[0005] Quaternary ammonium compounds such as alkoxylated salts have recently been developed as very effective detergents compared to conventional succinimide and Mannich base detergents. Quaternary ammonium compounds are known as is disclosed in US Patent No. 8,147,569. However highly dangerous ethylene oxides and propylene oxides are required to make such detergents.

[0006] Quaternary ammonium compounds through alkylation with dialkyl carbonate are also disclosed in US Patent No. 8,147,569. However the carbonate anion part of the molecule is susceptible to precipitation and drop out in fuels or additive packages. In addition, the detergency of quaternary ammonium carbonates may still need to be improved.

[0006a] In one aspect of the present disclosure, there is provided a fuel additive composition for a fuel injected engine comprising a fuel additive component and a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[0006b] In another aspect of the present disclosure, there is provided a fuel composition comprising the fuel additive as described herein, wherein the amount of hydrocarbyl soluble quaternary ammonium carboxylate ranges from about 5 to about 300 ppm based on a total weight of the fuel composition.

[0006c] In yet another aspect of the present disclosure, there is provided a diesel fuel composition comprising the fuel additive as described herein, wherein the amount of hydrocarbyl soluble quaternary ammonium carboxylate ranges from about from about 10 to about 200 ppm based on a total weight of the fuel composition, and wherein the fuel composition exhibits injector cleaning attributes and full water recovery and an interface rating of 1b in a demulsibility test according to ASTM D-1094.

[0006d] In a further aspect of the present disclosure, there is provided a method of improving the injector performance of a fuel injected engine comprising operating the engine on a fuel composition comprising a major amount of fuel and from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[0006e] In another aspect of the present disclosure, there is provided a method of reducing wear in a fuel system of an engine comprising combusting in the engine a fuel composition comprising a major amount of fuel and from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[0006f] In yet another aspect of the present disclosure, there is provided a method of improving the demulsibility of a fuel composition comprising providing as a fuel composition a major amount of fuel and from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[0006g] In a further aspect of the present disclosure, there is provided a process of making of making a hydrocarbyl substituted amido-trialkyl quaternary ammonium carbonate, comprising reacting an amidodialkylamine with dialkylcarbonate in the mole ratio of amine to carbonate of from about 1:1 to about 1:1.5 at a temperature ranging from about 120° to about 160° C in a reaction medium substantially devoid of a protic solvent.

[0007] In accordance with the disclosure, exemplary embodiments provide a fuel additive composition, fuel composition, method of improving the injector performance of a fuel injected engine, method of reducing wear in a fuel system of an engine, and method of improving the demulsibility of a fuel composition. The fuel composition includes from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[0008] One embodiment of the disclosure provides a method of improving the injector performance of a fuel injected engine. The method includes combusting in the engine a fuel composition comprising a major amount of fuel and from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[0009] Another embodiment of the disclosure provides a method of reducing wear in a fuel system of an engine. The method includes operating the engine on a fuel composition comprising a major amount of fuel and from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.

[00010] A further embodiment of the disclosure provides a method of improving the demulsibility of a fuel composition. The method includes providing as a fuel composition a major amount of fuel and from about 5 to about 300 ppm by weight based on a total weight of the fuel composition of a hydrocarbyl soluble quaternary ammonium carboxylate derived from a quaternary ammonium carbonate and an organic acid.