Claims

1. A method of removing deposits from a diesel engine having a high pressure fuel system, the method comprising combusting in the engine a diesel fuel composition comprising an engine cleaning additive, wherein the engine cleaning additive is the product of a Mannich reaction between:
   (a) an aldehyde;
   (b) ammonia, hydrazine or an amine; and
   (c) an optionally substituted phenol;

   wherein the or each substituent of the phenol component (c) has an average molecular weight of less than 400; wherein after running the engine for 32 hours, the engine has a power output of at least 97% of the power output obtained when using clean injectors; and wherein the engine has a pressure in excess of 1350 bar.

2. A method according to claim 1 wherein component (b) is a polyethylene polyamine having from 2 to 8 nitrogen atoms.

3. A method according to claim 1 or claim 2 wherein the engine cleaning additive is present in the diesel fuel composition in an amount of at least 30ppm.

4. A method according to any preceding claim wherein the or each substituent of component (c) has an average molecular weight of less than 300.

5. A method according to any preceding claim wherein the diesel fuel composition further comprises a quaternary ammonium salt additive formed by the reaction of a nitrogen containing species having at least one tertiary amine group and a quaternizing agent.

6. A method according to claim 5 wherein the nitrogen containing species comprises:

   (i) the reaction product of a hydrocarbyl-substituted acylating agent and a compound comprising at least one tertiary amine group and a primary amine, secondary amine or alcohol group;

   (ii) a mannich reaction product comprising a tertiary amine group; and

   (iii) a polyalkylene substituted amine having at least one tertiary amine group.

7. A method according to claim 5 or claim 6 wherein the quaternising agent is selected from dialkyl sulphates, benzyl halides, hydrocarbyl substituted carbonates, hydrocarbyl epoxides in combination with an acid, or mixtures thereof.

8. A method according to any preceding claim wherein the fuel composition further comprises one or more nitrogen-containing detergents.

9. A method according to claim 8 wherein the nitrogen-containing detergent is the reaction product of a hydrocarbyl-substituted carboxylic acid acylating agent and an amine.

10. A method according to any preceding claim wherein the fuel composition further comprises a metal-deactivating compound.

11. A method according to any preceding claim wherein after running the engine for 24 hours there is an increase in power output of at least 3%.

12. A method according to any preceding claim wherein the diesel fuel composition comprises from 0.1 to 10ppm of a metal containing species.

13. The use of an engine cleaning additive to remove deposits from a diesel engine, wherein the engine cleaning additive is the product of a Mannich reaction between:

(a) an aldehyde;

(b) ammonia, hydrazine or an amine; and

(c) an optionally substituted phenol;

wherein the or each substituent of the phenol component (c) has an average molecular weight of less than 400; wherein after running the engine for 32 hours, the engine has a power output of at least 97% of the power output obtained when using clean injectors; and wherein the engine has a pressure in excess of 1350 bar.

14. The use of an engine cleaning additive according to claim 13 in combination with a nitrogen-containing detergent.

Claims

1. A method of removing deposits from a diesel engine, the method comprising combusting in the engine a diesel fuel composition comprising an engine cleaning additive, wherein the engine cleaning additive is the product of a Mannich reaction between:
   (a) an aldehyde;
   (b) ammonia, hydrazine or an amine; and
   (c) an optionally substituted phenol;

   wherein the or each substituent of the phenol component (c) has an average molecular weight of less than 400.

2. A method according to claim 1 wherein component (b) is a polyethylene polyamine having from 2 to 8 nitrogen atoms.

3. A method according to any preceding claim wherein the engine cleaning additive is present in the diesel fuel composition in an amount of at least 30ppm.

4. A method according to any preceding claim wherein the diesel fuel composition further comprises a quaternary ammonium salt additive formed by the reaction of a nitrogen containing species having at least one tertiary amine group and a quarternizing agent.

5. A method according to claim 4 wherein the nitrogen containing species comprises:

   (i) the reaction product of a hydrocarbyl-substituted acylating agent and a compound comprising at least one tertiary amine group and a primary amine, secondary amine or alcohol group;

   (ii) a mannich reaction product comprising a tertiary amine group; and

   (iii) a polyalkylene substituted amine having at least one tertiary amine group.

6. A method according to claim 4 or claim 5 wherein the quaternising agent is selected from dialkyl sulphates, benzyl halides, hydrocarbyl substituted carbonates hydrocarbyl epoxides in combination with an acid, or mixtures thereof.

7. A method according to any preceding claim wherein the fuel composition further comprises one or more nitrogen-containing detergents.

8. A method according to claim 7 wherein the nitrogen-containing detergent is the reaction product of a hydrocarbyl-substituted carboxylic acid acylating agent and an amine.

9. A method according to any preceding claim wherein the fuel composition further comprises a metal-deactivating compound.

10. A method according to any preceding claim wherein the diesel engine has a high pressure fuel system.

11. A method according to any preceding claim wherein after running the engine for 24 hours there is an increase in power output of at least 3%.

12. A method according to any preceding claim wherein the diesel fuel composition comprises from 0.1 to 10ppm of a metal containing species.

13. A diesel fuel composition as described in any preceding claim.

14. The use of an engine cleaning additive to remove deposits from a diesel engine, wherein the engine cleaning additive is the product of a Mannich reaction between:

(a) an aldehyde;

(b) ammonia, hydrazine or an amine; and

(c) an optionally substituted phenol;

wherein the or each substituent of the phenol component (c) has an average molecular weight of less than 400.

15. The use of a combination of a quaternary ammonium salt and an engine cleaning additive to remove deposits from a diesel engine, wherein the engine cleaning additive is the product of a Mannich reaction between:

(a) an aldehyde;

(b) ammonia, hydrazine or an amine; and

(c) an optionally substituted phenol;

wherein the or each substituent of the phenol component (c) has an average molecular weight of less than 400.

16. The use of a combination of a nitrogen-containing detergent and an engine cleaning additive to remove deposits from a diesel engine, wherein the engine cleaning additive is the product of a Mannich reaction between:

(a) an aldehyde;

(b) ammonia, hydrazine or an amine; and

(c) an optionally substituted phenol;

wherein the or each substituent of the phenol component (c) has an average molecular weight of less than 400.