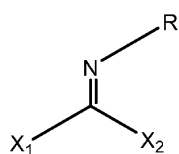


CLAIMS

1. A fuel composition comprising (1) greater than 50 wt % of a hydrocarbon fuel boiling in the gasoline or diesel range and (2) a minor amount of one or more of:

a primary low-speed pre-ignition (LSPI)-reducing additive comprising (i) an amino additive, (ii) an amine additive, (iii) a triazole additive, (iv) a benzamidine additive, (v) a benzoxazole additive, or (vi) a N=C-X motif additive having a structure of



wherein X₁ and X₂ are independently H, C, N, O, or S; and

wherein X₁ or X₂ independently includes one or more C₁-C₂₀ alkyl group or one or more aromatic group.

2. The fuel composition of claim 1, wherein the amino additive is a beta-amino alkanol, an amino acid, or an amino ester.

3. The fuel composition of claim 1, wherein the amine additive is aromatic amine or aliphatic amine.

4. The fuel composition of claim 1, wherein the triazole additive is 5,6-dimethylbenzotriazole.

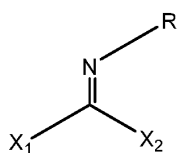
5. The fuel composition of claim 1, wherein the primary LSPI-reducing additive is prolinol, aliquat, morphguam, 2-aminobenzimidazole, AHPD, N,N-dimethyl-N-octylbenzamidine-2-oxide, benzoxazole, 2-methylquinolin-8-amine, or 2-aminobenzoxazole.

6. The fuel composition of claim 1, wherein the N=C-X motif additive is an amidine, a guanidine, an imidazole, a benzamidine, a benzimidazole, or an amino benzimidazole.
7. The fuel composition of claim 6, wherein the amidine is 1,4,5,6-tetrahydropyrimidine, 1,2-dimethyl-1,4,5,6-tetrahydropyrimidine, 1,2-diethyl-1,4,5,6-tetrahydropyrimidine, 1,5-diazabicyclo[4.3.0]non-5-ene (DBN), 2-phenyl-1H-benzo[d]imidazole, or 1,8-diazabicyclo[5.4.0]-undec-7-ene (DBU).
8. The fuel composition of claim 6, wherein the guanidine is 1,1,3,3-tetramethylguanidine (TMG), 2-tert-butyl-1,1,3,3-tetramethylguanidine (BTMG), 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD), 1,2-diphenylguanidine, or 7-methyl-1,5,7-triazabicyclo[4.4.0]dec-5-ene (MTBD).
9. The fuel composition of claim 1, further comprising:
a secondary LSPI-reducing additive comprising an acid additive, a phenol additive, a 1,3 dicarbonyl additive, a hydroxamide additive, antioxidant additive, or salicylate additive.
10. The fuel composition of claim 9, wherein the primary LSPI-reducing additive and the secondary LSPI-reducing additive form a salt.
11. The fuel composition of claim 9, wherein the acid additive is an aliphatic acid, an unsaturated acid, an alkylaromatic acid, an aromatic acid, a hydroxy acid, or an amino acid.
12. The fuel composition of claim 9, wherein the secondary LSPI-reducing additive is 2-ethylhexanoate, isostreate, proline, diketone, oleate, toluene, tetraline carboxylate,

phenoxide, phenol carboxylate, hydroxy acid, 2-hydroxy-5-(tetracos-1,3,5,7,9,11,13,15,17,19,21,23-dodecayn-1-yl)benzoic acid--dihydrogen or ketoester.

13. A fuel concentrate comprising (1) from 90 to 30 wt % of an organic solvent boiling in a range of from 65°C to 205°C and (2) from 10 to 70 wt % of an additive component selected from one or more of

(i) an amino additive, (ii) an amine additive, (iii) a triazole additive, (iv) a benzamidinium additive, (v) a benzoxazole additive, or (vi) a N=C-X motif additive having a structure of



wherein X_1 and X_2 are independently H, C, N, O, or S; and

wherein X_1 or X_2 independently includes one or more C_1 - C_{20} alkyl group or one or more aromatic group.

14. The fuel concentrate of claim 13, wherein the amino additive is a beta-amino alkanol, an amino acid, or an amino ester.

15. The fuel concentrate of claim 13, wherein the amine additive is aromatic amine or aliphatic amine.

16. The fuel concentrate of claim 13, wherein the triazole additive is 5,6-dimethylbenzotriazole.

17. The fuel concentrate of claim 13, primary LSPI-reducing additive is prolinol, aliquat, morphguam, 2-aminobenzimidazole, AHPD, N,N-dimethyl-N-

octylbenzamidine-2-oxide, benzoxazole, 2-methylquinolin-8-amine, or 2-aminobenzoxazole.

18. The fuel concentrate of claim 13, wherein the N=C-X motif additive is an amidine, a guanidine, an imidazole, a benzamidine, a benzimidazole, or an amino benzimidazole.

19. The fuel concentrate of claim 18, wherein the amidine is 1,4,5,6-tetrahydropyrimidine, 1,2-dimethyl-1,4,5,6-tetrahydropyrimidine, 1,2-diethyl-1,4,5,6-tetrahydropyrimidine, 1,5-diazabicyclo[4.3.0]non-5-ene (DBN), 2-phenyl-1H-benzo[d]imidazole, or 1,8-diazabicyclo[5.4.0]-undec-7-ene (DBU).

20. The fuel concentrate of claim 18, wherein the guanidine is 1,1,3,3-tetramethylguanidine (TMG), 2-tert-butyl-1,1,3,3-tetramethylguanidine (BTMG), 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD), 1,2-diphenylguanidine, or 7-methyl-1,5,7-triazabicyclo[4.4.0]dec-5-ene (MTBD).

21. The fuel concentrate of claim 13, further comprising:

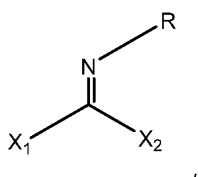
a secondary LSPI-reducing additive comprising an acid additive, a phenol additive, a 1,3 dicarbonyl additive, a hydroxamide additive, an antioxidant additive, or a salicylate additive.

22. The fuel concentrate of claim 21, wherein the acid additive is an aliphatic acid, an unsaturated acid, an alkylaromatic acid, an aromatic acid, a hydroxy acid, or an amino acid.

23. The fuel concentrate of claim 21, wherein the secondary LSPI-reducing additive is 2-ethylhexanoate, isostreate, proline, diketone, oleate, toluene, tetraline carboxylate, phenoxide, phenol carboxylate, hydroxy acid, or ketoester.

24. A lubricating oil composition comprising (1) greater than 50 wt % of a base oil and (2) 0.01 to 15 wt % of a component selected from one or more of

a primary low-speed pre-ignition (LSPI)-reducing additive comprising (i) an amino additive, (ii) an amine additive, (iii) a triazole additive, (iv) a benzamidinium additive, (v) a benzoxazole additive, or (vi) a N=C-X motif additive having a structure of



wherein X_1 and X_2 are independently H, C, N, O, or S; and

wherein X_1 or X_2 independently includes one or more C_1 - C_{20} alkyl group or one or more aromatic group.

25. The lubricating oil composition of claim 24, wherein the amino additive is a beta-amino alkanol, an amino acid, or an amino ester.

26. The lubricating oil composition of claim 24, wherein the amine additive is aromatic amine or aliphatic amine.

27. The lubricating oil composition of claim 24, wherein the triazole additive is 5,6-dimethylbenzotriazole.

28. The lubricating oil composition of claim 24, wherein the primary LSPI-reducing additive is prolinol, aliquat, morphguam, 2-aminobenzimidazole, AHPD, N,N-dimethyl-N-octylbenzamidinium-2-oxide, benzoxazole, 2-methylquinolin-8-amine, or 2-aminobenzoxazole.

29. The lubricating oil composition of claim 24, wherein the N=C-X motif additive is an amidine, a guanidine, an imidazole, a benzamidine, a benzimidazole, or an amino benzimidazole.

30. The lubricating oil composition of claim 29, wherein the amidine is 1,4,5,6-tetrahydropyrimidine, 1,2-dimethyl-1,4,5,6-tetrahydropyrimidine, 1,2-diethyl-1,4,5,6-tetrahydropyrimidine, 1,5-diazabicyclo[4.3.0]non-5-ene (DBN), 2-phenyl-1H-benzo[d]imidazole, or 1,8-diazabicyclo[5.4.0]-undec-7-ene (DBU).

31. The lubricating oil composition of claim 29, wherein the guanidine is 1,1,3,3-tetramethylguanidine (TMG), 2-tert-butyl-1,1,3,3-tetramethylguanidine (BTMG), 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD), 1,2-diphenylguanidine, or 7-methyl-1,5,7-triazabicyclo[4.4.0]dec-5-ene (MTBD).

32. The lubricating oil composition of claim 24, further comprising:
a secondary LSPI-reducing additive comprising an acid additive, a phenol additive, a 1,3 dicarbonyl additive, a hydroxamide additive, antioxidant additive, or salicylate additive.

33. The lubricating oil composition of claim 32, wherein the secondary LSPI-reducing additive is 2-ethylhexanoate, isostreate, proline, diketone, oleate, toluene, tetraline carboxylate, phenoxide, phenol carboxylate, hydroxy acid, or ketoester.

34. A method for preventing or reducing low speed pre-ignition events in a spark-ignited internal combustion engine, the method comprising supplying to the engine the lubricating oil composition comprising of claim 24.

35. The method of claim 34, wherein the spark-ignited internal combustion engine is operated at a speed of less than 3000 rpm.

36. The method of claim 34, wherein the spark-ignited internal combustion engine is operated under a load with a brake mean effective pressure of at least 10 bar (1 MPa).

37. A method for preventing or reducing low speed pre-ignition events in a spark-ignited internal combustion engine, the method comprising supplying to the engine the fuel composition comprising of claim 1.

38. The method of claim 37, wherein the spark-ignited internal combustion engine is operated at a speed of less than 3000 rpm.

39. The method of claim 37, wherein the spark-ignited internal combustion engine is operated under a load with a brake mean effective pressure of at least 10 bar (1 MPa).