QUATERNARY AMMONIUM COMPOUNDS AS FUEL OR LUBRICANT ADDITIVES

The present invention relates to novel quaternary ammonium compounds, to compositions comprising such compounds and to methods and uses relating thereto.

In particular the present invention relates to the use of quaternary ammonium compounds as fuel or lubricant additives, especially as fuel additives, for example diesel fuel additives or gasoline fuel additives.

It is common to include nitrogen-containing detergent compounds in lubricating oil and fuel oil compositions in order to improve the performance of engines using such compositions. The inclusion of detergent additives prevents the fouling of moving parts of the engine. Without such additives fouling would cause the performance of the engine to diminish and eventually cease.

Many different types of quaternary ammonium salts are known in the art for use as detergent additives in fuel and lubricating oil compositions. Examples of such compounds are described in US4171959 and US7951211. One commonly used class of quaternary ammonium additives is prepared by the reaction of a tertiary amine with an epoxide and an acid. Various acids may be used but typically these are small acid molecules, for example acetic acid, and the counterion to the quaternary ammonium cation is not considered to be of importance.

Detergent additive compounds typically include a polar group and a hydrophobic group. The hydrophobic group is typically a long chain hydrocarbyl moiety. A common feature of existing quaternary ammonium salt detergent additives is that the hydrophobic group is included within the cationic portion of the compound. The present inventors have surprisingly found that quaternary ammonium salts including a hydrophobic moiety in the anion can provide good performance as a detergent.

Summary

In an aspect, there is provided a method of preparing a fuel or lubricating oil composition; the method comprising preparing a quaternary ammonium compound by reaction of:

(a) a tertiary amine;

(b) an epoxide; and

(c) an acid including an optionally substituted hydrocarbyl moiety having at least 6 carbon atoms; and

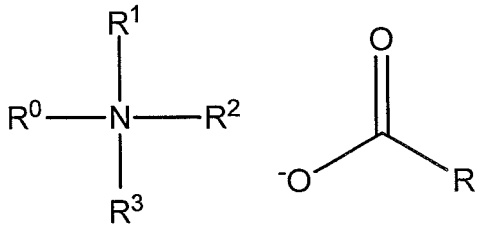
mixing the quarternary ammonium compound into a fuel.

In another aspect, there is provided a method of improving the performance of an engine, the method comprising combusting in said engine a fuel composition comprising as defined herein.

In a further aspect, there is provided the use of an additive in a fuel composition to improve the performance of an engine combusting said fuel composition wherein the additive is a quaternary ammonium compound as defined herein.

Detailed Disclosure of Embodiments

According to a first aspect of the present invention there is provided a quaternary ammonium compound of formula (X):



(X)

Claims

1. A method of preparing a fuel or lubricating oil composition, the method comprising : preparing a quaternary ammonium compound by reaction of:

(a) a tertiary amine;

(b) an epoxide; and

(c) an acid including an optionally substituted hydrocarbyl moiety having at least 6 carbon atoms; and

mixing the quaternary ammonium compound into a fuel.

2. A method according to claim 1 wherein component (c) is selected from a monoacid, diacid, monoester of a diacid, a polyacid or a partial ester of a polyacid.

3. A method according to claim 2 wherein component (c) is selected from a monoacid, diacid or a monoester of a diacid.

4. A method according to any preceding claim wherein the quaternary ammonium compound is the reaction product of:

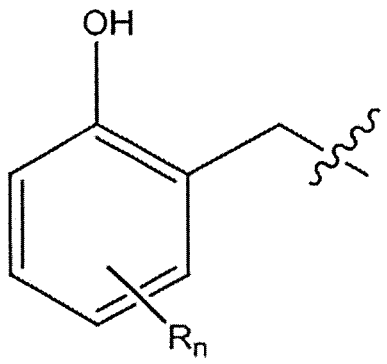
(a) a tertiary amine of formula $R^1R^2R^3N$;

(b) an epoxide; and

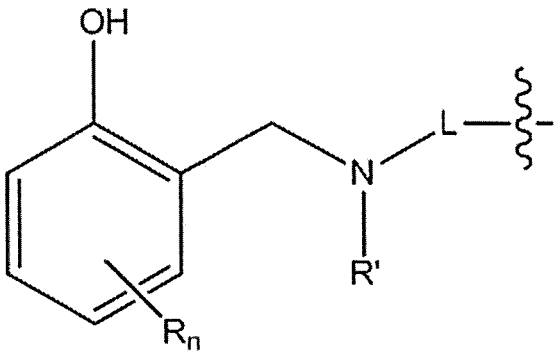
(c) an acid including an optionally substituted hydrocarbyl moiety having at least 6 carbon atoms;

wherein each of R^1 and R^2 is independently an optionally substituted alkyl or alkenyl group and R^3 is selected from:

(x) an optionally substituted alkylene phenol moiety of formula (A) or (B)



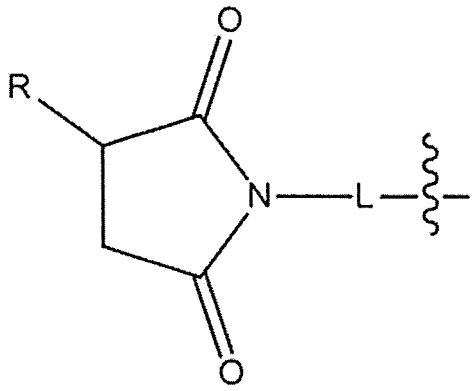
(A)



(B)

wherein n is 0 to 4, preferably 1, R is an optionally substituted hydrocarbyl group, R' is an optionally substituted alkyl, alkenyl or aryl group; and L is a linking group;

(y) a succinimide moiety of formula:



wherein R is an optionally substituted hydrocarbyl group and L is a linking group; and

(z) a polyisobutenyl group having a molecular weight of from 100 to 500, preferably from 500 to 2000.

5. A methodaccording to claim 4 wherein component (c) is a monoester of a diacid.

6. A method according to any of claims 1 to 5, wherein the quaternary ammonium compound is the reaction product of:

(a) a tertiary amine of formula $R^1R^2R^3N$;
(b) an epoxide; and
(c) an acid including an optionally substituted hydrocarbyl moiety having at least 6 carbon atoms;

wherein each of R^1 and R^2 is independently an optionally substituted alky or alkenyl group and R^3 is an optionally substituted alkyl or alkenyl group having from 1 to 30 carbon atoms and component (c) is a diacid.

7. A method according to any preceding claim wherein the fuel or the lubricating oil composition comprises more than one quaternary ammonium compounds.

8. A method according to any preceding claim wherein the composition is a fuel composition and the fuel is diesel fuel.

9. A method according to claim 8, wherein the diesel fuel composition comprises one or more further detergents selected from:

(i) an additional quaternary ammonium salt additive which is not a quaternary ammonium compound of claim 1;

(ii) the product of a Mannich reaction between an aldehyde, an amine and an optionally substituted phenol;

(iii) the reaction product of a polyisobutenyl substituted succinic acid derivative and an amine;

(iv) the reaction product of a polyisobutenyl substituted succinic acid derivative and hydrazine;

(v) a salt formed by the reaction of a carboxylic acid with di-n-butylamine or tri-n-butylamine;

(vi) the reaction product of a hydrocarbyl-substituted dicarboxylic acid or anhydride and an amine compound or salt which product comprises at least one amino triazole group; and

(vii) a substituted polyaromatic detergent additive.

10. A method according to any of claims 1 to 7,wherein the composition is fuel composition and the fuel is gasoline fuel.

11. A fuel composition according to claim 10 which comprises one or more gasoline detergents selected from:

(p) hydrocarbyl-substituted polyoxyalkylene amines or polyetheramines;

(q) acylated nitrogen compounds which are the reaction product of a polyisobutenyl substituted succinic acid derivative and an amine;

(r) hydrocarbyl-substituted amines wherein the hydrocarbyl substituent is aliphatic and contains at least 8 carbon atoms;

(s) Mannich base additives comprising nitrogen-containing condensates of a phenol, aldehyde and primary or secondary amine;

(t) aromatic esters of a polyalkylphenoxyalkanol;

(u) an additional quaternary ammonium salt additive which is not a quaternary ammonium compound of claim 1; and

(v) tertiary hydrocarbyl amines having a maximum of 30 carbon atoms

12. A method of improving the performance of an engine, the method comprising combusting in said engine a fuel composition as defined in any preceding claim.

13. A method according to claim 12 wherein the engine is a gasoline engine and the fuel is gasoline.

14. A method according to claim 12 wherein the engine is a diesel engine having a fuel injection system which comprises a high pressure fuel injection (HPFI) system with fuel pressures greater than 1350 bar.

15. A method according to claim 12 or claim 14 wherein improvement in performance is achieved by combating deposits in the engine.

16. A method according to claim 15 which combats internal diesel injector deposits.

17. A method according to claim 15 or claim 16 which combats external diesel injector deposits, including injector nozzle deposits and injector tip deposits.

18. A method according to any of claims 15 to 17 which combats fuel filter deposits.

19. The use of an additive in a fuel composition to improve the performance of an engine combusting said fuel composition wherein the additive is a quaternary ammonium compound as defined in any of claims 1 to 6.

20. The use according to claim 19 to achieve "keep clean" performance.

21. The use according to claim 19 to achieve "clean up" performance.