CLAIMS

WHAT IS CLAIMED IS:

1. A gasoline fuel additive package comprising:

(i) a quaternary ammonium internal salt detergent and (ii) a Mannich base detergent mixture,

wherein the quaternary ammonium internal salt is obtained from amines or polyamines that is substantially devoid of any free anion species,

wherein the Mannich base detergent mixture comprises (a) a first Mannich base detergent component derived from a di- or polyamine and (b) a second Mannich base detergent component derived from a monoamine,

wherein the weight ratio of the first Mannich base detergent to the second Mannich base detergent mixture ranges from about 1:6 to about 3:1,

wherein the weight ratio of the quaternary ammonium internal salt detergent and the Mannich base detergent mixture ranges from about 1:25 to about 1:35.

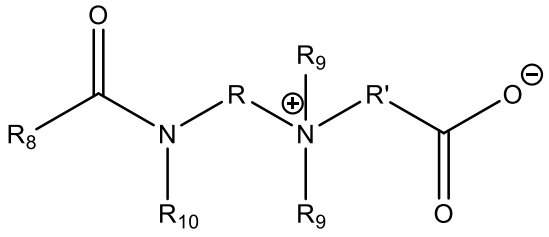
2. The gasoline fuel additive package according to claim 1, wherein the weight ratio of the first Mannich base detergent to the second Mannich base detergent ranges from about 1:1 to about 1:3.

3. The gasoline fuel additive package according to claim 1, wherein the first Mannich base detergent and the second Mannich base detergent are derived from polyisobutenyl-substituted hydroxyaromatic and wherein the polyisobutenyl group has a molecular weight ranging from 500 to 1000 Daltons, as determined by gel permeation chromatography.

4. The gasoline fuel additive package according to claim 3, wherein the polyisobutenyl-substituted hydroxyaromatic is polyisobutenyl-substituted phenol or cresol.

5. The gasoline fuel additive package according to claim 4, wherein the polyisobutenyl-substituted hydroxyaromatic is polyisobutenyl-substituted cresol.

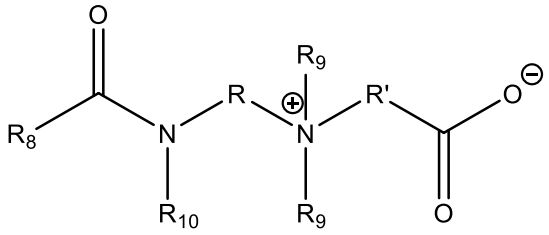
6. The gasoline fuel additive package according to claim 1, wherein the quaternary ammonium internal salt has the structure of Formula II



(Formula II)

wherein R and R' are, independently, alkylene linkers having 1 to 10 carbon atoms; R_8 is a C12 to C100 alkylene, alkene, or hydrocarbyl group or an aryl group or optionally substituted aryl group; each R_9 is, independently, a linear or branched C1 to C4 alkyl group; and R_{10} is a hydrogen atom or a C1 to C4 alkyl group.

7. The gasoline fuel additive package according to claim 5, wherein the quaternary ammonium internal salt has the structure of Formula II



(Formula II)

wherein R and R' are, independently, alkylene linkers having 1 to 10 carbon atoms; R_8 is a C12 to C100 alkylene, alkene, or hydrocarbyl group or an aryl group or optionally substituted aryl group; each R_9 is, independently, a linear or branched C1 to C4 alkyl group; and R_{10} is a hydrogen atom or a C1 to C4 alkyl group.

8. The gasoline fuel additive package according to claim 1, wherein the package further comprises a solvent, and the quaternary ammonium internal salt detergent (i) and the Mannich base detergent mixture (ii) constitutes 5-90% by weight of the package.

9. The gasoline fuel additive package according to claim 7, wherein the package further comprises a solvent, and the quaternary ammonium internal salt detergent (i) and the Mannich base detergent mixture (ii) constitutes 5-90% by weight of the package.

10. The gasoline fuel additive package according to claim 1, wherein the package further comprises one or more of a demulsifier, a corrosion inhibitor, an antiwear additive, an antioxidant, a metal deactivator, an antistatic additive, a dehazer, an antiknock additive, a lubricity additive, and a combustion improver.

11. The gasoline fuel additive package according to claim 7, wherein the package further comprises one or more of a demulsifier, a corrosion inhibitor, an antiwear additive, an antioxidant, a metal deactivator, an antistatic additive, a dehazer, an antiknock additive, a lubricity additive, and a combustion improver.

12. The gasoline fuel additive package according to claim 11, wherein the package further comprises a solvent, and the quaternary ammonium internal salt detergent (i) and the Mannich base detergent mixture (ii) constitutes 5-90% by weight of the package.

13. The gasoline fuel additive package according to claim 1, wherein the first Mannich base detergent component (a) is derived from N,N-dimethyl-1,3-propanediamine and the second Mannich base detergent component (b) is derived from dialkyl monoamine.

14. The gasoline fuel additive package according to claim 1, wherein the package further comprises a polyether monool or polyether polyol carrier fluid.

15. The gasoline fuel additive package according to claim 7, wherein the package further comprises a polyether monool or polyether polyol carrier fluid.

16. The gasoline fuel additive package according to claim 11, wherein the package further comprises a polyether monool or polyether polyol carrier fluid.

17. The gasoline fuel additive package according to claim 1, wherein the weight ratio of the quaternary ammonium internal salt detergent and the Mannich base detergent mixture ranges from about 1:30 to about 1:35.