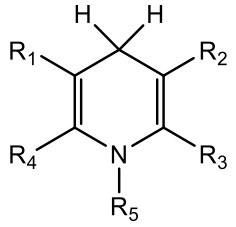
CLAIMS

1. A fuel composition comprising (1) greater than 50 wt. % of a hydrocarbon fuel boiling in gasoline or diesel range and (2) a minor amount of one or more of organic hydride-based reductant, wherein the one or more organic hydride-based reductant is:

(a) a DHPD-type reductant as illustrated by generalized structure Formula 1



Formula 1

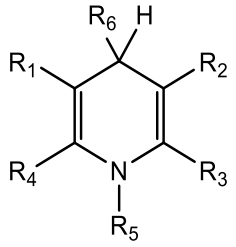
wherein:

R_1 and R_2, are each component independently selected from the following group: H, ester moiety, amide moiety, and cyanide moiety;

R_3 and R_4 are each component independently selected from the following group: H, and alkyl moiety; and

R_5 is a component selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, benzyl moiety, and alkanol moiety;

(b) a NADH-type reductant as illustrated by generalized structure Formula 2



Formula 2

wherein:

R_1 and R_2 are each component independently selected from the following group: H, ester moiety, amide moiety, and cyanide moiety;

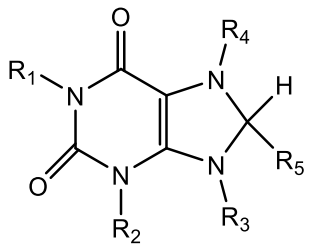
R_3 and R_4 are each component independently selected from the following group: H, and alkyl moiety;

R_5 is a component selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, benzyl moiety, and alkanol moiety;

R_6 is selected from the following group: H, and alkyl moiety; and

optionally wherein R_1 and R_4 or R_2 and R_3 form a cyclic or heterocyclic structure;

(c) a methylene tetrahydromethanopterin-type reductant as illustrated by generalized structure Formula 3,



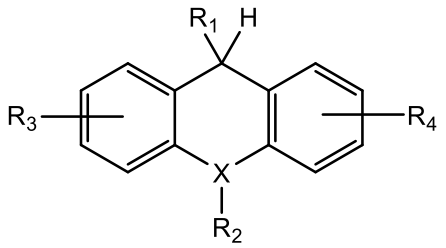
Formula 3

wherein:

R_1, R_2, R_3 and R_4 are each component independently selected from the following group: H, alkyl moiety, allyl moiety, and alkanol moiety; and

R_5 is selected from the following group: H, and alkyl moiety;

(d) an acridine-type reductant as illustrated by generalized structure Formula 4



Formula 4

wherein X is N or O; and

when X is N:

R_1 is selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, and benzyl moiety;

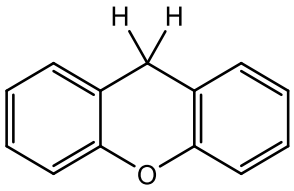
R_2 is selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, benzyl moiety, and alkanol moiety;

R_3 and R_4 are each component independently selected from the following group: H, alkyl moiety, aryl moiety, benzyl moiety, amine moiety, alkoxy moiety, and heteroatoms;

optionally wherein R_3 as well as R_4 independently occupy more than one substitution position within its respective rings; and

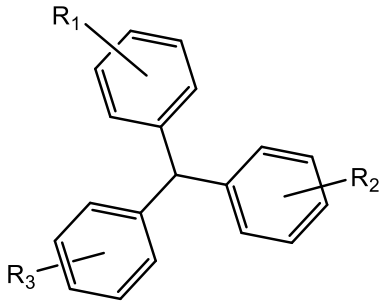
optionally wherein R_1 and R_3 or R_1 and R_4 form a cyclic structure;

when X is O, the acridine-type reductant is as illustrated by structure Formula 4H



Formula 4H

(e) a triarylmethane-type reductant as illustrated by generalized structure Formula 5



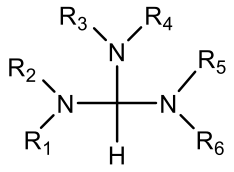
Formula 5

wherein:

R_1, R_2, and R_3 are independently selected from the following group: H, alkyl moiety, aryl moiety, benzyl moiety, allyl moiety, amide moiety, ester moiety, ether moiety, hydroxyl moiety, and amine moiety;

optionally wherein R_1, R_2, and R_3 independently occupy more than one substitution position in their respective ring;

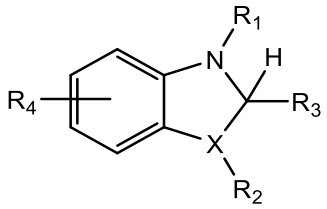
(f) a triamine-type reductant as illustrated by generalized structure Formula 6



Formula 6

wherein R_1, R_2, R_3, R_4, R_5, and R_6 are connected to form three cyclic rings;

(g) an aryl benzoimidazoline-type reductant as illustrated by generalized structure Formula 7



Formula 7

wherein:

X is N, O, or S;

when X is N:

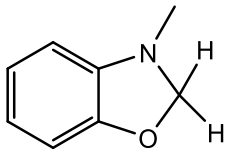
R1 and R2 are each component independently selected from the following group: H, and alkyl moiety;

R_3 is selected from the following group: H, alkyl moiety, alkene moiety, alkyne moiety, aryl moiety, and benzyl moiety; and

R_4 is selected from the following group: H, alkyl moiety, aryl moiety, benzyl moiety, and allyl moiety;

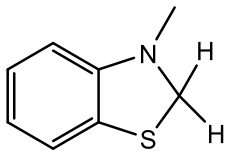
optionally wherein R_4 independently occupies more than one substitution position;

when X is O, the aryl benzoimidazoline-type reductant is as illustrated by structure Formula 7I



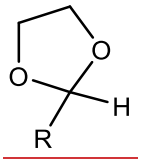
Formula 7I

when X is S, the aryl benzoimidazoline-type reductant is as illustrated by structure Formula 7J



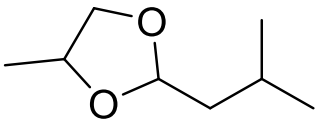
Formula 7J

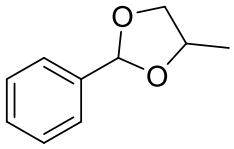
(h) a dioxolane-type reductant as illustrated by generalized structure Formula 8



Formula 8

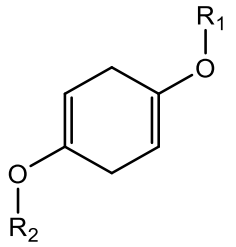
wherein R is a component selected from the following group: H, alkyl moiety, allyl moiety, benzyl moiety, and alkanol moiety; or dioxolane-type reductant as illustrated by structure Formulas 8D and 8E:





Formula 8D Formula 8E

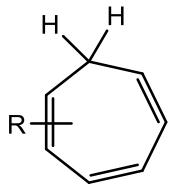
(i) a diethercyclohexadiene-type reductant as illustrated by generalized structure Formula 9



Formula 9

wherein R is a component selected from the following group: H, alkyl moiety, allyl moiety, benzyl moiety, and alkanol moiety; or

(j) a cycloheptatriene-type reductant as illustrated by generalized structure Formula 10



Formula 10

wherein R is a component selected from the following group: H, alkyl moiety, allyl moiety, benzyl moiety, and alkanol moiety; optionally wherein R occupies more than one substitution position.

2. The fuel composition of claim 1, wherein the organic hydride-based reductant is substantially free of halogen, boron, or silicon.

~~3. The fuel composition of claim 1, wherein the organic hydride-based reductant is dihydropyridine, nicotinamide adenine dinucleotide, methylene tetrahydromethanopterin, acridine, triarylmethane, hexahydro triazaphenalene, triamine, aryl benzoimidazoline, dioxolane, diethercyclohexadiene, cycloheptatriene, flavin adenine dinucleotide, or an analog thereof.~~

~~4~~3. The fuel composition of claim 1, wherein the organic hydride-based reductant is present in 25 to 5000 ppm by weight.

~~5~~4. The fuel composition of claim 1, wherein the organic hydride-based reductant is present in 250 to 2000 ppm by weight.

~~6~~5. The fuel composition of claim 1, further comprising:

oxygenate, anti-knock agent, detergent, dispersant, friction modifier, antioxidant, metal deactivator, demulsifier, pour point depressant, flow improver, cetane improver, or lubricity additive.

~~7~~6. A method of preventing or reducing undesirable ignition events in an internal combustion engine, the method comprising:

supplying to the engine, a fuel composition ~~comprising (1) greater than 50 wt.% of a hydrocarbon fuel boiling in gasoline or diesel range and (2) a minor amount of one or more of organic hydride-based reductant~~according to any one of claims 1-5.

7. A method of preventing or reducing low-speed pre-ignition events in an internal combustion engine, the method comprising:

supplying to the engine, a fuel composition comprising (1) greater than 50 wt.% of a base oil and (2) a minor amount of one or more of an organic hydride-based reductant as defined in claim 1.

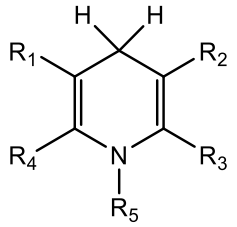
8. The method of claims 6-7, wherein the internal combustion engine is spark-ignited.

9. The method of claims 6-7, wherein the internal combustion engine is operated at less than 3000 rpm.

10. The method of claims 6-7, wherein the spark-ignited internal combustion engine is operated under a load with a brake mean effective pressure of at least 1 MPa (10 bar).

11. A lubricating oil composition comprising (1) greater than 50 wt. % of a base oil and (2) a minor amount of one or more of an organic hydride-based reductant, wherein the one or more organic hydride-based reductant is;

(a) a DHPD-type reductant as illustrated by generalized structure Formula 1



Formula 1

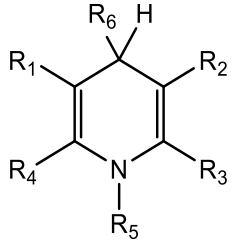
wherein:

R_1 and R_2, are each component independently selected from the following group: H, ester moiety, amide moiety, and cyanide moiety;

R_3 and R_4 are each component independently selected from the following group: H, and alkyl moiety; and

R_5 is a component selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, benzyl moiety, and alkanol moiety;

(b) a NADH-type reductant as illustrated by generalized structure Formula 2



Formula 2

wherein:

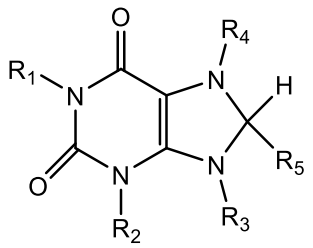
R_1 and R_2 are each component independently selected from the following group: H, ester moiety, amide moiety, and cyanide moiety;

R_3 and R_4 are each component independently selected from the following group: H, and alkyl moiety;

R_5 is a component selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, benzyl moiety, and alkanol moiety;

R_6 is selected from the following group: H, and alkyl moiety; and optionally wherein R_1 and R_4 or R_2 and R_3 form a cyclic or heterocyclic structure;

(c) a methylene tetrahydromethanopterin-type reductant as illustrated by generalized structure Formula 3,



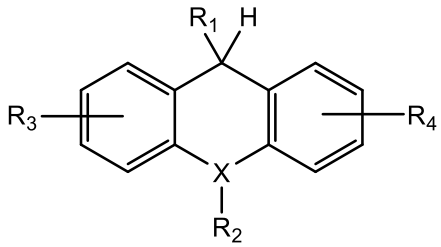
Formula 3

wherein:

R_1, R_2, R_3 and R_4 are each component independently selected from the following group: H, alkyl moiety, allyl moiety, and alkanol moiety; and

R_5 is selected from the following group: H, and alkyl moiety;

(d) an acridine-type reductant as illustrated by generalized structure Formula 4



Formula 4

wherein X is N or O; and

when X is N:

R_1 is selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, and benzyl moiety;

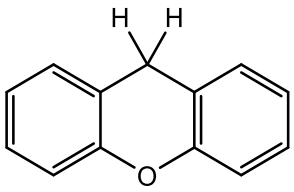
R_2 is selected from the following group: H, alkyl moiety, allyl moiety, aryl moiety, benzyl moiety, and alkanol moiety;

R_3 and R_4 are each components independently selected from the following group: H, alkyl moiety, aryl moiety, benzyl moiety, amine moiety, alkoxy moiety, and heteroatoms;

optionally wherein R_3 as well as R_4 independently occupy more than one substitution position within its respective rings; and

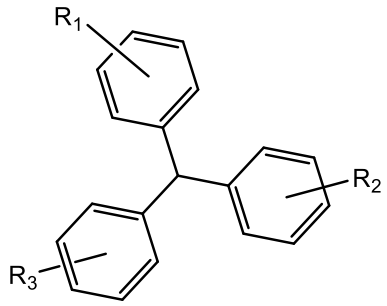
optionally wherein R_1 and R_3 or R_1 and R_4 form a cyclic structure;

when X is O, the acridine-type reductant is as illustrated by structure Formula 4H



Formula 4H

(e) a triarylmethane-type reductant as illustrated by generalized structure Formula 5



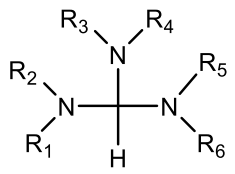
Formula 5

wherein:

R_1, R_2, and R_3 are independently selected from the following group: H, alkyl moiety, aryl moiety, benzyl moiety, allyl moiety, amide moiety, ester moiety, ether moiety, hydroxyl moiety, and amine moiety;

optionally wherein R_1, R_2, and R_3 independently occupy more than one substitution position in their respective ring;

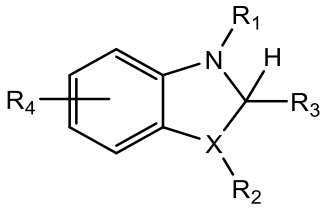
(f) a triamine-type reductant as illustrated by generalized structure Formula 6



Formula 6

wherein R_1, R_2, R_3, R_4, R_5, and R_6 are connected to form three cyclic rings;

(g) an aryl benzoimidazoline-type reductant as illustrated by generalized structure Formula 7



Formula 7

wherein:

X is N, O, or S;

when X is N:

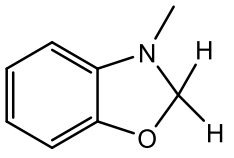
R1 and R2 are each components independently selected from the following group: H, and alkyl moiety;

R_3 is selected from the following group: H, alkyl moiety, alkene moiety, alkyne moiety, aryl moiety, and benzyl moiety; and

R_4 is selected from the following group: H, alkyl moiety, aryl moiety, benzyl moiety, and allyl moiety;

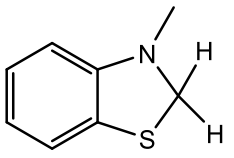
optionally wherein R_4 independently occupies more than one substitution position;

when X is O, the aryl benzoimidazoline-type reductant is as illustrated by structure Formula 7I



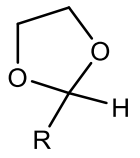
Formula 7I

when X is S, the aryl benzoimidazoline-type reductant is as illustrated by structure Formula 7J



Formula 7J

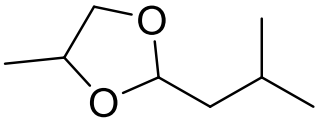
(h) a dioxolane-type reductant as illustrated by generalized structure Formula 8

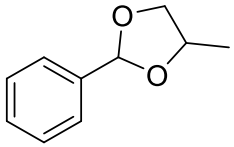


Formula 8

wherein R is a component selected from the following group: H, alkyl moiety, allyl

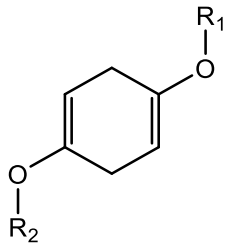
moiety, benzyl moiety, and alkanol moiety; or dioxolane-type reductant as illustrated by structure Formulas 8D and 8E:





Formula 8D Formula 8E

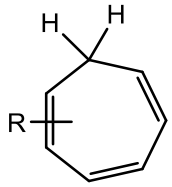
(i) a diethercyclohexadiene-type reductant as illustrated by generalized structure Formula 9



Formula 9

wherein R is a component selected from the following group: H, alkyl moiety, allyl moiety, benzyl moiety, and alkanol moiety; or

(j) a cycloheptatriene-type reductant as illustrated by generalized structure Formula 10



Formula 10

wherein R is a component selected from the following group: H, alkyl moiety, allyl moiety, benzyl moiety, and alkanol moiety; optionally wherein R occupies more than one substitution position.

12. The lubricating oil composition of claim 11, wherein the organic hydride-based reductant is substantially free of halogen, boron, or silicon.

~~13. The lubricating oil composition of claim 11, wherein the organic hydride-based reductant is dihydropyridine, nicotinamide adenine dinucleotide, methylene~~

~~tetrahydromethanopterin, acridine, triarylmethane, hexahydro triazaphenalene, triamine, aryl benzomidazoline, dioxolane, diethercyclohexadiene, cycloheptatriene, flavin adenine dinucleotide, or an analog thereof.~~

~~14~~13. The lubricating oil composition of claim 11, wherein the organic hydride-based reductant is present in 0.001 to 10% by weight.

~~15~~14. The lubricating oil composition of claim 11, wherein the organic hydride-based reductant is present in 0.5 to 5% by weight.

~~16~~15. The lubricating oil composition of claim 11, further comprising:

antioxidant, ashless dispersant, anti-wear agent, detergent, rust inhibitor, dehazing agent, demulsifying agent, friction modifier, metal deactivating agent, pour point depressant, viscosity modifier, antifoaming agent, co-solvent, package compatibilizer, corrosion-inhibitor, dye, or extreme pressure agent.

~~17~~16. A method of preventing or reducing undesirable ignition events in an internal combustion engine, the method comprising:

supplying to the engine a lubricating oil composition ~~comprising (1) greater than 50 wt. % of a base oil and (2) a minor amount of one or more of an organic hydride-based reductant~~as defined in any one of claims 11-15.

17. A method of preventing or reducing low-speed pre-ignition events in an internal combustion engine, the method comprising:

supplying to the engine a lubricating oil composition comprising (1) greater than 50 wt.% of a base oil and (2) a minor amount of one or more of an organic hydride-based reductant as defined in claim 11.

18. The method of claims ~~17~~16-17, wherein the internal combustion engine is spark-ignited.

19. The method of claims ~~17~~16-17, wherein the internal combustion engine is operated at less than 3000 rpm.

20. The method of claims ~~17~~16-17, wherein the internal combustion engine is operated under a load with a brake mean effective pressure of at least 1 MPa (10 bar).