

[54] ADDITIVE COMPOSITION FOR COMPRESSION-IGNITION ENGINE FUELS

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[51] Int. Cl.<sup>2</sup> ..... C10L 1/20

[58] Field of Search ..... 44/63, 74, 78; 252/392, 252/393

[56] **References Cited**  
UNITED STATES PATENTS

2,002,523	5/1935	Buc	252/393
2,907,646	10/1959	O'Kelly	44/63
2,920,948	1/1960	Weeks	44/78
2,930,681	3/1960	Barusch	44/74
3,098,727	7/1963	Hamer et al.	44/63
3,615,295	10/1971	Manary, Jr.	44/78

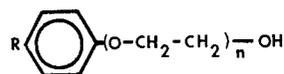
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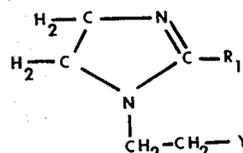
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[57] **ABSTRACT**

A synergistic, corrosion-preventive additive for use with compression-ignition petroleum products such as diesel fuels and which comprises an admixture of an alkylphenol ethoxylate compound of the formula



where R represents an alkyl group having from nine to 12 carbon atoms inclusive, and n averages from about four to five combined with an imidazoline compound of the formula



wherein R<sub>1</sub> represents an alkyl or alkenyl group having from nine to twenty-one carbon atoms, inclusive, and Y is either a hydroxyl or amino group. By virtue of the synergistic action developed by the two components of the composition, metallic surfaces in contact therewith are rendered resistant to corrosion caused by exposure to air, water and diesel fuel, and overall engine maintenance is facilitated by virtue of the cleaning action attributable to the combination and particularly the inclusion of the alkylphenol ethoxylate component.

3 Claims, No Drawings

## ADDITIVE COMPOSITION FOR COMPRESSION-IGNITION ENGINE FUELS

### BACKGROUND

This invention relates to a corrosion-preventive additive composition for use with compression-ignition petroleum products such as diesel fuel or the like and which is capable of protecting the metallic surfaces of such engines from corrosion caused by exposure to air, water, and fuel, and moreover aids in keeping such surfaces free of unwanted deposits thereon thus facilitating overall engine maintenance. More specifically, the invention is concerned with a synergistic, two-component additive composition comprising a selected alkylphenol ethoxylate in conjunction with a specific class of imidazoline compounds which when added to diesel fuel give enhanced protection against normally encountered types of engine corrosion.

Corrosion and deposit of undesirable contaminants such as gums or the like on the internal metallic surfaces of diesel engines has been a persistent, costly and troublesome problem for the operators of such machines. Such corrosion and dirtying of engine components can be caused by exposure to air or moisture or even the diesel fuel itself. In practice, it has been found that fuel filters and lines can become corroded or clogged by the presence of water and gum-forming materials in such fuels, which of course necessitates frequent cleaning. These maintenance problems are aggravated by the fact that moisture and other undesirable contaminants are almost invariably found to some degree in all diesel fuels, which in many instances results in breakdowns and consequent costly repairs. It will be readily apparent that all of these problems detract from the optimum efficiency desirable in the operation of a diesel engine, because the latter depends upon an unimpeded, regular supply of fuel through the injection system and into the combustion chamber thereof, and on the general cleanliness of the internal engine components.

A large number of additives has been proposed in the past for introduction into compression-ignition fuels to resolve the problems outlined above. An example of prior additive compositions is found in U.S. Pat. No. 2,930,681, which describes an additive employing an ammonium salt of an alkyl aryl sulfonic acid in combination with an oil-soluble polyoxyalkylene ether. An additive of this type is conventionally added to diesel fuels in a concentration of about 200 ppm for the purpose of corrosion inhibition and suppression of other undesirable contaminants found in the fuel itself.

While diesel fuel additives as disclosed in the U.S. Pat. No. 2,930,681 above and a number of other commercially available additive compositions are in widespread use, several problems have arisen through the use of these additives. Most importantly, while these prior compositions are capable of preventing corrosion of metallic surfaces continually exposed to, for example, diesel fuel, they are generally deficient in providing similar levels of protection to those engine components intermittently exposed to air or water. Thus, while these compositions find limited utility in preventing certain specific types of corrosion in diesel engines, the latter are nevertheless susceptible to corrosion from sources which are not effectively arrested by the particular additive composition in use. As a result, overall

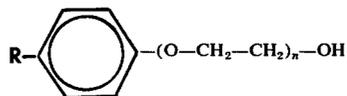
engine maintenance is sacrificed in order to achieve the limited protection afforded by these prior additives.

Therefore, there is a need in the art for an effective additive composition for diesel fuels which facilitates overall engine maintenance and is capable of giving enhanced, broad protection to the metallic surfaces of the internal engine components which are subjected to varying corrosive attacks from a number of different sources.

### SUMMARY

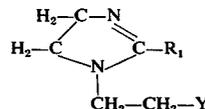
Accordingly, it has been discovered that an additive composition for compression-ignition engine fuels can be provided which gives enhanced protection against corrosion from air, water, and the fuel itself, and moreover serves to prevent other undesirable deposits from forming on the internal components of the engine. Broadly, the composition comprises a synergistic, two-component system employing a selected class of alkylphenol ethoxylate compounds in conjunction with a select group of imidazoline compounds.

More specifically, the compositions of the present invention comprise an admixture employing an alkylphenol ethoxylate of the formula:



wherein R represents an alkyl group having from 9 to 12 carbon atoms inclusive, and  $n$ , which represents the average number of ethylene oxide molecules reacted with the alkylphenol, is from about 4 to 5.

The second component of the composition is an imidazoline of the formula:



wherein  $\text{R}_1$  represents an alkyl or alkenyl group having from 9 to 21 carbon atoms, inclusive, and Y is either a hydroxyl or amino group.

It has been found that the components defined above act in a synergistic fashion to inhibit corrosion of metallic surfaces and to prevent deposition of undesirable contaminants on engine surfaces. More specifically, while single members of either of the above classes of compounds may in some instances give very limited corrosion inhibition, combinations of compounds within the scope of this invention give enhanced results that cannot be attributed to cumulative effect of the separate components. While the synergistic action of these compounds is not completely understood, it is believed that the latter in some fashion cooperate to deposit a relatively corrosion-impervious molecular layer upon metallic surfaces coming into contact therewith, to hereby achieve the enhanced corrosion-prevention effects referred to previously.

In particular embodiments of the invention, it has been determined that the alkylphenol ethoxylate component should be present in compression-ignition diesel fuels (generally defined as a mixture of hydrocarbons boiling in the range of from about 350° to 750° F) in an amount of from about 20 to 300 ppm. Likewise,

the imidazoline is advantageously employed therein in amounts ranging from about 1 to 100 ppm.

In the most preferred form of the invention, nonylphenol ethoxylated with about 4 moles of ethylene oxide is utilized at a level of from about 190 to 195 ppm, and 1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline is employed in amounts totaling from about 5 to 10 ppm. Consequently, the total additive concentration in the diesel fuel is about 200 ppm, and this level has proven to be economically feasible for commercial-scale usage while nevertheless providing excellent overall corrosion inhibition and protection against undue deposition of gum-forming materials or the like on engine surfaces.

#### DETAILED DESCRIPTION

Representative compounds found to possess effective and synergistic activity in combined form as additive compositions for diesel fuel include the following:

Alkylphenyl Ethoxylates:	
nonylphenol reacted with an average of 4 ethylene oxide groups	(N-4)
dodecylphenol reacted with an average of 5 ethylene oxide groups	(DD-5)
Imidazolines:	
1-(2-hydroxyethyl)-2-nonyl-2-imidazoline	(9-H)
1-(2-hydroxyethyl)-2-tridecyl-2-imidazoline	(13-H)
1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline	(17-H)
1-(2-hydroxyethyl)-2-uncosyl-2-imidazoline	(21-H)
1-(2-aminoethyl)-2-nonyl-2-imidazoline	(9-A)
1-(2-aminoethyl)-2-tridecyl-2-imidazoline	(13-A)
1-(2-aminoethyl)-2-heptadecenyl-2-imidazoline	(17-A)
1-(2-aminoethyl)-2-uncosyl-2-imidazoline	(21-A)

(The designation given in parenthesis for each compound is used hereinafter as needed to refer to the particular compounds.)

The alkylphenol ethoxylates were obtained commercially from the Thompson Hayward Chemical Company of Kansas City, Kansas. One imidazoline 1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline (17-H) was purchased from the Diamond Shamrock Chemical Company under the trade name Nopcogen 22-0. The remaining imidazolines were synthesized according to the following conventional procedures.

The imidazolines designated 9-H, 13-H and 21-H were prepared by adding 0.1 moles of the proper carboxylic acid to 0.2 moles of 2-(2-aminoethylamino) ethanol in a reaction flask. 4-5 times as much xylene (about 20 ml.) as the water expected from the reaction (about 3.6 ml) was also added to each flask, followed by heating to a temperature of about 250° C for a period of 4-6 hours until the theoretical amount of water had been liberated from the mixtures. The remaining xylene and 2-(2-aminoethylamino) ethanol was then removed by vacuum distillation at less than 1 mm Hg. The crude product was then recrystallized using a suitable organic solvent such as acetone.

Following recrystallization, the IR spectrum of each compound showed only the imidazoline peak at about 1590-1610 cm<sup>-1</sup> with little or no amide peak at 1650 cm<sup>-1</sup>. Elemental analysis of compound 21-H gave the following results:

		C	N	O
C <sub>26</sub> H <sub>52</sub> N <sub>2</sub> O	Calculated	76.47	12.75	6.86
	found	76.02	12.79	6.85

In similar fashion, the amino-substituted imidazolines (9-A, 13-A, 17-A, 21-A) were prepared by reacting equal molar amounts (0.1 mol) of the appropriate carboxylic acid and diethylenetriamine. These mixtures were heated to about 300-310° C over a period of 4-6 hours until the theoretical amount of water had been liberated (3.6 ml). The remaining liquid was then vacuum distilled at less than 1 mm Hg, discarding the first 2-5 ml of material and saving the next 5-10 ml thereof. Infrared spectral analysis of the second fractions indicate primarily imidazoline with little or no amide side product.

#### EXAMPLE I

In order to confirm the rust prevention capabilities of the compositions of this invention as compared with the individual components thereof, the following test was devised. A series of spindles was made from No. 1018 cold rolled steel rod which was cut into three inch lengths and deburred. The spindles were then polished on a turning lathe operating at 2800 rpm by using course, medium and then fine emery cloth. The spindles were subsequently polished until no noticeable pits could be seen thereon, and they were then stored in hexane to prevent any surface corrosion.

Two related tests were performed with different grades of diesel fuel at different additive concentrations. This was done because commercial diesel fuel is generally a mixture of grades, and therefore any additive employed must be capable of giving beneficial results in different grades of fuel. For the first series of tests, standard D-grade diesel fuel was employed. The additives were prepared by weighing out 0.20 grams of the appropriate imidazoline and then adding 3.8 grams of a respective alkylphenol ethoxylate thereto. The mixture was stirred whereupon 0.0200 grams thereof was then added to 100 grams of the D-grade diesel fuel. This procedure resulted in a sample of diesel fuel having a total additive concentration of approximately 200 ppm, with the alkylphenol ethoxylate component comprising approximately 190 ppm thereof, and the imidazole component being at a level of about 10 ppm.

A control of diesel fuel was also prepared consisting of 100 grams of the fuel with no additive being employed therewith. For the comparative alkylphenol ethoxylate only tests, 0.0190 grams of the appropriate ethoxylate was added to 100 grams of diesel fuel. Similarly, in the imidazoline only tests, 0.20 grams of the selected imidazoline and 3.80 grams of diesel fuel were first mixed, and 0.02 grams of the resulting mixture was then added to 100 grams of diesel fuel in order to achieve the proper comparative parts per million concentration therein. In this series of tests, the imidazolines labeled hereinabove as 17-H, 9-H and 9-A were employed in conjunction with both of the alkylphenol ethoxylates listed.

The remaining imidazolines (13-H, 21-H, 13-A, 17-A and 21-A) were tested in premium grade diesel fuel obtained from the refinery without any other additives present therein. Stock solutions of the imidazoline (0.05 mg/ml) and alkylphenol ethoxylate (1.95

mg./ml) were prepared. The ethoxylate only or imidazoline only tests solutions were prepared by diluting 5.00 milliliters of the stock solutions of the compound to a total of 50 grams with diesel fuel. Combination solutions (i.e., those employing both an alkylphenol ethoxylate and an imidazoline) were prepared by diluting 5.00 milliliters of ethoxylate and 5.00 milliliters of imidazoline to a total of 50 grams with diesel fuel. In this manner, the combination tests were run at a level of approximately 5 ppm imidazoline and 195 ppm alkylphenol ethoxylate, with the single component test solutions being likewise at a concentration of 5 ppm and 195 ppm respectively.

In order to determine the rust prevention capabilities of the various solutions prepared, 50 milliliters of each fuel with the defined additive therein was placed in a 4 ounce bottle provided with a cap and a polyethylene liner. A steel spindle was placed in each bottle, and the bottles were securely capped and placed on their sides for about five to 10 minutes in order to soak the spindle in the fuel. 25 milliliters of water was then added to each bottle, and the latter was capped and agitated in order to insure a uniform mixing of all of the phases within the bottle (i.e., air, fuel and water). During the testing period which followed, the caps were periodically removed and then returned to sealing disposition in conjunction with remixing of the phases. The degree of rusting on each spindle was visually observed at various intervals and recorded. For this purpose, the following keys were employed.

## KEYS

TABLE I

A = Air Phase	0 = no rust
F = Fuel Phase	0+= average of 0 and trace
W = Water Phase	T = trace, 1 or 2 small spots
	T+= average of T and L
	L = light rust, 3 spots to 10%
	L+= average of L and M
	M = medium rust, 10 to 50%
	M+= average of M and H
	H = heavy rust, over 50%

TABLE IA

A = Air Phase	0 = no rust
F = Fuel Phase	0+= one small spot
W = Water Phase	T = trace, two small spots
	T+= two small spots to 1% rust
	L = light rust, 1 to 5%
	L+= 5 to 10% rust
	M = medium rust, 10 to 25%
	M+= 25 to 50% rust
	H = heavy rust, over 50%

The rust test data obtained in accordance with the methods defined above is given in Tables I and IA below. As can be seen, readings were taken at various time intervals in order to estimate the degree of rust coverage on each of the spindles. In this connection, it should be noted that the following data is the average obtained from duplicate runs with each of the various test solutions, and in general the agreement between the separate runs was extremely close.

TABLE I

Test Additive	Tests In D-Grade Diesel Fuel Rust Results		
	8 days A F W	21 days A F W	39 days A F W
<sup>1</sup> Control	L O M	L T H	H H H
<sup>2</sup> N-4	L O H	H O H	H L H
<sup>3</sup> DD-5	L O M+	H O H	H L H
<sup>39</sup> -H	L O H	H T H	H L H
<sup>317</sup> -H	L+O O	H O O	H O L+
<sup>39</sup> -A	L O L	H O L	H O+H

TABLE I-continued

Test Additive	Tests In D-Grade Diesel Fuel Rust Results		
	8 days A F W	21 days A F W	39 days A F W
<sup>4</sup> N-4 + 9-H	H O L+	H O L+	H O H
<sup>4</sup> DD-5 + 9-H	L O L	H O L	H O+H
<sup>4</sup> N-4 + 17-H	L O O	M+O O	H O O
<sup>4</sup> DD-5 + 17-H	L O O	M+O O	H O O
<sup>4</sup> N-4 + 9-A	L O T	H O T	H O T
<sup>4</sup> DD-5 + 9-A	<sup>5</sup> —	—	—

<sup>1</sup>No additive employed

<sup>2</sup>190 ppm of the alkylphenol ethoxylate component in D-grade diesel fuel

<sup>3</sup>10 ppm of the imidazoline component in D-grade diesel fuel

<sup>4</sup>190 ppm alkylphenol ethoxylate plus 10 ppm imidazoline in D-grade diesel fuel.

<sup>5</sup>Separate identical test wherein at 5 days: control DD-5-LT+H, 9-A-LOL and DD-5+9-A-TOO.

TABLE IA

Test Additive	Tests In Premium Grade Diesel Fuel Rust Results		
	2 days A F W	5 days A F W	32 days A F W
<sup>1</sup> Control	L O M	L T H	H H H
<sup>2</sup> N-4	O O O	L L H	H L+H
<sup>3</sup> DD-5	L O L	L L H	H L+H
<sup>313</sup> -H	L O L	L O H	H M H
<sup>321</sup> -H	L O L	L O H	H M H
<sup>313</sup> -A	T T M	L T H	H L H
<sup>317</sup> -A	L O L	L O M	H L+H
<sup>321</sup> -A	L O L	L L H	H M H
<sup>4</sup> N-4 + 13-H	L O O	L O O	H L H
<sup>4</sup> DD-5 + 13-H	L O L	L O H	H O H
<sup>4</sup> N-4 + 21-H	L O L	L T H	H L H
<sup>4</sup> DD-5 + 21-H	T O O	L O O	H O O
<sup>4</sup> N-4 + 13-A	L O O	L T O	M T M+
<sup>4</sup> DD-5 + 13-A	L O L	L O H	H L H
<sup>4</sup> N-4 + 17-A	L O L	L O L	H O M
<sup>4</sup> DD-5 + 17-A	O O O	L O L	M O H
<sup>4</sup> N-4 + 21-A	L O L	L T H	H L H
<sup>4</sup> DD-5 + 21-A	L O L	L O H	H L H

<sup>1</sup>No additive employed

<sup>2</sup>195 ppm of the alkylphenol ethoxylate component in premium grade diesel fuel

<sup>3</sup>5 ppm of the imidazoline component in premium grade diesel fuel

<sup>4</sup>195 ppm alkylphenol ethoxylate plus 5 ppm imidazoline in premium grade diesel fuel

It will be seen from a study of Tables I and IA that in every case the additive compositions in accordance with the invention gave enhanced corrosion resistance to the steel spindles at one or more time periods and in at least one of the three corrosion phases. Moreover, it is significant to note that the two components of the additive compositions, namely the alkylphenol ethoxylate and the imidazoline, produce a synergistic corrosion inhibition on the steel spindles. Specifically, a comparison of the results obtained by the employment of the additive compositions herein with the individual components thereof shows that in every case the composition gave markedly better protection against corrosion. Although the chemical interaction of the two components of the composition is not completely understood, it is apparent that a synergistic result obtains through their use in diesel fuel as a single additive composition.

For example, in the additive composition referred to in Table I as "N-4 + 17-H," which is 1-(2-hydroxyethyl-2heptadecenyl-2-imidazoline plus nonylphenol reacted with an average of four ethylene oxide molecules, a significant degree of synergism results. Referring specifically to the ratings at 39 days, it will be seen that the two component composition has completely prevented corrosion in both the fuel and water phases; this is to be contrasted with the single component data for both N-4 and 17-H. In neither instance do these com-

pounds alone give such enhanced corrosion inhibition when used as a diesel fuel additive.

In a similar fashion, it will be observed that all of the

The following Table II documents the data collected from the test outlined above, using the key for Table I as a guide.

TABLE II

Test Additive	<sup>1</sup> N-4 Conc. (ppm)	<sup>2</sup> 17-H Conc. (ppm)	Rust Test Results		
			30 days A F W	30 days A F W	30 days A F W
Control	—	—	H M H	H M H	H M H
<sup>3</sup> Commercial Additive (198 ppm)	—	—	M T T	M L H	M O L
N-4 17-H	195	2.5	H L + H	H L H	H L H
N-4 + 17-H	193	4.9	H L L	H L T	H L L
N-4 + 17-H	191	7.5	H L O	H L M	H L L
N-4 + 17-H	188	9.9	M O O	M T L	M O O
N-4 + 17-H	137	9.9	M O O	M O O	M O O
N-4 + 17-H	89	9.9	M O O	M O O	M O O
N-4 + 17-H	39.5	9.9	L O O	L O O	M O O
N-4 + 17-H	29	9.9	M O O	M T O	M O O
N-4 + 17-H	19	9.9	L O O	L O O	L O O
N-4 + 17-H	9.9	9.9	H L T	H L O	H L H

<sup>1</sup> N-4 = nonylphenol reacted with an average of 4 ethylene oxide groups

<sup>2</sup> 17-H = 1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline

<sup>3</sup> an ammonium salt of an alkyl aryl sulfonic acid plus an oil-soluble polyoxyalkylene ether

combined additive compositions tested above gave synergistic results to a greater or lesser degree. Likewise, all of the compounds within the classes defined by formulas I and II above were shown to be operable in a similar fashion.

In order to demonstrate the broad concentration levels of additives usable in diesel fuel, the following test was conducted.

#### EXAMPLE II

A series of steel spindles was prepared in the manner described in Example I, and the spindles were placed in a number of closed bottles containing 50 milliliters of D-grade diesel fuel treated with various types and concentrations of additive compositions.

Specifically, a control was employed which consisted of diesel fuel alone. For purposes of comparison, a series of tests was also run using the alkyl aryl sulfonic acid-polyoxyalkylene ether additive described above was used at a concentration level of approximately 198 ppm. Additionally, a series of tests was conducted on the preferred composition of this invention wherein various levels of nonylphenol reacted with an average of four ethylene oxide molecules and 1-2-hydroxyethyl-2-heptadecenyl-1-imidazolines were employed. The concentration of the latter components was varied in order to demonstrate the broad range of use for the composition. In this regard, it is to be noted that in some instances good corrosion inhibition was obtained by using low concentrations of the alkylphenol ethoxylate component, for example on the order of 40 ppm. However, it has been determined that at such levels, while corrosion inhibition is good, the engine components may be susceptible to undesirable contamination from other sources in the fuel itself. Consequently, gum-forming materials and related contaminants can become a serious problem if the alkylphenol ethoxylate component is used at too low a level. Accordingly, in order to give the desirable overall protection to the diesel engine, a level of ethoxylate in the range of about 175 ppm or above should be maintained in the diesel fuel. On the other hand, if corrosion protection is the primary consideration, a lesser amount of a given alkylphenol ethoxylate may be used.

As is apparent from the results documented in Table II, the preferred additive composition is effective as a corrosion inhibitor over a wide range of concentration levels. Moreover, the synergistic effects between the two components of the composition is readily observable from a study of the rust test ratings of the compositions wherein decreasing concentrations of the N-4 alkylphenol ethoxylate components were employed. As the N-4 component was lowered, the overall rust inhibition properties of the composition nevertheless remained essentially constant or even increased. It is clear that if the effects between the ethoxylate and imidazoline component were simply additive in nature, there would have been of necessity a corresponding decrease in the rust prevention capabilities of the composition as the concentration of the ethoxylate component was progressively reduced. As can readily be seen from the Table, there was no such effect. Instead, the preferred composition of this invention maintained its effectiveness over an extremely broad concentration range of both the N-4 and 17-H components.

Moreover, it is also significant to note that enhanced corrosion inhibition is present in the N-4 + 17-H composition when compared to the commercial product and the control. Hence, it is apparent that the compositions of the present invention not only are synergistic in nature but also give unexpectedly enhanced corrosion resistance to metallic surfaces, when compared to prior compositions heretofore available.

Having thus described the invention, what is claimed as new and desire to be secured by Letters Patent is:

1. In combination:

a quantity of compression ignition fuel;  
an additive admixed with said fuel and taken from the group consisting of:

A. from about 20 to 300 ppm, based upon the fuel, of nonylphenol ethoxylate containing an average of about 4 radicals of the formula  $-\text{O}-\text{CH}_2-\text{CH}_2-$ , and from about 1 to 100 ppm, based upon the fuel of 1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline;

B. from about 20 to 300 ppm, based upon the fuel, of dodecylphenol ethoxylate containing an average of about 5 radicals of the formula  $-\text{O}-\text{CH}_2-\text{CH}_2-$ , and from about 1 to 100 ppm, based

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upon the fuel, of 1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline; and  
C. from about 20 to 300 ppm, based upon the fuel, of dodecylphenol ethoxylate containing an average of about 5 radicals of the formula —O—CH<sub>2</sub>—CH<sub>2</sub>—, and from about 1 to 100 ppm, based upon the fuel, of 1-(2-hydroxyethyl)-2-uncosyl-2-imidazoline.

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2. The combination of claim 1 wherein said additive is from about 190 to 195 ppm, based upon the fuel, of nonylphenol ethoxylate containing an average of about 4 radicals of the formula —O—CH<sub>2</sub>—CH<sub>2</sub>—, and from about 5 to 10 ppm, based upon the fuel, of 1-(2-hydroxyethyl)-2-heptadecenyl-2-imidazoline.

3. The combination of claim 1 wherein said fuel is diesel fuel.

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