QUATERNARY AMMONIUM COMPOUNDS AS FUEL OR LUBRICANT ADDITIVES

The present invention relates to novel quaternary ammonium compounds, to a composition 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 and preferably as diesel 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 even when a lower molecular weight cation is used. Furthermore the inventors have noted that use of diacid species as the anion is particularly beneficial.

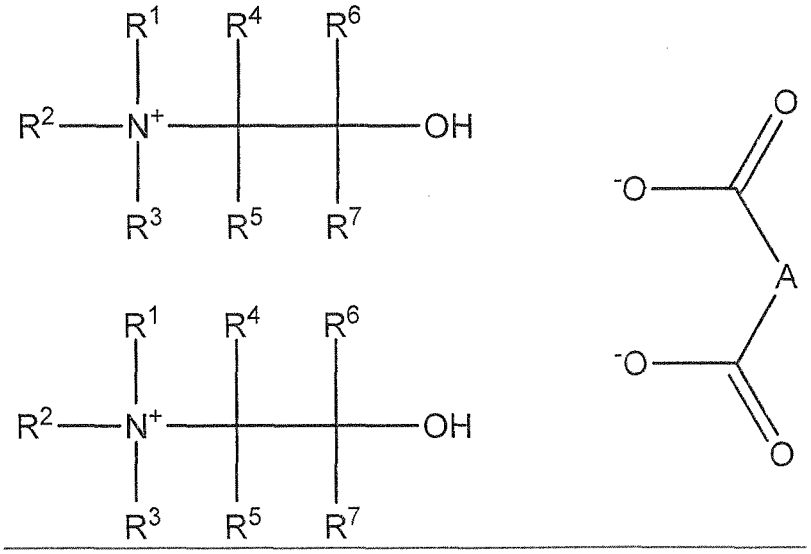
The present invention relates to a fuel or lubricating oil composition comprising as an additive a quaternary ammonium compound which is the reaction product of:

(a) a tertiary amine having a molecular weight of less than 1000;

(b) an acid-activated alkylating agent; and

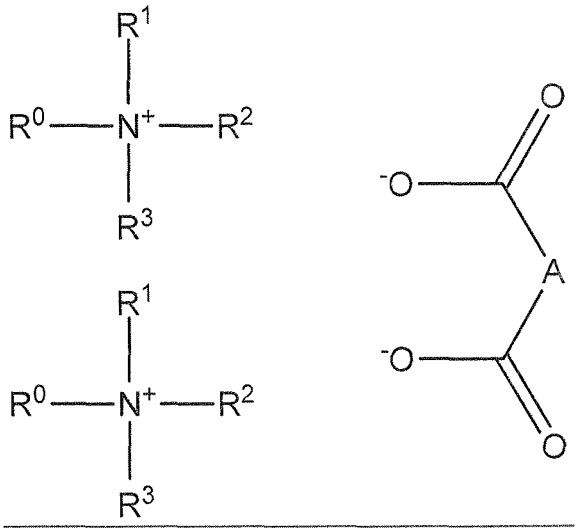
(c) a diacid including an optionally substituted hydrocarbyl moiety having at least 5 carbon atoms.

The present invention further relates to a fuel or lubricating oil composition comprising as an additive a compound of formula:



wherein R^1, R^2 and R^3 are each independently selected from an optionally substituted alkyl, alkenyl or aryl group; R^4, R^5, R^6 and R^7 are each independently selected from hydrogen or an optionally substituted alkyl, alkenyl or aryl group; and A includes an optionally substituted alkyl or alkenyl moiety having at least 5 carbon atoms.

The present invention further relates to a fuel or lubricating oil composition comprising as an additive a quaternary ammonium compound of formula (X):



(X)

wherein each of R^0, R^1, R^2 and R^3 is independently an optionally substituted alkyl, alkenyl or aryl group and A includes an optionally substituted hydrocarbyl moiety having at least 5 carbon atoms.

The present invention also relates to a method of improving the performance of an engine, the method comprising combusting in said engine a fuel composition as described herein.

The present invention also relates to 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.

According to a first aspect of the present invention there is provided a quaternary ammonium compound which is the reaction product of:

(a) a tertiary amine having a molecular weight of less than 1000;

(b) an acid-activated alkylating agent; and

(c) a diacid including an optionally substituted hydrocarbyl moiety having at least 5 carbon atoms.

Component (a) used to prepare the quaternary ammonium salts of the present invention is a tertiary amine having a molecular weight of less than 1000. Any suitable tertiary amine may be used.

Claims

1. A fuel or lubricating oil composition comprising as an additive a quaternary ammonium compound which is the reaction product of:

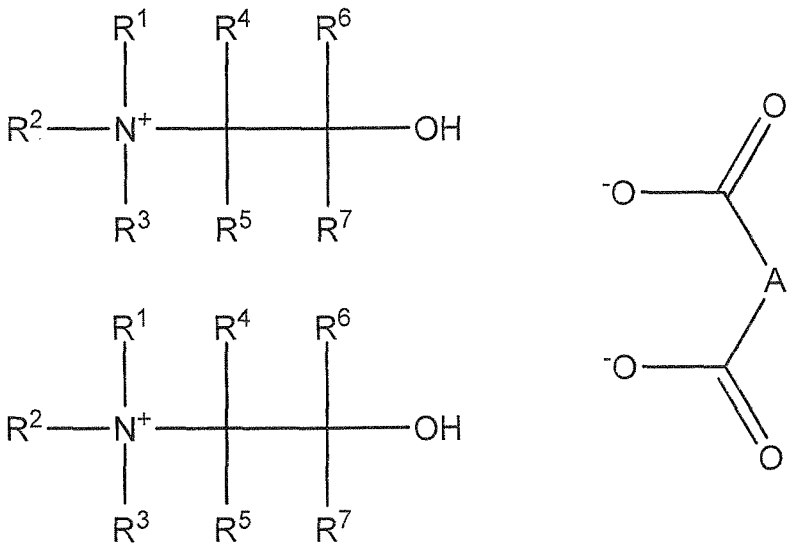
(a) a tertiary amine having a molecular weight of less than 1000;

(b) an acid-activated alkylating agent; and

(c) a diacid including an optionally substituted hydrocarbyl moiety having at least 5 carbon atoms.

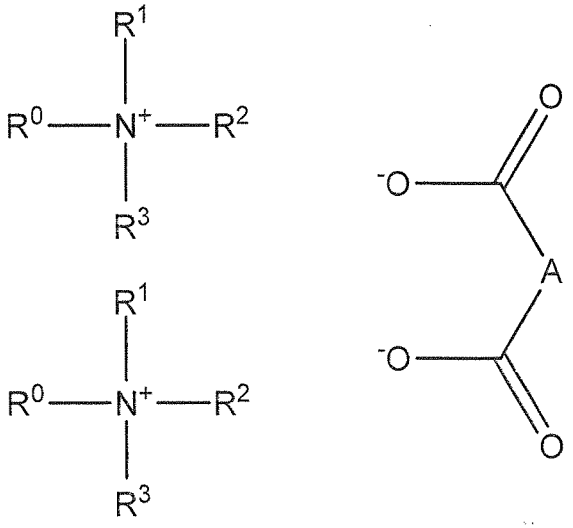
2. A fuel or lubricating oil composition ~~quaternary ammonium compound~~ according to claim 1 wherein component (b) is an epoxide.

3. A fuel or lubricating oil composition comprising as an additive a compound of formula:



wherein R^1, $R^2$and R^3 are each independently selected from an optionally substituted alkyl, alkenyl or aryl group; R^4, R^5, R^6 and R^7 are each independently selected from hydrogen or an optionally substituted alkyl, alkenyl or aryl group; and A includes an optionally substituted alkyl or alkenyl moiety having at least 5 carbon atoms.

4. A fuel or lubricating oil composition comprising as an additive a quaternary ammonium compound of formula (X):



(X)

wherein each of R^0, R^1, R^2 and R^3 is independently an optionally substituted alkyl, alkenyl or aryl group and A includes an optionally substituted hydrocarbyl moiety having at least 5 carbon atoms.

5. A composition according to any preceding claim which is a fuel composition.

~~5. A method of preparing a quaternary ammonium salt, the method comprising reacting (a) a tertiary amine having a molecular weight of less than 1000 with (b) an acid-derived alkylating agent in the presence of (c) a diacid including an optionally substituted hydrocarbyl moiety having at least 5 carbon atoms.~~

~~6. An additive composition comprising one or more quaternary ammonium compounds as claimed in any of claims 1 to 4 and a diluent or carrier.~~

~~7. A fuel composition comprising as an additive one or more quaternary ammonium compounds as claimed in any of claims 1 to 4.~~

~~8~~6. A fuel composition according to claim ~~7~~5 wherein the fuel is diesel fuel.

~~9~~7. A fuel composition according to claim ~~8~~6 which 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 carboxylic acid-derived acylating agent and an amine;

(iv) the reaction product of a carboxylic acid-derived acylating agent 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 an optionally substituted 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~~8. A ~~fuel~~ composition according to any of claims 1 to ~~57~~ wherein the fuel is gasoline fuel.

~~11~~9. A fuel composition according to claim ~~10~~ 8 which comprises comprise 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 carboxylic acid-derived acylating agent and an amine;

(r) hydrocarbyl-substituted amines wherein the hydrocarbyl substituent is substantially 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;and

(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~~10. A method of improving the performance of an engine, the method comprising combusting in said engine a fuel composition ~~comprising as an additive one or more quaternary ammonium compounds~~ as claimed in any preceding ~~of~~ claims ~~1 to 4~~.

~~13~~11. A method according to claim ~~12~~ 10 wherein the engine is a gasoline engine and the fuel is a gasoline fuel.

~~14~~12. A method according to claim ~~12~~ 10 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~~13. A method according to claim 10 or claim 12 ~~or claim 14~~ wherein improvement in performance is achieved by combating deposits in the engine.

~~16~~14. A method according to claim ~~15~~ 13 which combats internal diesel injector deposits.

~~17~~15. A method according to claim ~~15~~ 10 or claim ~~16~~ 12 which combats external diesel injector deposits, including injector nozzle deposits and injector tip deposits.

~~18~~16. A method according to any of claims ~~15~~ 13 to ~~17~~ 15 which combats fuel filter deposits.

~~19~~17. 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 ~~claimed~~ defined in any of claims 1 to ~~49~~.

~~20~~18. The use according to claim ~~19~~ 17 to achieve "keep clean" performance.

~~21~~19. The use according to claim ~~19~~ 17 to achieve "clean up" performance.