DESCRIPTION

TITLE OF INVENTION:
LUBRICANT COMPOSITION FOR REDUCED ENGINE SLUDGE

TECHNICAL FIELD

[0001] The present disclosure generally relates to lubricating oil compositions and additives therefor effective for reducing engine sludge.

BACKGROUND

[0002] Lubricants intended for use as motor oils (also commonly referred to as engine oils or crankcase oils) in gasoline or diesel automobile engines commonly include a base oil or a blend of base oils of lubricating viscosity and one or more additives to meet certain performance requirements for the intended application. Modern industry standards are placing increasingly stringent requirements in terms composition and performance of such oils, which often leaves little room for lubricant formulation flexibility. As lubricant manufacturers strive to meet various industry standards, it becomes a challenge to cost effectively achieve all the needed performance and industry standards at the same time.

[0003] As manufacturers continue to push for improved efficiency and fuel economy, demands on engines, lubricants, and their components continue to increase. More stringent testing and certifications are often required of today's lubricants, and one area of recent focus is an evaluation of the lubricant's role in sludge formation in cylinder head, oil sump, valve covers, and/or timing covers of engines during extended operation. Newer and more stringent engine tests, such as the M271 EVO fired engine test (CEC L-107-19), place heightened demands on lubricants to not only minimize sludge formation, but also adequately suspend sludge in solution to minimize fluid viscosity increases and the associated oil pressure increases at the same time.

SUMMARY

[0003a] In a first aspect of the present disclosure, there is provided a lubricant composition effective to reduce engine sludge, the lubricant composition comprising

a base oil of lubricating viscosity;

nitrogen provided by a dispersant system and an antioxidant system;

1 to 8 weight percent of the dispersant system including a first hydrocarbyl substituted succinimide dispersant obtainable by reacting a hydrocarbyl substituted acylating agent with a nitrogen source wherein the hydrocarbyl substituent of the first dispersant has a number average molecular weight of at least 1900 and a second hydrocarbyl substituted succinimide dispersant obtainable by reacting a hydrocarbyl substituted acylating agent with a nitrogen source wherein the hydrocarbyl substituent of the second dispersant has a number average molecular weight less than 1900;

0.3 to 4 weight percent of the antioxidant system including at least an alkylated diphenyl aminic antioxidant and a hindered phenolic antioxidant;

a weight ratio of nitrogen provided by the dispersant system to total nitrogen in the lubricant composition of 0.6:1 to 0.8:1;

at least 75% of the nitrogen provided by the dispersant system is a primary or secondary nitrogen and not post-reacted;

a weight ratio of nitrogen provided by the aminic antioxidant of the antioxidant system to the total nitrogen in the lubricant composition of 0.15:1 to 0.4:1;

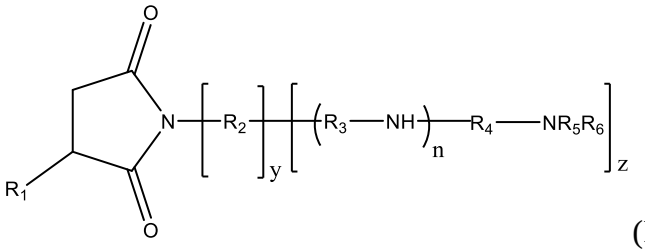
a weight ratio of nitrogen provided by the dispersant system to nitrogen provided by the aminic antioxidant of 1.8:1 to 5.3:1; and

wherein the lubricant composition exhibits an average engine sludge of 7 to 10 merits pursuant to CEC L-107-19.

[0004] In accordance with one example, a lubricant composition effective to reduce engine sludge pursuant to CEC 107-19 is described herein. In one approach, the lubricant composition includes a base oil of lubricating viscosity and nitrogen provided by a dispersant system and an antioxidant system. In examples, the dispersant system includes at least one

hydrocarbyl substituted succinimide dispersant obtainable by reacting a hydrocarbyl substituted acylating agent with a nitrogen source, and the antioxidant system includes at least one aminic antioxidant. In other example, the lubricating compositions have a weight ratio of nitrogen provided by the dispersant system to total nitrogen in the lubricant composition of about 0.6:1 to about 0.85:1, and at least about 75% of the nitrogen provided by the dispersant system is a primary or secondary nitrogen that is not post-reacted.

[0005] In other approaches or examples, the lubricant composition of the prior paragraph may be combined with optional features or optional examples in any combination. Such optional features or optional examples include one or more of: further comprising a weight ratio of nitrogen provided by at least one aminic antioxidant of the antioxidant system to the total nitrogen in the lubricant composition of about 0.15:1 to about 0.4:1; and/or further comprising a weight ratio of nitrogen provided by the dispersant system to nitrogen provided by the at least one aminic antioxidant of about 1.8:1 to about 5.3:1; and/or further comprising an average engine sludge of about 7 to about 10 merits pursuant to CEC L-107-19; and/or further including a phosphorus source including one or more phosphorus-containing compounds independently selected from a thiophosphate, a dithiophosphate, a metal phosphate, a metal thiophosphate, a metal di-thiophosphate, a phosphate, a phosphite, a phosphonate, salts thereof, and mixtures thereof; and/or further including a detergent system including at least one metal containing detergent providing up to about 3500 ppm metal to the composition and having a combined total base number of 0 to about 500; and/or wherein hydrocarbyl substituted succinimide dispersant of the dispersant system has a structure of Formula I:



(Formula I), wherein R_1 is a hydrocarbyl group having a number average molecular weight of about 350 to about 5,000, and wherein R_2, R_3, and R_4 are independently divalent C_1-C_6 moieties, and each of R_5 and R_6, independently, is hydrogen, a C_1-C_6 alkyl group, or together with the nitrogen to which they are attached form a 5- or 6-membered ring optionally fused with one or more aromatic or non-aromatic rings, and n is an

antioxidant, a sulfurized olefin, aminic antioxidants, or combinations thereof; and/or wherein the detergent systems include one or more metal containing phenates, sulfur-containing phenates, sulfonates, calixarates, salixarates, salicylates, carboxylic acids, phosphorus acids, mono- and/or di-thiophosphoric acids, alkyl phenols, sulfur coupled alkyl phenol compounds, methylene bridged phenols, or combinations thereof.

[0006] In yet other examples or approaches, the present disclosure provides for the use of a lubricant composition to reduce engine sludge pursuant to CEC L-107-19 and/or methods of lubricating an engine to reduce engine sludge, and in particular, to achieve an average engine sludge of about 7 to about 10 merits pursuant to CEC L-107-19 using any example of the lubricant composition in the previous two paragraphs.

TERMS

[0007] The following definitions of terms are provided in order to clarify the meanings of certain terms as used herein.

[0008] The terms "oil composition," "lubrication composition," "lubricating oil composition," "lubricating oil," "lubricant composition," "lubricating composition," "fully formulated lubricant composition," "lubricant," "crankcase oil," "crankcase lubricant," "engine oil," "engine lubricant," "motor oil," and "motor lubricant" are considered synonymous, fully interchangeable terminology referring to the finished lubrication product comprising a major amount of a base oil plus a minor amount of an additive composition.

[0009] As used herein, the terms "additive package," "additive concentrate," "additive composition," "engine oil additive package," "engine oil additive concentrate," "crankcase additive package," "crankcase additive concentrate," "motor oil additive package," "motor oil concentrate," are considered synonymous, fully interchangeable terminology referring the portion of the lubricating oil composition excluding the major amount of base oil stock mixture. The additive package may or may not include the viscosity index improver or pour point depressant.

[00010] The term "overbased" relates to metal salts, such as metal salts of sulfonates, carboxylates, salicylates, and/or phenates, wherein the amount of metal present exceeds the stoichiometric amount. Such salts may have a conversion level in excess of 100% (i.e., they may comprise more than 100% of the theoretical amount of metal needed to convert the acid to its "normal," "neutral" salt). The expression "metal ratio," often abbreviated as MR, is used to designate the ratio of total chemical equivalents of metal in the overbased salt to chemical

CLAIMS

1. A lubricant composition effective to reduce engine sludge, the lubricant composition comprising

a base oil of lubricating viscosity;

nitrogen provided by a dispersant system and an antioxidant system;

1 to 8 weight percent of the dispersant system including a first hydrocarbyl substituted succinimide dispersant obtainable by reacting a hydrocarbyl substituted acylating agent with a nitrogen source wherein the hydrocarbyl substituent of the first dispersant has a number average molecular weight of at least 1900 and a second hydrocarbyl substituted succinimide dispersant obtainable by reacting a hydrocarbyl substituted acylating agent with a nitrogen source wherein the hydrocarbyl substituent of the second dispersant has a number average molecular weight less than 1900;

0.3 to 4 weight percent of the antioxidant system including at least an alkylated diphenyl aminic antioxidant and a hindered phenolic antioxidant;

a weight ratio of nitrogen provided by the dispersant system to total nitrogen in the lubricant composition of 0.6:1 to 0.8:1;

at least 75% of the nitrogen provided by the dispersant system is a primary or secondary nitrogen and not post-reacted;

a weight ratio of nitrogen provided by the aminic antioxidant of the antioxidant system to the total nitrogen in the lubricant composition of 0.15:1 to 0.4:1;

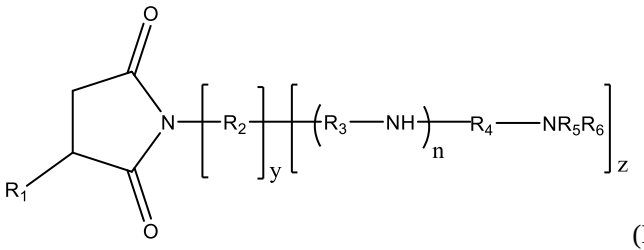
a weight ratio of nitrogen provided by the dispersant system to nitrogen provided by the aminic antioxidant of 1.8:1 to 5.3:1; and

wherein the lubricant composition exhibits an average engine sludge of 7 to 10 merits pursuant to CEC L-107-19.

2. The lubricant composition of claim 1, further including a phosphorus source including one or more phosphorus-containing compounds independently selected from a thiophosphate, a dithiophosphate, a metal phosphate, a metal thiophosphate, a metal di-thiophosphate, a phosphate, a phosphite, a phosphonate, salts thereof, and mixtures thereof.

3. The lubricant composition of claim 1, further including a detergent system including at least one metal containing detergent providing up to 3500 ppm metal to the composition and having a combined total base number of 0 to 500.

4. The lubricant composition of claim 1, wherein each of the hydrocarbyl substituted succinimide dispersants of the dispersant system has a structure of Formula I:



(Formula I);

wherein

R_1 of the first dispersant is a hydrocarbyl group having a number average molecular weight of 1900 to 5,000 and R_1 of the second dispersant is a hydrocarbyl group having a number average molecular weight of 350 to 1900;

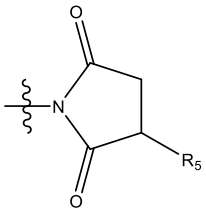
R_2, R_3, and R_4 are independently divalent C_1-C_6 moieties;

each of R_5 and R_6, independently, is hydrogen, a C_1-C_6 alkyl group, or together with the nitrogen to which they are attached form a 5- or 6-membered ring optionally fused with one or more aromatic or non-aromatic rings;

n is an integer from 0 to 8; and

y and z are each integers and wherein y + z = 1.

5. The lubricant composition of claim 4, wherein R_5 and R_6 together with the nitrogen to which they are attached form a radical of Formula II



(Formula II).

6. The lubricant composition of claim 1, wherein the hydrocarbyl substituted acylating agent is maleic anhydride; and the nitrogen source is a polyalkylene polyamine

selected from a mixture of polyethylene polyamines having an average of 5 nitrogen atoms, diethylene triamine, triethylene tetramine, tetraethylene pentamine, pentaethylene hexamine, or combinations thereof.

7. The lubricant composition of claim 6, wherein only one of the hydrocarbyl substituted succinimide dispersants is post-treated with a boron source and/or maleic anhydride.

8. The lubricant composition of claim 7, wherein the dispersant system includes 2 to 4 times more of the non-post treated dispersant than the post-treated dispersant.

9. The lubricant composition of claim 7, wherein the dispersant systems provides no more than 300 ppm of total boron to the lubricant composition.

10. The lubricant composition of claim 2, wherein the phosphorus source is present in an amount to provide up to 900 ppm of phosphorus to the lubricating composition.

11. The lubricant composition of claim 2, wherein the one or more phosphorus-containing compounds is independently selected from a metal phosphate, a metal thiophosphate, a metal dithiophosphate, or combinations thereof.

12. The lubricant composition of claim 11, wherein the one or more phosphorus-containing compounds is a metal dithiophosphate and includes 12 to 32 total carbon atoms within alkyl groups thereon, wherein each of the alkyl groups independently averages 3 to 8 carbon atoms.

13. The lubricant composition of claim 11, wherein the one or more phosphorus-containing compounds include a first metal dithiophosphate with the alkyl groups derived from secondary alcohols and a second metal dithiophosphate with the alkyl groups derived from primary alcohols.

14. The lubricant composition of claim 11, wherein the metal of the one or more phosphorus-containing compounds is independently selected from the group consisting of

aluminum, lead, tin, molybdenum, manganese, nickel, copper, titanium, tungsten, zirconium, or zinc.

15. The lubricant composition of claim 3, wherein the detergent systems include one or more metal containing phenates, sulfur-containing phenates, sulfonates, calixarates, salixarates, salicylates, carboxylic acids, phosphorus acids, mono- and/or di-thiophosphoric acids, alkyl phenols, sulfur coupled alkyl phenol compounds, methylene bridged phenols, or combinations thereof.