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CORROSION INHIBITING LUBRICATION METHOD

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ABSTRACT OF THE DISCLOSURE

Method for inhibiting corrosion in a power system containing a lubricating oil and wherein metallic members of the system are only intermittently contacted with the liquid lubricating oil and are susceptible to corrosion comprising adding an alkylaminoalkanol or alkylaminomethylether corrosion inhibitor to the lubricating oil, said alkylaminoalkanol or alkylaminomethylether having the formula:

RR'N—Y—OR

in which R is an alkyl radical having from 3 to 10 carbon atoms, R' is hydrogen, an alkyl radical having 1 to 8 carbon atoms, or in conjunction with R a cyclohexyl radical, Y is an alkylene radical having from 2 to 3 carbon atoms and R" is hydrogen or a methyl group.

BACKGROUND OF THE INVENTION

Field of the invention

In the lubrication and operation of power systems wherein a fluid is employed for lubrication, cooling and/or for transmitting power, such as in internal combustion engines and hydraulic systems, the fluid or lubricant is not continuously in contact with the metallic parts of the engine or hydraulic system. This condition is particularly pronounced when the power system is not in use since the fluid drains into a reservoir in a lower part of the equipment leaving parts of the power system exposed to the prevailing atmospheric envoronments. It will be appreciated that when the power system is in operation, the fluid will generally provide a satisfactory level of lubrication protecting the system from wear and corrosion. However, during intermittent operations or during the periods when the system is at rest, the fluid is ineffective for providing a satisfactory level of corrosion protection. This is particularly true under conditions in which corrosive gases or substantial amounts of water vapor come in contact with important parts of the power equipment. A method of lubrication which inhibits or prevents the corrosion of the equipment under the foregoing condition has now been developed.

Description of the prior art

U.S. Pat. 2,775,560 discloses a lubricant containing a so-called vapor phase corrosion inhibiting agent. The particular agent is a low molecular weight aliphatic monocarboxylic acid containing from 8 to 10 carbon atoms in the molecule.

SUMMARY OF THE INVENTION

A novel method for lubricating and for inhibiting corrosion in a power system wherein integral parts of the system or metal surfaces are intermittently exposed in an atmosphere which is corrosive or permits corrosion to occur has now been developed. This method is based on the employment of a lubricating oil containing a specific class of alkylaminoalkanols therein. A particular feature of the invention is that the specific alkylaminoalkanols function as vapor phase corrosion inhibitors in power systems. Since these corrosion inhibitors are vaporized under conditions present in power systems, they

are effective for protecting all of the metallic components of the system during normal operation periods as well as when the equipment is at rest. Another feature is that the lubricating fluid retains its corrosion inhibiting properties for an extended period of time as required of such fluids. A further feature of the invention is that the class of additives do not adversely effect the acidity or neutralization properties of the carrier fluid.

The vapor phase corrosion inhibiting method of this invention is effective when employed in conjunction with a wide variety of lubricating oils. The inhibitors may be employed in both mineral and synthetic types of lubricating oils and may also be employed with other conventional lubricating oil additives.

DESCRIPTION OF PREFERRED EMBODIMENTS

The corrosion inhibiting lubrication method of the invention employs a fluid of lubricating viscosity containing a minor corrosion inhibiting amount of an alkylaminoalkanol or alkylaminomethylether represented by the formula:

RR'N—Y—OR

in which R is an alkyl radical having from 3 to 10 carbon atoms, R' is hydrogen, an alkyl radical having 1 to 8 carbon atoms, or in conjunction with R a cyclohexyl radical, Y is an alkylene radical having from 2 to 3 carbon atoms and R" is hydrogen or a methyl group. The preferred compounds are those in which R has 3 to 6 carbon atoms, R' is hydrogen, Y is a divalent ethylene radical and R" is hydrogen.

Typical compounds which are effective as vapor phase corrosion inhibitors in the lubrication method of the invention include t-butylaminoethanol, n-hexylaminoethanol, cyclohexylaminoethanol, 1,3-dimethylbutylaminoethanol, n-pentylaminopropanol-2, n-butylaminopropanol-2, and n-hexylaminoethyl methyl ether. Mixtures of these compounds such as a 3/1 mixture of mono- and diheptylaminoethanol have been observed to provide advantages over the use of a single corrosion inhibitor, a mixture of n-heptylaminoethanol and n-hexylaminopropanol-2 is also suitable.

The fluids which can be employed in preparing a lubricating oil for the method of this invention include both mineral and synthetic oils of lubricating viscosities. The hydrocarbon mineral oils usable in this invention can be distillate or residual oils. Paraffin base distillate lubricating oil fractions are preferred for the formulation of premium engine oils. The lubricating oil base generally has been subjected to solvent refining to improve its lubricity and viscosity temperature relationship as well as solvent dewaxing to remove waxy components and improve the pour of the oil. Generally, mineral lubricating oils having an SUS viscosity at 100° F. between 50 and 1000 may be used in the formulation of the improved lubricants of this invention although the viscosity range will usually fall between 70 and 500 SUS at 100° F. A blend of base oils can be employed to provide a suitable base for multigrade oils.

A suitable synthetic fluid is an ester base fluid prepared from pentaerythritol or trimethylolpropane and a mixture of hydrocarbyl monocarboxylic acids. Polypentaerythritols, such as dipentaerythritol, tripentaerythritol and tetra-pentaerythritol can also be employed in the reaction to prepare the base oil.

The hydrocarbon monocarboxylic acids which are used to form the ester-base fluid include the straight-chain and branched-chain aliphatic acids, cycloaliphatic acids and aromatic acids as well as mixtures of these acids. The acids employed have from about 2 to 18 carbon atoms per molecule, and preferably from about 5 to 10 carbon atoms. Examples of suitable specific acids are acetic, pro-

pionic, butyric, valeric, isovaleric, caproic, decanoic, cyclohexanoic nephthenic, benzoic, phenylacetic, tertiarybutylacetic and 2-ethylhexanoic acids.

In general, the acids are reacted in proportions leading to a completely esterified pentaerythritol or trimethylolpropane with the preferred ester bases being the pentaerythritol tetraesters include pentaerythritol and crude caproic acid containing other C_{5-10} monobasic acids. Another suitable tetraester is prepared from a technical grade pentaerythritol and a mixture of acids comprising 38 percent valeric, 13 percent 2-methyl pentanoic, 32 percent octanoic and 17 percent pelargonic acids. Another effective ester is the triester of trimethylolpropane in which the trimethylolpropane is esterified with a monobasic acid mixture consisting of 2 percent valeric, 9 percent caproic, 13 percent heptanoic, 7 percent heptanoic, 7 percent octanoic, 3 percent caprylic, 65 percent pelargonic and 1 percent capric acids. Trimethylolpropane triheptanoate, trimethylolpropanepentanoate and trimethylolpropanehexanoate are also suitable ester bases.

The fluid employed in the method of the invention comprises a substantial proportion of the base oil and a minor corrosion inhibiting amount of the alkylaminoalkanol defined above. Corrosion inhibiting amounts of the alkylaminoalkanol are readily dissolved in the base fluid. In general, from about 0.01 to 5 weight percent of the alkylaminoalkanol is dissolved in the base oil to provide an effective corrosion inhibiting method although larger amounts can also be employed. The preferred concentration range is from 0.10 to 1.5 weight percent.

The examples in Table I below illustrate preferred lubricant embodiments for use in the method of the invention. In each of these examples the base fluid was a blend of refined mineral oils. Specifically the base oil consisted of a 30 percent to 70 percent blend of 145 SUS and 600 SUS at 100° F. paraffinic pale turbine oils. The corrosion inhibitors were blended into the base fluid and the latter tested in the method of the invention. The test employed was a modified version of the Shell Reflux Rust Test wherein the modification involved replacing the hot plate with a constant temperature oil bath maintained ta 210° F. In addition, the metal test specimens were inspected at one and two hour intervals as well as at the usual 20 hour interval. A rating of no rust to trace rust for this test shows that the method employing the indicated fluid was outstanding in providing vapor phase corrosion inhibition. Several individual runs were made for certain specific fluids.

TABLE I.—VAPOR PHASE RUST TEST

Example	Inhibitor	Concentration, wt. percent	Rusting rate, hours 1	2	20
1	t-Butylaminoethanol	1.00	2NR, T	NR, 2T	NR, 2T
2	do	0.50	3NR	3NR	NR, 2T
3	do	0.10	3T	2T, L	2T, L
4	n-Butylaminoethanol	1.00	3NR	3NR	3NR
5	do	0.50	3NR	3NR	2NR, T
6	do	0.10	3T	T, 2L	T, 2L
7	n-Pentylaminoethanol	1.00	3NR	3NR	3NR
8	do	0.50	2NR, T	2NR, T	3T
9	do	0.10	2T	T, L	L/M, M
10	n-Hexylaminoethanol	1.00	3T	3T	3T
11	do	0.50	2NR, T	2NR, T	2NR, T
12	do	0.10	3NR	3NR	3NR
13	Cyclohexylaminoethanol	1.00	T	T	T
14	do	0.50	T	T	T
15	n-Heptylaminoethanol	1.00	NR	NR	T
16	do	0.50	T	T	L
17	do	0.10	T	L	M
18	n-Pentylaminopropanol-2	1.00	NR, T	NR, T	NR, T
19	do	0.50	NR, T	NR, T	NR, T
20	do	0.10	NR	T	T
21	n-Hexylaminopropanol-2	1.00	3NR	3NR	NR, 2T
22	do	0.50	2NR, T	2NR, T	3T
23	Cyclohexylaminoethanol	1.00	NR	NR	NR
24	do	0.50	NR	NR	T
25	1, 3 dimethylbutyliminoethanol	1.00	NR	NR	NR
26	do	0.50	NR	NR	T
27	n-Hexylaminoethylmethylether	1.00	3NR	3NR	NR, 2T
28	do	0.50	2NR, T	2NR, T	2T, L
29	do	0.10	L	L	L/M
30	3/1 mixture mono- and diheptylaminoethanol	1.00			3NR
31	do	0.50			3NR
32	do	0.10			2NR, T
33	Base oil[1]		2L, M	M, 2S	3S
34	Decanoic acid	0.10	3NR	3NR	3NR

[1] Base oil is 30/70 145PPTO/600PPTO.

LEGEND.—NR=no rust; T=trace, few pin points; L=light rust; S=severe, pitting, heavy rust; M=moderate rust.

The foregoing test results show that the method of the invention is outstandingly effective for providing extended vapor phase corrosion inhibition required by many kinds of power systems.

We claim:

1. In a power system comprised of metallic conduit and friction creating sliding surfaces susceptible to corrosion normally containing a liquid lubricating oil having an SUS viscosity at 100° F. between 70 and 500 and wherein the lubricant is only intermittently in contact with parts of the metallic surfaces, the method of inhibiting corosion in said system which comprises employing a mineral lubricating oil containing from about 0.01 to 5.00 weight percent of an alkylaminomethylether having the formula:

$$RR'N—Y—OCH_3$$

in which R is an alkyl radical having from 3 to 10 carbon atoms, R' is hydrogen, an alkyl radical having from 1 to 8 carbon atoms or a cyclohexyl radical, and Y is an alkylene radical having from 2 to 3 carbon atoms.

2. A method according to claim **1** in which said alkylaminomethylether is n-hexylaminoethylmethylether.

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