Method of lubricating a driveline with a lubricating oil composition comprising capped Polyoxyalkylene Polysols

Methode der Schmierung eines Antriebsstrangs mit einem Schmiermittel enthaltend endveretherte Polyoxyalkylenpolysole

Méthode pour lubrifier une chaîne de transmission avec une composition de lubrification comprenant des polysols éthérifiés

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References cited:
EP-A- 0 401 969
EP-A- 0 989 180
DE-A1- 2 806 133
US-A- 5 652 204

Remarks:
The file contains technical information submitted after the application was filed and not included in this specification

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Description

FIELD OF INVENTION

[0001] The present invention relates to a method of lubricating a driveline device with a lubricating composition comprising hydrocarbyl-capped polyoxyalkylene polyol.

BACKGROUND OF THE INVENTION

[0002] It is known to lubricate mechanical devices such as driveline power transmitting devices, internal combustion engines or hydraulic systems with a lubricant comprising a polyalkylene glycol oil of lubricating viscosity.

[0003] In addition driveline power transmitting devices such as gears or transmissions, especially axle fluids and manual transmission fluids (MTFs), present highly challenging technological problems and solutions for satisfying the multiple and often conflicting lubricating requirements, whilst providing at least one of wear performance, durability and fuel economy. One of the important parameters influencing performance is lubricant viscosity. Lubricants capable of performing at lower viscosity typically provide increased fuel economy (thus improving CAFE efficiency). Conversely, lower viscosity fluids also contribute to elevated gear and transmission operating temperatures, which are believed to reduce fuel economy. Additionally, increasing lubricant viscosity is believed to provide better wear protection and durability to gears and transmissions. Consequently, it would be desirable to provide a correctly balanced lubricant composition to meet the needs of mechanical devices such as gears and transmissions. Typically the lubricating composition is capable of imparting at least one of an acceptable co-efficient of friction, viscosity index (VI), oil blend thickening capabilities, shear stability, good low temperature viscosity performance, reduced operating temperatures, acceptable wear performance, acceptable durability, or acceptable fuel economy.


[0005] US Patent 4,370,247 discloses the use of a polyalkylene glycol to reduce power loss due to a frictional decrease.

[0006] European Patent Application 460 317 discloses gear oil a lubricating composition containing a polyalkylene glycol lubricant and at least one sulphur-containing antiwear or extreme pressure agent. The polyalkylene glycol is prepared using water or monohydric alcohols. The monohydric alcohols listed include methanol, ethanol, propanol, butanol, pentanol, hexanol, isobutanol, neopentanol and decanol. The examples disclose Emkarox® series poly(ethylene-propylene) glycols available from Uniquema that are believed to be made using a butanol initiator.

DE 2806133 discloses a lubricant consisting essentially of a polyoxyalkylene glycol diether having a specific formula. DE 2806133 does not disclose the hydrocarbyl-capped polyoxyalkylene polyol required by the method of this invention.

SUMMARY OF THE INVENTION

[0007] The invention provides a method of lubricating a driveline device with a lubricating composition comprising:

(a) a hydrocarbyl-capped polyoxyalkylene polyol, wherein (i) the hydrocarbyl-capped group of the polyoxyalkylene polyol comprises a residue of a mixture of linear monohydric alcohols selected from the group consisting of dodecanol, tridecanol, tetradecanol and pentadecanol, (ii) the hydrocarbyl-capped polyoxyalkylene polyol comprises 0 wt % to 80 wt % of ethylene oxide and an alkylene oxide containing 3 to 8 carbon atoms present at 20 wt % to 100 wt % of the hydrocarbyl-capped polyoxyalkylene polyol, and (iii) the hydrocarbyl-capped polyoxyalkylene polyol is present in the lubricating composition at 50 wt % to 95 wt % of the lubricating composition; and

(b) a phosphorus-containing acid, salt or ester, or mixtures thereof wherein the phosphorus-containing acid, salt or ester, or mixtures thereof is present in the lubricating composition at 0.1 wt % to 5 wt % of the lubricating composition.

[0008] In one embodiment the lubricating composition further comprises a non-phosphorus extreme pressure agent, or mixtures thereof.

[0009] In one embodiment the invention provides for the use of the hydrocarbyl-capped polyoxyalkylene polyol disclosed herein as an oil of lubricating viscosity.

DETAILED DESCRIPTION OF THE INVENTION

[0010] As disclosed above, the present invention provides a method of lubricating a driveline device with a lubricating composition comprising a hydrocarbyl-capped polyoxyalkylene polyol.
Hydrocarbyl-Capped Polyoxyalkylene Polyol

[0011] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol includes compounds derived from a homopolymer or a copolymer of an alkylene oxide. In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is a copolymer and may be random or block. In one embodiment the copolymer is block. In one embodiment the copolymer is random.

[0012] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol has a weight average molecular weight of about 200 to about 50,000, or about 500 to about 20,000, or about 750 to about 10,000, or about 1000 to about 5000.

[0013] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol includes compounds derived from a copolymer of two or more alkylene oxides.

[0014] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable by a process that comprises reacting (i) an alkylene oxide, (ii) a mixture of linear C_{12-15} monohydric alcohols, (iii) optionally a base catalyst, and (iv) optionally an alcohol other than (ii).

[0015] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable by a process that comprises reacting (i) an alkylene oxide, (ii) a mixture of linear C_{12-15} monohydric alcohols, (iii) a base catalyst, (iv) optionally an alcohol other than (ii).

[0016] In one embodiment the processes defined above to prepare the hydrocarbyl-capped polyoxyalkylene polyol comprise a mixture of a linear C_{12-15} monohydric alcohols, and an alcohol other than the linear alcohols as defined above.

[0017] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable from an alkylene oxide including ethylene oxide, propylene oxide, butylene oxide, hexylene oxide, heptylene oxide, octylene oxide, nonylene oxide, decylene oxide, dodecylene oxide, undecylene oxide, dodecylene oxide, tetradecylene, pentadecylene oxide, hexadecylene oxide, heptadecylene oxide, octadecylene oxide, nonadecylene oxide, eicosylene oxide, or mixtures thereof.

[0018] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable from a mixture of (1) at least one alkylene oxide selected from the group consisting of ethylene oxide, propylene oxide, butylene oxide, pentylene oxide, hexylene oxide, heptylene oxide, and mixtures thereof; and (2) at least one alkylene oxide selected from the group consisting of octylene oxide, nonylene oxide, decylene oxide, undecylene oxide, dodecylene oxide, tridecylene oxide, tetradecylene, pentadecylene oxide, hexadecylene oxide, heptadecylene oxide, octadecylene oxide, nonadecylene oxide, eicosylene oxide, or mixtures thereof.

[0019] In one embodiment the alkylene oxide of (2) is selected from the group including decylene oxide, undecylene oxide, dodecylene oxide, tridecylene oxide, tetradecylene, pentadecylene oxide, hexadecylene oxide, heptadecylene oxide, octadecylene oxide, and mixtures thereof.

[0020] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable from a copolymer of two or more alkylene oxides.

[0021] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable from a copolymer of (i) one or more alkylene oxides, and (ii) styrene oxide.

[0022] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is obtained/obtainable from a copolymer of ethylene oxide and propylene oxide.

[0023] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol in mono-capped.

[0024] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol in di-capped. A di- hydrocarbyl-capped polyoxyalkylene polyol may be formed by either (i) a mixture of linear C_{12-15} monohydric alcohols, or (ii) an alcohol other than the linear alcohols of (i).

[0026] In one embodiment the di- hydrocarbyl-capped polyoxyalkylene polyol in mono-capped.

[0026] In one embodiment the di- hydrocarbyl-capped polyoxyalkylene polyol in di-capped. A di- hydrocarbyl-capped polyoxyalkylene polyol may be formed by either (i) a mixture of linear C_{12-15} monohydric alcohols, or (ii) an alcohol other than the linear alcohols of (i).

[0028] The hydrocarbyl-capped polyoxyalkylene polyol comprises (i) 0 wt % to 80 wt % of ethylene oxide, and an alkylene oxide containing 3 to 8 carbon atoms present at 20 wt % to 100 wt % of the hydrocarbyl-capped polyoxyalkylene polyol.

[0029] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol comprises (i) 0 wt % to 75 wt % of ethylene oxide, and an alkylene oxide containing 3 to 8 carbon atoms present at about 25 wt % to about 100 wt % of the hydrocarbyl-capped polyoxyalkylene polyol.

[0030] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol comprises (i) 1 wt % to 70 wt % of ethylene oxide, and an alkylene oxide containing 3 to 8 carbon atoms present at 30 wt % to 99 wt % of the hydrocarbyl-capped polyoxyalkylene polyol.
polyoxyalkylene polyol.

In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol comprises (i) 5 wt % to 60 wt % of ethylene oxide, and an alkylene oxide containing 3 to 8 carbon atoms present at 40 wt % to 95 wt % of the hydrocarbyl-capped polyoxyalkylene polyol.

The hydrocarbyl-capped polyoxyalkylene polyol is commercially available for example available from Bayer with tradename Actaclear™ ND-21.

The hydrocarbyl-capped polyoxyalkylene polyol may be prepared by basic catalysis. U.S. Patents 4,274,837, 4,877,416, and 5,600,025 disclose the use of alkali metals such as potassium as a basic catalyst for making hydrocarbyl-capped polyoxyalkylene polyol.

In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol may be prepared using a double metal cyanide catalyst. Suitable double cyanide catalysts are described in U.S. Pat. Nos. 3,278,457, 3,941,849, 4,472,560, 5,158,922, 5,470,813, 5,482,908.

In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol may be prepared using a zinc hexacyano-cobaltate-tert-butyl alcohol complex as disclosed in US Pat No. 6,821,308.

In one embodiment the base catalyst includes Lewis bases.

The reaction may be carried out a reaction temperature range of about 50 °C to about 150 °C, or about 100 °C to about 120 °C.

Typically the hydrocarbyl-capped polyoxyalkylene polyol will undergo remove or neutralize the base catalyst. The base catalyst may be removed or neutralised by techniques including acid neutralization, ion exchange, adsorption of metals, or mixtures thereof.

The monohydric alcohol typically forms a capping group on the hydrocarbyl-capped polyoxyalkylene polyol. Also the monohydric alcohol may also be described as an initiator.

In different embodiments the hydrocarbyl-capped group of the polyoxyalkylene polyol comprises a residue of a mixture of linear monohydric alcohols containing 12 to 15 carbon atoms.

The mixture of linear monohydric alcohols includes dodecanol, tridecanol, tetradecanol and/or pentadecanol.

In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol is present in the lubricating composition at a range of 65 wt % to 95 wt %, of the lubricating composition.

Phosphorus-Containing Acid, Salt or Ester

The lubricating composition includes a phosphorus-containing acid, salt or ester. The phosphorus-containing acid, salt or ester may be an antwear agent and/or an extreme pressure agent. In one embodiment the phosphorus-containing acid, salt or ester is in the form of a mixture.

The phosphorus-containing acid, salt or ester may be ash-containing (i.e. metal containing) or ashless (i.e. metal free (prior to being mixed with other components)).

The phosphorus-containing acid, salt or ester includes (i) a non-ionic phosphorus compound; (ii) an amine salt of a phosphorus compound; (iii) an ammonium salt of a phosphorus compound; (iv) a monovalent metal salt of a phosphorus compound, such as a metal dialkyldithiophosphate or a metal dialkylphosphate; or (v) mixtures of (i), (ii), (iii) or (iv).

In one embodiment the phosphorus-containing acid, salt or ester includes a metal dialkyldithiophosphate. The alkyl groups of the dialkyldithiophosphate include linear or branched containing about 2 to about 20 carbon atoms, provided that the total number of carbons is sufficient to make the metal dialkyldithiophosphate soluble in the hydrocarbyl-capped group of the polyoxyalkylene polyol. The metal of the metal dialkyldithiophosphate typically includes monovalent or divalent metals. Examples of suitable metals include sodium, potassium, copper, calcium, magnesium, barium or zinc. In one embodiment the phosphorus-containing acid, salt or ester is a zinc dialkyldithiophosphate.

Examples of a zinc dialkyldithiophosphate derived from mixtures of alcohols include those derived from (i) a mixture of amyl alcohol and isobutyl alcohol, (ii) 2-ethylhexyl alcohol and isopropyl alcohol, and (iii) 4-methyl-2-pentanol and isopropyl alcohol.

In one embodiment the phosphorus-containing acid, salt or ester is other than metal dialkyldithiophosphate.
The amine salt of a phosphorus acid or ester includes phosphoric acid esters and amine salts thereof; di-alkylthiophosphoric acid esters and amine salts thereof; amine salts of phosphites; and amine salts of phosphorus-containing carboxylic esters, ethers, and amides; and mixtures thereof.

The amine salt of a phosphorus acid or ester may be used alone or in combination. In one embodiment the amine salt of a phosphorus compound is derived from an amine salt of a phosphorus compound, or mixtures thereof.

In one embodiment the amine salt of a phosphorus acid or ester includes a partial amine salt-partial metal salt or mixtures thereof. In one embodiment the amine salt of a phosphorus acid or ester further includes at least one sulphur atom in the molecule.

Suitable amines that are suitable for making the amine salt include primary amines, secondary amines, tertiary amines, and mixtures thereof. The amines include those with at least one hydrocarbyl group, or, in certain embodiments, two or three hydrocarbyl groups. The hydrocarbyl groups may contain 2 to 30 carbon atoms, or in other embodiments 8 to 26, or 10 to 20, or 13 to 19 carbon atoms.

Primary amines include ethylamine, propylamine, butylamine, 2-ethylhexylamine, octylamine, and docylamine, as well as such fatty amines as n-octylamine, n-decylamine, n-dodecylamine, n-tetradecylamine, n-hexadecylamine, n-octadecylamine and oleyamine. Other useful fatty amines include commercially available fatty amines such as "Armeen®" amines (products available from Akzo Chemicals, Chicago, Illinois), such as Armeen C, Armeen O, Armeen OL, Armeen T, Armeen HT, Armeen S and Armeen SD, wherein the letter designation relates to the fatty group, such as coco, oleyl, tallow, or stearyl groups.

Examples of suitable secondary amines include dimethylamine, diethylamine, dipropylamine, dibutylamine, diamyamine, dihexylamine, diheptylamine, methylethylamine, ethylethyamine, and ethylamylamine. The secondary amines include cyclic amines such as piperidine, piperazine and morpholine.

In one embodiment the amine includes a tertiary-aliphatic primary amine. The aliphatic group of the tertiary-aliphatic primary amine includes an alkyl group containing 2 to 30, or 2 to 24 carbon atoms. Tertiary alkyl amines include monoamines such as tert-butylamine, tert-hexylamine, 1-methyl-1-amino-cyclohexane, tert-octylamine, tert-decylamine, tertdodecylamine, tert-tetradecylamine, tert-hexadecylamine, tert-octadecylamine, tert-tetrasosanlyamine, and tert-octacosanlyamine.

In one embodiment the amine salt of a phosphorus acid or ester includes an amine with C11 to C14 tertiary alkyl primary groups or mixtures thereof. In one embodiment the amine salt of a phosphorus compound includes an amine with C14 to C18 tertiary alkyl primary amines or mixtures thereof. In one embodiment the amine salt of a phosphorus compound includes an amine with C18 to C22 tertiary alkyl primary amines or mixtures thereof.

Mixtures of amines may also be used in the invention. In one embodiment a useful mixture of amines includes "Primene® 81R" or "Primene® JMT." Primene® 81 R and Primene® JMT (both produced and sold by Rohm & Haas) are mixtures of about C11 to about C14 tertiary alkyl primary amines and about C18 to about C22 tertiary alkyl primary amines respectively.

In one embodiment the amine salt of a phosphorus acid or ester is the reaction product of a about C14 to about C18 alkyl phosphoric acid with Primene 81R® (produced and sold by Rohm & Haas) which is a mixture of about C11 to about C14 tertiary alkyl primary amines.

Examples of the amine salt of a phosphorus acid or ester include the reaction product(s) of isopropyl, methyl-amy1 (4-methyl-2-pentyl or mixtures thereof), 2-ethylhexyl, heptyl, octyl or nonyl diithiophosphoric acids with ethylene diamine, morpholine, or Primene 81R™, and mixtures thereof.

In one embodiment a diithiophosphoric acid may be reacted with an epoxide or a glycol. This reaction product is further reacted with a phosphorus acid, anhydride, or lower ester (where "lower" signifies about 1 to about 8, or about 1 to about 6, or about 1 to about 4, or 1 about 2 carbon atoms in the alcohol-derived portion of the ester). The epoxide includes an aliphatic epoxide or a styrene oxide. Examples of useful epoxides include ethylene oxide, propylene oxide, butene oxide, octene oxide, dodecene oxide, styrene oxide and the like. In one embodiment the epoxide is propylene oxide. Suitable examples of the glycols include aliphatic glycols having 1 to about 12, or 2 to 6, or 2 to 3 carbon atoms. The diithiophosphoric acids, glycols, epoxides, inorganic phosphorus reagents and methods of reacting the same are described in U.S. Patent numbers 3,197,405 and 3,544,465. The resulting acids may then be salted with amines. An example of suitable diithiophosphoric acid is prepared by adding phosphorus pentoxide (about 64 grams) at about 58 °C over a period of about 45 minutes to about 514 grams of hydroxypropyl O,O-di(4-methyl-2-pentyl)phosphorodithioate (prepared by reacting di(4-methyl-2-pentyl)-phosphorodithioic acid with 1.3 moles of propylene oxide at about 25 °C). The mixture is heated at about 75 °C for about 2.5 hours, mixed with a diatomaceous earth and filtered at about 70 °C. The filtrate contains about 11.8% by weight phosphorus, about 15.2% by weight sulphur, and an acid number of 87 (bromophenol blue).

In one embodiment the phosphorus-containing acid, salt or ester includes a non-ionic phosphorus compound. Typically the non-ionic phosphorus compound may have an oxidation of +3 or +5. The different embodiments include phosphite ester, phosphate esters, or mixtures thereof. A more detailed description of the non-ionic phosphorus compound include column 9, line 48 to column 11, line 8 of US 6,103,673.
In one embodiment the phosphorus-containing acid, salt or ester includes an amine salt of at least one partially esterified monothiophosphoric acid, or mixtures thereof.

In one embodiment the phosphorus-containing acid, salt or ester includes an amine salt of at least one partially esterified phosphoric acid.

A more detailed description of the amine salt of at least one partially esterified monothiophosphoric acid; and the amine salt of at least one partially esterified phosphoric acid is disclosed in EP 460 317.

The phosphorous-containing acid, salt or ester is present in the lubricating composition at a range of 0.1 wt % to 5 wt %, of the lubricating composition.

In one embodiment the extreme pressure agent includes a boron-containing compound, a sulphur-containing compound, or mixtures thereof.

In one embodiment the extreme pressure agent includes a boron-containing compound, or mixtures thereof.

In one embodiment the extreme pressure agent includes a sulphur-containing compound, or mixtures thereof.

In one embodiment the extreme pressure agent includes a sulphur-containing compound and a boron-containing compound.

In one embodiment the extreme pressure agent is present in the lubricating composition at a range selected from the group consisting of 0.01 wt % to 20 wt %, or 0.05 wt % to 10 wt %, and 0.1 wt % to 8 wt %, of the lubricating composition.

In one embodiment the extreme pressure agent includes a sulphur-containing compound. In one embodiment the sulphur-containing compound includes a sulphurised olefin, a polysulphide, or mixtures thereof.

Examples of the sulphurised olefin include an olefin derived from propylene, isobutylene, pentene, an organic sulphide and/or polysulphide including benzyl disulphide; bis-(chlorobenzyl) disulphide; dibutyl tetrasulphide; di-tertiary butyl polysulphide; and sulphurised methyl ester of oleic acid, a sulphurised alkylphenol, a sulphurised dipentene, a sulphurised terpene, a sulphurised Diels-Alder adduct, an alkyl sulphenyl N’N-dialkyl dithiocarbamates; or mixtures thereof.

In one embodiment the extreme pressure agent sulphur-containing compound including a dimercaptothiadiazole derivative, or mixtures thereof. Examples of the dimercaptothiadiazole derivative include 2,5-dimercapto-1,3,4-thiadiazole or a hydrocarbyl-substituted 2,5-dimercapto-1,3,4-thiadiazole, or oligomers thereof. The oligomers of hydrocarbyl-substituted 2,5-dimercapto-1,3,4-thiadiazole typically form by forming a sulphur-sulphur bond between 2,5-dimercapto-1,3,4-thiadiazole units to form oligomers of two or more of said thiadiazole units. Suitable 2,5-dimercapto-1,3,4-thiadiazole compounds include 2,5-bis(tert-nonyldithio)-1,3,4-thiadiazole or 2-tert-nonyldithio-5-mercapto-1,3,4-thiadiazole.

The number of carbon atoms on the hydrocarbyl substituents of the hydrocarbyl-substituted 2,5-dimercapto-1,3,4-thiadiazole typically include about 1 to about 30, or about 2 to about 20, or about 3 to about 16.

In one embodiment the extreme pressure agent includes a boron-containing compound. The boron-containing compound includes a borate ester, a borate alcohol, or mixtures thereof.

In one embodiment the boron-containing compound includes a borate ester or a borate alcohol. The borate ester or borate alcohol compounds are substantially the same except the borate alcohol has at least one hydroxyl group that is not esterified. Therefore, as used herein the term “borate ester” is used to refer to either borate ester or borate alcohol.

The borate ester may be prepared by the reaction of a boron compound and at least one compound selected from epoxy compounds, halohydrin compounds, epihalohydrin compounds, alcohols and mixtures thereof. The alcohols include dihydric alcohols, trihydric alcohols or higher alcohols, with the proviso for one embodiment that hydroxyl groups are on adjacent carbon atoms i.e. vicinal. Hereinafter "epoxy compounds" is used when referring to "at least one compound selected from epoxy compounds, halohydrin compounds, epihalohydrin compounds and mixtures thereof."

Boron compounds suitable for preparing the borate ester include the various forms selected from the group consisting of boric acid (including metaboric acid, HBO₂, orthoboric acid, H₃BO₃, and tetraboric acid, H₄B₄O₁₀), boric oxide, boron trioxide and alkyl borates. The borate ester may also be prepared from boron halides.

In one embodiment the borate ester is formed by the reaction of a borating agent with an epoxy compound,
dihydric alcohols, trihydric alcohols or higher alcohols.

The borating agent includes various forms of boric acid (including metaboric acid, HBO₂, orthoboric acid, H₂BO₃, and tetraboric acid, H₂B₄O₇), boric oxide, boron trioxide, and alkyl borates, such as those of the formula (RO)ₓB(OH)ᵧ, wherein x is 1 to 3 and y is 0 to 2, the sum of x and y being 3, and where R is a hydrocarbyl group containing about 1 or more carbon atoms, provided that the borating agent is soluble in the hydrocarbyl-capped group of the polyoxyalkylene polyol.

In one embodiment, the borating agent includes an alkali or mixed alkali metal and alkaline earth metal borate. These metal borates are generally hydrated particulate metal borates which are known in the art. In one embodiment the metal borates include mixed alkali and alkaline earth metal borates. These metal borates are available commercially.

In one embodiment x is equal to 2 or 3 for the formula (RO)ₓB(OH)ᵧ. When x is equal to 2 or 3, at least two of the R groups per the above formula are hydrocarbyl groups. The hydrocarbyl groups include alkyl, aryl or cycloalkyl when any two adjacent R groups are connected in a ring. When R is alkyl, the group include saturated or unsaturated. In one embodiment the hydrocarbyl group is an unsaturated alkyl. In one embodiment the hydrocarbyl group is cyclic.

In one embodiment the hydrocarbyl groups are mixtures of alkyl and cycloalkyl.

Generally there is no upper limit on the number of carbon atoms in the molecule, but a practical limit includes 500, or 400, or 200, or 100, or 60. For example, the number of carbon atoms present in each R group includes 1 to 60, or 1 to 40, or 1 to 30 carbon atoms, provided the total number of carbon atoms on the R groups typically ranges from in 9 or more, or 10 or more, or 12 or more, or 14 or more.

In one embodiment all R groups are hydrocarbyl groups containing 1 to 30 carbon atoms, provided the total number of carbon atoms is 9 or more.

Examples of R groups include isopropyl, n-butyl, isobutyl, amyl, 2-pentenyl, 4-methyl-2-pentyl, 2-ethylhexyl, heptyl, isoctyl, nonyl, decyl, undecyl, dodecenyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl and eicosyl groups.

In one embodiment the epoxy compounds useful for preparing the borate ester or borate alcohol includes those represented by the formulae:

\[ \text{R1} - \text{O} - \text{H} - \text{T} - \text{R2} \]

or

\[ \text{R1} - \text{O} - \text{T} - \text{R2} \]

wherein
- R₁ includes independently H or an alkyl chain containing 1 to about 4, or about 1 to about 2 carbon atoms;
- R₂ includes an alkyl chain containing 8 to 30, or 10 to 26, or 12 to 22 carbon atoms; and
- T includes independently hydrogen or a halogen.

In one embodiment T includes a halogen, such as, chlorine, bromine, iodine or fluorine or mixtures thereof; and the epoxy compounds are epihalohydrin compounds. In one embodiment T is chlorine. In one embodiment T is hydrogen.

In one embodiment the epoxy compounds of the invention include commercial mixtures of C₁₄-C₁₆ epoxides or C₁₄-C₁₈ epoxides. In one embodiment, the epoxy compounds of the invention are substantially of the same carbon number. Examples of suitable such epoxy compounds may include 1,2-epoxydecane, 1,2-epoxyundecane, 1,2-epoxydodecane, 1,2-epoxytriadecane, 1,2-epoxybutadecane, 1,2-epoxypentadecane 1,2-epoxyhexadecane, 1,2-epoxyhepta-
Conventional Oil of Lubricating Viscosity

In one embodiment the hydrocarbyl-capped polyoxyalkylene polyol disclosed herein, is mixed with a conventional oil of lubricating viscosity. In instance where a conventional oil of lubricating viscosity may be immiscible with the hydrocarbyl-capped polyoxyalkylene polyol disclosed herein, a person skilled in the art may further include ester base oils. The presence of ester base oils without being bound by theory is believed to aid in solubilising hydrocarbyl-capped polyoxyalkylene polyol disclosed herein, and a conventional oil of lubricating viscosity.

In one embodiment the lubricating compositions of the present invention are lubricated with the hydrocarbyl-capped polyoxyalkylene polyol as disclosed herein i.e. the lubricating composition is free of a conventional oil of lubricating viscosity, other than diluent oil conventionally associated with lubricant additives.

The conventional oil of lubricating viscosity is an oil other than the hydrocarbyl-capped polyoxyalkylene polyol as disclosed herein. The conventional oil of lubricating viscosity includes natural and synthetic oils, oil derived from hydrotreating, hydrogenation, and hydrofinishing, unrefined, refined and re-refined oils or mixtures thereof.

Unrefined oils are those obtained directly from a natural or synthetic source generally without (or with little) further purification treatment.

Refined oils are similar to the unrefined oils except they have been further treated in one or more purification steps to improve one or more properties. Purification techniques are known in the art and include solvent extraction, secondary distillation, acid or base extraction, filtration, percolation and the like.

Re-refined oils are also known as reclaimed or reprocessed oils, and are obtained by processes similar to those used to obtain refined oils and often are additionally processed by techniques directed to removal of spent additives and oil breakdown products.

Natural oils useful in making the conventional oil of lubricating viscosity include animal oils, vegetable oils (e.g., castor oil, lard oil), mineral lubricating oils such as liquid petroleum oils and solvent-treated or acid-treated mineral lubricating oils of the paraffinic, naphthenic or mixed paraffinic-naphthenic types and oils derived from coal or shale or mixtures thereof.

Synthetic conventional oils of lubricating viscosity are useful and include hydrocarbon oils such as polymerised and interpolymerised olefins (e.g., polybutylenses, polypropylenes, propyleneisobutylene copolymers); poly(1-hexenes), poly(1-octenes), poly(1-decenes), and mixtures thereof; alkylbenzenes (e.g. dodecylbenzenes, tetradecylbenzenes, dinonylbenzenes, di-(2-ethylhexyl)-benzenes); polyphenyls (e.g., biphenyls, terphenyls, alkylated polyphenyls; alkylated diphenyl ethers and alkylated diphenyl sulphones and the derivatives, analogs and homologs thereof or mixtures thereof.

Another synthetic conventional oil of lubricating viscosity include polyol esters other than the hydrocarbyl-capped polyoxyalkylene polyol as disclosed herein, diesters, liquid esters of phosphorus-containing acids (e.g., tricresyl phosphate, trioctyl phosphate, and the diethyl ester of decane phosphonic acid), or polymeric tetrahydrofurans. Synthetic conventional oil of lubricating viscosity also include those produced by Fischer-Tropsch reactions and typically may be hydroisomerised Fischer-Tropsch hydrocarbons or waxes. In one embodiment conventional oil of lubricating viscosity may be prepared by a Fischer-Tropsch gas-to-liquid synthetic procedure as well as other gas-to-liquid oils.

Conventional oils of lubricating viscosity may also be defined as specified in the American Petroleum Institute (API) Base Oil Interchangeability Guidelines. The five base oil groups are as follows: Group I (sulphur content >0.03 wt %, and/or <90 wt % saturates, viscosity index 80-120); Group II (sulphur content ≤0.03 wt %, and ≥90 wt % saturates, viscosity index 80-120); Group III (sulphur content ≤0.03 wt %, and ≥90 wt % saturates, viscosity index ≥120); Group IV (all polyalphaolefins (PAOs)); and Group V (all others not included in Groups I, II, III, or IV). The oil of lubricating
viscosity comprises an API Group I, Group II, Group III, Group IV, Group V oil or mixtures thereof. Often the oil of lubricating viscosity is an API Group I, Group II, Group III, Group IV oil or mixtures thereof. Alternatively the oil of lubricating viscosity is often an API Group II, Group III or Group IV oil or mixtures thereof.

**Other Performance Additive**

[0107] The lubricating composition of the invention optionally further includes at least one other performance additive. The other performance additives include metal deactivators, detergents, dispersants, viscosity index improvers, antioxidants, corrosion inhibitors, foam inhibitors, demulsifiers, pour point depressants, seal swelling agents, or mixtures thereof.

[0108] In one embodiment the total combined amount of the other performance additive compounds present on an oil free basis is present in the lubricating composition at a range selected from the group consisting of 0 wt % to 25 wt %, or 0.01 wt % to 20 wt %, or 0.1 wt % to 15 wt % or 0.5 wt % to 10 wt %, and 1 to 5 wt %, of the lubricating composition. Although one or more of the other performance additives may be present, it is common for the other performance additives to be present in different amounts relative to each other.

[0109] Antioxidants include molybdenum compounds such as molybdenum dithiocarbamates, sulphurised olefins, hindered phenols, amine compounds (such as alkylated diphenylamines, (typically di-nonyl diphenylamine, octyl diphenylamine, di-octyl diphenylamine)); detergents include neutral or overbased detergents, Newtonian or non-Newtonian, basic salts of alkali, alkaline earth or transition metals with one or more of a phenate, a sulphurised phenate, a sulphonate, a carboxylic acid, a phosphorus acid, a mono- and/or a di-thiophosphoric acid, a saligenin, an alkylsalicylate, and a salicylate; and dispersants include N-substituted long chain alkenyl succinimides, as well as Mannich condensation products as well as post-treated versions thereof. Post-treated dispersants include those by reaction with urea, thiourea, dimercaptothiadiazoles, carbon disulphide, aldehydes, ketones, carboxylic acids, hydrocarbon-substituted succinic anhydrides, nitriles, epoxides, and phosphorus compounds.

[0110] Antifouling agents including organic sulphides and polysulphides, such as benzyl disulphide, bis-(chlorobenzyl) disulphide, dibutyl tetrasulphide, di-tertiary butyl polysulphide, di-tert-butylsulphide, sulphurised Diels-Alder adducts or alkyl sulphenyl N,N-dialkyl dithiocarbamates; and extreme pressure (EP) agents including chlorinated wax, metal thio-carbamates, such as zinc diocylthiocarbamate and barium heptylphenol diacid may also be used in the composition of the invention.

[0111] Additionally the invention may also include friction modifiers other than component including fatty amines, esters such as borated glycerol esters, fatty glycerol partial esters (for example glycerol mono-oleate, or glycerol di-oleate), fatty phosphates, fatty acid amides, fatty epoxides, borated fatty epoxides, alkoxylated fatty amines, borated alkoxylated fatty amines, metal salts of fatty acids, or fatty imidazolines, condensation products of carboxylic acids and polyalkylene-polyamines.

[0112] Viscosity modifiers include polymethacrylate acid esters, polycrylate acid esters, and esters of maleic anhydride-styrene copolymers. In one embodiment the polymer of the invention is mixed with a viscosity modifier. The viscosity modifier polymer architecture includes linear or star structures.

[0113] Other performance additives such as corrosion inhibitors including octylamine octanoate, condensation products of dodecyl succinic acid or anhydride and a fatty acid such as oleic acid with a polyamine; metal deactivators including derivatives of benzotriazoles (typically tolytriazole), 1,2,4-triazoles, benzimidazoles, 2-alkyldithiobenzimidazoles or 2-alkyldithiobenzothiazoles; foam inhibitors including copolymers of ethyl acrylate and 2-ethylhexyl acrylate and optionally vinyl acetate; demulsifiers including trialkyl phosphates, polyethylene glycols, polyethylene oxides, polypropylene oxides and (ethylene oxide-propylene oxide) polymers; pour point depressants including esters of maleic anhydride-styrene, polymethacrylates, polycrylates or polyyacrylamides; and seal swell agents including Exxon Necton-37™ (FN 1380) and Exxon Mineral Seal Oil (FN 3200); and dispersant viscosity modifiers (often referred to as DVM) include functionalised polyolefins, for example, ethylene-propylene copolymers that have been functionalized with the reaction product of maleic anhydride and an amine, a polymethacrylate functionalised with an amine, or esters of styrenemaleic anhydride copolymers reacted with an amine; may also be used in the composition of the invention.

**Industrial Application**

[0114] The method of the invention is useful for lubricating a variety of mechanical devices. The mechanical device comprises at least one of an internal combustion engine (for crankcase lubrication), a hydraulic system, an axle, a gear, a gearbox or a transmission.

[0115] The transmission may include manual transmissions, continuously variable transmissions (CVT), infinitely variable transmissions (IVT), Toroidal transmissions, continuously slipping torque converted clutches (CSTCC), automatic transmissions, stepped automatic transmissions, traction drive transmissions or dual clutch transmissions (DVT). In one embodiment the transmission is a manual transmission.

[0116] In one embodiment the hydrocarbyl-capped polyoxyalkylene polyl and lubricating composition thereof is ca-
pable of providing the mechanical device with an oil of lubricating viscosity capable of imparting at least one of an acceptable coefficient of friction, viscosity index (VI), oil blend thickening capabilities, shear stability, good low temperature viscosity performance, reduced operating temperatures, acceptable wear performance, acceptable durability, or acceptable fuel economy.

[0117] The following examples provide illustrations of the invention. These examples are non exhaustive and are not intended to limit the scope of the invention.

EXAMPLES

[0118] As quoted herein, the amount of additives added to the examples below includes conventional amounts of diluent (may be 0 wt % to about 60 wt % depending on additive).

[0119] Reference 1: is a gear oil containing 10 wt % of a commercially available additive package and about 90 wt % of a commercially available butanol-initiated polyalkylene glycol derived from propylene glycol. The gear oil further contains about 5 wt % of a viscosity index improver (esters of maleic anhydride-styrene copolymers), about 4.6 wt % of a sulphurised olefin, about 1.9 wt % of phosphorus antiwear agents, about 3.25 wt % of antioxidants (includes phenolic and aminic compounds).

[0120] Example 1: a gear oil containing 10 wt % of a commercially available additive package and about 90 wt % of a C12-15-alkyl alcohol-initiated polyalkylene glycol derived from propylene glycol (commercially available from Bayer with the trade name Actaclear™ND-21). The gear oil further contains about 5 wt % of a viscosity index improver (esters of maleic anhydride-styrene copolymers), about 4.6 wt % of a sulphurised olefin, about 1.9 wt % of phosphorus antiwear agents, about 3.25 wt % of antioxidants (includes phenolic and aminic compounds).

Test 1: Axle Efficiency

[0121] The axle efficiency of Reference example 1 and Example 1 is determined by employing the methodology disclosed in SAE Paper No. 2003-01-3235 (entitled: “Developing Next Generation Axle Fluids: Part III - Laboratory CAFE Simulation Test as Key Fluid Development Tool”, authors: Akucewich, E. S.; O’Connor, B. M.; Vinci, J. N.; Schenkenberger, C.). The test method simulates the Federal Test Procedure 75 (FTP-75). The method simulates FTP-75 by performing a series of steady-state speed and load conditions in a laboratory full-scale axle stand. The test method employs a single axle for multiple lubricant evaluations. In order to minimize drift in efficiency performance associated with a new axle, a break-in procedure is conducted on the axle before the testing commences. Following the break-in procedure, the examples are evaluated twice. The results obtained are:

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<tr>
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<th>Run 1</th>
<th>Run 2</th>
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<tr>
<td>Example 1</td>
<td>95.14</td>
<td>95.17</td>
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<tr>
<td>Reference Example 1</td>
<td>94.18</td>
<td>94.13</td>
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[0122] The results from the axle efficiency test indicate that the present invention containing a hydrocarbyl-capped group of the polyoxyalkylene polyol initiated with a linear or branched monohydric alcohol containing about 6 or more carbon atoms has improved axle efficiency over a similar lubricating composition employing a polyoxyalkylene polyol initiated with butanol.

Test 2: Coefficient of Friction

[0123] The example compositions disclosed above are evaluated for coefficient of friction using a Mini Traction Machine (MTM) available from PCS Instruments. The test configuration is that of a 19.05 mm (¾ inch) diameter bearing steel ball making a contact on a highly polished surface on a 46 mm diameter bearing steel disk. Ball makes contact with the disc such that spin in the contact is eliminated. Rolling velocity, slide/roll ratio, temperature and load, were the parameters that could be varied during each test. The specimen speeds are independently controlled using servo-motors to produce desired slide/roll motion at the contact. The specimens are contained in a sealed temperature controlled reservoir that contains an approximately 35 ml fluid sample. The test temperature is controlled through the use of electric heaters. The contact is automatically loaded to the desired Hertz pressure. The series of tests that were run for this particular study were carried out at a Hertz pressure of 1.25 GPa, temperature range of 40°C to 120 °C, rolling velocity of 2.5 m/s and continuously variable slide to roll ratios from 0% to 30%. The results obtained are:
Overall the data obtained demonstrates that the hydrocarbyl-capped polyoxyalkylene polyol and lubricating compositions thereof, is capable of providing the mechanical device with an oil of lubricating viscosity capable of imparting at least one of an acceptable co-efficient of friction, viscosity index (VI), oil blend thickening capabilities, shear stability, good low temperature viscosity performance, reduced operating temperatures, acceptable wear performance, acceptable durability, or acceptable fuel economy.

It is known that some of the materials described above may interact in the final formulation, so that the components of the final formulation may be different from those that are initially added. The products formed thereby, including the products formed upon employing lubricant composition of the present invention in its intended use, may not be susceptible of easy description. Nevertheless, all such modifications and reaction products are included within the scope of the present invention; the present invention encompasses lubricant composition prepared by admixing the components described above.

Claims

1. A method of lubricating a driveline device with a lubricating composition comprising:
   (a) a hydrocarbyl-capped polyoxyalkylene polyol, wherein (i) the hydrocarbyl-capped group of the polyoxyalkylene polyol comprises a residue of a mixture of linear monohydric alcohols selected from the group consisting of dodecanol, tridecanol, tetradecanol and pentadecanol, (ii) the hydrocarbyl-capped polyoxyalkylene polyol comprises 0 wt % to 80 wt % of ethylene oxide and an alkylene oxide containing 3 to 8 carbon atoms present at 20 wt % to 100 wt % of the hydrocarbyl-capped polyoxyalkylene polyol, and (iii) the hydrocarbyl-capped polyoxyalkylene polyol is present in the lubricating composition at 50 wt % to 95 wt % of the lubricating composition; and
   (b) a phosphorus-containing acid, salt or ester, or mixtures thereof wherein the phosphorus-containing acid, salt or ester, or mixtures thereof is present in the lubricating composition at 0.1 wt % to 5 wt % of the lubricating composition.

2. The method of claim 1, wherein the hydrocarbyl-capped polyoxyalkylene polyol is a mono-capped hydrocarbyl-capped polyoxyalkylene polyol, a di-capped hydrocarbyl-capped polyoxyalkylene polyol, or mixtures thereof.

3. The method of claim 1, wherein the hydrocarbyl-capped polyoxyalkylene polyol is derived from a homopolymer of an alkylene oxide.

4. The method of claim 1, wherein the hydrocarbyl-capped polyoxyalkylene polyol is derived from a copolymer of two or more alkylene oxides.

5. The method of claim 1 wherein the hydrocarbyl-capped polyoxyalkylene polyol is present in the lubricating composition at 65 wt % to 95 wt % of the lubricating composition.

6. The method of claim 1 wherein the the hydrocarbyl-capped poly oxyalkylene polyol comprises 1 wt % to 70 wt % of ethylene oxide and an alkylene oxide containing 3 to 8 carbon atoms present at 30 wt % to 99 wt % of the hydrocarbyl-capped polyoxyalkylene polyol.

7. The method of claim 1 wherein the hydrocarbyl-capped polyoxyalkylene polyol comprises 5 wt % to 60 wt % of ethylene oxide and an alkylene oxide containing 3 to 8 carbon atoms present at 40 wt % to 95 wt % of the hydrocarbyl-capped polyoxyalkylene polyol.

8. The method of claim 1 wherein the lubricating composition further comprises a non-phosphorus extreme pressure
agent, or mixtures thereof.

9. The method of claim 8, wherein the non-phosphorus extreme pressure agent is selected from the group consisting of a boron-containing compound, a sulphur-containing compound, and mixtures thereof.

10. The method of claim 8, wherein the non-phosphorus extreme pressure agent is present at 0.01 wt % to 20 wt %, or 0.05 wt % to 10 wt %, or 0.1 wt % to 8 wt % of the lubricating composition.

11. The method of claim 1, wherein the driveline device is selected from at least of the group consisting of an axle, a gear, a gearbox and a transmission.

12. The method of claim 11, wherein the transmission is selected from at least of the group consisting of manual transmissions, continuously variable transmissions, infinitely variable transmissions, toroidal transmissions, continuously slipping torque converted clutches, automatic transmissions, stepped automatic transmissions, traction drive transmissions and dual clutch transmissions.

13. Use of a lubricating composition comprising:

(a) a hydrocarbyl-capped polyoxyalkylene polyol, wherein

(i) the hydrocarbyl-capped group of the polyoxyalkylene polyol comprises a residue of a mixture of linear monohydric alcohols selected from the group consisting of dodecanol, tridecanol, tetradecanol and pentadecanol,

(ii) the hydrocarbyl-capped polyoxyalkylene polyol comprises 0 wt % to 80 wt % of ethylene oxide and an alkylen oxide containing 3 to 8 carbon atoms present at 20 wt % to 100 wt % of the hydrocarbyl-capped polyoxyalkylene polyol, and

(iii) the hydrocarbyl-capped polyoxyalkylene polyol is present in the lubricating composition at 50 wt % to 95 wt % of the lubricating composition; and

(b) a phosphorus-containing acid, salt or ester, or mixtures thereof wherein the phosphorus-containing acid, salt or ester, or mixtures thereof is present in the lubricating composition at 0.1 wt % to 5 wt % of the lubricating composition,

to impart fuel economy to a driveline device wherein said use involves the method of any one of claims 1 to 12.

Patentansprüche

1. Verfahren zum Schmieren einer Antriebsstrangvorrichtung mit einer Schmier zusammensetzung, die folgendes aufweist:

(a) ein mit Hydrocarbyl abgeschlossenes Polyoxyalkyl enpolyol, wobei (i) die mit Hydrocarbyl abgeschlossene Gruppe des Poly oxyalkyl enpolyols einen Rest einer Mischung von linear monohydri schen Alkoholen aufweist, die aus der Gruppe ausgewählt sind, die aus Dodecanol, Tridecanol, Tetradecanol und Pentadecanol besteht, (ii) das mit Hydrocarbyl abgeschlossene Poly oxyalkyl enpolyol 0 Gew.-% bis 80 Gew.-% Ethylenoxid und ein Alkylenoxid aufweist, das 3 bis 8 Kohlenstoff atome enthält, das mit 20 Gew.-% bis 100 Gew.-% der mit Hydrocarbyl abgeschlossenen Poly oxyalkyl enpolyol vorhanden ist, und (iii) das mit Hydrocarbyl abgeschlossene Poly oxyalkyl enpolyol in der Schmier zusammensetzung mit 50 Gew.-% bis 95 Gew.-% der Schmier zusammensetzung vorhanden ist; und

(b) eine phosphorhaltige Säure, ein phosphorhaltiges Salz oder ein phosphorhaltiger Ester oder Mischungen davon, wobei die phosphorhaltige Säure, das Salz oder der Ester oder Mischungen davon in der Schmier zusammensetzung mit 0,1 Gew.-% bis 5 Gew.-% der Schmier zusammensetzung vorhanden sind.

2. Verfahren nach Anspruch 1, wobei das mit Hydrocarbyl abgeschlossene Poly oxyalkyl enpolyol aus einem einfach abgeschlossenen, mit Hydrocarbyl abgeschlossenen Poly oxyalkyl enpolyol, einem zweifach abgeschlossenen, mit Hydrocarbyl abgeschlossenen Poly oxyalkyl enpolyol oder Mischungen davon besteht.

3. Verfahren nach Anspruch 1, wobei das mit Hydrocarbyl abgeschlossene Poly oxyalkyl enpolyol von einem Homop-
4. Verfahren nach Anspruch 1, wobei das mit Hydrocarbyl abgeschlossene Polyoxyalkylenpolyol von einem Copolymer von zwei oder mehreren Alkylenoxiden abgeleitet ist.

5. Verfahren nach Anspruch 1, wobei das mit Hydrocarbyl abgeschlossene Polyoxyalkylenpolyol in der Schmierzusammensetzung mit 65 Gew.-% bis 95 Gew.-% der Schmierzusammensetzung vorhanden ist.


7. Verfahren nach Anspruch 1, wobei das mit Hydrocarbyl abgeschlossene Polyoxyalkylenpolyol 5 Gew.-% bis 60 Gew.-% Ethylenoxid und ein Alkylenoxid aufweist, das 3 bis 8 Kohlenstoffatome enthält, das mit 40 Gew.-% bis 95 Gew.-% des mit Hydrocarbyl abgeschlossenen Polyoxyalkylenpolyols vorhanden ist.

8. Verfahren nach Anspruch 1, wobei die Schmierzusammensetzung ferner phosphorfreies Hochdruckmittel oder Mischungen davon aufweist.


10. Verfahren nach Anspruch 8, wobei das phosphorfreie Hochdruckmittel mit 0,01 Gew.-% bis 20 Gew.-% oder 0,05 Gew.-% bis 10 Gew.-% oder 0,1 Gew.-% bis 8 Gew.-% der Schmierzusammensetzung vorhanden ist.

11. Verfahren nach Anspruch 1, wobei die Antriebsstrangvorrichtung mindestens aus der Gruppe ausgewählt ist, die aus einer Achse, einem Zahnrad, einem Getriebekasten und einem Getriebe besteht.


13. Verwendung einer Schmierzusammensetzung, die folgendes aufweist:

(a) ein mit Hydrocarbyl abgeschlossenes Polyoxyalkylenpolyol, wobei

(i) die mit Hydrocarbyl abgeschlossene Gruppe des Polyoxyalkylenpolyols einen Rest einer Mischung von linearen monohydrischen Alkoholen aufweist, die aus der Gruppe ausgewählt sind, die aus Dodecanol, Tridecanol, Tetradecanol und Pentadecanol besteht,

(ii) das mit Hydrocarbyl abgeschlossene Polyoxyalkylenpolyol 0 Gew.-% bis 80 Gew.-% Ethylenoxid und ein Alkylenoxid aufweist, das 3 bis 8 Kohlenstoffatome enthält, das mit 20 Gew.-% bis 100 Gew.-% des mit Hydrocarbyl abgeschlossenen Polyoxyalkylenpolyols vorhanden ist, und

(iii) das mit Hydrocarbyl abgeschlossene Polyoxyalkylenpolyol in der Schmierzusammensetzung mit 50 Gew.-% bis 95 Gew.-% der Schmierzusammensetzung vorhanden ist; und

(b) eine phosphorhaltige Säure, ein phosphorhaltiges Salz oder ein phosphorhaltiger Ester oder Mischungen davon, wobei die phosphorhaltige Säure, das Salz oder der Ester oder Mischungen davon in der Schmierzusammensetzung mit 0,1 Gew.-% bis 5 Gew.-% der Schmierzusammensetzung vorhanden sind, um einer Antriebsstrangvorrichtung eine Kraftstoffersparnis zu verleihen, wobei die Verwendung das Verfahren nach einem der Ansprüche 1 bis 12 umfaßt.

Revendications

1. Méthode pour lubrifier une chaîne de transmission avec une composition de lubrification comprenant :

(a) un polyoxyalkylèneopol, coiffé par un hydrocarbyle, où (i) le groupement coiffé par un hydrocarbyle du
polyoxyalkylèneopolyol comprend un résidu d’un mélange d’alcools monohydriques linéaires choisis dans le groupe constitué par le dodécanol, le tridécanol, le tétradécanol et le pentadécanol, (ii) le polyoxyalkylèneopolyol coiffé par un hydrocarbure comprend de 0 % en poids à 80 % en poids d’oxyde d’éthylène et un oxyde d’alkylène contenant de 3 à 8 atomes de carbone présent à 20 % en poids à 100 % en poids du polyoxyalkylèneopolyol coiffé par un hydrocarbure, et (iii) le polyoxyalkylèneopolyol coiffé par un hydrocarbure est présent dans la composition de lubrification à 50 % en poids à 95 % en poids de la composition de lubrification ; et (b) un acide, sel ou ester contenant du phosphore, ou des mélanges de ceux-ci, l’acide, le sel ou l’ester contenant du phosphore ou des mélanges de ceux-ci étant présents dans la composition de lubrification à 0,1 % en poids à 5 % en poids de la composition de lubrification.

2. Méthode selon la revendication 1, caractérisée en ce que le polyoxyalkylèneopolyol coiffé par un hydrocarbure est un polyoxyalkylèneopolyol coiffé par un hydrocarbure, mono-coiffé, un polyoxyalkylèneopolyol coiffé par un hydrocarbure, dicoiffé, ou des mélanges de ceux-ci.

3. Méthode selon la revendication 1, caractérisée en ce que le polyoxyalkylèneopolyol coiffé par un hydrocarbure est issu d’un homopolymère d’un oxyde d’alkylène.

4. Méthode selon la revendication 1, caractérisée en ce que le polyoxyalkylèneopolyol coiffé par un hydrocarbure est issu d’un copolymère de deux oxydes d’alkylène ou plus.

5. Méthode selon la revendication 1, caractérisée en ce que le polyoxyalkylèneopolyol coiffé par un hydrocarbure est présent dans la composition de lubrification à 65 % en poids à 95 % en poids de la composition de lubrification.

6. Méthode selon la revendication 1, caractérisée en ce que le polyoxyalkylèneopolyol coiffé par un hydrocarbure comprend de 1 % en poids à 70 % en poids d’oxyde d’éthylène et un oxyde d’alkylène contenant de 3 à 8 atomes de carbone présent à 30 % en poids à 99 % en poids du polyoxyalkylèneopolyol coiffé par un hydrocarbure.

7. Méthode selon la revendication 1, caractérisée en ce que le polyoxyalkylèneopolyol coiffé par un hydrocarbure comprend de 5 % en poids à 60 % en poids d’oxyde d’éthylène et un oxyde d’alkylène contenant de 3 à 8 atomes de carbone présent à 40 % en poids à 95 % en poids du polyoxyalkylèneopolyol coiffé par un hydrocarbure.

8. Méthode selon la revendication 1, caractérisée en ce que la composition de lubrification comprend en outre un agent extrême-pression non phosphoré, ou des mélanges de celui-ci.

9. Méthode selon la revendication 8, caractérisée en ce que l’agent extrême-pression non phosphoré est choisi dans le groupe constitué par un composé contenant du bore, un composé contenant du soufre, et des mélanges de ceux-ci.

10. Méthode selon la revendication 8, caractérisée en ce que l’agent extrême-pression non phosphoré est présent à 0,01 % en poids à 20 % en poids, ou 0,05 % en poids à 10 % en poids, ou 0,1 % en poids à 8 % en poids de la composition de lubrification.

11. Méthode selon la revendication 1, caractérisée en ce que la chaîne de transmission est choisie parmi au moins le groupe constitué par un essieu, un engrenage, une boîte de vitesse et une transmission.

12. Méthode selon la revendication 11, caractérisée en ce que la transmission est choisie parmi au moins le groupe constitué par les transmissions manuelles, les transmissions à variation continue, les transmissions à variation infinie, les transmissions toroidales, les embrayages de convertisseurs de couple de glissement continu, les transmissions automatiques, les transmissions automatiques progressives, les transmissions de traction et les transmissions à double embrayage.

13. Utilisation d’une composition de lubrification comprenant :

   (a) un polyoxyalkylèneopolyol coiffé par un hydrocarbure, où

   (i) le groupement coiffé par un hydrocarbure du polyoxyalkylèneopolyol comprend un résidu d’un mélange d’alcools monohydriques linéaires choisis dans le groupe constitué par le dodécanol, le tridécanol, le tétradécanol et le pentadécanol,
   (ii) le polyoxyalkylèneopolyol coiffé par un hydrocarbure comprend de 0 % en poids à 80 % en poids d’oxyde
(d'ététhylène et un oxyde d'alkylène contenant de 3 à 8 atomes de carbone présent à 20 % en poids à 100 % en poids du polyoxyalkylènepolyol coiffé par un hydrocarbyle, et
(iii) le polyoxyalkylènepolyol coiffé par un hydrocarbyle est présent dans la composition de lubrification à 50 % en poids à 95 % en poids de la composition de lubrification ; et

(b) un acide, sel ou ester contenant du phosphore, ou des mélanges de ceux-ci, l'acide, le sel ou l'ester contenant du phosphore ou des mélanges de ceux-ci étant présents dans la composition de lubrification à 0,1 % en poids à 5 % en poids de la composition de lubrification,

pour donner une économie de carburant à une chaîne de transmission, ladite utilisation impliquant la méthode selon l'une quelconque des revendications 1 à 12.
REFERENCES CITED IN THE DESCRIPTION

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