water. Although developed specifically for steam-turbine oils having viscosities of 28.8-90 cSt (mm^2/s) at 40°C, this test method can be used to test oils of other types having various viscosities and synthetic fluids. It is recommended, however, that the test temperature be raised to $82 \pm 1^\circ\text{C}$ when testing products more viscous than 90 cSt (mm^2/s) at 40°C. For higher viscosity oils where there is insufficient mixing of oil and water, Test Method D 2711, is recommended. Other test temperatures such as 25°C can also be used. When testing synthetic fluids whose relative densities are greater than that of water, the procedure is unchanged, but it should be noted that the water will probably float on the emulsion or liquid.

7. Standard Practice for Calculating Viscosity Index From Kinematic Viscosity at 40°C and 100°C - This test method specifies the procedures for calculating the viscosity index of petroleum products, such as lubricating oils, and related materials from their kinematic viscosities at 40°C and 100°C.

8. Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel - This test method utilizes an oxygen-pressured vessel to evaluate the oxidation stability of new and in-service turbine oils having the same composition (base stock and additives) in the presence of water and a copper catalyst coil at 150°C.

9. Wear Preventive Characteristics of Lubricating Fluid (Four Ball Method) - This test method covers a procedure for making a preliminary evaluation of the anti-wear

properties of fluid lubricants in sliding contact by means of the Four-Ball Wear Test Machine.

10. Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature - This test method covers the measurement of the yield stress and viscosity of engine oils after cooling at controlled rates over a period exceeding 45 h to a final test temperature between -10°C and -40°C. The viscosity measurements are made at a shear stress of 525 Pa over a shear rate of 0.4 to 15 s⁻¹. This test method is applicable for unused oils, sometimes referred to as fresh oils, designed for both light duty and heavy duty engine applications. It also has been shown to be suitable for used diesel oils. This test method uses the millipascal second (mPa·s) as the unit of viscosity.

11. Standard Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components - This test method covers the determination of the degree of aerobic aquatic biodegradation of fully formulated lubricants or their components on exposure to an inoculum under laboratory conditions. This test method is intended to specifically address the difficulties associated with testing water insoluble materials and complex mixtures such as are found in many lubricants. This test method is designed to be applicable to all lubricants that are not volatile and are not inhibitory at the test concentration to the organisms present in the inoculum. The percent of biodegradability rating is explained in ASTM D-6046, Table 2 Environmental Persistence Classification-Aerobic Fresh Water. The persistence designations are Pw1 (with %CO₂ ≥ 60% in 28 days), Pw2 (≥ 60% in 84 days), Pw3 (≥ 40% in 84 days), and Pw4 (< 40% in 84 days). Ultimate Biodegradability Pw1 is the best rating.

Formulating Examples:

1. Formulation ISO 32 Hydraulic Fluid having a biodegradability rating of Pw1 at 65%

<u>Component</u>	<u>%Weight</u>
Trisun 90 HO	46.05
Chevron 4R	50.00
Ciba 3050A	0.95
RhMx 10-310	2.00
Irgamet 39	0.10
RLI AO	0.90
Viscosity @ 40°C	29.65 cSt

Viscosity @ 100°C 6.43 cSt
Viscosity Index 178

2. Formulation shows an ISO 32 Fluid with Chevron 4R greater than 60% of the total base oil and passed ASTM D-5864 as Ultimate Biodegradable rating Pw1 at 60.9%

<u>Component</u>	<u>%Weight</u>
Canola HO (high oleic)	37.85
Chevron 4R	60.00
LZ 5186B	1.25
RLI AO	0.90

Viscosity @ 40°C 23.76 cSt
Viscosity @ 100°C 5.43 cSt
Viscosity Index 176

3. Formulation ISO 68 Hydraulic Fluid having a Ultimate Biodegradable rating Pw1 at 65%

<u>Component</u>	<u>%Weight</u>
Canola HO	53.85
Chevron 4R	30.00
CG 5000	9.00
Indopol H-1500	3.00
LZ 5186B	1.25
RhMx 10-310	2.00
RLI AO	0.90

Viscosity @ 40°C 67.77 cSt
Viscosity @ 100°C 12.71 cSt
Viscosity Index 190

In the above formulations, Chevron 4R is an all-hydroprocessed Group III oil available from Chevron, CG 5000 is a synthetic ester available from Inolex, LZ 5186B is a non-food grade additive available from the Lubrizol corporation, RhMx 10-310 is a pour point depressant in the class of polyalkyl methacrylates available from RohMax, Ciba 3050A is a non-food grade additive available from Ciba Geigy, Irgamet 39 is a food grade triazole available from Ciba-Geigy, RLI AO is an antioxidant available from Renewable Lubricants, Inc., TriSun 90 is a high oleic sunflower oil and Canola HO is a high oleic canola oil available from AC Humko, and Indopol H1500 is a polybutene viscosity modifier available from BP North American.

The above examples have been depicted solely for the purpose of exemplification and are not intended to restrict the scope or embodiments of the invention. The invention is further illustrated with reference to the claims that follow thereto.

Other than in the operating examples, or where otherwise indicated, all numbers expressing quantities of ingredients, reaction conditions, and so forth used in the

specification and claims are to be understood as being modified in all instances by the term "about." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the following specification and attached claims are approximations that may vary depending upon the desired properties sought to be obtained by the present invention. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques.

Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical value, however, inherently contain certain errors necessarily resulting from the standard deviation found in their respective testing measurements.

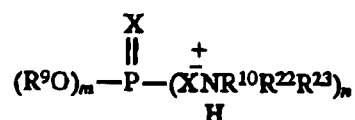
The invention has been described with reference to several embodiments. Obviously, modifications and alterations will occur to others upon a reading and understanding of the specification. It is intended by applicant to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the invention, it is now claimed:

What is claimed is:

1. A lubricant composition characterized by:
 - a) at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof;
 - b) at least one synthetic base oil having a sulfur content equal to or less than about 0.03 percent and saturates equal to or greater than about 90 percent; and,
 - c) at least one antioxidant.
2. The composition in claim 1, wherein the vegetable oil is selected from the group comprising: sunflower oil, canola oil, soybean oil, corn oil, peanut oil, palm oil, castor bean oil, cotton oil, lesquerella oil, crambe oil, safflower oil, high oleic sunflower oil, high oleic canola oil, high oleic soybean oil, high oleic corn oil, high oleic peanut oil, high oleic cotton oil, high oleic safflower oil, and mixtures thereof.
3. The composition of claim 1, wherein the vegetable oil is present in an amount greater than about 10%, based on total weight.
4. The composition of claim 1, wherein the vegetable oil is present in an amount less than about 90%, based on total weight.
5. The composition in claim 1, wherein the vegetable oil is present in a range from about 10% to about 90%, based on total weight.
6. The composition of claim 5, wherein the vegetable oil is present in a range from about 30% to about 70%, based on total weight.
7. The composition of claim 6, wherein the vegetable oil is present in a range from about 40% to about 60%, based on total weight.
8. The composition as described in claim 1, wherein the base oil is an all-hydroprocessed synthetic base oil.
9. The composition of claim 1, wherein the base oil is present in an amount greater than about 10%, based on total weight.
10. The composition of claim 1, wherein the base oil is present in an amount less than about 90%, based on total weight.
11. The composition in claim 1, wherein the base oil is present in a range from about 10% to about 90%, based on total weight.

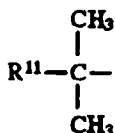
12. The composition of claim 11, wherein the base oil is present in a range from about 30% to about 70%, based on total weight.
13. The composition of claim 12, wherein the base oil is present in a range from about 40% to about 60%, based on total weight.
14. The composition in claim 1, wherein the antioxidant is selected from the group comprising: amines, phenols, and mixtures thereof.
15. The composition in claim 1, wherein the antioxidant is present in a range from about 0.01% to about 5.0%, based on total weight.
16. The composition in claim 15, wherein the antioxidant is present in a range from about 0.25% to about 1.5%, based on total weight.
17. The composition in claim 16, wherein the antioxidant is present in a range from about 0.5% to about 1.0%, based on total weight.
18. The composition of claim 1, wherein the composition further comprises at least one additive, the additive chosen from the group comprising: anti-wear inhibitor, extreme pressure additive, friction modifier, rust inhibitor, corrosion inhibitor, pour point depressant, tackifier, viscosity modifier, metal deactivator, foam inhibitor, emulsifier, and demulsifier.
19. The composition of claim 18, wherein the at least one additive is a phosphorous amine salt of the formula:



wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3 and X is oxygen or sulfur.

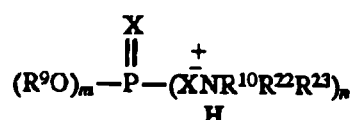
20. The composition of claim 19, wherein the phosphorous amine salt further comprises:

R^9 contains from about 8 up to 18 carbon atoms, R^{10} is

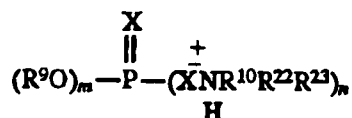


wherein R^{11} is an aliphatic group containing from about 6 up to about 12 carbon atoms, R^{22} and R^{23} are hydrogen, m is 2, n is 1 and X is oxygen.

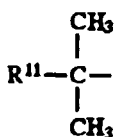
21. The composition of claim 18, wherein the at least one additive is chosen from the group comprising: phosphorous amine salt having the formula:



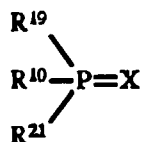
wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3 and X is oxygen or sulfur; phosphorous amine salt having the formula:



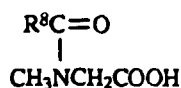
wherein R^9 and R^{10} are independently aliphatic groups containing from about 1 up to about 24 carbon atoms, R^{22} and R^{23} are independently hydrogen or aliphatic groups containing from about 1 up to about 18 aliphatic carbon atoms, the sum of m and n is 3 and X is oxygen or sulfur, wherein R^9 contains from about 8 up to 18 carbon atoms, R^{10} is



wherein R^{11} is an aliphatic group containing from about 6 up to about 12 carbon atoms, R^{22} and R^{23} are hydrogen, m is 2, n is 1 and X is oxygen; phosphorous compound having the formula:



wherein R^{19} , R^{20} , and R^{21} are independent hydrogen, an aliphatic or alkoxy group containing from 1 up to about 12 carbon atoms, or an aryl or aryloxy group wherein the aryl group is phenyl or naphthyl and the aryloxy group is phenoxy or naphthoxy and X is oxygen or sulfur; N-acyl derivative of sarcosine having the formula:



wherein R^8 is an aliphatic group containing from 1 up to about 24 carbon atoms; imidazoline; triazole; substituted triazole; tolu-triazole; alkylated polystyrene; polyalkyl methacrylate; ethylene vinyl acetate; polyisobutylenes; polybutenes; polymethacrylates; olefin copolymer; ester of styrene maleic anhydride copolymer; hydrogenated styrene-diene copolymer; hydrogenated radial polyisoprene; alkylated polystyrene; fumed silica; complex ester; and food grade tackifier.

22. The composition of claim 18, wherein the anti-wear inhibitor is from about 0.1% to about 4% by total weight, the corrosion inhibitor is from about 0.01% to about 4% by total weight, the metal deactivator is from about 0.05% to about 0.3% by total weight, the pour point depressant is from about 0.2% to about 4% by total weight, and the viscosity modifier is from about 0.5% to about 30% by total weight.

23. The composition of claim 22, wherein the corrosion inhibitor is from about 0.05% to about 2% by total weight, the metal deactivator is from about 0.05% to about 0.2% by total weight, and the viscosity modifier is from about 1% to about 20% by total weight.

24. The composition of claim 1, wherein the synthetic base oil has a viscosity index equal to or greater than about 120.

25. The composition of claim 1, wherein the composition has an oxidation characteristic in a range from about 60 to about 600 minutes.

26. The composition of claim 25, wherein the oxidation characteristic is in a range from about 200 to about 400 minutes.

27. The composition of claim 1, wherein the base oil is at least one oil chosen from the group comprising: synthetic ester base oil, polyalphaolefin, unrefined oil, refined oil, re-refined oil, and mixtures thereof.

28. A method of making a lubricant composition, the method characterized by the steps of:

providing at least one vegetable oil selected from the group comprising: natural vegetable oil, synthetic vegetable oil, genetically modified vegetable oil, and mixtures thereof;

providing at least one synthetic base oil having a sulfur content equal to or less than about 0.03 percent and saturates equal to or greater than about 90 percent;

providing at least one antioxidant; and,

blending together the vegetable oil, the base oil, and the at least one antioxidant.

29. The method claim 28, wherein the vegetable oil is selected from the group comprising: sunflower oil, canola oil, soybean oil, corn oil, peanut oil, palm oil, castor bean oil, cotton oil, lesquerella oil, crambe oil, safflower oil, high oleic sunflower oil, high oleic canola oil, high oleic soybean oil, high oleic corn oil, high oleic peanut oil, high oleic cotton oil, high oleic safflower oil, and mixtures thereof.

30. The method of claim 28, wherein the vegetable oil is present in an amount greater than about 10%, based on total weight.

31. The method of claim 28, wherein the vegetable oil is present in an amount less than about 90%, based on total weight.

32. A lubricant composition characterized by:

a) at least one vegetable oil selected from the group comprising: sunflower oil, canola oil, soybean oil, corn oil, peanut oil, palm oil, castor bean oil, cotton oil, lesquerella oil, crambe oil, safflower oil, high oleic sunflower oil, high oleic canola oil, high oleic soybean oil, high oleic corn oil, high oleic peanut oil, high oleic cotton oil, high oleic safflower oil, and mixtures thereof, wherein the at least one vegetable oil is present in a range from about 40% to about 60%;

b) at least one synthetic base oil having a sulfur content equal to or less than about

0.03 percent, saturates equal to or greater than about 90 percent, and a viscosity index equal to or greater than about 120, wherein the base oil is present in a range from about 40% to about 60%;

c) at least one antioxidant selected from the group comprising amines, phenols, and mixtures thereof, wherein the antioxidant is present in a range from about 0.5% to about 1.0%; and,

d) at least one additive, the additive chosen from the group comprising: anti-wear inhibitor, extreme pressure additive, friction modifier, rust inhibitor, corrosion inhibitor, pour point depressant, tackifier, viscosity modifier, metal deactivator, foam inhibitor, emulsifier, and demulsifier, wherein the corrosion inhibitor is about 0.05% to about 2% by total weight, the metal deactivator is about 0.05% to about 0.2% by total weight, the pour point depressant is about 0.2% to about 4% by total weight, and the viscosity modifier is about 1% to about 20% by total weight.

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