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CORROSION INHIBITING LUBRICATING COMPOSITIONS

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This invention relates to new and improved corrosion inhibiting compositions having excellent lubricating properties.

A serious problem in the field of lubrication and hydraulic systems exists where normally effective corrosion inhibiting lubricants or hydraulic fluids cannot continuously come in contact with parts of equipment they are supposed to lubricate and protect. Thus, during idle periods or on storage not all parts are protected by the contacting lubricant and these parts become susceptible to rust and corrosion. This problem becomes particularly grave where corrosive gases, moisture, high temperatures and other corrosion producing factors are present or form as in steam turbine lubricants, turbine oils, and various equipment such as hydraulic equipment, which comes in contact with moisture and the like.

It has now been discovered that the above objects can be attained by addition to various lubricating oil compositions, such as turbine oils and the like, a minor amount of a particular type of vapor phase corrosion inhibiting agent selected from low molecular weight aliphatic monocarboxylic acids containing from 8 to 10 carbon atoms in the molecule. The acids can be straight-chain, branched, saturated or unsaturated, aliphatic monocarboxylic acids of which the C_8 to C_{10} straight-chain aliphatic monocarboxylic acids are preferred. Included, however, among these acids are the saturated aliphatic monocarboxylic acids such as the straight-chain, octanoic, nonanoic, decanoic, acids; branched-chain aliphatic acids such as isononanoic acid and 3,5,5-trimethyl hexanoic acid and the like. Of the acids, the straight-chain aliphatic monocarboxylic acids are preferred, namely, the n-octanoic, n-nonanoic and n-decanoic acids.

The manner in which these acids function as vapor phase corrosion inhibitors particularly at ambient temperatures in systems of this invention is not clearly understood. However, these acids have been found to function as effective vapor phase corrosion inhibitors from oil solutions thereof.

These vapor phase corrosion inhibiting acids are effective when added to various types of lubricating oils but are particularly useful in compounded lubricating oils containing as active agents one or more of the following class of compounds (*a*) oil-soluble sulfur-containing compounds such as sulfurized oils and derivatives thereof such as sulfurized fatty oils and sulfurized fatty acids, examplified by sulfurized sperm or whale oils and sulfurized oleic, linoleic and dimerized linoleic acids; (*b*) oil-soluble phenolic compounds such as alkylated phenols which are illustrated by 2,6-ditertiarybutyl-4-methyl phenol, 2,4,6-trimethylphenol, 2,4-dimethyl-6-tertiarybutyl phenol; 2,2'-methylene bis(4-methyl-6-tertiarybutyl phenol); (*c*) oil-soluble aliphatic polycarboxylic acids and/or amides or partial esters of said acids such as mono- or polyalkyl- or alkenyl-polycarboxylic acids, wherein the alkyl or alkenyl group or groups contain from 3 to 36 and preferably from 8 to 18 carbon atoms. Such acids include oil-soluble C_6 to C_{36} and preferably

C_8 to C_{18} alkyl- or alkenyl-malonic, succinic, glutaric, adipic, pimelic, sebacic, azelaic, tartaric, citric, maleic, citraconic acids, of which the preferred acids are C_{16}-alkenylsuccinic acid, C_{18}-alkenylsuccinic acid, C_{36}-alkenylsuccinic acid, and corresponding alkylsuccinic acids, C_{10}-C_{18}-alkyltartaric acid, C_{10}-C_{18}-alkylmalonic acid. Partial or full amides and/or the partial esters of these acids can be used, and include alkylsuccinic acid monoamide or monooleyl alkenylsuccinate, monooctyl alkylsebacate, monobutyl alkyltartrate, monoisopropyl citrate, mono 2-ethylhexyl citrate, ester of wax phenol and alkenylsuccinic acid, ethyl decanylsuccinate, decyl isobutenylsuccinate, alkenylsuccinic acid mono (-dicyclohexyl)amide, C_{16}-alkenylsuccinic acid mono (2-ethylhexyl)amide, C_{18}-alkenylsuccinic acid monoamide; alkenylthiosuccinic acid, alkenylthiotartaric acid, 2-(1-thiotridecyl)succinic acid, 2-(1-thiodecyl)tartaric acid, 2-(1-thioamyl)citric acid, octadecylsuccinic acid, etc., and mixtures thereof.

The vapor phase corrosion inhibitors of this invention are activated by the class of compounds and mixtures thereof as enumerated in classes *a*, *b* and *c*. The manner in which this is accomplished is not understood but nevertheless a synergistic effect is produced when (*a*), (*b*) and/or (*c*) are used in combination with the vapor phase inhibitors of this invention. By means of this invention metal parts which are not in direct contact with the lubricant are equally protected against rust and corrosion.

In addition to the above-mentioned class of compounds other useful agents can be used in lubricants to which the vapor phase corrosion inhibitor is added. Included can be aromatic acids such as benzoic, salicylic, mandelic and cinnamic acids; oiliness agents, extreme pressure agents, anti-clogging agents and the like.

The base for additives of this invention can be a hydrocarbon oil obtained from a paraffinic, naphthenic, Mid-continent or Coastal stock and/or mixtures thereof and preferably base stocks which have been highly refined. The viscosity of these oils may vary over a wide range such as from 50 SUS at 100° F. to 100 SUS at 210° F.

The vapor phase corrosion inhibitors, namely, the C_8 to C_{10} aliphatic monocarboxylic acids as well as any additional agents which can be present can each be used in amounts of from 0.001% to about 5% and preferably from 0.01% to 1% depending upon the base oil and additive present in said base oil.

Preferred compositions of this invention are illustrated by the following examples:

COMPOSITION A

Octadecylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
Sulfurized oleic acid	do	0.02
n-Nonanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION B

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
Sulfurized oleic acid	do	0.02
n-Nonanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION C

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
Sulfurized oleic acid	do	0.02
Iso-nonanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION D

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
Sulfurized oleic acid	do	0.02
n-Decanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION E

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
n-Decanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION F

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
n-Decanoic acid	do	0.05
Benzoic acid	do	0.007
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION G

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
n-Decanoic acid	do	0.05
Salicylic acid	do	0.007
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION H

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,6-ditertiarybutyl-4-methyl phenol	do	0.5
Sulfurized oleic acid	do	0.02
n-Nonanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION I

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,2'methylene bis(4-methyl-6-tertiarybutyl phenol)	percent wt.	0.5
Sulfurized oleic acid	do	0.02
n-Nonanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

COMPOSITION J

C_{18}-alkenylsuccinic acid	percent wt.	0.015
2,2'-methylene bis(4-methyl-6-tertiarybutyl phenol)	percent wt.	0.5
Sulfurized oleic acid	do	0.02
n-Decanoic acid	do	0.05
Dimethyl silicone polymer	p. p. m.	5
Mineral oil		Balance

In order to demonstrate the effectiveness of compositions of this invention as vapor phase corrosion inhibitors the following tests weer conducted.

1. A vapor phase modification of the ASTM turbine oil rust test

A water cooled one-inch diameter freshly polished SAE 1020 steel disk is set in a rabbeted hole drilled through the plastic beaker lid. Water is added to the test oil and during a 20 hour period the rust accumulated on the surface not in contact with the oil is noted.

2. Vapor phase hot plate reflux test

To evaluate vapor phase rust inhibitors in this test a flask containing 10 milliliters of water and 5 milliliters of the test oil and an iron specimen suspended in the vapor phase is placed on a hot plate and the liquid gently refluxed. Time for initial rusting is observed as well as the condition of the iron specimen after 20 hours,

As can be noted from the test results which follow, compositions of this invention are excellent vapor phase corrosion inhibitors.

Composition [1]	ASTM Vapor Phase Rust Test Rust After 20 Hours	Vapor Phase Hot Plate Reflux Test	
		Time of Initial Rusting (Min.)	Rusting After 20 Hrs.
Composition B	None	None	Not tested.
Composition D	do	<45	Trace.
Composition E	do	<45	Do.
Composition F	do	360	Do.
Mineral Oil+0.05% of n-octanoic acid.	do	<150	
Mineral Oil+0.05% of n-decanoic acid.	do	<45	Do.
Mineral Oil+0.05% of n-nonanoic acid.	do		
Mineral Oil+0.05% of n-dodecanoic acid.	do	30	8%.
Mineral Oil+0.05% of palmitic acid.	Heavy	8 min	50% rusted, 3 hours.
Mineral Oil+0.05% of stearic acid.	do	do	Do.
Composition I: C_{18} alkenylsuccinic acid—0.015%. 2,6-ditertiarybutyl-4-methyl phenol—0.5%. Sulfurized oleic acid—0.02%. n-Hexanoic acid—0.05%. Dimethyl silicone polymer—5 p. p. m. Mineral Oil Balance	do	do	Do.
Composition II: C_{18} alkenylsuccinic acid—0.015%. 2,6-ditertiarybutyl-4-methyl phenol—0.5%. Sulfurized oleic acid—0.02%. Dimethyl silicone polymer—5 p. p. m. Mineral Oil Balance	do	do	Do.

[1] Mineral oil used was a highly refined SAE 10 base stock.

Other additives can be added to compositions of this invention such as oiliness agents, extreme pressure agents, anti-clogging agents and the like, in amounts of from 0.001% to 5% by weight.

In addition to being excellent turbine oils, compositions of this invention can be utilized as hydraulic oils, cutting fluids, drawing and rolling oils and the like.

We claim as our invention:

1. A vapor phase and liquid phase corrosion inhibiting lubricating composition comprising 0.015% C_{18}-alkenylsuccinic acid, 0.5% 2,6-ditertiarybutyl-4-methyl phenol, 0.02% sulfurized oleic acid, 0.05% n-nonanoic acid and the balance being a mineral lubricating oil.

2. A corrosion inhibiting lubricating oil composition exhibiting both vapor phase and liquid phase corrosion inhibiting properties comprising a major amount of a mineral lubricating oil, a minor effective antioxidant amount of an oil-soluble alkylphenol antioxidant, a minor liquid phase corrosion inhibiting amount of an oil-soluble aliphatic hydrocarbon polycarboxylic acid and a minor effective vapor phase corrosion inhibiting amount of from about 0.001 to about 5% of n-nonanoic acid.

3. A vapor phase and liquid phase corrosion inhibiting lubricating oil composition comprising a major amount of a mineral lubricating oil and from 0.01% to about 1% each of C_{18}-alkenylsuccinic acid, 2,6-ditertiary butyl-4-methyl phenol, sulfurized oleic acid and n-nonanoic acid.

4. A composition in accordance with claim 3, containing additionally about 5 parts per million of dimethyl silicone polymer.

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