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VEGETABLE BASED BIODEGRADABLE LIQUID LUBRICANTS

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(57) Claim

1. A biodegradable liquid lubricant composition consisting entirely of vegetable based products, wherein the composition is made by combining at least:

a vegetable fatty acid triglyceride base oil making up 65 to 85 percent of the composition by volume, wherein at least 75 percent of the fatty acid has a chain length of 18 to 24 carbon atoms;

a vegetable oil additive having hydroxy fatty acids and comprising 10 to 30 percent of the composition by volume; and

a liquid vegetable wax comprising 3 to 8 percent of the composition by volume.

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(54) Title: VEGETABLE BASED BIODEGRADABLE LIQUID LUBRICANTS

(57) Abstract

The vegetable based oil of the present invention is derived entirely from plants, a renewable resource. It is readily biodegradable by microbes naturally present in the earth's environment and is nontoxic to flora and fauna. The vegetable based lubricant of the invention includes a fatty acid base oil making up a majority of the composition, a vegetable oil additive having hydroxy fatty acids, and a liquid vegetable wax additive. The base oil is preferably derived from plants which are members of the genus Brassica and the Cruciferea (mustard) family, for example rapeseed, crambe and canola. The vegetable oil additive having hydroxy fatty acids is preferably castor, lesquerella or cosmos oil. The liquid vegetable wax additive is preferably derived from jojoba or meadowfoam.

Title of the Invention

Vegetable Based Biodegradable Liquid Lubricants

Background of the Invention

(1) Field of the Invention

The present invention relates to biodegradable vegetable based oil compositions particularly useful in lubricating combustion engines.

(2) Description of the related art

The primary purpose of motor oils is to prevent metal-to-metal contact between engine parts that move with respect toward one another. In the absence of a lubricant, friction caused by the rubbing of the moving parts causes wear and creates heat which welds tiny imperfections on the moving parts together. The parts then tear apart, weld together again, and so on. This process, referred to as "scuffing", if allowed to continue will soon cause failure of the engine. Motor oils prevent the metal-to-metal contact by forming a film between the moving parts. In addition to reducing the friction between moving parts, the lubricant also provides for cooling of the parts, prevention of corrosion, and enhancement of the sealing action of the piston rings.

Traditionally, mineral oils, produced from petroleum, have been the primary source of engine lubricants. The oils are

composed primarily of hydrocarbons (paraffins, naphtenes, asphaltenes, and aromatics) and are made by distilling and refining crude petroleum. A host of various chemicals are added to these petroleum based oils in order to improve their physical properties and performance. For example, polymeric substances are added to improve viscosity and act as dispersants; micronized polytetrafluoroethylene (PTFE) is added to provide lubricity and reduce engine wear; amines, metal phenates, and zinc salts are added as antioxidants; and alkaline-earth phenates are added to neutralize acids and reduce wear.

Petroleum based oils suffer from a number of drawbacks. The crude petroleum from which they are processed is a nonrenewable resource. The earth has only a finite number of oil reserves. Additionally, petroleum based motor oils are highly toxic to the environment; hazardous to both flora and fauna. Recent studies indicate that these oils are carcinogenic. Finally, petroleum based oils with their chemical additives are not readily biodegradable by microorganisms which are naturally present in the environment. Consequently, there is a strong need for a motor oil which effectively lubricates engines, yet at the same time is derived from a renewable resource, is nontoxic to the environment, and is readily biodegradable by microbes naturally present in the environment.

In addition to mineral oils, synthetic fluids have developed as a second class of liquid lubricants. Synthetic fluids contain compounds that have been synthesized to obtain a desired

intrinsic quality, for example, thermal stability. Often they are engineered for use in extreme temperature, vacuum, radiation, and chemical environments. The most common synthetic lubricants are silicones, polyglycols, phosphate esters, dibasic acid esters, and silicate esters. Synthetic lubricants, however, are relatively costly and suffer from many of same drawbacks as petroleum based oils. They are often toxic to the earth's environment, hazardous to both flora and fauna, and are not readily biodegradable by naturally present microbes.

Finally, a third class of liquid lubricants are fixed oils. Fixed oils are fatty substances extracted from animals, vegetable matter, and fish. They are called fixed oils because they will not volatize without decomposing. Generally, fixed oils are composed of fatty acids and alcohols, the radicals of which are combined to form fatty esters. The use of fixed oils, particularly vegetable based oils, as liquid lubricants, has been minimal and generally limited to blending with petroleum based oils. For example, castor oil is often blended with petroleum based oils (hence the beginning of "Castrol" at the turn of the century). These blended formulations suffer from the same drawbacks as petroleum based oils.

Brief Summary of the Invention

The present invention improves upon the prior art by providing a liquid lubricant that is composed entirely of vegetable based components. Unlike the conventional lubricants

of the prior art, the vegetable based oil of the present invention is derived from a renewable resource. It is readily biodegradable by microbes naturally present in the earth's environment and is nontoxic to flora and fauna.

The vegetable based lubricant of the invention includes a fatty acid base oil making up a majority of the composition (preferably 65-85% of the composition volume) wherein at least 75% of the fatty acid has a chain length of 18 to 24 carbon atoms. The composition further includes a vegetable oil additive having hydroxy fatty acids (preferably 10-30% of the composition volume) and a liquid vegetable wax additive (preferably 3-8% of the composition volume). The base oil is preferably derived from plants which are members of the genus Brassica and the Cruciferae (mustard) family, for example rapeseed, crambe and canola. The vegetable oil additive having hydroxy fatty acids is preferably castor, lesquerella, or cosmos oil. The liquid vegetable wax additive is preferably derived from jojoba or meadowfoam.

Accordingly, it is an objective of the present invention to provide a competitively priced vegetable based lubricant which is made from renewable resources, is nontoxic to the environment, and is biodegradable.

A further objective of the present invention is to provide an effective liquid lubricant for internal combustion engines.

These, and other objectives and advantages of the present invention will become apparent from the detailed description and claims which follow.

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These, and other objectives and advantages of the present invention will become apparent from the detailed description which follow.

Detailed Description of the Invention

The vegetable based liquid lubricant composition of the invention, unlike lubricants of the prior art, is derived from a renewable resource, is nontoxic to flora and fauna, and is readily biodegradable by microorganisms naturally present in the earth's environment. Initially, the lubricant was developed for use in two and four cycle engines (e.g. lawnmower engines) and those engines used in extremely fragile ecosystems (e.g. deserts, tundras, forests and wetlands). The invention, however, appears to have a broad spectrum of use in all forms of internal combustion engines. Moreover, it is envisioned that the lubricant composition of the invention has applicability as a chain lubricant, bar chail oil, and general purpose lubricant and may be adapted for use in hydraulics and greases.

The vegetable based lubricant of the invention includes a fatty acid base oil making up a majority of the composition wherein at least 75% of the fatty acid has a chain length of 18 to 24 carbon atoms. The composition further includes a vegetable oil additive having acids and a liquid vegetable wax additive.

A high percentage, at least 75 percent, of 18 to 22 carbon chain fatty acids is required for the fatty acids of the base oil in order for the base oil to provide adequate lubrication. Crude oils derived from plants which are members of the genus Brassica and the Cruciferae (mustard) family are preferred for use as the base oil. Members of the Cruciferae (mustard) family are unique in that the oil they produce contains erucic fatty acids (22 carbon chain, monosaturated) in their triglycerides (fats or oils). More particularly, rapeseed oil contains 20 to 24 percent erucic while crambe contains 24 to 28 percent erucic. Erucic acids have an important function in resisting breakdown under extreme temperature conditions which may exceed 425°F. Canola contains less than two percent erucic, but has 65 to 82 percent oleic fatty acid (18 carbon chain, monosaturated). While canola does not contain as much erucic acid as rapeseed or crambe, it does function in a similar manner when the temperatures do not reach extreme levels. Also present in each of the base oils are the fatty acids linoleic (18 carbon chain, 2 double bonds-or polyunsaturated), linolenic (18 carbon chain, 3 double bonds) and some palmitic (16 carbon chain, saturated or no double bond) and stearic (16 carbon chain, monosaturated).

Additionally, over 180 components have been identified in each of the rapeseed, crambe, and canola base oils which may affect the ability of the base oil to function. Although soybean, sunflower, and safflower oils have fatty acid profiles similar to rapeseed, crambe, and canola, they do not function

similarly and have initially proven to be unsatisfactory as a base oil. Consequently, it is believed that components of the base oil other than the triglycerides also affect the functionality of the oil More particularly, it is thought that the components of phosphotidyl cholines (e.g. lecithins and lectins), aliphatic alcohols, waxes, terpenoids, saponins functioning as detergents, and additional free fatty acids present in the rapeseed, crambe, and canola crude oils make these oils particularly well suited for use as a base in the lubricant composition.

The vegetable based biodegradable liquid lubricant composition includes an oil additive having significant amounts of hydroxy fatty acids (containing an OH group where normally a hydrogen branches from a carbon). Like the base oil, the oil additive is also derived from a vegetable source. The hydroxy fatty acids help to prevent the breakdown of the oils at high temperatures. Preferably, the oil additive makes up 10 to 30 percent of the total composition (by volume). Castor, lesquerella and cosmos oil each contain hydroxy fatty acids and can be used as the oil additive of the lubricant composition.

Also essential to the vegetable based biodegradable liquid lubricant composition is a source of liquid vegetable wax. Meadowfoam and jojoba provide the most common form of liquid vegetable waxes. These waxes are composed of esters of aliphatic alcohols and fatty acid chains of generally up to 30 carbons in length. In jojoba, an alcohol may be 20 to 26 carbons in length

and be combined with a fatty acid varying from 16 to 22 carbons in length. These waxes improve viscosity and tend to bond to metals thereby resisting wear. Sulfonated jojoba (wherein a normal acid COOH is replaced with a stronger acid, for example CSO_4, on the end of the fatty acid) functions as a viscosity improver for the oil.

When these components of the vegetable based lubricant composition are mixed, it is likely that any free fatty acids which are available link with preexisting diglycerides (forming additional triglycerides) or link with aliphatic alcohols to form more waxes. Additionally, it has been noted that the fatty acid containing triglycerides of the base oil react with the triglycerides of the hydroxy fatty acids to lower the viscosity. In conducting chromatographic analysis of the formulated oil, unusual methylated free fatty acids are observed. Plant fatty acids occur in even numbers while gas chromatic analysis of this oil shows odd numbered chains such as 17 carbon chain, again indicating chemical alteration of the base oil components. Although not completely understood, it is believed that reactions between the three different components of the composition work to enhance the ability of the vegetable based composition to act as an effective lubricant.

Initial tests of the vegetable based oil composition in small two-cycle engines (3.5 to 4 hp) indicate that the oil composition of the present invention permits the engines to run up to 30 percent cooler than engines run on conventional

petroleum based oils. Moreover, tests indicate that the vegetable based lubricant reduces engine wear by an estimated 10 to 20 percent over conventionally lubricated engines. Interestingly, the fatty acid profiles of the vegetable based lubricant remain unaltered after 20 hours of use in a 3.5 hp engine whereas petroleum based lubricants generally show significant alteration in its compositional analysis.

This description is given for the purposes of illustration and explanation. It will be apparent to those skilled in the relevant art that modifications can be made to the invention as described above without departing from its scope or spirit.

We claim:

1. A biodegradable liquid lubricant composition consisting entirely of vegetable based products, wherein the composition is made by combining at least:

a vegetable fatty acid triglyceride base oil making up 65 to 85 percent of the composition by volume, wherein at least 75 percent of the fatty acid has a chain length of 18 to 24 carbon atoms;

a vegetable oil additive having hydroxy fatty acids and comprising 10 to 30 percent of the composition by volume; and

a liquid vegetable wax comprising 3 to 8 percent of the composition by volume.

2. The lubricant composition of claim 1, wherein the base oil is derived from a vegetable in the Cruciferae family.

3. The lubricant composition of claim 1, wherein the base oil is canola oil.

4. The lubricant composition of claim 1, wherein the base oil is rapeseed oil or crambe oil.

5. The lubricant composition of claim 1, wherein the vegetable oil additive is castor oil.

6. The lubricant composition of claim 1, wherein the vegetable oil additive is lesquerella oil.

7. The lubricant composition of claim 1, wherein the vegetable oil additive is cosmos oil.

8. The lubricant composition of claim 1, wherein the liquid vegetable wax is jojoba wax.

9. The lubricant composition of claim 8, wherein the jojoba wax is sulfonated.

10. The lubricant composition of claim 1, wherein the liquid vegetable wax is meadowfoam wax.

11. A method of using the lubricant composition of 1, wherein the composition is used to lubricate an internal combustion engine.

12. The method of claim 11, wherein the internal combustion engine is a two cycle engine.

13. The method of claim 12, wherein the internal combustion engine is a four cycle engine.

14. A biodegradable liquid lubricant composition consisting entirely of vegetable based products, wherein the composition is made by combining at least:

a vegetable fatty acid triglyceride base oil making up a majority of the composition wherein at least 75 percent of the fatty acid has a chain length of 18 to 24 carbon atoms, wherein the base oil is derived from a vegetable in the Cruciferae family;

a vegetable oil additive serving as a source of hydroxy fatty acids; and

a liquid vegetable wax.

15. The lubricant composition of claim 14, wherein the base oil is canola oil.

16. The lubricant composition of claim 14, wherein the base oil is rapeseed oil or crambe oil.

17. A method of using the lubricant composition of 14, wherein the composition is used to lubricate an internal combustion engine.

18. The lubricant composition of claim 14, wherein the vegetable oil additive is castor oil.

19. The lubricant composition of claim 14, wherein the liquid vegetable wax is jojoba.

20. A process of making a biodegradable liquid lubricant composition consisting entirely of vegetable based products, wherein:

a vegetable fatty acid triglyceride base oil making up 65 to 85 percent of the composition by volume, wherein at least 75 percent of the fatty acid has a chain length of 18 to 24 carbon atoms, is combined with;

a the vegetable oil additive having hydroxy fatty acids and comprising 10 to 30 percent of the composition by volume; and

a liquid vegetable wax comprising 3 to 8 percent of the composition by volume.