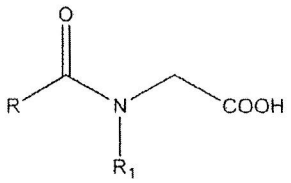
[0009] WO 2009/140108 discloses the use of variety of different rust inhibiting compounds for certain types of multifunctional oils. In the specification there is a brief mention of the possibility of using a compound of the formula:



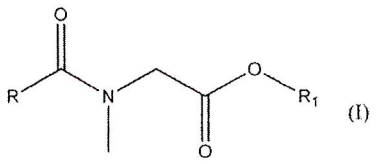
wherein R and R_1 are not defined. No further details are given as to the amounts that should be used, nor are any specific formulations including such compounds exemplified in the application.

[0010] GB 1235896 discloses multifunctional lubricants and includes an example of a wet brake formulation including oleoyl sarcosine. The exemplified composition also includes basic calcium sulphonate detergent (TBN=300), P_2S_5 - polybutene barium phenate/sulphonate detergent, a dispersant that is a reaction product of polybutenyl succinic anhydride with an Mw=900 PIB group and tetraethylene pentamine, zinc dihexyl dithiophosphate, dioleoyl phosphite, sperm oil, and sulphurised polybutene.

SUMMARY

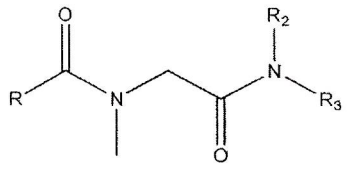
[0011] The present disclosure provides a lubricating oil composition comprising a major amount of base oil and a minor amount of an additive package, wherein the additive package comprises one or more friction modifier components selected from:

(A) one or more compounds of the formulae I and II:



(I)

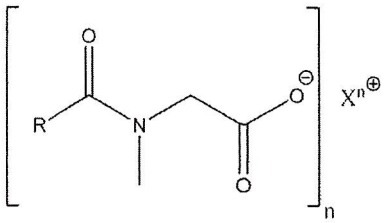
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms and R_1 is a hydrocarbyl group having from about 1 to about 8 carbon atoms or a C_1-C_8 hydrocarbyl group containing one or more heteroatoms:



(II)

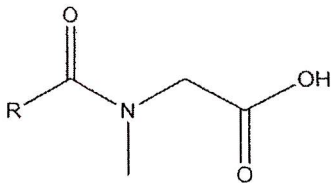
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms and R_2 and R_3 are independently selected from hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms;

(B) at least two compounds independently selected from the formulae III and IV:



(III)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms; and X is an alkali metal, alkaline earth metal, or ammonium cation and n is the valence of cation X;



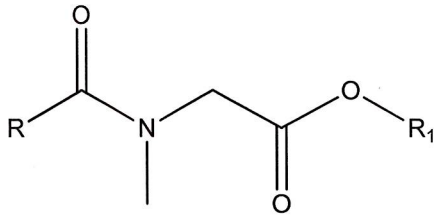
(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms; and

(C) at least one compound of the formulae III and IV in combination with at least one compound of the formulae I and II.

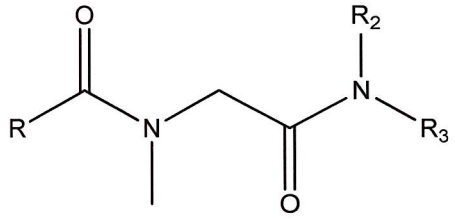
[0011a] In one aspect of the present disclosure, there is provided an engine oil composition comprising greater than 50 wt% of base oil selected from the group consisting of a Group II, Group III, Group IV and Group V base oil and mixtures thereof, wherein the Group II and Group III base oils have at least 90% saturates, and an additive package, wherein the additive package comprises one or more friction modifier components selected from the group consisting of:

(A) one or more compounds of the formulae I and II:



(I)

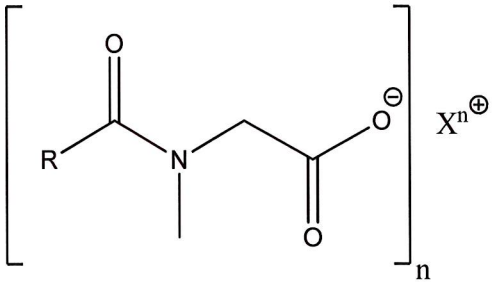
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms and R_1 is a hydrocarbyl having from 1 to 8 carbon atoms or a C_1-C_8 hydrocarbyl group containing one or more heteroatoms;



(II)

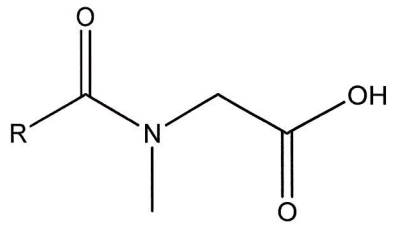
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms and R_2 and R_3 are independently selected from the group consisting of hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms;

(B) two or more compounds independently selected from the group consisting of compounds of the formulae III and IV:



(III)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms; and X is an alkali metal, alkaline earth metal, or ammonium cation and n is the valence of cation X;



(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms; and

(C) at least one compound of the formulae III and IV in combination with at least one compound of the formulae I and II;

wherein the engine oil composition is adapted for use as a crankcase engine oil lubricant suitable for lubricant of valve systems and top and bottom dead centers of pistons/cylinder linear contact zones, the engine oil composition has a phosphorus content of 50-1000 ppm and the engine oil composition comprises 0.1-2.0 wt. % of the one or more friction modifier components (A)-(C), based on the total weight of the engine oil composition.

[0012] The one or more friction modifiers of the formula I may be esters.

[0013] The one or more friction modifiers of the formula II may be amides.

[0014] The friction modifier may comprise at least one salt of the formula III.

[0015] The additive package may comprise at least two different friction modifiers independently selected from the formulae I-IV.

[0016] R may have from about 10 to about 20 carbon atoms. R may alternatively have from about 12 to about 18 carbon atoms.

[0017] R_1 may be a hydrocarbyl group having from about 1 to about 8 carbon atoms. Alternatively R_1 may be a hydrocarbyl group containing a C_1-C_8 hydrocarbyl group containing one or more heteroatoms.

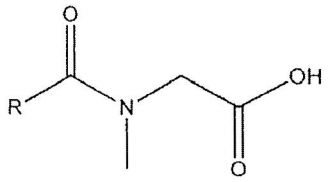
[0018] R_2 and R_3 may be independently selected from hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms. Alternatively, R_2 and R_3 are independently selected from hydrogen and C_4-C_8 hydrocarbyl groups.

[0019] The one or more friction modifiers of the formula III may be salts of one or more cations selected from sodium, lithium, potassium, calcium, magnesium, and ammonium cations.

[0020] The foregoing lubricating oil composition may comprise an engine oil.

[0021] The present disclosure also provides a lubricating oil composition comprising a major amount of a base oil and a minor amount of an additive package, wherein the additive package comprises one or more reaction products of:

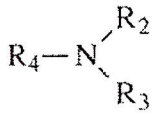
one or more compounds of the Formula IV:



(IV)

wherein R is a linear or branched, saturated, unsaturated. or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms, and the hydroxyl moiety on the acid group may be replaced by a suitable leaving group, if desired, prior to the reaction and

one or more amines of the Formula V:

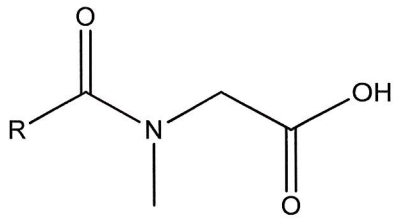


(V)

wherein R_2, R_3, and R_4 are independently selected from hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms.

[0021a] In another aspect of the present disclosure, there is provided an engine oil composition comprising greater than 50 wt% of base oil selected from the group consisting of Group II, Group III, Group IV and Group V base oil and mixtures thereof, wherein the Group II and Group III base oils have at least 90% saturates, and an additive package, wherein the additive package comprises one or more amide reaction products of:

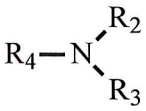
one or more compounds of the formula IV:



(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms, and

one or more amines of the formula V:



(V)

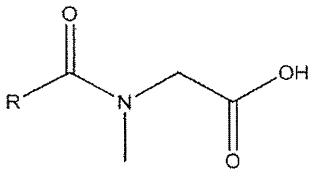
wherein R_2, R_3, and R_4 are independently selected from the group consisting of hydrogen, C_1-C_{18} hydrocarbyl groups, and hydrocarbons containing C_1-C_{18} hydrocarbyl groups and one or more heteroatoms,

wherein the engine oil composition is adapted for use as a crankcase engine oil lubricant suitable for lubrication of valve systems and top and bottom dead centers of pistons/cylinder linear contact zones, the engine oil composition has a phosphorus content of 50-1000ppm, and the engine oil composition comprises 0.1-2.0 wt. % of the amide reaction products, based on the total weight of the engine oil composition.

[0022] R may have from about 10 to about 20 carbon atoms, R_2, R_3, and R_4 may be independently selected from hydrogen, C_3-C_{12} hydrocarbyl groups, and hydrocarbons containing C_3-C_{12} hydrocarbyl groups and one or more heteroatoms.

[0023] The foregoing lubricating oil composition may comprise an engine oil.

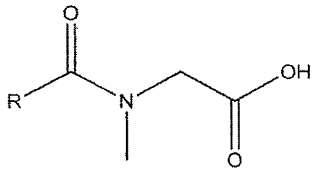
[0024] The present disclosure also provides a lubricating oil composition comprising a major amount of a base oil and a minor amount of an additive package, wherein the additive package comprises one or more a reaction products of one or more alcohols with one or more compounds of the Formula IV:



(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms. The hydroxyl moiety may be replaced by a suitable leaving group, if desired, prior to reaction with the alcohol. The alcohol may be represented by R_1-OH, where R_1 comprises a hydrocarbyl group or a C_1-C_8 hydrocarbyl group containing one or more heteroatoms.

[0024a] In yet another aspect of the present disclosure, there is provided an engine oil composition comprising greater than 50 wt% of base oil selected from a Group II, Group III, Group IV and Group V base oil and mixtures thereof, wherein the Group II and Group III base oils have at least 90% saturates, and an additive package, wherein the additive package comprises one or more ester reaction products of one or more alcohols with one or more compounds of the Formula IV



(IV)

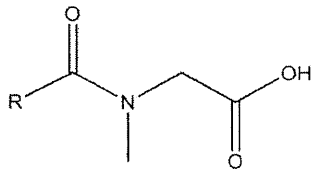
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms,

wherein the engine oil composition is adapted for use as a crankcase engine oil lubricant suitable for lubrication of valve systems and top and bottom dead centers of pistons/cylinder linear contact zones, the engine oil composition has a phosphorus content of 50-1000ppm, and the engine oil composition comprises 0.1-2.0 wt. % of the one or more alcohols with one or more compounds of the formula IV, based on the total weight of the engine oil composition.

[0024b] In a further aspect of the present disclosure, there is provided an engine oil composition comprising greater than 50 wt% base oil selected from a Group II, Group III, Group IV and Group V base oil and mixtures thereof, wherein the Group II and Group III base oils have at least 90% saturates, and

an additive package, wherein the additive package comprises one or more amide or ester reaction products of:

one or more compounds of the formula IV:



(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group about 8 to 22 carbon atoms, and

one or more amine alcohol(s);

wherein the engine oil composition is adapted for use as a crankcase engine oil lubricant suitable for lubrication of valve systems and top and bottom dead centers of pistons/cylinder linear contact zones, the engine oil composition has a phosphorus content of 50-1000 ppm, and the engine oil composition comprises 0.1-2.0 wt. % of the one or more amide or ester reaction products, based on the total weight of the engine oil composition.

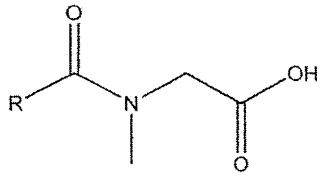
[0025] R may be a hydrocarbyl group having from about 10 to about 20 carbon atoms.

[0026] The alcohol may contain a hydrocarbyl group having from about 1 to about 8 carbon atoms. Alternatively, the alcohol contains a hydrocarbyl group having from about 1 to about 8 carbon atoms and one or more heteroatoms.

[0027] The foregoing lubricating oil composition may comprise an engine oil.

[0028] The present disclosure also provides an engine oil composition comprising a major amount of a base oil and a minor amount of an additive package, wherein the additive package comprises one or more salts that are reaction products of:

one or more compounds of the formula IV:



(IV)

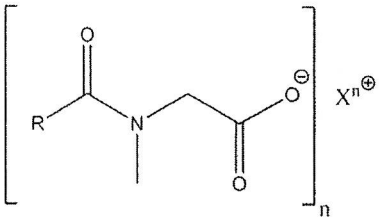
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms; and an alkali or alkaline earth

metal hydroxide, an alkali or alkaline earth metal oxide, ammonia, an amine or mixtures thereof.

[0029] The present disclosure also provides a lubricating oil comprising a major amount of a base oil and a minor amount of an additive package, wherein the additive package comprises one or more reaction products of:

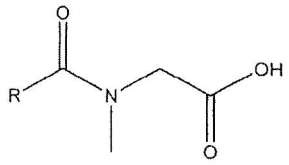
one or more compounds of the formula IV:

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms and R_2 and R_3 are independently selected from hydrogen, C_1-C_{18} hydrocarbyl groups and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms;



(III)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms; and X is an alkali metal, alkaline earth metal or ammonium cation and n is the valence of cation X: and

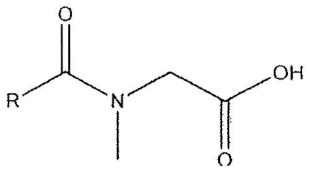


(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms.

[0032] The present disclosure also provides a lubricating oil composition comprising a major amount of a base oil and a minor amount of an additive package, wherein the additive package comprises:

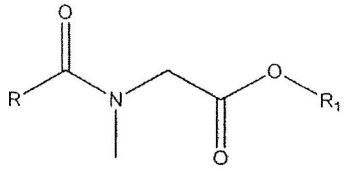
(A) one or more compounds of the formula IV:



(IV)

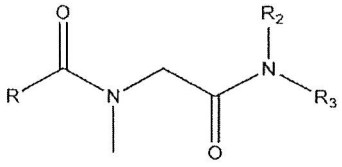
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms; and

(B) at least one compound of the formulae I-IV different from the one or more compounds of component (A):



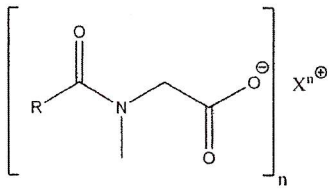
(I)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms and R_1 is a hydrocarbyl having from about 1 to about 8 carbon atoms or a C_1-C_8 hydrocarbyl group containing one or more heteroatoms:



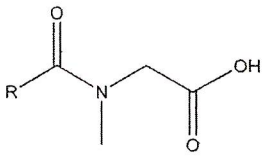
(II)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms and R_2 and R_3 are independently selected from hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms:



(III)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms; and X is an alkali metal, alkaline earth metal or ammonium cation and n is the valence of cation X: and

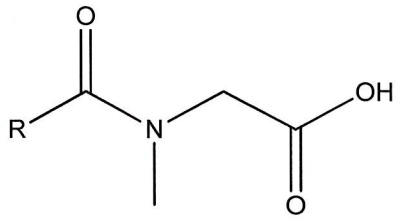


(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having about 8 to about 22 carbon atoms.

[0032a] In another aspect of the present disclosure, there is provided an engine oil composition comprising greater than 50 wt% of base oil selected from a Group II, Group III, Group IV and Group V base oil and mixtures thereof, wherein the Group II and Group III base oils have at least 90% saturates, and an additive package, wherein the additive package comprises

(A) a salt reaction product of one or more compounds of the formula IV:

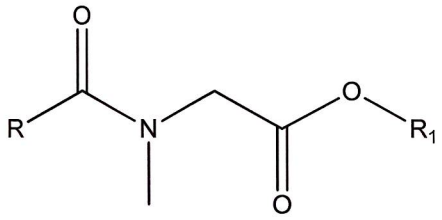


(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms, and

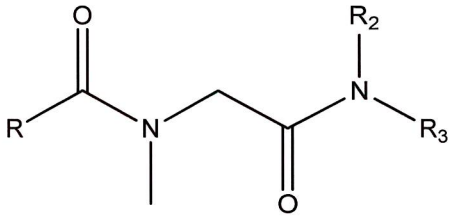
one or more of an alkali metal hydroxide, and alkaline earth metal hydroxide, an alkali metal oxide, an alkaline earth metal hydroxide, ammonia, or an amine; and

(B) at least one compound of the formulae I-IV different from the one or more compounds of component (A):



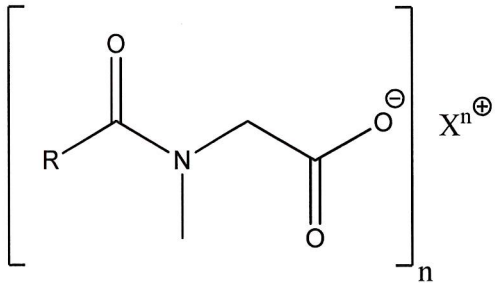
(I)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms and R_1 is a hydrocarbyl having from 1 to 8 carbon atoms or a C_1-C_8 hydrocarbyl group containing one or more heteroatoms;



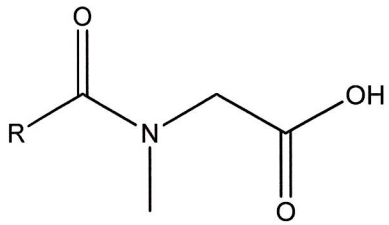
(II)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms and R_2 and R_3 are independently selected from hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms;



(III)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms; and X is an alkali metal, alkaline earth metal or ammonium cation and n is the valence of cation X; and



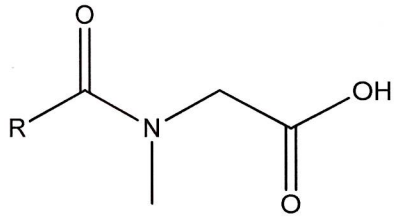
(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms,

wherein the engine oil composition is adapted for use as a crankcase engine oil lubricant suitable for lubrication of valve systems and top and bottom dead centers of pistons/cylinder linear contact zones, the engine oil composition has a phosphorus content of 50-1000 ppm, and the engine oil composition comprises 0.1-2.0 wt. % of a combination of the one or more reaction products (A) and the at least one compound (B), based on the total weight of the engine oil composition.

[0032b] In yet another aspect of the present disclosure, there is provided an engine oil composition comprising greater than 50 wt% of base oil selected from a Group II, Group III, Group IV and Group V base oil and mixtures thereof, wherein the Group II and Group III base oils have at least 90% saturates and an additive package, wherein the additive package comprises

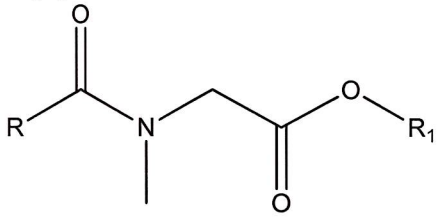
(A) one or more compounds of the formula IV:



(IV)

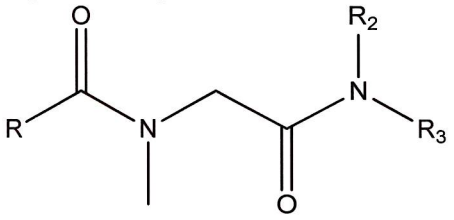
wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms; and

(B) at least one compound of the formulae I-IV different from the one or more compounds of component (A):



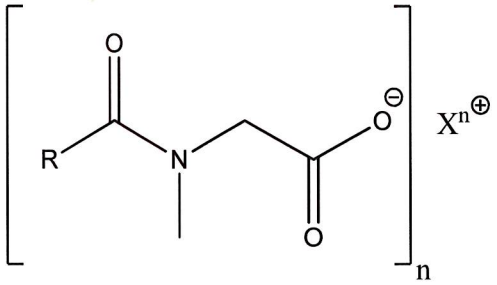
(I)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms and R_1 is a hydrocarbyl having from 1 to 8 carbon atoms or a C_1-C_8 hydrocarbyl group containing one or more heteroatoms;



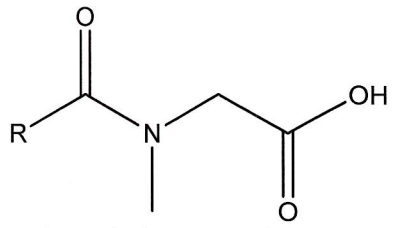
(II)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms and R_2 and R_3 are independently selected from the group consisting of hydrogen, C_1-C_{18} hydrocarbyl groups, and C_1-C_{18} hydrocarbyl groups containing one or more heteroatoms;



(III)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms; and X is an alkali metal, alkaline earth metal or ammonium cation and n is the valence of cation X; and



(IV)

wherein R is a linear or branched, saturated, unsaturated, or partially saturated hydrocarbyl group having 8 to 22 carbon atoms,

wherein the engine oil composition is adapted for use as a crankcase engine oil lubricant suitable for lubrication of valve systems and top and bottom dead centers of pistons/cylinder linear contact zones, the engine oil composition has a phosphorus content of 50-1000 ppm, and the engine oil composition comprises 0.1-2.0 wt. % of a combination of the one or compounds (A) and the at least one compound (B) that is different from the one or more compounds (A), based on the total weight of the engine oil composition.

[0033] The additive package may additionally comprise at least one additive selected from the group consisting of antioxidants, antifoam agents, molybdenum-containing compounds, titanium-containing compounds, phosphorus-containing compounds, viscosity index improvers, pour point depressants, and diluent oils.

[0034] The present disclosure provides a method for improving thin film and boundary layer friction between surfaces in contact moving relative to one another, comprising the step of lubricating the surface with a lubricating oil composition as disclosed herein. In some embodiments, the surfaces are the contacting surfaces of an engine.

[0035] The improved thin film and boundary layer friction may be determined relative to a same composition in the absence of the one or more friction modifiers as described herein.

[0036] The present disclosure also provides a method for improving boundary layer friction between surfaces in contact moving relative to one another, comprising the step of lubricating the surface with a lubricating oil composition as disclosed herein. In some embodiments, the surfaces are the contacting surfaces of an engine.

[0036a] In a further aspect of the present disclosure, there is provided a method for reducing thin film and boundary layer friction in an engine comprising the step of lubricating the engine with the engine oil composition as described herein.

[0036b] In another aspect of the present disclosure, there is provided a method for reducing boundary layer friction in an engine, comprising the step of lubricating the engine with the engine oil composition as described herein.

[0036c] In yet another aspect of the present disclosure, there is provided a method for reducing thin film friction in an engine, comprising the step of lubricating the engine with the engine oil composition as described herein.

[0037] The improved boundary layer friction may be determined relative to a same composition in the absence of the one or more friction modifiers as claimed in claim 1.

[0038] The present disclosure provides a method for improving thin film friction between surfaces in contact moving relative to one another, comprising the step of lubricating the surface with a lubricating oil composition as disclosed herein. In some embodiments, the surfaces are the contacting surfaces of an engine.

DEFINITIONS

[0039] The following definitions of terms are provided in order to clarify the meanings of certain terms as used herein.

[0040] It must be noted that as used herein and in the appended claims, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Furthermore, the terms "a" (or "an"'), "one or more," and "at least one" can be used interchangeably herein. The terms "comprising," "including," "having," and "constructed from" can also be used interchangeably.

[0041] Unless otherwise indicated, all numbers expressing: quantities of ingredients, properties such as molecular weight, percent, ratio, 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," whether or not the term "about" is present. Accordingly, unless indicated to the contrary, the numerical parameters set forth in the specification and claims are approximations that may vary depending upon the desired properties sought to be obtained by the present disclosure. 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