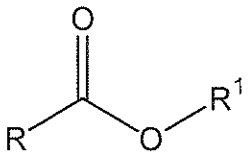
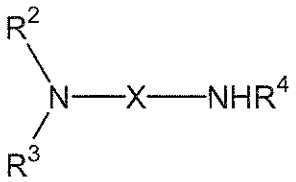
existing deposits from fuel filter deposits i.e. provide a "clean up" function. Compositions able to provide both of these functions would be especially useful.

According to a first aspect of the present invention there is provided a diesel fuel composition comprising a first additive (i) comprising a quaternary ammonium salt and a second additive (ii) comprising a Mannich reaction product; wherein the quaternary ammonium salt additive (i) is formed by the reaction of a compound of formula (A):

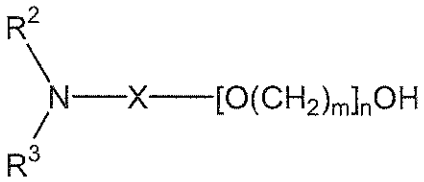


(A)

and a compound formed by the reaction of a hydrocarbyl-substituted acylating agent and an amine of formula (B1) or (B2):



(B1)



(B2)

wherein R is an optionally substituted alkyl, alkenyl, aryl or alkylaryl group; R^1 is a C_1 to C_{22} alkyl, aryl or alkylaryl group; wherein R^2 and R^3 are the same or different alkyl, alkenyl or aryl groups having from 1 to 22 carbon atoms; X is a bond or alkylene group having from 1 to 20 carbon atoms; n is from 0 to 20; m is from 1 to 5; and R^4 is hydrogen or a C_1 to C_{22} alkyl group; and wherein the Mannich reaction product additive (ii) is the product of a Mannich reaction between:

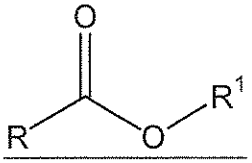
(a) an aldehyde;

(b) an amine; and

(c) a substituted phenol;

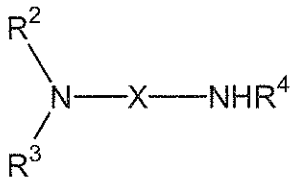
wherein the phenol is substituted with at least one branched hydrocarbyl group having a molecular weight of between 200 and 3000.

Another aspect relates to a diesel fuel composition comprising a first additive (i) comprising a quaternary ammonium salt and a second additive (ii) comprising a Mannich reaction product; wherein the quaternary ammonium salt additive (i) is formed by the reaction of a compound of formula (A):



(A)

and a compound formed by the reaction of a hydrocarbyl-substituted succinic acid acylating agent and an amine of formula (B1):



(B1)

selected from N,N-dimethyl-1,3-diaminopropane, N,N-diethyl-1,3-diaminopropane, N,N-dimethylethylenediamine, N,N-diethylethylenediamine, N,N-dibutylethylenediamine, or combinations thereof;

wherein R^1 is a C1 to C22 alkyl, aryl or alkylaryl group, and wherein compound (A) is selected from an ester of a carboxylic acid selected from one or more of oxalic acid, phthalic acid, salicylic acid, maleic acid, malonic acid, citric acid, nitrobenzoic acid, aminobenzoic acid and 2, 4, 6-trihydroxybenzoic acid; and

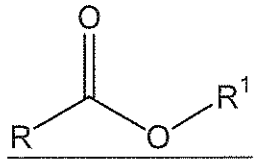
wherein the Mannich reaction product additive (ii) is the product of a Mannich reaction between:

(a) formaldehyde;

(b) a (poly)ethylene polyamine; and

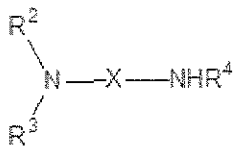
(c) a polyisobutylene-substituted phenol; wherein the polyisobutenyl substituent has a molecular weight of between 300 and 2000.

Another aspect relates to the use of a quaternary ammonium salt additive (i) and a Mannich reaction product additive (ii) in a diesel fuel composition to improve the engine performance of a diesel engine when using said diesel fuel composition, wherein the quaternary ammonium salt additive (i) is formed by the reaction of a compound of formula (A):



(A)

and a compound formed by the reaction of a hydrocarbyl-substituted succinic acid acylating agent and an amine of formula (B1)



(B1)

selected from N,N-dimethyl-1,3-diaminopropane, N,N-diethyl-1,3-diaminopropane, N,N-dimethylethylenediamine, N,N-diethylethylenediamine, N,N-dibutylethylenediamine, or combinations thereof;

wherein R^1 is selected from a C1-C22 alkyl, aryl, or alkylaryl group;

said compound (A) is selected from an ester of a carboxylic acid selected from one or more of oxalic acid, phthalic acid, salicylic acid, maleic acid, malonic acid, citric acid, nitrobenzoic acid, aminobenzoic acid and 2, 4, 6-trihydroxybenzoic acid; and

wherein the Mannich reaction product additive (ii) is the product of a Mannich reaction between:

(a) formaldehyde

(b) a (poly)ethylene polyamine; and

(c) a polyisobutylene-substituted phenol; wherein the polyisobutenyl substituent has a molecular weight of between 300 and 2000, and

wherein said improvement in engine performance is measured by the reduction or prevention of injector deposits, by a reduction in power loss, by an improvement in fuel economy, or by preventing or removing deposits on a vehicle fuel filter.

Additive compounds (i) may be referred to herein as “the quaternary ammonium salt additives” or additive (i).