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RUST-INHIBITING LUBRICATING OIL

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8 Claims. (Cl. 252—49.9)

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This invention relates to lubricants especially adapted to the lubrication of steam turbines and, in particular, steam turbines employed in naval and other marine use where severe conditions conducive to rusting are encountered. Though especially designed for use in steam turbines, the lubricants of the invention may advantageously be employed for general lubrication, particularly in installations where rusting conditions are encountered such as, for example, in internal combustion engines, air compressors, and the like.

It is an object of the invention to provide a lubricating oil for steam turbines which will give enhanced protection against rusting under operating conditions where rusting is normally encountered. It is also an object of the invention to provide a steam turbine oil giving enhanced anti-rust protection as indicated by the U. S. Navy corrosion test mentioned herein. Briefly, these purposes are accomplished in accordance with the invention by adding to a base oil, of suitable grade, two constituents in minor but effective proportions. One constituent is an alkyl acid phosphate, or mixture of acid alkyl phosphates, having 8 to 16 carbon atoms in the alkyl groups. The other constituent is an alkoxy phenyl amine which is added in an amount from a few to several times greater than that required to combine chemically with the acid radical of the alkyl phosphate. The preferred alkoxy phenyl amines are the meta and para anisidines and phenetidines.

In the lubrication of modern steam turbines the requirements of the lubricants employed are most exacting since the lubricant employed comes in contact with condensed steam and, at times, even with salt water due to leaks in the condensing and cooling systems. The lubricant must successfully separate from the water without the formation of troublesome emulsions and must be able substantially to protect the metal surfaces of the turbines from rust even under these severe conditions. The rust protection is needed not only by those parts continually wetted by the lubricant, but also by those parts of the system which are not continually flooded by the oil. In addition, the lubricant must not foam to any substantial extent.

In order to insure proper performance from lubricants supplied for marine steam turbines, the U. S. Navy has adopted rigid specifications set forth in the Navy Department Specification Pamphlet 14–0–15 dated August 15, 1945. Among the important tests of these specifications is the test for "Corrosion (in presence of salt water)" described therein in paragraphs E–5 and

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F–3c. In brief, this corrosion test provides that a polished cylindrical steel specimen shall show no corrosion when partially immersed for 48 hours in a bath composed of 300 ml. of oil and 30 ml. of synthetic sea water and maintained at 140° F. This test is recognized by the Navy as a means of indicating the degree of protection against rust afforded by a lubricant under test.

Many rust-inhibiting lubricants have been proposed for use in steam turbines. A large proportion of these are composed of well refined mineral oil to which have been added small quantities of alkyl phosphate esters. Improved results are claimed by many when alkyl acid phosphates are used and the acid radical is neutralized with a slight excess of an organic amine, for which purpose various amines have been suggested. In general, these lubricants have given more or less satisfactory results in steam turbines. However, most of them fail to meet the rigid Navy corrosion test because rusting occurs during the test on that portion of the steel specimen not immersed in the oil bath, or at the surface of the oil, indicating that the lubricant is somewhat deficient in the protection afforded to those parts of the turbine not continually wetted by the oil.

In accordance with the invention it has been found that alkyl acid phosphates containing from 8 to 16 carbon atoms in the alkyl groups in combination with a large excess of an alkoxy phenyl amine, when added in certain proportions to a suitable lubricating oil, provide excellent protection against rusting in steam turbines and successfully pass the Navy corrosion test with no rusting on any portion of the steel specimen. The addition of these materials to the oil does not increase the emulsion or foaming characteristics beyond permissible limits.

The base oil used in the invention may be any refined mineral oil of suitable viscosity. For example a 50 V. I. solvent refined hydrocarbon oil having a Saybolt viscosity at 130° F. of 185–205 seconds may be used.

To this base oil is added a small amount of alkyl acid phosphate having from 8 to 16 carbon atoms in the alkyl group. The di-alkyl phosphates are preferred and the preferred amount is from 0.01% to 0.02% by weight although somewhat greater amounts may be used if desired. For this purpose it is preferred to use a product marketed under the trade name of "Ortholeum 162" which is understood to be the C_8 to C_{12} cut of alcohols derived from coconut fatty acids esterified with phosphoric acid to approximately the di-alkyl state.

In addition to the alkyl phosphates there is added to the oil an alkoxy aniline in considerably greater amount. Depending upon the particular alkoxy aniline used, the amount thereof added to the oil will vary upwards from three to several times the amount stoichiometrically required to form an addition compound by reacting with the acid radical of the alkyl phosphate. Para-anisidine in an amount of 0.05% by weight upwards to its solubility limit in the oil has proven satisfactory for the purpose, when the concentration of alkyl acid phosphate in the oil is about 0.015%. Para-phenetidine, and also meta-phenetidine, in an amount of 0.15% upwards have given even better results. Likewise, both ortho-anisidine and ortho-phenetidine have shown similar usefulness, but require substantially larger quantity to be as effective as the corresponding meta and para compounds. For example, 0.8% by weight of ortho-anisidine was required to give results equal to 0.05% para-anisidine.

The manner of adding the alkyl acid phosphates and the alkoxy anilines to the oil is of no particular importance. They may be added either separately, in any order, or the proper amounts may be mixed together and the mixture added to the oil. Likewise, a concentrate of the compounds in a portion of the oil may be prepared and this concentrate added to the oil.

In addition to the rust-inhibiting properties of the alkoxy anilines, these amines have proven to be good oxidation inhibitors and assist in preventing deterioration of the oil to a marked degree. However, additional compatible oxidation inhibitors may be incorporated in the finished oil without departing from the spirit of the invention.

Indicative of the superior rust-inhibiting properties afforded by the oils of this invention, the following table shows the results obtained by the Navy corrosion test mentioned about on a 50 V. I. solvent refined oil having a Saybolt viscosity of 445 sec. at 100° F. compounded with Ortholeum 162 and various amines, including alkoxy anilines:

Amine Used	Amine, Wt. Percent	Ortholeum 162 Wt. Percent	Condition of Specimen After Test	
			Below Oil Level	Above Oil Level
none		none	rusted	no rust.
Do		0.015	no rust	rusted.
Do		0.02	do	Do.
Di B Naphthyl-p-phenylene diamine.	0.03	0.015	do	rusted.
Tri-n-butyl amine	0.017	0.015	do	Do.
Do	0.30	0.015	rusted	no rust.
Do	0.30	0.02	no rust	rusted.
Methyl aniline	0.30	0.015	do	Do.
Para-amino phenol	trace [1]	0.015	rusted	Do.
Para-anisidine	0.05	0.015	no rust	no rust.
Do	0.15	0.015	do	Do.
Do	0.25	0.015	do	Do.
Do	0.15	none	rusted	Do.
Para-phenetidine	0.15	0.015	no rust	Do.
Do	0.35	0.015	do	Do.
Meta-phenetidine	0.25	0.015	do	Do.
Ortho-anisidine	1.00	0.015	do	Do.
Ortho-phenetidine	1.00	0.015	do	Do.

[1] Para-amino phenol is almost insoluble in the oil.

Although, in the practice of the invention, the mono- and diphosphoric acid esters of the several aliphatic alcohols from octyl to hexadecyl alcohol may be used, mixtures of these are generally more readily available commercially. Such mixtures are intended to be included within the scope of the term "alkyl acid phosphate" as used in the claims.

This application is a continuation-in-part of my copending application Serial Number 43,152, filed August 7, 1948, now abandoned.

I claim:

1. A lubricant especially adapted for the lubrication of steam turbines for marine use, comprising essentially a mineral lubricating oil and a rust-inhibiting quantity of not less than .01% by weight of alkyl acid phosphate having from 8 to 16 carbon atoms in the alkyl group and an alkoxy aniline of the group consisting of anisidine and phenetidine, the alkoxy aniline being present in quantity of not less than three times the amount theoretically required to react with the alkyl acid phosphate, the alkoxy aniline varying in percent of weight of the oil from .05% to the limit of its solubility in the oil.

2. The lubricant of claim 1 in which the alkoxy aniline is para anisidine.

3. The lubricant of claim 1 in which the alkoxy aniline is para phenetidine.

4. The lubricant of claim 1 in which the alkoxy aniline is meta phenetidine.

5. The lubricant of claim 1 in which the alkyl acid phosphate has from 8 to 12 atoms in the alkyl group.

6. The lubricant of claim 1 in which the quantity of alkyl acid phosphate is not greater than .02% by weight.

7. The lubricant of claim 1 in which the alkyl acid phosphate is di-alkyl phosphate.

8. A mineral lubricating oil containing as essential rust-inhibiting components the amine phosphate salt and free amine resulting from the admixing of from 0.01% to about 0.02% by weight of acid alkyl phosphate derived by esterifying phosphoric acid to approximately the di-alkyl state with C_8 to C_{12} alcohols and from about 0.05% to a percentage not in excess of its solubility in the oil of an alkoxy aniline selected from the group consisting of anisidine and phenetidine.

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