DEMULSIFIER FOR QUATERNARY AMMONIUM SALT CONTAINING FUELS

TECHNICAL FIELD

[0001] This disclosure is directed to fuel additive compositions that include polymeric blends suitable for demulsification of fuels including quaternary ammonium salts.

BACKGROUND

[0002] Diesel and gasoline fuel often contain small amounts of water, typically from a few ppm up to several percent by weight. Such water may be the result of, for instance, condensation into the fuel while in tanks and pipelines during transport and storage. The amount of water may separate as a layer at the bottom of the storage tank and/or may be emulsified in the fuel. The presence of water is undesired as it can cause problems during transport and/or during use in combustion.

[0003] Water is separated from fuels typically through the use of various agents that demulsify or break the water-fuel emulsion in order to separate the water as a distinct layer in the fuel that can be removed by various applications. However, many common fuel additives tend to hinder or even limit the functionality of the conventional demulsification agents. Quaternary ammonium salts, for instance, are one such additive category commonly used in gasoline and diesel fuels as a detergent. A shortcoming of quaternary ammonium salts in the presence of conventional demulsification additives, however, is that such salts tend to have a negative effect on fuel demulsibility rendering it more difficult to separate and remove water from the fuel in tanks and transport lines.

SUMMARY

[0003a] In a first aspect of the present disclosure, there is provided a fuel performance additive comprising:

a quaternary ammonium salt obtained from the reaction of a nitrogen containing compound having at least a tertiary amino group and a quaternizing agent; and

a demulsifier component including a blend of (i) at least two alkoxylated phenol formaldehyde polymers, the first alkoxylated phenol formaldehyde polymer having a relative solubility number of 18 to 22 and the second alkoxylated phenol formaldehyde polymer having a relative solubility number of 12 to 16; (ii) an alkoxylated fatty acid polymer having a relative

solubility number of 12 to 16 (iii) an alkoxylated polyimine polymer having a relative solubility number of less than 10.

[0003b] In another aspect of the present disclosure, there is provided a fuel composition including a major amount of a fuel and a fuel performance additive as disclosed herein.

[0003c] In yet another aspect of the present disclosure, there is provided a method of improving the demulsibility of an additive-containing fuel, the method comprising:

combining a major amount of fuel with a quaternary ammonium salt fuel performance additive and a demulsifier component including a blend of (i) at least two alkoxylated phenol formaldehyde polymers, the first alkoxylated phenol formaldehyde polymer having a relative solubility number of 18 to 22 and the second alkoxylated phenol formaldehyde polymer having a relative solubility number of 12 to 16; (ii) an alkoxylated fatty acid polymer having a relative solubility number of 12 to 16 (iii) an alkoxylated polyimine polymer having a relative solubility number of less than 10.

[0004] In one example, a fuel performance additive including a quaternary ammonium salt obtained from the reaction of a nitrogen containing compound having at least a tertiary amino group and a quaternizing agent and a demulsifier component is described herein. In one approach, the demulsifier component includes a blend of (i) at least two alkoxylated phenol formaldehyde polymers, the first alkoxylated phenol formaldehyde polymer having a relative solubility number of 18 to 22 and the second alkoxylated phenol formaldehyde polymer having a relative solubility number of 12 to 16; (ii) an alkoxylated fatty acid polymer having a relative solubility number of 12 to 16 (iii) an alkoxylated polyimine polymer having a relative solubility number of less than 10.

[0005] In another example, approaches or examples of the fuel performance additive of the previous paragraph may be combined with other optional features in any combination. These optional features or examples may include one or more of the following: wherein the first alkoxylated phenol formaldehyde polymer is an ethoxylated phenol formaldehyde polymer having about 25 to about 75 moles of ethylene oxide; and/or wherein the second alkoxylated phenol formaldehyde polymer is an ethoxylated and propoxylated phenol formaldehyde polymer having about 5 to 30 moles of ethylene oxide and propylene oxide combined; and/or wherein the alkoxylated fatty acid polymer is derived from a dimer fatty diacid, a trimer fatty triacid, a dimer fatty diol and/or a trimer fatty triol and at least one alkylene oxide derived group and has about 5 to about 30 total moles of alkoxylation; and/or wherein the alkoxylated polyimine has about 10 to about 50 moles of alkoxylation; and/or wherein the demulsifier component includes a blend of about 10 to about 50 weight percent of the first alkoxylated phenol formaldehyde, about 10 to about 50 weight percent of the second alkoxylated phenol formaldehyde polymer, about 10 to about 50 weight percent of the alkoxylated fatty acid polymer, and about 1 to about 15 weight percent of the alkoxylated polyimine; and/or further including a weight ratio of the quaternary ammonium salt to the demulsifier component of about 5:1 to about 1:1; and/or further including about 45 to about 190 total moles of alkoxylation provided by the blend of (i), (ii), and (iii); and/or wherein the nitrogen containing compound of the quaternary ammonium salt is the reaction product of a hydrocarbyl-substituted acylating agent and a compound having an oxygen or nitrogen atom capable of condensing with the hydrocarbyl-substituted acylating agent and including the tertiary amino group; and/or wherein the nitrogen containing compound is a polyamine including the tertiary amino group and a primary amine, a secondary amine, or combinations thereof; and/or wherein the hydrocarbyl-substituted acylating agent is a hydrocarbyl substituted succinic acid, ester, anhydride, mono-acid/mono-ester, or diacid; and/or wherein the quaternizing agent is selected from the group consisting of hydrocarbyl substituted carboxylates, carbonates, cyclic carbonates, phenates, epoxides, carbamates, halides, sulfates, sulfites, sulfides, sulfonates, phosphates, phosphonates, salicylates, oxalates, or mixtures thereof; and/or wherein the quaternary ammonium salt is a hydrocarbyl soluble quaternary ammonium carboxylate derived from a reaction of a quaternary ammonium carbonate with an organic acid; and/or wherein the quaternary ammonium carbonate is formed by reacting a carbonic acid diester with a tertiary amido amine compound; and/or wherein the quaternary ammonium carbonate is

selected from the group consisting of succinimidoalkyl trialkyl ammonium carbonates, succinamido/succinyl ester ammonium carbonates and amidoalkyl trialkyl ammonium carbonates; and/or wherein the organic acid is selected from the group consisting of stearic acid, nonadecanoic acid, arachidic acid, tuberculostearic acid, tuzuic acid, petroselinic acid, oleic acid, elaidic acid, vaccenic acid, gadoleic acid, polyalkyl or polyalkenyl succinic ester acid, amide acid, imide acid, hexadecane diacid, heptadecane diacid, octadecane diacid, noncadecane diacid, eicosane diacid, 3-hexyl-4-decene-1,2-dicarboxylic acid, 3-hexyl-1,12-decanedicarboxylic acid, 6-ethylene-9-hexadecene-1,16-dicarboxylic acid, 6-ethyl-1,16-hexadecanedicarboxylic acid, 6-phenyl-1,12-dodecane dicarboxylic acid, 7,12-dimeth-y-7,1-octadecanediene-1,18-dicarboxylic acid, 7,12-dimeth-yl-1,18-octadecanedicarboxylic acid, 6,8-diphenyl-1,14-tetradecane dicarboxylic acid, and polyalkyl or polyalkenyl succinic diacids; and/or wherein the quaternary ammonium salt is derived from an amido amine containing at least one tertiary amino group and an epoxide in the presence of a proton donor selected from a carboxylic acid and an alkyl phenol; and/or wherein the amido amine is in a reaction medium substantially devoid of an acylating agent; and/or wherein the proton donor is a carboxylic acid selected from the group consisting of fatty acids, formic acid, acetic acid, propionic acid, butyric acid, polyisobutenyl succinic acid, amide/acid, or acid/ester, and polymeric acids, and mixtures thereof.

[0006] In another example, a fuel composition including a major amount of a fuel and a fuel performance additive as described in any of the two preceding paragraphs or examples. In some approaches, the fuel is selected from gasoline or diesel.

[0007] In yet another example, a method of improving the demulsibility of an additive-containing fuel and/or the use of a demulsifier component to improve the demulsibility of a fuel is provided herein. In some approaches, the method or use includes combining a major amount of fuel with a quaternary ammonium salt fuel performance additive and a demulsifier component including a blend of (i) at least two alkoxylated phenol formaldehyde polymers, the first alkoxylated phenol formaldehyde polymer having a relative solubility number of 18 to 22 and the second alkoxylated phenol formaldehyde polymer having a relative solubility number of 12 to 16; (ii) an alkoxylated fatty acid polymer having a relative solubility number of 12 to 16 (iii) an alkoxylated polyimine polymer having a relative solubility number of less than 10. In some optional approaches or examples, the fuel is selected from gasoline or diesel; and/or wherein the improved demulsibility is measured per ASTM D1094, ASTM D7451, and the like

CLAIMS

What is claimed is:

1. A fuel performance additive comprising:

a quaternary ammonium salt obtained from the reaction of a nitrogen containing compound having at least a tertiary amino group and a quaternizing agent; and

a demulsifier component including a blend of (i) at least two alkoxylated phenol formaldehyde polymers, the first alkoxylated phenol formaldehyde polymer having a relative solubility number of 18 to 22 and the second alkoxylated phenol formaldehyde polymer having a relative solubility number of 12 to 16; (ii) an alkoxylated fatty acid polymer having a relative solubility number of 12 to 16 (iii) an alkoxylated polyimine polymer having a relative solubility number of less than 10.

2. The fuel performance additive of claim 1, wherein the first alkoxylated phenol formaldehyde polymer is an ethoxylated phenol formaldehyde polymer having 25 to 75 moles of ethylene oxide; and/or wherein the second alkoxylated phenol formaldehyde polymer is an ethoxylated and propoxylated phenol formaldehyde polymer having 5 to 30 moles of ethylene oxide and propylene oxide combined; and/or wherein the alkoxylated fatty acid polymer is derived from a dimer fatty diacid, a trimer fatty triacid, a dimer fatty diol and/or a trimer fatty triol and at least one alkylene oxide derived groups and has 5 to 30 total moles of alkoxylation; and/or wherein the alkoxylated polyimine has 10 to 50 moles of alkoxylation.

3. The fuel performance additive of claim 1, wherein the demulsifier component includes a blend of 10 to 50 weight percent of the first alkoxylated phenol formaldehyde, 10 to 50 weight percent of the second alkoxylated phenol formaldehyde polymer, 10 to 50 weight percent of the alkoxylated fatty acid polymer, and 1 to 15 weight percent of the alkoxylated polyimine.

4. The fuel performance additive of claim 1, further including a weight ratio of the quaternary ammonium salt to the demulsifier component of 5:1 to 1:1; and/or further including 45 to 190 total moles of alkoxylation provided by blend of (i), (ii), and (iii).

5. The fuel performance additive of claim 1, wherein the nitrogen containing compound of the quaternary ammonium salt is the reaction product of a hydrocarbyl-substituted acylating agent and a compound having an oxygen or nitrogen atom capable of condensing with the hydrocarbyl-substituted acylating agent and including the tertiary amino group.

6. The fuel performance additive of claim 5, wherein the nitrogen containing compound is a polyamine including the tertiary amino group and a primary amine, a secondary amine, or combinations thereof; and/or wherein the hydrocarbyl-substituted acylating agent is a hydrocarbyl substituted succinic acid, ester, anhydride, mono-acid/mono-ester, or diacid; and/or wherein the quaternizing agent is selected from the group consisting of hydrocarbyl substituted carboxylates, carbonates, cyclic carbonates, phenates, epoxides, carbamates, halides, sulfates, sulfites, sulfides, sulfonates, phosphates, phosphonates, salicylates, oxalates, or mixtures thereof; and/or

7. The fuel performance additive of claim 1, wherein the quaternary ammonium salt is a hydrocarbyl soluble quaternary ammonium carboxylate derived from a reaction of a quaternary ammonium carbonate with an organic acid.

8. The fuel performance additive of claim 7, wherein the quaternary ammonium carbonate is formed by reacting a carbonic acid diester with a tertiary amido amine compound; and/or wherein the quaternary ammonium carbonate is selected from the group consisting of succinimidoalkyl trialkyl ammonium carbonates, succinamido/succinyl ester ammonium carbonates and amidoalkyl trialkyl ammonium carbonates.

9. The fuel performance additive of claim 7, wherein the organic acid is selected from the group consisting of stearic acid, nonadecanoic acid, arachidic acid, tuberculostearic acid, tuzuic acid, petroselinic acid, oleic acid, elaidic acid, vaccenic acid, gadoleic acid, polyalkyl or polyalkenyl succinic ester acid, amide acid, imide acid, hexadecane diacid, heptadecane diacid, octadecane diacid, noncadecane diacid, eicosane diacid, 3-hexyl-4-decene-1,2-dicarboxylic acid, 3-hexyl-1,12-decanedicarboxylic acid, 6-ethylene-9-hexadecene-1,16-dicarboxylic acid, 6-ethyl-1,16-hexadecanedicarboxylic acid, 6-phenyl-1,12-dodecane

dicarboxylic acid, 7,12-dimeth-y-7,1-octadecanediene-1,18-dicarboxylic acid, 7,12-dimeth-yl-1,18-octadecanedicarboxylic acid, 6,8-diphenyl-1,14-tetradecanedicarboxylic acid, and polyalkyl or polyalkenyl succinic diacids.

10. The fuel performance additive of claim 1, wherein the quaternary ammonium salt is derived from an amido amine containing at least one tertiary amino group and an epoxide in the presence of a proton donor selected from a carboxylic acid and an alkyl phenol.

11. The fuel performance additive of claim 10, wherein the amido amine is in a reaction medium substantially devoid of an acylating agent; and/or wherein the proton donor is a carboxylic acid selected from the group consisting of fatty acids, formic acid, acetic acid, propionic acid, butyric acid, polyisobutenyl succinic acid, amide/acid, or acid/ester, polymeric acids, or mixtures thereof.

12. A fuel composition including a major amount of a fuel and a fuel performance additive of claim 1.

13. The fuel composition of claim 12, wherein the fuel is selected from gasoline or diesel.

14. A method of improving the demulsibility of an additive-containing fuel, the method comprising:

combining a major amount of fuel with a quaternary ammonium salt fuel performance additive and a demulsifier component including a blend of (i) at least two alkoxylated phenol formaldehyde polymers, the first alkoxylated phenol formaldehyde polymer having a relative solubility number of 18 to 22 and the second alkoxylated phenol formaldehyde polymer having a relative solubility number of 12 to 16; (ii) an alkoxylated fatty acid polymer having a relative solubility number of 12 to 16 (iii) an alkoxylated polyimine polymer having a relative solubility number of less than 10.

15. The method of claim 14, wherein the fuel is selected from gasoline or diesel; and/or wherein the improved demulsibility is measured per one of ASTM D1094, ASTM D7451, or combinations thereof.