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MINERAL OIL LUBRICATING COMPOSITIONS

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The present invention relates to improved mineral oil lubricating compositions and, more particularly, to novel liquid compounded lubricating compositions possessing a combination of properties that adapt them for lubricating use under rust- and emulsion-inducing conditions.

As those skilled in the art are aware, the requirements for lubricants for particular purposes are somewhat exacting with an illustration thereof being mineral oil compositions contemplated for use in lubricating turbines wherein the lubricant may come into contact with water due to steam leaks through shaft seals as well as water from oil coolers of steam turbine lubricating systems. Among the desired requisites for a compounded lubricant for such usage are that it should (1) separate readily from water without formation of troublesome relatively stable emulsions, (2) protect metal components of the turbine against rusting, (3) resist oxidation, and (4) be stable against ingredient separation and/or sludge-forming tendencies upon storage for an extended period of time.

Among the numerous types of additive materials that have been proposed for mineral oil lubricants are oil-soluble or oil-miscible rust-inhibiting polycarboxylic acids and, particularly, relatively high molecular weight alkylated aliphatic polycarboxylic acids that are soluble or miscible in mineral oils in small amounts sufficient to impart rust-preventive properties to the mineral oil compositions. Illustrative of such acids are polycarboxylic acids such as alkylated and alkenylated succinic, glutaric, adipic, pimelic, suberic, maleic and others. Specific illustrations include alkenylated succinic acids and alkylated maleic acids with the alkenylated succinic acid preferably having a total of more than sixteen carbon atoms and the alkylated maleic acid containing at least ten carbon atoms. As set forth hereinafter, the compositions embodied herein contain, as an essential ingredient, a polycarboxylic acid that imparts rust-preventive properties to mineral oils when added thereto in small amounts. Hence, and although the invention set forth hereinafter is described by use, for purposes of illustration, of specific rust-inhibiting polycarboxylic acids, the invention in generic aspect embodies use of polycarboxylic acids, preferably dicarboxylic acids, that impart rust-preventive properties to mineral oil compositions and further detailed discussion of which acids is not deemed essential herein in view of the numerous disclosures in the art pertaining thereto.

Also known to those skilled in the art is the use in mineral oil compositions of aromatic amine compounds as anti-oxidants with the naphthylamines being illustrations thereof and, more specifically, the phenyl alpha naphthylamines. Although naphthylamines other than phenyl alpha naphthylamine have been proposed for use as anti-oxidants, phenyl alpha naphthylamine, due to its effectiveness as an anti-oxidant and commercial availability, is perhaps the most widely used anti-oxidant of the aromatic amine type although derivatives thereof such as alkylated phenyl alpha naphthylamines also merit consideration for use as anti-oxidants, with illustrations of the latter being p-tert. butyl phenyl alpha naphthylamine, paramethyl phenyl alpha naphthylamine, and the like.

Although the addition of a rust-inhibiting polybasic acid and an anti-oxidant aromatic amine to a mineral oil lubricating composition may provide compositions possessing the desired properties imparted by said additive materials, it has been found that compositions that contain both the aforesaid rust-inhibiting acids and anti-oxidant amines possess an enhanced tendency to emulsify with water and for the composition to form and deposit oil-insoluble materials upon storage for a relatively short period of time, particualrly when the composition is exposed to light, heat or other conditions that enhance formation of oil-insoluble materials. Thus, desiderata are the provision of mineral oil compositions, containing a rust-inhibiting polycarboxylic acid and anti-oxidant aromatic amine, that are inhibited against such formation of oil-insoluble materials and are also inhibited against emulsification with water or the formation of emulsions which do not readily separate into an oil phase and an aqueous phase.

The present invention is based on the discovery that mineral oil lubricating compositions that contain an oil-soluble or oil-miscible rust-preventive polycarboxylic acid and oil-soluble aromatic amine anti-oxidant in small amounts sufficient, respectively, to impart rust-preventive and anti-oxidant properties to the composition, may be inhibited against formation of relatively stable emulsions with water and formation of oil-insoluble materials by addition to the composition of a small amount of an oil-soluble aliphatic amine.

In order to illustrate the invention and the aspect thereof pertaining to inhibiting the mineral oil compositions as embodied herein against formation of oil-insoluble materials, the following tabulation (Table I) sets forth data obtained by observing, at frequent intervals, the tendency, if any, of the mineral oil compositions (stored in capped glass bottles) to form insoluble material. The mineral oils used in the test compositions were highly refined oils of turbine lubricating grade, of the viscosity shown, obtained by solvent extracting (furfural) a petroleum lubricating oil distillate, and the rust-inhibitor employed was a rust-inhibiting product, marketed as "Lubrizol 850" by the Lubrizol Corporation of Cleveland, Ohio, and understood to comprise an about 80 percent by weight concentrate in a mineral oil of an alkenylated succinic acid (molecular weight of about 400).

Table I

Comp. No.	Composition						Oil-Insoluble Material-Forming Characteristics
	Mineral Oil		Phenyl alpha naphthylamine (Percent by Wt.)	Lubrizol 850 (Percent by Wt.)	Aliphatic Amine		
	Amount (Percent by Weight)	Viscosity			Percent by Weight	Amine	
1	99.72	150–160 (SUS at 100° F.).	0.25	0.03			Substantial precipitation of oil-insoluble material in 14 days.
2	99.70	do	0.25	0.03	0.02	tributylamine	No precipitation in 60 days.
3	99.70	do	0.25	0.03	0.02	18 carbon atom branched chain primary alkyl amine.	Do.
4	99.70	do	0.25	0.03	0.02	n-amylamine	Do.
5	99.70	do	0.25	0.03	0.02	dibutylamine	Do.
6	99.70	do	0.25	0.03	0.02	tert. butylamine	Do.
7	99.72	215–225 (SUS at 100° F.).	0.25	0.03			Substantial precipitation of oil-insoluble material in 11 days.
8	99.70	do	0.25	0.03	0.02	tributylamine	No precipitation in 60 days.
9	99.72	300–315 (SUS at 100 °F.).	0.25	0.03			Substantial precipitation of oil-insoluble material in 14 days.
10	99.70	do	0.25	0.03	0.02	tributylamine	No precipitation in 60 days.

As is apparent from the data in Table I, the oil compositions (Nos. 1, 7 and 9) containing the polycarboxylic acid rust-inhibitor and aromatic amine anti-oxidant possessed instability characteristics in that substantial formation and precipitation of oil-insoluble material occurred within a relatively short period of time. However, and as shown by the data for the remaining examples in the table and which additionally contained a small amount of an aliphatic amine, no formation or precipitation of oil-insoluble materials occurred for at least 60 days, thereby evidencing the marked improvement in stability that results by practice of this invention.

In order to further describe the invention and the aspect thereof pertaining to inhibiting mineral oil compositions as embodied herein against formation of relatively stable emulsions with water, the following tabulation (Table II) sets forth data obtained by subjecting the compositions described therein to the emulsion test (using distilled water) described in Navy Department specification, pamphlet 14–0–15, symbol 2190–T as amended March 1, 1948. Briefly, in that test, 40 ml. of the test composition and 40 ml. of distilled water are stirred together for 5 minutes at 1500 R. P. M. in a 100 ml. graduate at 130° F. and the time required for the mixture to separate completely into an oil phase and an aqueous phase is observed.

Table II

Comp. No.	Composition						Emulsion Test Results
	Mineral Oil		Phenyl alpha naphthylamine (Percent by Wt.)	Lubrizol 850 (Percent by Wt.)	Aliphatic Amine		
	Amount (Percent by Weight)	Viscosity			Percent by Weight	Amine	
11	100.0	300–315 (SUS at 100° F.).					Complete separation in 4 minutes.
12	99.75	do	0.25				Complete separation in 10 minutes.
13	99.97	do		0.03			Complete separation in 11 minutes.
14	99.72	do	0.25	0.03			Incomplete separation even after 60 minutes.
15	99.70	do	0.25	0.03	0.02	18 carbon atom branched chain primary alkyl amine.	Complete separation in 6 minutes.
16	99.715	do	0.25	0.03	0.005	do	Complete separation in 5 minutes.
17	99.70	do	0.25	0.03	0.02	tert. butylamine	Complete separation in 8 minutes.
18	99.70	do	0.25	0.03	0.02	tributylamine	Complete separation in 20 minutes.
19	99.715	do	0.25	0.03	0.005	do	Complete separation in 20 minutes.

As is apparent from the data in Table II, the mineral oil per se (composition 11) the mineral oil containing the anti-oxidant naphthylamine (composition 12) and the mineral oil containing the rust-inhibiting polycarboxylic acid (composition 13) separated into an oil phase and aqueous phase in relatively short periods of time when subjected to the emulsion test. However, as shown by the data for composition 14, the oil containing both the rust-inhibitor and anti-oxidant amine did not completely separate even after an extended period of time, but, as shown by the data for compositions Nos. 15 to 19, inclusive, illustrating compositions as embodied herein, addition of a small amount of an aliphatic amine suppressed to a marked extent the tendency of composition 14 to form an emulsion that did not readily separate completely into an oil phase and an aqueous phase.

With reference to the oil component of the compositions embodied herein, the invention contemplates use of mineral oil fractions of lubricating grade, derived from a variety of petroleum crudes, and which fractions are susceptible to improvement in oxidation resistance by aromatic amine anti-oxidants and are also improvable in rust-preventive properties by rust-inhibiting polycarboxylic acids. In particular, however, the invention relates to use, as the mineral oil fraction, of highly refined lubricating oil fractions produced by solvent extraction, acid treatment or other methods, known to these skilled in the art, for removal of more-aromatic components from mineral oil lubricating fractions to provide highly refined oils of more-paraffinic nature than the fraction subjected to the refining treatment. Though it is not intended that the invention be limited thereto, a preferred embodiment relates to mineral oil compositions comprising a highly refined solvent (e. g. furfural) extracted mineral oil of

lubricating grade in major amount based on the weight of the composition, with a specific illustration thereof being a furfural extracted lubricating oil distillate such as the oil used in the foregoing specific examples, a small amount, sufficient to impart anti-oxidant properties to said oil, of phenyl alpha naphthylamine, a small amount, sufficient to impart rust-preventive properties to said oil, of a rust-preventive alkenyl succinic acid, and an oil-soluble aliphatic amine in a small amount, sufficient to inhibit the composition against formation of relatively stable emulsions with water and to inhibit formation of oil-insoluble materials. Although the proportional amounts of ingredients employed may be varied, with satisfactory results, over a rather wide range depending on factors such as the particular components used in preparing the compositions, the degree of rust-preventive and emulsification-inhibiting properties desired, and considerations of economic nature, the amount of anti-oxidant employed is usually from about 0.05 to 1.0 percent or higher based on the weight of the composition, the polycarboxylic acid rust-inhibitor from about 0.001 to 1.0 percent, and the aliphatic amine from about 0.005 to about 1.0 percent. A more specific embodiment of compositions as embodied herein is illustrated by the compositions in the foregoing tabulations that contained the rust-inhibitor and anti-oxidant in amounts that impart excellent rust-preventive and anti-oxidant properties to the compositions.

With reference to the aliphatic amine, it is apparent from the numerous amines used in the foregoing examples that the invention may be carried out by use of oil-soluble aliphatic amines of rather wide scope as is apparent from the examples used for illustrating the invention wherein the amines employed include primary aliphatic amines, secondary aliphatic amines, tertiary aliphatic amines, normal amines, branched chain aliphatic amines and amines having an aliphatic group of a relatively small number of carbon atoms (e. g. four carbon atoms) as well as amines having a relatively high number of carbon atoms (e. g. 18 carbon atoms).

Although the invention has been described in conjunction with certain preferred embodiments thereof, those skilled in the art will readily recognize that variations and modifications can be made. Such modifications and variations are to be considered to be within the purview of the specification and scope of the appended claims. Moreover, it should be understood that compositions, as embodied herein, may also contain additional ingredients for imparting other desired properties to the compositions. In illustration, the compositions may contain anti-foam agents, e. g. of the silicone type, viscosity index improvers, such as the polyisobutylenes, pour point depressants such as the wax-alkylated naphthalenes, and others.

I claim:

1. A mineral oil lubricating composition comprising a mineral oil of lubricating grade in major amount based on the weight of the composition, a small amount, sufficient to impart rust-preventive properties to said composition, of an oil-soluble rust-inhibiting alkenylated succinic acid having a molecular weight of about 400, a small amount, sufficient to impart anti-oxidant properties to said composition, of an oil-soluble anti-oxidant phenyl naphthylamine, and a small amount, sufficient to inhibit said composition against formation of relatively stable emulsions with water, of an oil-soluble alkyl amine having from 4 to 18 carbon atoms.

2. A mineral oil lubricating composition comprising a solvent extracted mineral oil in major amount based on the weight of the composition, about 0.001 to about 1.0 percent by weight of a rust-inhibiting alkenylated succinic acid having a molecular weight of about 400, about 0.05 to about 1.0 percent by weight of an anti-oxidant phenyl naphthylamine, and about 0.005 to about 1.0 percent by weight of an oil-soluble alkyl amine having from 4 to 18 carbon atoms.

3. A composition, as defined in claim 2, wherein the mineral oil is a solvent extracted lubricating oil distillate of turbine lubricating grade.

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