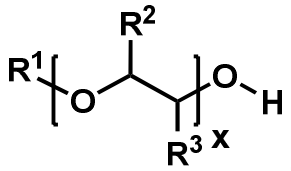
CLAIMS

1. A fuel composition comprising:

i) a hydrocarbon-based fuel boiling in the gasoline or diesel range;

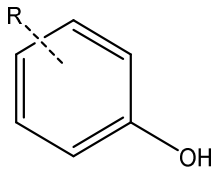
ii) a carrier fluid comprising a compound having the following structure:



,

wherein each R^2 and R^3 is independently hydrogen, C_1-C_4 hydrocarbyl group, or C_1-C_3 alcohol, wherein R^1 is C_4-C_{100} hydrocarbyl group, carboxyl group, ether group, thioether group, or aromatic group, wherein x is from 1 to 20;

or a hydrocarbyl phenol having the following structure:



wherein R is a hydrocarbyl group from C_4-C_{100};

iii) an amine-based detergent having the following formula,

$$R^4\text{-}O\text{-}(CH_2)_y\text{-}NHR^5,$$

wherein the amine-based detergent is present in 10 ppm to 750 ppm by weight based on total weight of the fuel composition; wherein R^4 is a hydrocarbyl group having 8 to 20 carbons, R^5 is hydrogen or $(CH_2)_zNH_2$ moiety, and wherein y, z are independently integers having a value of 2 or greater; and

iv) one or more nitrogen-containing detergent.

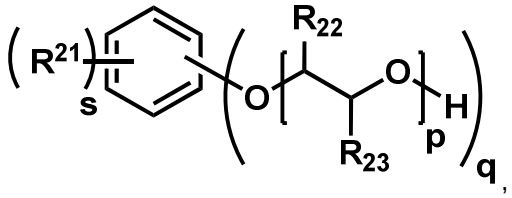
2. The fuel composition of claim 1, wherein the carboxyl group is a carboxylic acid, ester, amide, or ketone.

3. The fuel composition of claim 1, wherein the C_1 – C_3 alcohol has a structure represented by

$$-[CH_2]_w-OH$$

wherein w is 1 to 3.

4. The fuel composition of claim 1, wherein the compound is represented by the following structure:



wherein each R^{22} and R^{23} is independently hydrogen, C_1-C_4 hydrocarbyl group, or C_1-C_3 alcohol; wherein p is from 1 to 20, q is from 1 to 3, s is from 1 to 3, wherein q + s < 6; and R^{21} is C_1-C_{100} hydrocarbyl group, carboxyl group, ether group, thioether group, amino alkyl group, or hydroxyl group.

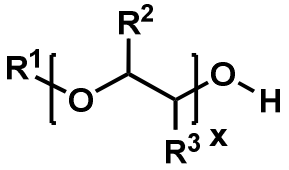
5. The fuel composition of claim 1, wherein the fuel composition comprises 50 ppmw to 2000 ppmw of the carrier fluid or 100 ppmw to 750 ppmw of the amine-based detergent.

6. A method for controlling carbon deposits in an internal combustion engine comprising:

providing a fuel in the internal combustion engine, wherein the fuel comprises:

i) a hydrocarbon-based fuel boiling in the gasoline or diesel range;

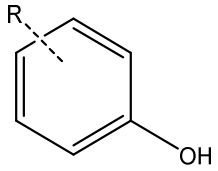
ii) a carrier fluid comprising an alkyl polyethoxylated having the following structure:



,

wherein each R^2 and R^3 is independently hydrogen, C_1-C_4 hydrocarbyl group, or C_1-C_3 alcohol, wherein R^1 is C_4-C_{100} hydrocarbyl group, carboxyl group, ether group, thioether group, or aromatic group, wherein x is from 1 to 20,

or a hydrocarbyl phenol having the following structure:



wherein R is a hydrocarbyl group from C_4-C_{100};

iii) an amine-based detergent having the following formula, R^4-O-$(CH_2)_y$-NHR^5,

wherein the amine-based detergent is present in 10 ppm to 750 ppm by weight based on total weight of the fuel composition; wherein R^4 is a hydrocarbyl group having 8 to 20 carbons, R^5 is hydrogen or $(CH_2)_zNH_2$ moiety, and wherein y, z are independently integers having a value of 2 or greater; and

iv) one or more nitrogen-containing detergent.

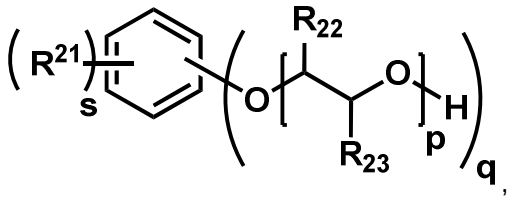
7. The method of claim 6, wherein the carboxyl group is a carboxylic acid, ester, amide, or ketone.

8. The method of claim 6, wherein the C_1 – C_3 alcohol has a structure represented by

$$-[CH_2]_w-OH$$

wherein w is 1 to 3.

9. The method of claim 6, wherein the compound is represented by the following structure:



wherein each R^{22} and R^{23} is independently hydrogen, C_1-C_4 hydrocarbyl group, or C_1-C_3 alcohol; wherein p is from 1 to 20, q is from 1 to 3, s is from 1 to 3, wherein q + s < 6; and R^{21} is C_1-C_{100} hydrocarbyl group, carboxyl group, ether group, thioether group, amino alkyl group, or hydroxyl group.

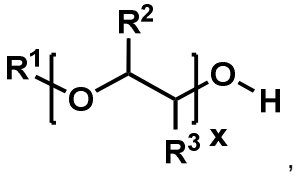
10. The method of claim 6, wherein the fuel composition comprises 50 ppmw to 2000 ppmw of the carrier fluid.

11. A concentrate composition comprising:

30 to 90 wt % of an organic solvent boiling in a range of from 65°C to 205°C and;

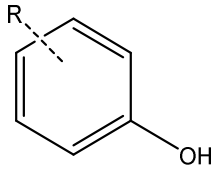
10 to 70 wt % of a detergent mixture comprising:

i) a carrier fluid comprising an alkyl polyethoxylated having the following structure:



wherein each R^2 and R^3 is independently hydrogen, C_1-C_4 hydrocarbyl group, or C_1-C_3 alcohol, wherein R^1 is C_4-C_{100} hydrocarbyl group, carboxyl group, ether group, thioether group, or aromatic group, wherein x is from 1 to 20,

or a hydrocarbyl phenol having the following structure



wherein R is a hydrocarbyl group from C_4-C_{100};

ii) an amine-based detergent having the following formula,

R_4-O-$(CH_2)_y$-NHR_5,

wherein R_4 is a hydrocarbyl group having 8 to 20 carbons, R_5 is hydrogen or $(CH_2)_zNH_2$ moiety, and wherein y, z are independently integers having a value of 2 or greater; and

iii) one or more nitrogen-containing detergent.

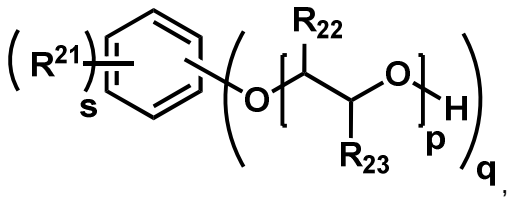
12. The concentrate of claim 11, wherein the carboxyl group is a carboxylic acid, ester, amide, or ketone.

13. The concentrate of claim 11, wherein the C_1 – C_3 alcohol has a structure represented by

$$-[CH_2]_w-OH$$

wherein w is 1 to 3.

14. The concentrate of claim 11, wherein the compound is represented by formula 6,



wherein each R^{22} and R^{23} is independently hydrogen, C_1-C_4 hydrocarbyl group, or C_1-C_3 alcohol; wherein p is from 1 to 20, q is from 1 to 3, s is from 1 to 3, wherein q + s < 6; and R^{21} is C_1-C_{100} hydrocarbyl group, carboxyl group, ether group, thioether group, amino alkyl group, or hydroxyl group.

15. Use of a fuel composition according to any one of claims 1-5 in an internal combustion engine to reduce injector fouling, as determined by assessing fuel injector flow restoration in accordance with the test method described in the description.