United States Patent Office

3,285,755

Patented Nov. 15, 1966

3,285,755

CORROSION INHIBITING MATERIAL

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No Drawing. Filed July 3, 1963, Ser. No. 292,757
4 Claims. (Cl. 106—14)

This invention relates to corrosion inhibiting materials, and more particularly, to a petroleum distillate base liquid material particularly useful in sea water corrosive atmospheres.

Machinery which operates near or on the sea is continually subjected to a corrosive, salt-laden atmosphere which can cause extensive corrosion and serious damage to parts of the machinery. In such an atmosphere, electrolytic cells can be created on the surface of even the so called "stainless steels." In addition, serious damage can result to parts made from aluminum and magnesium.

This type of corrosion problem is particularly significant and particularly dynamic in gas turbine apparatus installed in coastal areas, aboard ships, or installed as jet engines in aircraft operating over or near the sea. Current procedures to prevent corrosion from occurring include a regular water washing or spraying step followed by the addition of a corrosion preventive liquid to protect the parts during their inoperative periods. There are commercially available corrosion preventative materials which will protect machinery such as a jet engine compressor during inoperative periods. However, it has been recognized that upon re-running the apparatus at temperatures which evaporate the corrosion preventative medium, a residue remains. Such residue can, over a period of time, cause corrosion to occur due to oxygen starvation.

It is a principal object of the present invention to provide a corrosion inhibiting material in liquid form which includes good film forming characteristics and, upon evaporation, leaves little if any residue or lacquers on the surface of the part to which it is applied.

Another object of this invention is to provide such a corrosion inhibiting material particularly useful for application to jet engine parts and which results in the deposition on such parts of virtually no residue which will subsequently lead to corrosion.

These and other objects and advantages will be more clearly understood from the following detailed description and examples which are meant to be exemplary of rather than limitations on the scope of the present invention.

The present invention, in one form, comprises a corrosion inhibiting liquid based on a petroleum distillate having a minimum boiling point of about 300° F. and a film former of a petroleum oil, preferably solvent extracted, having a viscosity of about 180–220 S.S.U. at 100° F. Included with these two basic ingredients is about 8–15 weight percent of an emulsifying agent of the polyoxyethylene fatty acid ester derivative type, a glycol fatty acid ester derivative such as a stearate, for example propylene glycol monostearate, as a water repellent in a quantity of about 5–15 weight percent, and about 0.25–5 weight percent of a volatile, high molecular weight amine type corrosion protector such as cyclohexylamine carbonate. If long shelf life is desired, a small percentage of a coupling agent, for example about 2 weight percent of a glycol such as hexylene glycol can be added to inhibit separation of the materials during storage.

There are available commercially a number of corrosion inhibiting materials and oils which adequately prevent corrosion when used at temperatures below that at

which their ingredients evaporate. However, upon evaporation of ingredients volatile at temperatures experienced in the latter stages of a gas turbine engine compressor, residues remain which have been found to lead to corrosion. One such material based on a high boiling point petroleum distillate includes a refined mineral oil, white commercial petrolatum, hexylene glycol as a coupling agent, an oxidized petroleum oil or wax and a petroleum sulfonate emulsifier. It has been recognized that the oxidized petroleum fraction and the petroleum sulfonate emulsifier are the two main contributors to the formation of residue which primarily contribute to long term corrosion of jet engine compressor parts. As will be shown later in connection with the following table and associated discussion, the elimination of the sulfonate emulsifier, the oxidized petroleum fraction and the petrolatum while at the same time including a solvent extracted petroleum oil along with the combination of (1) a polyoxyethylene fatty acid ester derivative as an emulsifying agent, (2) a glycol fatty acid ester derivative as a water repellent and (3) a volatile high molecular weight amine as a vapor phase corrosion inhibiting agent results in an unusual corrosion inhibiting material of very low residue content upon evaporation and greatly improved corrosion inhibiting properties.

The following table includes some of the variety of compositions evaluated in connection with the present invention.

TABLE.—COMPOSITION IN WT. PERCENT

Composition No.	97	105	107	108
H.B.P.D.	65	64	38	61
Petrolatum	2	2		
S.E.P.O.	20	20	45	20
P.O.A.E.	3	6	10	10
O.P.W.		3		
P.G.M.S.		5	5	7
C.H.C.			2	2

The abbreviations in the above table have the following meanings. Also, some examples of commercial names are given:

H.B.P.D.—Hot boiling point petroleum distillate (example: #2251 oil from Pennsylvania Refining Company).

Petrolatum—White commercial petrolatum.

S.E.P.O.—Solvent extracted petroleum oil (example: Zerice 45 from Standard Oil Company).

P.O.A.E.—Polyoxyethylene oleic acid ester (example: Lipal 30W from E. F. Drew and Company).

O.P.W.—Oxidized petroleum wax.

P.G.M.S.—Propylene glycol monostearate.

C.H.C.—Cyclohexylamine carbonate.

In the above table, the high hoiling point petroleum distillate specifically preferred for use in this invention had an initial boiling point of about 385–400° F. and was a water-white, deodorized product. However, the present invention broadly contemplates the use of a high boiling point distillate having a minimum boiling point of about 300° F. and preferably between 300–500° F. In addition to the high boiling point petroleum distillate as a carrier, all of the compositions in the table included a solvent extracted petroleum oil, having a viscosity of about 180–220 S.S.U. at 100° F., as a film former. In some ordinary applications, a solvent extracted oil need not be required. However, it was found that for use with apparatus operating at relatively high temperatures such as about 500° F. or above, the solvent extracted type of material is essential because that processing removes unsaturated materials which form lacquers upon evapo-

ration and heating. A solvent extracted mineral oil can be used as well, the elimination of the residue and lacquer forming materials being the important feature.

Also included in all of the mixtures of the above table is polyoxyethylene oleic acid ester as an emulsifying agent. It has been found that the oleic acid ester is specifically preferable for the jet engine corrosion inhibiting application. However, it is contemplated that any polyoxyethylene fatty acid ester derivative would be suitable to perform this function, a characteristic of such material being the formation of extremely low or no residues upon evaporation while at the same time acting as a good emulsifying agent.

It is preferred in the present invention that the water repellent propylene glycol monostearate be used because of its unusual interaction with the polyoxyethylene oleic acid ester in jet engine corrosion inhibiting applications. However, other glycol fatty acid ester derivatives such as coconates, oleates and rincinoleates, in addition to other stearates, should act equally well as a water repellent.

It was found that cyclohexylamine carbonate, in addition to providing corrosion resistance, has a lower toxicity level than do other similar compounds. Its alkaline pH nullifies free water reaction on steel. However, where toxicity is no problem, it is contemplated that other similar volatile, high-molecular amines could be substituted.

The compositions of the above table were tested, along with other compositions, in a simulated laboratory test engine cycle.

New jet engine compressor stator ring sections made of two kinds of type 400 series stainless steel were used as samples. The ring sections included A.I.S.I. type 410 stainless steel vanes having the following composition by weight: 0.15% max. C; 11.5–13.5% Cr; 0.25–0.80% Mn; 0.5% max. each of Ni and Si; 0.2% max. Mo; 0.03% max. each of P and S; 0.05% max. each of Al and Sn; with the balance Fe. These vanes were brazed with a 40% Cu, 5% Zn, 1% Ni, and the balance Ag brazing alloy to an A.I.S.I. type 403 ring section having the following composition by weight: 0.08–0.13% C; 11.5–13.0% Cr; 0.25–0.80% Mn; with the balance Fe and the same limits on the optional eelments Ni, Si, Mo, P, S, Al and Sn as in type 410 stainless steel above. The samples were coated with each of the compositions tested after which they were submerged in sea water for one hour. The samples were then removed from the sea water and heated for one hour at 500° F. after which they were rinsed in fresh water for 3 seconds. The samples were then coated again with the mixture and exposed to 96–100% relative humidity at 100° F. for 22 hours. If no corrosion was present after this cycle, the samples were resubmerged in sea water for 1 hour and the cycle was repeated. Of the samples listed in the above table, those coated with compositions 97 and 105 exhibited corrosion after 1 cycle; samples coated with composition 107 exhibited corrosion after 2 cycles; but samples coated with composition 108 exhibited no corrosion after 5 cycles.

It is to be noted from the above table that, comparing composition 105 with 107, upon the removal of petrolatum and the oxidized petroleum wax, and the addition of cyclohexylamine carbonate, improved corrosion resistance was achieved. However, with these same ingredients, when the balance between the solvent extracted petroleum oil and the high boiling point petroleum distillate carrier was adjusted so that the solvent extracted petroleum oil was in the range of 10–30 weight percent, an unusual and unexpected increase in corrosion resistance was achieved. This is noted by comparing corrosion failure in 2 cycles for samples coated with composition 107 and no corrosion failure for samples coated with composition 108 even after 5 full test cycles.

From test evaluation it is contemplated that the range of the present invention, in one form, comprises, by weight, 10–30% solvent extracted petroleum oil, 8–15% polyoxyethylene oleic acid ester, 5–15% propylene glycol monostearate, 0.25–5% cyclohexylamine carbonate with the balance high boiling point petroleum distillate. Although about 1–2% of the cyclohexylamine carbonate is preferred for apparatus operating in free flowing air, with closed-type operation such as in motor housings, gear boxes and the like, the cyclohexylamine carbonate could be reduced to about 0.25 weight percent.

As was mentioned above, in the event a long shelf life is desired, a small amount of hexylene glycol can be added as a coupling agent, for example, about 2 weight percent. It is contemplated that other glycols could be substituted as well.

The material of the present invention is made preferably by mixing together the high boiling point petroleum distillate, the solvent extracted petroleum oil and the polyoxyethylene oleic acid ester and then heating to between about 165 and 170° F. Then the propylene glycol monostearate is added and dissolved after which the cyclohexylamine carbonate is added and dissolved. The glycol, if included, can be added last.

Although the present invention has been described in connection with specific examples, it will be recognized by those skilled in the art, the variations and modifications of which the present invention is capable.

What is claimed is:

1. A corrosion inhibiting liquid of low residue and having improved corrosion and film forming characteristics, consisting essentially of, by weight:

10–30% of a solvent extracted oil selected from the group consisting of petroleum oil and mineral oil and having a viscosity of about 180–220 SSU at 100° F.;

8–15% of a polyoxyethylene fatty acid ester emulsifier substantially free of residue forming materials for solvent extracted oils;

5–15% of a glycol fatty acid ester water repellent selected from the group consisting of coconates, oleates, rincinoleates and stearates;

0.25–5% cyclohexylamine carbonate;

with the balance a petroleum distillate having a minimum initial boiling point of about 300° F.

2. A corrosion inhibiting liquid of low residue and having improved corrosion and film forming characteristics, consisting essentially of, by weight:

10–30% of a solvent extracted oil selected from the group consisting of petroleum oil and mineral oil and having a viscosity of about 180–220 SSU at 100° F.;

8–15% of a polyoxyethylene fatty acid ester low residue emulsifier for solvent extracted oils;

5–15% of a glycol fatty acid ester water repellent selected from the group consisting of coconates, oleates, rincinoleates and stearates;

0.25–0.5% cyclohexylamine carbonate;

up to about 2% hexylene glycol coupling agent;

with the balance a petroleum distillate having a minimum initial boiling point of about 300° F.

3. A corrosion inhibiting liquid of low residue having improved corrosion and film forming characteristics consisting essentially of, by weight:

10–30% of a solvent extracted petroleum oil having a viscosity of 180–220 SSU at 100° F.;

8–15% of a polyoxyethylene oleic acid ester;

5–15% of a propylene glycol monostearate;

0.25–5% cyclohexylamine carbonate;

with the balance a high boiling point petroleum distillate having an initial boiling point of 300–500° F.

4. A corrosion inhibiting liquid of low residue having improved corrosion and film forming characteristics consisting essentially of, by weight:

about 20% of a solvent extracted petroleum oil having a viscosity of 180–220 SSU at 100° F.;

about 10% of a polyoxyethylene oleic acid ester;

about 7% of a propylene glycol monostearate;

about 2% cyclohexylamine carbonate;

with the balance a high boiling point petroleum distillate having an initial boiling point of 300–500° F.

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