Summary

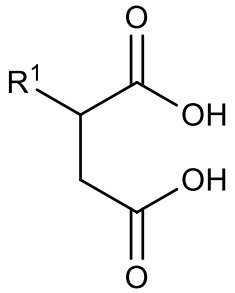
In one aspect, there is provided a diesel fuel composition comprising as an additive an ester compound which is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1; and wherein the diesel fuel composition comprises less than 50 ppm sulphur by weight.

In another aspect, there is provided a method of combatting deposits in a modern diesel engine having a high pressure fuel system, the method comprising combusting in the engine a diesel fuel composition comprising as an additive the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1

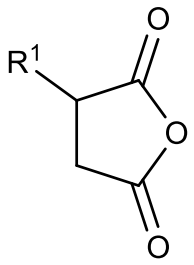
In yet another aspect, there is provided a use of an ester compound as a detergent additive in a diesel fuel composition in a modern diesel engine having a high pressure fuel system; wherein the ester compound is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1

Detailed Description

According to a first aspect of the present invention there is provided a diesel fuel composition comprising as an additive an ester compound which is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein the optionally substituted polycarboxylic acid or anhydride thereof is of formula (A3) or (A4):



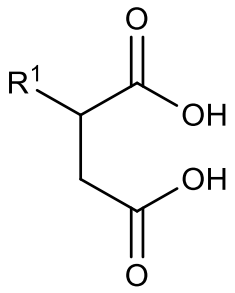
(A3)



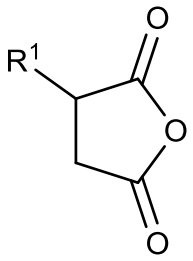
(A4)

wherein R^1 is an optionally substituted hydrocarbyl group having less than 30 carbon atoms; and wherein R is an optionally substituted alkylene group and n is at least 1.

According to a second aspect of the present invention there is provided a method of combatting deposits in a modern diesel engine having a pressure in excess of 1350 bar, the method comprising combusting in the engine a diesel fuel composition comprising as an additive an ester compound which is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1; wherein the optionally substituted polycarboxylic acid or anhydride thereof is of formula (A3) or (A4):



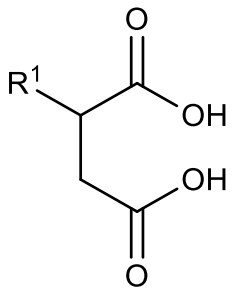
(A3)



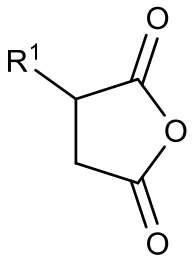
(A4)

wherein R^1 is an optionally substituted hydrocarbyl group having less than 30 carbon atoms.

According to a third aspect of the present invention there is provided the use of an ester compound as a detergent additive in a diesel fuel composition in a modern diesel engine having a pressure in excess of 1350 bar; wherein the compound is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1; wherein the optionally substituted polycarboxylic acid or anhydride thereof is of formula (A3) or (A4):



(A3)



(A4)

wherein R^1 is an optionally substituted hydrocarbyl group having less than 30 carbon atoms.

The method of the second aspect preferably involves combusting in the engine a composition of the first aspect.

Preferred features of the first, second and third aspects of the invention will now be described. Any feature of any aspect may be combined with any feature of any other aspect as appropriate.

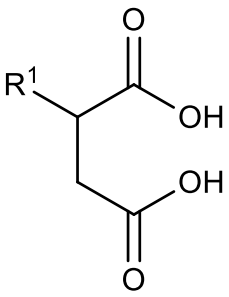
The present invention relates to a composition, a method and a use involving a fuel additive. This additive is the reaction product of a polyhydric alcohol of formula $H-(OR)_n-OH$ and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof. The additive may be referred to herein as “the additive of the present invention” or as “the ester additive”.

The ester additive may comprise a single compound. In some embodiments mixtures containing more than one ester additive may be used. References herein to “an additive” of the invention or “the additive” include mixtures comprising two or more such compounds.

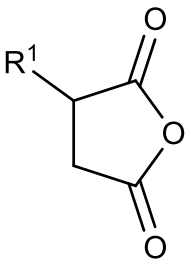
The ester additive of the present invention is prepared from an optionally substituted acid/anhydride and a polyhydric alcohol which is present in an amount or at least 1.5 molar equivalents compared with the polyhydric alcohol $H(OR)_nOH$.

Claims

1. A diesel fuel composition comprising as an additive an ester compound which is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1; wherein the optionally substituted polycarboxylic acid or anhydride thereof is of formula (A3) or (A4):



(A3)

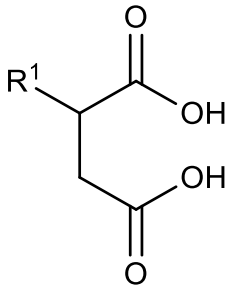


(A4)

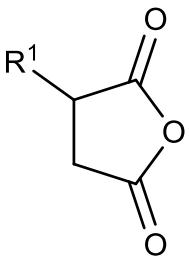
wherein R^1 is an optionally substituted hydrocarbyl group having less than 30 carbon atoms

and wherein the diesel fuel composition comprises less than 50 ppm sulphur by weight.

2. A method of combatting deposits in a modern diesel engine having a pressure in excess of 1350 bar, the method comprising combusting in the engine a diesel fuel composition comprising as an additive the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1; wherein the optionally substituted polycarboxylic acid or anhydride thereof is of formula (A3) or (A4):



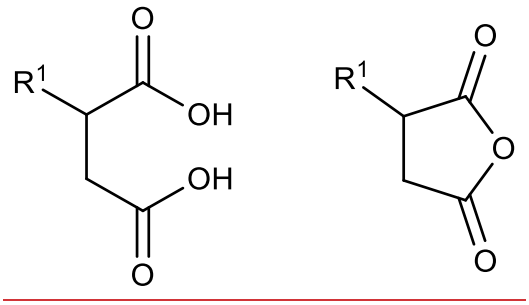
(A3)



(A4)

wherein R^1 is an optionally substituted hydrocarbyl group having less than 30 carbon atoms.

3. Use of an ester compound as a detergent additive in a diesel fuel composition in a modern diesel engine having a pressure in excess of 1350 bar; wherein the ester compound is the reaction product of a polyhydric alcohol of formula H-$(OR)_n$-OH and at least 1.5 molar equivalents of an optionally substituted polycarboxylic acid or an anhydride thereof, wherein R is an optionally substituted alkylene group and n is at least 1; wherein the optionally substituted polycarboxylic acid or anhydride thereof is of formula (A3) or (A4):



(A3) (A4)

wherein R^1 is an optionally substituted hydrocarbyl group having less than 30 carbon atoms.

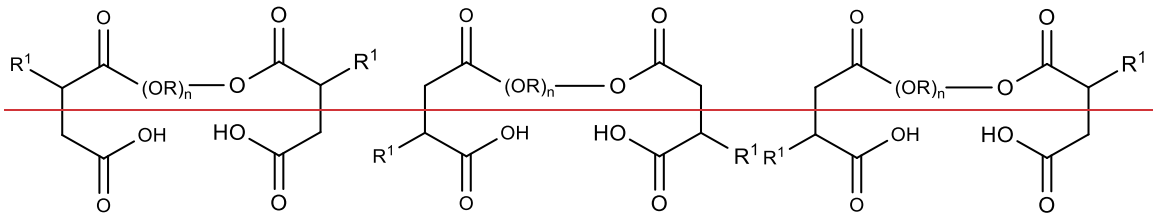
~~4. A method or use according to any preceding claim wherein the optionally substituted polycarboxylic acid or anhydride thereof is a hydrocarbyl substituted succinic acid or a hydrocarbyl substituted succinic anhydride.~~

~~5~~4. A composition, method or use according to any preceding claim wherein each R is ethylene or propylene, preferably $-CH_2CH_2-$ or $-CH(CH_3)CH_2-$, more preferably $-CH(CH_3)CH_2-$; and n is from 1 to 20.

~~6. A method or use according to any preceding claim wherein the polycarboxylic acid or anhydride thereof includes an optionally substituted alkyl or alkenyl group having 6 to 100 carbon atoms, preferably 6 to 50 carbon atoms.~~

~~7~~5. A composition, method or use according to any preceding claim wherein the optionally substituted polycarboxylic acid or hydrocarbyl substituted anhydride and alcohol of formula H-(OR)n-OH are reacted in a molar ratio of from 2.5:1 to 1.8:1.

~~8. A method or use according to any preceding claim wherein the additive comprises compounds of formula (C1), (C2) or (C3):~~

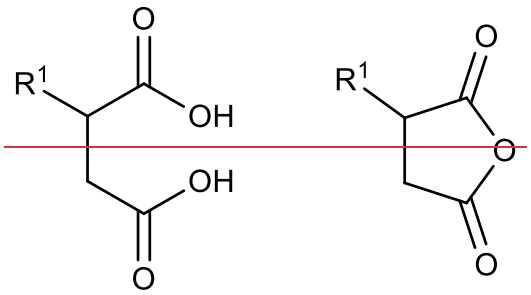


(C1) (C2) (C3)

and isomers and mixtures thereof,

wherein R^1 is hydrogen or an optionally substituted hydrocarbyl group.

9. A method or use according to any preceding claim wherein the additive comprises the reaction product of an alcohol of formula $H-(OR)_n-OH$ selected from ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, dipropylene glycol, tripropylene glycol, tetrapropylene glycol, trehalose, sorbitol, glycerol, pentaerythritol, trimethylolpropane, 1,3-propanediol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 1,6-hexanediol, neopentyl glycol and a polyethylene or polypropylene glycol having a number average molecular weight of 300 to 1200; and at least 1.5 molar equivalents of one or more optionally substituted succinic acids or anhydrides of formula (A3) or (A4):

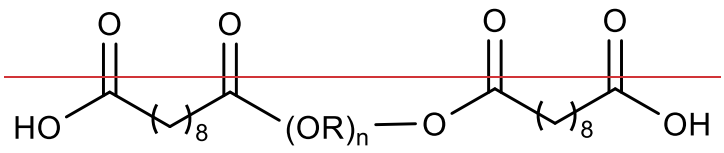


(A3) (A4)

wherein each R^1 is an alkyl or alkenyl group having 6 to 36 carbon atoms or a polyisobutenyl group having a number average molecular weight of from 200 to 1300.

10. A composition, method or use according to any preceding claim wherein the additive comprises the reaction product an alcohol selected from 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, tripropylene glycol and polypropylene glycols having a number average molecular weight of from 300 to 600 and at least 1.5 molar equivalents of a succinic acid or anhydride having a C_{20} to C_{24} alkyl or alkenyl substituent.

~~11. A method or use according to any preceding claim wherein the additive comprises a compound of formula (D):~~



~~(D)~~

~~12~~7. A method or use according to any of claims 2 to ~~11~~ 6 which achieves “keep clean” performance.

~~13~~8. A method or use according to any of claims 2 to ~~12~~ 7 which achieves “clean up” performance.

~~14~~9. A method according to any of claims 2 and 4 to ~~13~~ 8 wherein the deposits are injector deposits.

~~15~~10. A method according to claim ~~14~~ 9 wherein the deposits are internal diesel injector deposits.

~~16~~11. A method or use according to any of claims 2 to ~~15~~ 10 wherein the diesel fuel composition comprises less than 50 ppm sulphur by weight.

~~17~~12. A composition, method or use according to any preceding claim wherein the diesel fuel composition comprises biodiesel.

~~18~~13. A composition, method or use according to any preceding claim wherein the diesel fuel composition comprises one or more further detergents selected from:

(i) a quaternary ammonium salt additive;

(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 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.

~~19~~14. A composition, method or use according to any preceding claim wherein the diesel fuel composition comprises a mixture of two or more ester additives.

~~20~~15. A method or use according to any of claims 2 to ~~19~~ 14 which achieves an improvement in performance selected from one or more of:

- a reduction in power loss of the engine;
- a reduction in external diesel injector deposits;
- a reduction in internal diesel injector deposits;
- an improvement in fuel economy;
- a reduction in fuel filter deposits;
- a reduction in emissions; and
- an increase in maintenance intervals.

~~21~~16. A method or use according to claim ~~20~~ 15 which provides an improvement in performance in modern diesel engines having a high pressure fuel system and provides an improvement in performance in traditional diesel engines.

~~22~~17. Use according to any of claims 3 to ~~13~~ 8 and ~~16~~ 11 to ~~22~~ 16 which provides one or more further benefits selected from lubricity benefits, corrosion inhibition and cold flow improvement.

~~23~~18. A composition according to any of claims 1, 4 to ~~11~~ 6 and ~~17~~ 12 to ~~19~~ 14 which further comprises one or more further additives selected from lubricity improvers, corrosion inhibitors and cold flow improvers.