CALCIUM NEUTRAL AND OVERBASED MANNICH AND ANHYDRIDE ADDUCTS AS DETERGENTS FOR ENGINE OIL LUBRICANTS

TECHNICAL FIELD:

[0001] The disclosure relates to lubricant additives and in particular to sulfur-free detergent additives for crankcase lubricant compositions.

BACKGROUND AND SUMMARY:

[0002] Lubricating oil compositions, as used in the internal combustion engines and transmissions of automobiles or trucks, are subjected to a demanding environment. This environment results in the lubricating oil composition suffering oxidation that is catalyzed by the presence of impurities in the lubricating oil composition, such as iron compounds. Additionally, oxidation of the lubricating oil composition is promoted by the elevated temperatures of the lubricating oil composition during use.

[0003] The oxidation of the lubricating oil composition during use is usually controlled to some extent by the use of additives, such as antioxidants or acid neutralizers, which may extend the useful life of the lubricating oil composition, particularly by reducing or preventing unacceptable viscosity increases.

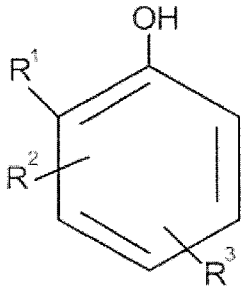
[0004] Acid neutralizers generally used in lubricant compositions may be selected from metal alkyl phenates and metal alkylaryl sulfonates. The metal of the metal of the phenates and sulfonates may be selected from alkali and alkaline earth metals such as calcium, magnesium, sodium, or barium.

[0005] In recent years, phosphorus compounds and sulfur (from sulfonates, sulfur-containing phenates, and metal-containing dithiophosphates) derived from engine lubricants have been shown to contribute in part to particulate emissions. Also, sulfur and phosphorus tend to poison the catalysts used in catalytic converters, resulting in a reduction in performance of the catalysts.

[0006] Accordingly, there exists a need for improved lubricant compositions that have reduced levels of sulfur and phosphorus. By reduced levels is meant less than 1.0 wt.% phosphorus and less than 0.5 wt. % sulfur based on the total weight of the lubricant composition.

[0006a] In one aspect of the present disclosure, there is provided a sulfur-free salt detergent additive that is a reaction product of:

(a) an intermediate product of a phenolic compound, an aldehyde and an amine in a molar range of 0.5-5:0.5-5:1 phenolic compound to aldehyde to amine, wherein the phenolic compound comprises a compound of the formula:



wherein R^1, R^2, and R^3 are independently selected from the group consisting of hydrogen, an alkyl group, an alkenyl group, an alkoxy group, an aminic group having from 1 to 24 carbon atoms, and an aryl group having from 6 to 24 carbon atoms; with

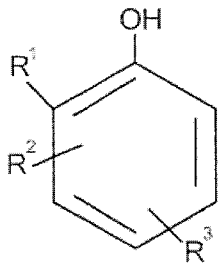
(b) a compound selected from the group consisting of an acylating agent, an electrophilic compound, and mixtures thereof, and

(c) a compound selected from an alkali or alkaline earth metal and a basic nitrogen-containing compound to provide an overbased or neutral sulfur-free salt detergent additive.

[0006b] In another aspect of the present disclosure, there is provided a lubricant composition comprising a base oil and from about 1 to about 5 wt.% of the sulfur-free salt detergent additive as described herein.

[0006c] In yet another aspect of the present disclosure, there is provided a method for making a sulfur-free salt compound for use as a detergent additive component of a lubricant composition comprising:

reacting a phenolic compound with an aldehyde, and an amine in a molar range of 0.5-5:0.5-5:1 phenolic compound to aldehyde to amine to provide an intermediate product, wherein the phenolic compound comprises a compound of the formula:



wherein R^1, R^2, and R^3 are independently selected from the group consisting of hydrogen, an alkyl group, an alkenyl group, an alkoxy group, an aminic group having from 1 to 24 carbon atoms, and an aryl group having from 6 to 24 carbon atoms;

subsequently reacting the intermediate product with (b) a compound selected from the group consisting of an acylating agent, an electrophilic compound, and mixtures thereof to provide a reaction product adduct, and

neutralizing or overbasing the reaction product adduct with (c) a basic nitrogen-contaning compound or a metal selected from alkali and alkaline earth metals to provide the detergent additive component.

[0006d] In a further aspect of the present disclosure, there is provided a lubricant composition comprising the sulfur-free salt detergent additive as described herein and one or more additional additives selected from the group consisting of a polymeric viscosity modifier, a detergent, an antioxidant, a dispersant, a rust inhibitor, an antiwear agent, a boron-containing compound, a friction modifier, a pour-point depressant, and an antifoaming agent.

[0006e] In another aspect of the present disclosure, there is provided a method for lubricating an internal combustion engine comprising adding the lubricant composition as described herein to a crankcase of said engine.

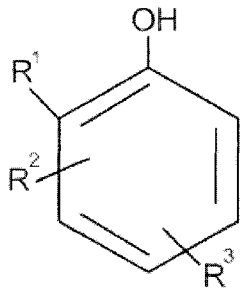
[0006f] In yet another aspect of the present disclosure, there is provided a lubricating oil concentrate comprising the sulfur-free salt detergent additive as described herein and one or more additional additives selected from the group consisting of a polymeric viscosity modifier, a detergent, an antioxidant, a dispersant, a rust inhibitor, an antiwear agent, a boron-containing compound, a friction modifier, a pour-point depressant, and an antifoaming agent.

[0007] In view of the foregoing, an embodiment of the disclosure provides sulfur-free metal or ammonium salt compound, a method of making the compound, and a lubricant additive concentrate, and lubricant composition containing the compound. The compound is

What is Claimed is:

1. A sulfur-free salt detergent additive that is a reaction product of:

(a) an intermediate product of a phenolic compound, an aldehyde and an amine in a molar range of 0.5-5:0.5-5:1 phenolic compound to aldehyde to amine, wherein the phenolic compound comprises a compound of the formula:



wherein R^1, R^2, and R^3 are independently selected from the group consisting of hydrogen, an alkyl group, an alkenyl group, an alkoxy group, an aminic group having from 1 to 24 carbon atoms, and an aryl group having from 6 to 24 carbon atoms; with

(b) a compound selected from the group consisting of an acylating agent, an electrophilic compound, and mixtures thereof, and

(c) a compound selected from an alkali or alkaline earth metal and a basic nitrogen-containing compound to provide an overbased or neutral sulfur-free salt detergent additive.

2. The sulfur-free salt detergent additive of claim 1, wherein the aldehyde comprises formaldehyde.

3. The sulfur-free salt detergent additive of claim 1, wherein the amine comprises a mono- or polyamine.

4. The sulfur-free salt detergent additive of claim 1, wherein component (b) is selected from the group consisting of maleic acid or anhydride, succinic acid or anhydride, alkenyl succinic acid or anhydride, and halo-carboxylic acid.

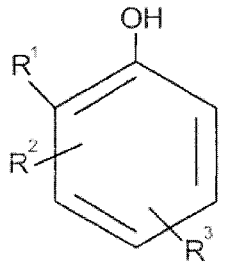
5. The sulfur-free salt detergent additive of claim 1, wherein the sulfur-free salt detergent is an overbased calcium or magnesium salt of the reaction product.

6. The sulfur-free salt detergent additive of claim 1, wherein the sulfur-free salt detergent is a neutral ammonium salt of the reaction product.

7. A lubricant composition comprising a base oil and from about 1 to about 5 wt.% of the sulfur-free salt detergent additive of claim 1.

8. A method for making a sulfur-free salt compound for use as a detergent additive component of a lubricant composition comprising:

reacting a phenolic compound with an aldehyde, and an amine in a molar range of 0.5-5:0.5-5:1 phenolic compound to aldehyde to amine to provide an intermediate product, wherein the phenolic compound comprises a compound of the formula:



wherein R^1, R^2, and R^3 are independently selected from the group consisting of hydrogen, an alkyl group, an alkenyl group, an alkoxy group, an aminic group having from 1 to 24 carbon atoms, and an aryl group having from 6 to 24 carbon atoms;

subsequently reacting the intermediate product with (b) a compound selected from the group consisting of an acylating agent, an electrophilic compound, and mixtures thereof to provide a reaction product adduct, and

neutralizing or overbasing the reaction product adduct with (c) a basic nitrogen-contaning compound or a metal selected from alkali and alkaline earth metals to provide the detergent additive component.

9. The method of claim 8, comprising overbasing the reaction product adduct to provide an overbased calcium or magnesium salt adduct.

10. The method of claim 8, wherein component (b) is selected from the group consisting of maleic acid or anhydride, succinic acid or anhydride, and halo-carboxylic acid.

11. The method of claim 8, wherein the amine comprises a mono- or polyamine.

12. The method of claim 8, comprising neutralizing the reaction product adduct with a basic nitrogen-containing compound to provide an ammonium salt of the reaction product adduct.

13. A lubricant composition comprising the sulfur-free salt detergent additive of claim 1 and one or more additional additives selected from the group consisting of a polymeric viscosity modifier, a detergent, an antioxidant, a dispersant, a rust inhibitor, an antiwear agent, a boron-containing compound, a friction modifier, a pour-point depressant, and an antifoaming agent.

14. A method for lubricating an internal combustion engine comprising adding the lubricant composition of claim 13 to a crankcase of said engine.

15. The method of claim 14, wherein the engine comprises a heavy duty diesel engine.

16. A lubricating oil concentrate comprising the sulfur-free salt detergent additive of claim 1 and one or more additional additives selected from the group consisting of a polymeric viscosity modifier, a detergent, an antioxidant, a dispersant, a rust inhibitor, an antiwear agent, a boron-containing compound, a friction modifier, a pour-point depressant, and an antifoaming agent.