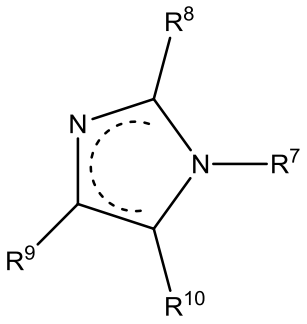
**[0018]** In some embodiments, the grease thickener in the lubricating grease composition can be lithium based.

**[0019]** Another aspect of the present technology includes a method of operating a mechanical device. The method can include A) supplying to the mechanical device a lubricating grease composition as described herein, i.e., having 1) a major amount of an oil of lubricating viscosity, 2) at least one salt of a phosphate hydrocarbon ester, and 3) at least one N-hydrocarbyl substituted imidazoline, and B) operating the mechanical device.

**[0019A]** The invention also provides an additive composition comprising 1) at least one salt of a phosphate hydrocarbon ester wherein the salt of a phosphate hydrocarbon ester comprises a monoalkyl phosphate, dialkyl phosphate, or mixture thereof, and 2) at least one N-hydrocarbyl substituted imidazoline, wherein the N-hydrocarbyl substituted imidazoline is of the formula:




wherein

the dashed line indicates resonance,

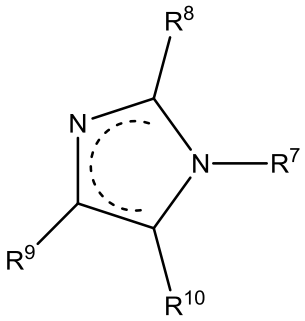
$R^7$ is a hydrocarbyl group containing from 2 to 18 carbon atoms and at least one heteroatom,

$R^8$ is hydrogen or a hydrocarbyl group containing from 1 to 40 carbon atoms, and

$R^9$ and $R^{10}$ are independently hydrogen or a hydrocarbyl group containing from 1 to 4 carbon atoms.

**[0019B]** The invention also provides a lubricating grease composition comprising 1) a major amount of an oil of lubricating viscosity, 2) a grease thickener, 3) at least one salt of the phosphate hydrocarbon ester, wherein the salt of a phosphate hydrocarbon ester comprises a monoalkyl phosphate, dialkyl phosphate, or mixture

thereof, and 4) at least one N-hydrocarbon substituted imidazole, wherein the N-hydrocarbyl substituted imidazoline is of formula:




wherein

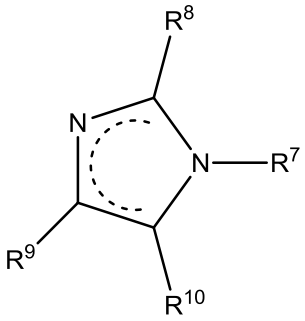
the dashed line indicates resonance,

$R^7$ is a hydrocarbyl group containing from 2 to 18 carbon atoms and at least one heteroatom,

$R^8$ is hydrogen or a hydrocarbyl group containing from 1 to 40 carbon atoms, and

$R^9$ and $R^{10}$ are independently hydrogen or a hydrocarbyl group containing from 1 to 4 carbon atoms.

**[0019C]** The invention also provides a method of operating a mechanical device comprising A) supplying to the mechanical device a lubricating grease composition comprising 1) a major amount of an oil of lubricating viscosity, 2) at least one salt of a phosphate hydrocarbon ester, wherein the salt of a phosphate hydrocarbon ester comprises a monoalkyl phosphate, dialkyl phosphate, or mixture thereof, and 3) at least one N-hydroalkyl substituted imidazoline, wherein the N-hydrocarbyl substituted imidazoline is of formula:




wherein

the dashed line indicates resonance,

$R^7$ is a hydrocarbyl group containing from 2 to 18 carbon atoms and at least one heteroatom,

$R^8$ is hydrogen or a hydrocarbyl group containing from 1 to 40 carbon atoms, and $R^9$ and $R^{10}$ are independently hydrogen or a hydrocarbyl group containing from 1 to 4 carbon atoms; and B) operating the mechanical device.

## DETAILED DESCRIPTION OF THE INVENTION

**[0020]** Various preferred features and embodiments will be described below by way of non-limiting illustration.

**[0021]** The present technology includes an additive composition containing 1) at least one salt of a phosphate hydrocarbon ester, and 2) at least one imidazoline, such as, for example, an N-hydrocarbyl substituted imidazoline. In an embodiment, the additive composition comprises 1) and 2). In another embodiment, the additive composition consists essentially of 1) and 2). In a further embodiment, the additive composition consists of 1) and 2). The ratio of the at least one salt of a phosphate hydrocarbon ester to the imidazoline in the additive composition may be from about 1:10 to about 10:1, or from about 1:5 to 5:1, or in some instances from about 1:3 to about 3:1. In an embodiment, the ratio of the at least one salt of a phosphate hydrocarbon ester to the imidazoline, such as, for example, an N-hydrocarbyl substituted imidazoline, in the additive composition may be from about 1:3 to about 3:1, or from about 1:2 to about 2:1, or even from about 1:1.5 to about 1.5:1, or about 1:1.

### Salt of a Phosphate Hydrocarbon Ester

**[0022]** The additive and/or grease composition contains at least one phosphorus compound that may be a salt of a phosphate hydrocarbon ester (i.e., a salt of a hydrocarbon ester of phosphoric acid). The salt of a phosphate hydrocarbon ester may be derived from a salt of a phosphate. The phosphate hydrocarbon ester may be an amine salt, an alkali metal salt, particularly a sodium or potassium salt, or an alkaline earth metal salt, particularly a magnesium or calcium salt, or a combination of the foregoing salts. The salt of the phosphate hydrocarbon ester may be represented, for example, by the formula I:

overbased metal-containing detergent may be may be selected from the group consisting of non-sulfur containing phenates, sulfur containing phenates, sulfonates, and mixtures thereof. The overbased detergent may be borated with a borating agent such as boric acid such as a borated overbased calcium, sodium, or magnesium sulfonate detergent, or mixtures thereof.

**[0077]** In one embodiment the grease disclosed herein may contain a friction modifier. The friction modifier may be present at 0 wt % to 6 wt %, or 0.01 wt % to 4 wt %, or 0.05 wt % to 2 wt %, or 0.1 wt % to 2 wt % of the grease composition.

**[0078]** Friction modifiers may also encompass materials such as sulfurized fatty compounds and olefins, molybdenum dialkyldithiophosphates, molybdenum dithiocarbamates, or other oil soluble molybdenum complexes such as Molyvan® 855 (commercially available from R.T. Vanderbilt, Inc) or Sakuralube® S-700 or Sakuralube® S-710 (commercially available from Adeka, Inc). The oil soluble molybdenum complexes assist in lowering the friction, but can compromise seal compatibility.

**[0079]** In one embodiment the friction modifier may be an oil soluble molybdenum complex. The oil soluble molybdenum complex may include molybdenum dithiocarbamate, molybdenum dithiophosphate, molybdenum blue oxide complex or other oil soluble molybdenum complex or mixtures thereof. The oil soluble molybdenum complex may be a mix of molybdenum oxide and hydroxide, so called “blue” oxide. The molybdenum blue oxides have the molybdenum in a mean oxidation state of between 5 and 6 and are mixtures of MoO2(OH) to MoO2.5(OH)0.5. An example of the oil soluble is molybdenum blue oxide complex known by the trade name of Luvodur® MB or Luvodur® MBO (commercially available from Lehmann and Voss GmbH), The oil soluble molybdenum complexes may be present at 0 wt % to 5 wt %, or 0.1 wt % to 5 wt % or 1 to 3 wt % of the grease composition.

**[0080]** In one embodiment the friction modifier may be a long chain fatty acid ester. In another embodiment the long chain fatty acid ester may be a mono-ester and in another embodiment the long chain fatty acid ester may be a triglyceride such as sunflower oil or soybean oil or the monoester of a polyol and an aliphatic carboxylic acid.

**[0081]** The grease composition optionally further includes at least one anti-wear agent. Examples of suitable anti-wear agents include titanium compounds, tartrates, tartrimides, oil soluble amine salts of phosphorus compounds, sulfurized olefins, metal dihydrocarbyldithiophosphates (such as zinc dialkyldithiophosphates), phosphites (such as dibutyl or dioleyl phosphite), phosphonates, thiocarbamate-containing compounds, such as thiocarbamate esters, thiocarbamate amides, thiocarbamic ethers, alkylene-coupled thiocarbamates, bis(S-alkyldithiocarbamyl) disulfides, and oil soluble phosphorus amine salts. In one embodiment the grease composition may further include metal dihydrocarbyldithiophosphates (such as zinc dialkyldithiophosphates).

**[0082]** The Extreme pressure agent may be a compound containing sulfur and/or phosphorus. Examples of an extreme pressure agents include a polysulfide, a sulfurized olefin, a thiadiazole, or mixtures thereof.

**[0083]** Examples of a thiadiazole include 2,5-dimercapto-1,3,4-thiadiazole, or oligomers thereof, a hydrocarbyl-substituted 2,5-dimercapto-1,3,4-thiadiazole, a hydrocarbylthio-substituted 2,5-dimercapto-1,3,4-thiadiazole, or oligomers thereof. The oligomers of hydrocarbyl-substituted 2,5-dimercapto-1,3,4-thiadiazole typically form by forming a sulfur-sulfur bond between 2,5-dimercapto-1,3,4-thiadiazole units to form oligomers of two or more of said thiadiazole units. Examples of a suitable thiadiazole compound include at least one of a dimercaptothiadiazole, 2,5-dimercapto-[1,3,4]-thiadiazole, 3,5-dimercapto-[1,2,4]-thiadiazole, 3,4-dimercapto-[1,2,5]-thiadiazole, or 4-5-dimercapto-[1,2,3]-thiadiazole. Typically readily available materials such as 2,5-dimercapto-1,3,4-thiadiazole or a hydrocarbyl-substituted 2,5-dimercapto-1,3,4-thiadiazole or a hydrocarbylthio-substituted 2,5-dimercapto-1,3,4-thiadiazole are commonly utilized. In different embodiments the number of carbon atoms on the hydrocarbyl-substituent group includes 1 to 30, 2 to 25, 4 to 20, 6 to 16, or 8 to 10. The 2,5-dimercapto-1,3,4-thiadiazole may be 2,5-dioctyl dithio-1,3,4-thiadiazole, or 2,5-dinonyl dithio-1,3,4-thiadiazole.

**[0084]** In one embodiment at least 50 wt % of the polysulfide molecules are a mixture of tri- or tetra- sulfides. In other embodiments at least 55 wt %, or at least 60 wt % of the polysulfide molecules are a mixture of tri- or tetra- sulfides.

**[0085]** The polysulfide includes a sulfurized organic polysulfide from oils, fatty acids or ester, olefins or polyolefins.

**[0086]** Oils which may be sulfurized include natural or synthetic fluids such as mineral oils, lard oil, carboxylate esters derived from aliphatic alcohols and fatty acids or aliphatic carboxylic acids (e.g., myristyl oleate and oleyl oleate), and synthetic unsaturated esters or glycerides.

**[0087]** Fatty acids include those that contain 8 to 30, or 12 to 24 carbon atoms. Examples of fatty acids include oleic, linoleic, linolenic, and tall oil. Sulfurized fatty acid esters prepared from mixed unsaturated fatty acid esters such as are obtained from animal fats and vegetable oils, including tall oil, linseed oil, soybean oil, rapeseed oil, and fish oil.

**[0088]** The polysulfide includes olefins derived from a wide range of alkenes. The alkenes typically have one or more double bonds. The olefins in one embodiment contain 3 to 30 carbon atoms. In other embodiments, olefins contain 3 to 16, or 3 to 9 carbon atoms. In one embodiment the sulfurized olefin includes an olefin derived from propylene, isobutylene, pentene or mixtures thereof.

**[0089]** In one embodiment the polysulfide comprises a polyolefin derived from polymerizing by known techniques an olefin as described above.

**[0090]** In one embodiment the polysulfide includes dibutyl tetrasulfide, sulfurized methyl ester of oleic acid, sulfurized alkylphenol, sulfurized dipentene, sulfurized dicyclopentadiene, sulfurized terpene, and sulfurized Diels-Alder adducts.

**[0091]** The extreme pressure agent may be present at 0 wt % to 5 wt %, 0.01 wt % to 4 wt %, 0.01 wt % to 3.5 wt %, 0.05 wt % to 3 wt %, and 0.1 wt % to 1.5 wt %, or 0.2 wt % to 1 wt % of the lubricating composition.

**[0092]** Metal deactivators include derivatives of benzotriazoles (typically tolyltriazole), 1,2,4-triazoles, benzimidazoles, 2-alkyldithiobenzimidazoles or 2-alkyldithiobenzothiazoles. The metal deactivators may also be described as corrosion inhibitors.

**[0093]** Corrosion inhibitors useful for a mechanical device include 1-amino-2-propanol, amines, triazole derivatives including tolyltriazole, dimercaptothiadiazole derivatives, octylamine octanoate, condensation products of dodecenyl succinic acid or anhydride and/or a fatty acid such as oleic acid with a polyamine.

**[0094]** The grease composition may comprise:

(a) from about 0.5 wt % to about 10 wt % of at least one salt of a phosphate hydrocarbon ester;

(b) from about 0.5 wt % to about 10 wt.% of at least one N-hydrocarbyl substituted imidazolines;

(c) 0.1 wt % to 45 wt % of a grease thickener;

(d) 0 wt % to 10 wt % of other performance additives; and

(e) balance of an oil of lubricating viscosity.

Industrial Application

**[0095]** The combination of a the salt of a phosphate hydrocarbon ester and the N-hydrocarbyl substituted imidazoline in the above described additive compositions may be employed to provide a synergistic improvement in rust inhibition for mechanical devices subjected to salt water environments.

**[0096]** In an embodiment, the present technology provides a method of operating a mechanical device comprising A) supplying to the mechanical device a lubricating grease composition comprising 1) a major amount of an oil of lubricating viscosity, 2) at least one salt of a phosphate hydrocarbon ester, and 3) at least one N-hydrocarbyl substituted imidazoline, and B) operating the mechanical device.

**[0097]** The additive composition and lubricating grease compositions may therefore be employed on mechanical devices, for example, near the sea or the ocean. The mechanical devices may include, for example, a bearing, or a joint. The mechanical device bearing, or joint may be within an automotive power transmission, a driveline device, a vehicle suspension or steering system, or a hydraulic system. In one embodiment the mechanical device may be an automobile driving shaft. The mechanical device may contain a constant velocity joint.

**[0098]** The grease may include a lithium soap grease made with a monocarboxylic acid (a simple soap grease), a lithium complex soap grease, a calcium soap grease or a calcium complex soap grease, or urea or urea complex grease.

**[0099]** The grease composition may also be useful for a low noise grease which are known and typically used in rolling element bearing applications such as pumps or compressors.

**[00100]** The amount of each chemical component described is presented exclusive of any solvent or diluent oil, which may be customarily present in the commercial material, that is, on an active chemical basis, unless otherwise indicated. However, unless otherwise indicated, each chemical or composition referred to herein should be interpreted as being a commercial grade material which may contain the isomers, by-products, derivatives, and other such materials which are normally understood to be present in the commercial grade.

**[00101]** As used herein, the term "hydrocarbyl substituent" or "hydrocarbyl group" is used in its ordinary sense, which is well-known to those skilled in the art. Specifically, it refers to a group having a carbon atom directly attached to the remainder of the molecule and having predominantly hydrocarbon character. Examples of hydrocarbyl groups include:

hydrocarbon substituents, that is, aliphatic (e.g., alkyl or alkenyl), alicyclic (e.g., cycloalkyl, cycloalkenyl) substituents, and aromatic-, aliphatic-, and alicyclic-substituted aromatic substituents, as well as cyclic substituents wherein the ring is completed through another portion of the molecule (e.g., two substituents together form a ring);

substituted hydrocarbon substituents, that is, substituents containing non-hydrocarbon groups which, in the context of this invention, do not alter the predominantly hydrocarbon nature of the substituent (e.g., halo (especially chloro and fluoro), hydroxy, alkoxy, mercapto, alkylmercapto, nitro, nitroso, and sulfoxy);

hetero substituents, that is, substituents which, while having a predominantly hydrocarbon character, in the context of this invention, contain other than carbon in a ring or chain otherwise composed of carbon atoms and encompass substituents as pyridyl, furyl, thienyl and imidazolyl. Heteroatoms include sulfur, oxygen, and nitrogen. In general, no more than two, or no more than one, non-hydrocarbon substituent will be present for every ten carbon atoms in the hydrocarbyl group; alternatively, there may be no non-hydrocarbon substituents in the hydrocarbyl group.

**[00102]** It is known that some of the materials described above may interact in the final formulation, so that the components of the final formulation may be different from those that are initially added. For instance, metal ions (of, e.g., a detergent) can migrate to other acidic or anionic sites of other molecules. The products formed

thereby, including the products formed upon employing the composition of the present invention in its intended use, may not be susceptible of easy description. Nevertheless, all such modifications and reaction products are included within the scope of the present invention; the present invention encompasses the composition prepared by admixing the components described above.

**[00103]** The invention herein is useful for preventing rust on a mechanical device, particularly where the mechanical device is subject to contact with salt water, which may be better understood with reference to the following examples.

EXAMPLES

**[00104]** A comprehensive study was undertaken to identify new grease salt water rust inhibitors. The study reviewed individual components as well as combinations of components. All the data generated in the study was from a group I simple lithium grease with 3 wt% of a standard grease additive package and an appropriate amount of a sample rust inhibitor under review. The formulation of the grease can be seen in Table 1.

Table 1

| Ingredient | Wt.% |
|---|---|
| Oil of lubricating viscosity | 29-36% |
| Lithium soap base grease thickener | 60% |
| Extreme Pressure and Anti-wear Containing Additive Package | 3% |
| Sample Rust Preventative | 1-8% |

**[00105]** Sample 1 - A $C_8$-amine salt of a phosphate dioctyl ester.

**[00106]** Sample 2 - A reaction product of naphthenic acid and diethylenetriamine providing a mixture containing an N-hydrocarbyl substituted imidazoline.

**[00107]** Sample 3 – Anedco® AC-163 - reaction product of tall oil fatty acid and diethylenetriamine, providing a mixture containing N-$C_{18}$ substituted imidazoline.

**[00108]** Sample 4 – Anedco® AC-164 - reaction product of tall oil fatty acid and aminoethyl ethanolamine, providing a mixture containing N-$C_{18}$ substituted imidazoline.

**[00109]** Sample 5 – Reaction product of isostearic acid and tetraethylenepentamine, providing a mixture containing an N-hydrocarbyl substituted imidazoline.

**[00110]** Sample 6 – Reaction product of tall oil fatty acid and aminoethyl ethanolamine, providing a mixture containing N-$C_{11-19}$ (mostly $C_{18}$) substituted imidazoline.

**[00111]** Sample 7 – Reaction product of tall oil fatty acid and aminoethyl ethanolamine, providing a mixture containing N-$C_{11-19}$ (mostly $C_{18}$) substituted imidazoline.

**[00112]** Sample 8 – Reaction product of tall oil fatty acid and aminoethyl ethanolamine, providing a mixture containing an N-$C_{18}$ substituted imidazoline.

**[00113]** Grease formulations containing various combinations of Samples 1 through 12 were tested in ASTM D5969 (10% synthetic sea water ("SSW"), see ASTM D665-2012, paragraph 6.3 for a definition of SSW). This test method covers the determination of the corrosion preventive properties of greases using lubricated tapered roller bearings exposed to various concentrations of dilute synthetic sea water stored under wet conditions. In the test, a new bearing is cleaned and packed with a lubricating grease. The bearings are run under a light load to evenly distribute the grease in a pattern consistent with that found in service. The bearings are then exposed to SSW and stored for 24 h at 52 °C and 100 % relative humidity. After cleaning, the bearing cups are examined for evidence of corrosion. The following rating scale of the rust present was used for the results (Clean=0, Trace=1, Light=2, Med=3, Heavy=4). Each test had results on three bearings. These three results were added together to get the rating per test, which could range from 0 to 12. (0 meaning all three bearings clean, 12 meaning all three bearings had heavy rust). For a give sample, the "Overall Rating" is the sum of the bearing ratings over the total number of tests performed. The results of the testing are shown in Table 2 below.

Table 2

| Sample # | Treat Rate (%) | # Tests | Overall Rating |
|---|---|---|---|
| 1 | 2% | 2 | 5.0 |
| 1 | 3% | 2 | 3.0 |
| 1 | 4% | 2 | 2.5 |
| 1 | 5% | 2 | 2.5 |
| 1 | 6% | 2 | 3.0 |
| 1 | 7% | 2 | 3.0 |
| 1 | 8% | 2 | 3.0 |
| 2 | 2% | 4 | 7.0 |
| 3 | 2% | 2 | 6.0 |
| 3 | 3% | 2 | 6.0 |

| | | | |
|---|---|---|---|
| 3 | 4% | 2 | 6.0 |
| 3 | 5% | 2 | 4.0 |
| 3 | 6% | 2 | 5.0 |
| 4 | 2% | 2 | 6.0 |
| 4 | 3% | 2 | 6.0 |
| 4 | 4% | 2 | 7.5 |
| 4 | 5% | 2 | 4.0 |
| 4 | 6% | 2 | 5.5 |
| 5 | 2% | 2 | 9.0 |
| 5 | 3% | 2 | |
| 5 | 4% | 2 | |
| 5 | 5% | 2 | |
| 6 | 2% | 2 | 7.5 |
| 6 | 3% | 2 | 6.5 |
| 6 | 4% | 2 | 6.5 |
| 6 | 5% | 2 | 6.0 |
| 6 | 6% | 2 | 7.0 |
| 7 | 2% | 2 | 3.0 |
| 7 | 3% | 2 | 3.0 |
| 7 | 4% | 2 | 3.0 |
| 7 | 5% | 2 | |
| 7 | 6% | 2 | |
| 8 | 2% | 2 | 6.0 |
| 8 | 3% | 2 | 3.0 |
| 8 | 4% | 2 | 4.0 |
| 8 | 5% | 2 | 3.0 |
| 8 | 6% | 2 | 2.5 |

**[00114]** Combinations of the phosphate salt of sample 1 and the various imidazolines samples 3 through 8 were also tested. Results for the combined formulations are provided in Table 3 below.

Table 3

| | Sample # | Treat Rate (%) | Sample # | Treat Rate (%) | # Tests | Test Rating |
|---|---|---|---|---|---|---|
| S010-2602-12-151 | 7 | 1.00% | 1 | 1.00% | *2* | *3.0* |
| S010-2602-12-152 (157) | 7 | 2.00% | 1 | 2.00% | *4* | *2.25* |
| S010-2602-12-259 | 7 | 2.50% | 1 | 2.50% | *2* | |
| S010-2602-12-260 | 7 | 3.00% | 1 | 3.00% | *2* | |
| S010-2602-12-159 | 5 | 2.00% | 1 | 2.00% | *2* | *2.5* |

| | | | | | | |
|---|---|---|---|---|---|---|
| S010-2602-12-264 | 5 | 2.50% | 1 | 2.50% | *2* | |
| S010-2602-12-265 | 5 | 3.00% | 1 | 3.00% | *2* | |
| S010-2602-12-228 | 6 | 2.50% | 1 | 2.50% | *2* | *0.5* |
| S010-2602-12-230 | 6 | 1.25% | 1 | 3.75% | *2* | *0.0* |
| S010-2602-12-232 | 6 | 3.00% | 1 | 3.00% | *2* | *1.0* |
| S010-2602-12-213 | 4 | 1.00% | 1 | 3.00% | *2* | *0.5* |
| S010-2602-12-215 | 4 | 2.50% | 1 | 2.50% | *2* | *1.0* |
| S010-2602-12-217 | 4 | 1.25% | 1 | 3.75% | *2* | *0.5* |
| S010-2602-12-219 | 4 | 3.00% | 1 | 3.00% | *2* | *0.5* |
| S010-2602-12-195 | 3 | 1.50% | 1 | 1.50% | *2* | *0.5* |
| S010-2602-12-200 | 3 | 1 .00% | 1 | 3.00% | *2* | *0.5* |
| S010-2602-12-202 | 3 | 2.50% | 1 | 2.50% | *2* | *1.0* |
| S010-2602-12-204 | 3 | 1.25% | 1 | 3.75% | *2* | *0.0* |
| S010-2602-12-206 | 3 | 3.00% | 1 | 3.00% | *2* | *0.0* |
| S010-2602-12-183 | 8 | 1.80% | 1 | 1.20% | *2* | *0.5* |
| S010-2602-12-189 | 8 | 2.50% | 1 | 2.50% | *2* | *1.0* |
| S010-2602-12-154 | 8 | 2.00% | 1 | 3.00% | *4* | *0.5* |
| S010-2602-12-190 | 8 | 3.75% | 1 | 1.25% | *2* | *1.0* |
| S010-2602-12-193 | 8 | 3.00% | 1 | 3.00% | *2* | *0.5* |

**[00115]** As can be seen in Table 3, mixtures of a salt of a phosphate hydrocarbon ester with an imidazoline at total treat rates as low as 3 wt% have given passing results in ASTM D5969 (10% SSW). In this type of grease formulation, a salt of a phosphate hydrocarbon ester alone could not achieve a passing result in ASTM D5969 (10% SSW) at concentrations up to 8w%.

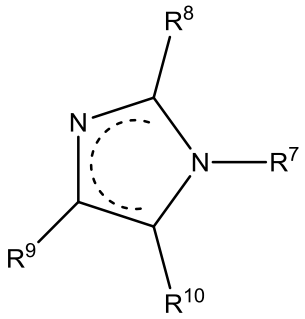
**[00116]** Each of the documents referred to above is incorporated herein by reference, including any prior applications, whether or not specifically listed above, from which priority is claimed. The mention of any document is not an admission that such document qualifies as prior art or constitutes the general knowledge of the skilled person in any jurisdiction. Except in the Examples, or where otherwise explicitly indicated, all numerical quantities in this description specifying amounts of materials, reaction conditions, molecular weights, number of carbon atoms, and the like, are to be understood as modified by the word "about." It is to be understood that the upper and lower amount, range, and ratio limits set forth herein may be independently combined. Similarly, the ranges and amounts for each element of the invention can be used together with ranges or amounts for any of the other elements.

**[00117]** As used herein, the transitional term "comprising," which is synonymous with "including," "containing," or "characterized by," is inclusive or open-ended and does not exclude additional, un-recited elements or method steps. However, in each recitation of "comprising" herein, it is intended that the term also encompass, as alternative embodiments, the phrases "consisting essentially of" and "consisting of," where "consisting of" excludes any element or step not specified and "consisting essentially of" permits the inclusion of additional un-recited elements or steps that do not materially affect the essential or basic and novel characteristics of the composition or method under consideration.

**[00118]** While certain representative embodiments and details have been shown for the purpose of illustrating the subject invention, it will be apparent to those skilled in this art that various changes and modifications can be made therein without departing from the scope of the subject invention. In this regard, the scope of the invention is to be limited only by the following claims.

What is claimed is:

1. An additive composition comprising 1) at least one salt of a phosphate hydrocarbon ester wherein the salt of a phosphate hydrocarbon ester comprises a monoalkyl phosphate, dialkyl phosphate, or mixture thereof, and 2) at least one N-hydrocarbyl substituted imidazoline, wherein the N-hydrocarbyl substituted imidazoline is of the formula:




wherein

the dashed line indicates resonance,

$R^7$ is a hydrocarbyl group containing from 2 to 18 carbon atoms and at least one heteroatom,

$R^8$ is hydrogen or a hydrocarbyl group containing from 1 to 40 carbon atoms, and

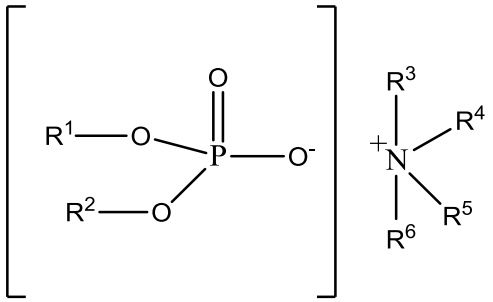
$R^9$ and $R^{10}$ are independently hydrogen or a hydrocarbyl group containing from 1 to 4 carbon atoms.

2. The additive composition of Claim 1, wherein the salt of a phosphate hydrocarbon ester is a monoalkyl phosphate comprising a monoalkyl group, and the monoalkyl group comprises a $C_4$ to $C_{40}$ alkyl group.

3. The additive composition of Claim 1 or Claim 2, wherein the salt of the phosphate hydrocarbon ester is a dialkyl phosphate comprising alkyl groups, and the alkyl groups each comprise, individually, a $C_4$ to $C_{40}$ alkyl group.

4. The additive composition of any one of the preceding Claims, wherein the salt of a phosphate hydrocarbon ester is selected from an amine salt, an alkali metal salt, and an alkaline earth metal salt.

5. The additive composition of any one of the preceding Claims, wherein the at least one salt of a phosphate hydrocarbon ester is an amine salt of a phosphate hydrocarbon ester of formula:



wherein:

$R^1$ and $R^2$ are independently hydrogen or a hydrocarbon containing from 4 to 40 carbon atoms, with the proviso that at least one of $R^1$ or $R^2$ is a hydrocarbon group; and

$R^3$, $R^4$, $R^5$ and $R^6$ are independently hydrogen or a hydrocarbyl group containing from 4 to 40 carbon atoms, with the proviso that at least one of $R^3$, $R^4$, $R^5$ and $R^6$ is a hydrocarbyl group.

6. The additive composition of any one of the preceding Claims, wherein the N-hydrocarbyl substituent in the at least one N-hydrocarbyl substituted imidazoline comprises a $C_1$ to $C_{30}$ alcohol.

7. The additive composition of any one of the preceding Claims, wherein the at least one heteroatom of $R^7$ comprises at least one of O, N, S, a halogen, or a combination thereof.

8. The additive composition of any one of the preceding Claims, wherein the ratio of the 1) at least one salt of a phosphate hydrocarbon ester to the 2) at least one imidazoline is from 1:10 to 10:1, optionally 1:3 to 3:1.

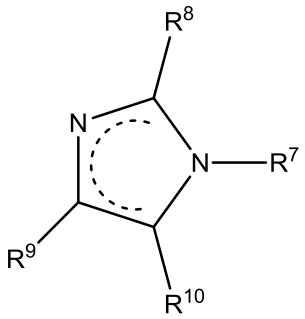
9. A lubricating grease composition comprising:

1) a major amount of an oil of lubricating viscosity;

2) a grease thickener;

3) at least one salt of the phosphate hydrocarbon ester, wherein the salt of a phosphate hydrocarbon ester comprises a monoalkyl phosphate, dialkyl phosphate, or mixture thereof; and

4) at least one N-hydrocarbon substituted imidazole, wherein the N-hydrocarbyl substituted imidazoline is of formula:




wherein

the dashed line indicates resonance,

$R^7$ is a hydrocarbyl group containing from 2 to 18 carbon atoms and at least one heteroatom,

$R^8$ is hydrogen or a hydrocarbyl group containing from 1 to 40 carbon atoms, and

$R^9$ and $R^{10}$ are independently hydrogen or a hydrocarbyl group containing from 1 to 4 carbon atoms.

10. The lubricating grease composition of Claim 9, further comprising:

5) other performance additives.

11. The lubricating grease composition of Claim 9 or Claim 10, wherein the at least one salt of a phosphate hydrocarbon ester is present from 0.5 to 10 weight percent based on the total weight of the lubricating grease.

12. The lubricating grease composition of any one of Claims 9 to 11, wherein the at least one N-hydroalkyl substituted imidazole is present from 0.5 to 10 weight percent based on the total weight of the lubricating grease.

13. The lubricating grease composition of any one of Claims 9 to 12, wherein the ratio of the 3) at least one salt of a phosphate hydrocarbon ester to the 4) at least one N-hydroalkyl substituted imidazoline is from 1:10 to 10:1, optionally 1:3 to 3:1.

14. The lubricating grease composition of any one of claims 9 to 13, wherein the grease thickener is lithium-based.

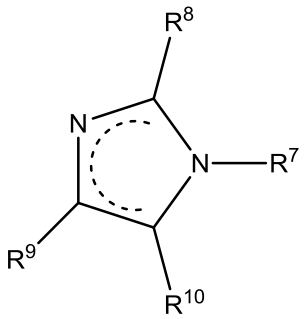
15. A method of operating a mechanical device comprising:

A) supplying to the mechanical device a lubricating grease composition comprising:

1) a major amount of an oil of lubricating viscosity,

2) at least one salt of a phosphate hydrocarbon ester, wherein the salt of a phosphate hydrocarbon ester comprises a monoalkyl phosphate, dialkyl phosphate, or mixture thereof, and

3) at least one N-hydroalkyl substituted imidazoline, wherein the N-hydrocarbyl substituted imidazoline is of formula:




wherein

the dashed line indicates resonance,

$R^7$ is a hydrocarbyl group containing from 2 to 18 carbon atoms and at least one heteroatom,

$R^8$ is hydrogen or a hydrocarbyl group containing from 1 to 40 carbon atoms, and

$R^9$ and $R^{10}$ are independently hydrogen or a hydrocarbyl group containing from 1 to 4 carbon atoms; and

B) operating the mechanical device.