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LUBRICANT

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This invention relates to improved steam cylinder lubricants and methods of preparing same.

It is well known to those familiar with the compounding of steam cylinder oils and steam plant engineers that the presence of moisture in steam will result in a film of straight mineral oil being rapidly washed off from steam engine cylinder walls and other surfaces where steam contacts them. Therefore, to secure proper lubrication under wet steam conditions, such oils have often been compounded with a fatty oil, such as lard oil, degreas, or tallow; this helps to prevent lubricant wash-off, but it does not prevent it completely. Furthermore, the presence of fatty oils and other fatty materials generally not only facilitates emulsification of the lubricant with condensed steam, but also appears to favor formation of emulsions from which the water separates only with great difficulty and upon long standing.

One object of the present invention is to provide a lubricant which has great resistance to the washing-off action of wet steam, in other words, not only a lubricant which has good adhesivity, but has especially good adhesivity under wet steam conditions, so that with the use of this lubricant there will be less scoring of the cylinder walls and less wearing of the moving parts. Another object of this invention is to provide a lubricant which not only has the above-mentioned good lubricating qualities but also shows rapid settling out in the steam emulsion test. A third object is to provide a lubricant having the above-described desirable characteristics by the use of a compounding agent which, when subjected to the high temperatures frequently used in operating conditions, will decompose without leaving any charred or gummy or other undesirable residue.

Broadly, the invention comprises adding to a suitable mineral oil base stock, such as will be described later, a small amount of a high molecular weight, oxygen-containing polymer which is depolymerizable at high temperature without charring. Small amounts of fatty materials may be, and preferably are, also present.

The mineral oil to be used as the base stock is a cylinder oil which may be derived from any of the commonly available crude oils, such as the paraffinic crudes (typified by Pennsylvania crude), naphthenic base crudes, e. g. from California, and mixed base crudes, such as a Mid-Continent oil. The cylinder oil may be a steam-reduced fraction, as from a Pennsylvania crude, 55

or may be an overhead stock, for example, as produced by distillation under vacuum. The oil is preferably a filtered oil of high quality, and should have a high flash point, low carbon content, good resistance to the development of acidity, and a satisfactorily low pour point. The flash point should be at least as high as 500° F. and may range from there on up to 625° F., or higher. The viscosity of this mineral oil base stock should be between the approximate limits of 100 and 250° seconds Saybolt at 210° F., with a viscosity index between the approximate limits of 70 and 100.

The oxygen-containing polymer which is to be incorporated in the above-described base stock, according to this invention, should be of a high molecular weight, e. g., at least 1,000 and may be 50,000, 100,000, or even considerably higher, although it must not be so high in molecular weight as to be insoluble in the mineral oil base stocks referred to. In general, these polymers are obtained by polymerizing unsaturated monomeric chemical compounds, such as, esters, ethers, acids, etc. A particularly preferred class of polymers are those produced from esters of acrylic acid and alkyl derivatives thereof, such as methacrylic acid containing a methyl substituent in the alpha position, or other higher alkyl groups, such as, ethyl, propyl, etc., in a similar position; these esters should be derived from monohydric alcohols preferably containing more than 4 carbon atoms, such as amyl, hexyl, heptyl, octyl, lauryl, cetyl, octadecyl, etc. Such acrylic compounds contain the group $\text{CH}_2=\text{C}$, and have attached to this latter carbon atom a carboxylic ester group and either a hydrogen or a hydrocarbon group, such as, an alkyl or aryl group.

Although the above polymerized acrylic compounds are preferred, polymers of other vinyl compounds may be used, such as, a stearic acid vinyl ester having a molecular weight of about 5,000, a polymerized vinyl octadecyl ether or polymerized vinyl butyl ether having a molecular weight of about 3,000 to 10,000 or higher.

In preparing the steam cylinder lubricants of this invention, there is also added some fatty material or so-called "fixed oil," such as tallow, preferably acidless tallow, or other animal glyceride of the tallow type. Acidless tallow is especially preferred because it gives much better results in combination with the high flash mineral oil base stock and the oxygen-containing polymer of this invention, than do other fatty materials in similar combinations.

The proportions of ingredients to be used in preparing the steam cylinder lubricants of this invention may, of course, be varied over a very wide range depending upon the particular ingredients used and the operating conditions under which the lubricant is intended to be used, but ordinarily the amount of oxygen-containing polymer should be between the limits of about 0.1 and 2.0%, preferably about 0.5-1.0%, and the fatty material, if used, should be about 1-15%, preferably about 5-10% in concentration.

The steam cylinder lubricant of this invention has good adhesivity to the cylinder walls, valve stems, and other metal parts of the steam cylinder engine and this is especially advantageous under wet steam conditions. It has a high viscosity index (i. e., it shows a relatively low change in viscosity for any particular change in temperature). It results in a relatively lower consumption of lubricant than many lubricants used heretofore. By reason of the properties of the oxygen-containing polymer, the product requires smaller amounts of fatty oil compounding agent than similar products free from such oxygen-containing polymer. (In view of the tendency of fatty materials to decompose at high temperature with the production of charred or gummy materials which cause unsatisfactory service, it is desirable to use only the minimum amount of fatty material necessary). The steam cylinder lubricant of this invention also has a relatively low steam emulsion number, by which is meant that it permits ready separation of water from the emulsion for re-use in steam boilers or for other purposes and permits re-use of the lubricant. Another important feature of this invention is that the oxygen-containing polymer used is relatively stable at elevated temperatures, and even when exposed to temperatures high enough to cause decomposition, it merely depolymerizes without the formation of any charred or other undesirable residue.

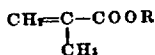
Inspection of the finished steam cylinder lubricant of this invention should show approximately the following characteristics:

Viscosity, between the approximate limits of 110-250 seconds Saybolt at 210° F.
Viscosity index, about 70 to 130
Pour point, about 0 to 50° F.
Flash, °F., 500 to 600
Fire, °F., 550 to 650

The objects and advantages of the invention will be better understood from a consideration of the following specific examples.

EXAMPLE 1

1% of "Acryloid 100," which is the trade name of a product understood to be a polymerized methacrylic acid ester having the general formula



in which R is an aliphatic hydrocarbon group derived from an alcohol having at least 8 carbon atoms and probably 12 or even 16 carbon atoms, such as a polymerization product of lauryl methacrylate or cetyl methacrylate, dissolved in a concentration of 25 to 35% in light hydrocarbon mineral oil, was dissolved along with 7.5% by weight of acidless tallow in a mineral oil base stock prepared from a Mid-Continent crude and having the following physical properties.

Gravity, °A. P. I.	24.5
Viscosity at 100° F. Saybolt sec.	2600
Viscosity at 210° F. Saybolt sec.	137
Viscosity index	80
Pour, °F.	10
Flash, °F.	505
Fire	580

This composition made a very satisfactory steam cylinder lubricant having the following characteristics:

Gravity, °A. P. I.	25.2
Viscosity at 100° F. Saybolt sec.	2103
Viscosity at 210° F. Saybolt sec.	148
Viscosity index	103
Pour, °F.	20
Flash, °F.	505
Fire	580

EXAMPLE 2

The composition prepared in Example 1 was subjected to the steam emulsion test in comparison with several other materials, with the following results:

Steam emulsion test¹

Blends	No. of cc. water settling out in 20 minutes
99.7% oil A.	0.5 cc.
0.3% acryloid 100.	
7.5% acidless tallow.	
92.5% oil A.	17 cc.
7.5% acidless tallow.	
91.5% oil A.	
1.0% polyisobutylene (about 60,000 mol. wt.).	17 cc.
7.5% acidless tallow.	
91.5% oil A.	
1.0% acryloid 100.	All water out in 15 minutes.

¹ Steam passed into 20 cc. of compounded oil for 4 to 6 min. or until double oil volume (emulsion). Then the emulsified oil set at 200° F. for 20 minutes.

It is noted from this series of tests that the composition of this invention, namely, the composition containing the mineral oil, acidless tallow, and the acrylate polymer separated completely from the water in the emulsion test in 15 minutes; whereas, a composition identical except lacking the acrylate polymer, and a composition identical except containing a high molecular polyisobutylene, instead of the acrylate polymer, both had only shown a separation of 17 cc. of water in 20 minutes.

EXAMPLE 3

Steam emulsion test

Blends	No. of cc. water settling out in 20 minutes
7.50% acidless tallow.	All water out in 12 minutes.
91.50% oil A.	
0.35% lauryl methacrylate.	
7.50% acidless tallow.	All water out in 15 minutes.
91.50% oil A.	
0.35% cetyl methacrylate.	
7.50% tallow.	All water out in 10 minutes.
91.50% oil A.	
0.35% copolymer of ethyl methacrylate and n-octa-decylalphi methacrylate.	

If desired, various other addition agents known to the art may also be added to the steam cylinder lubricants described above; for instance, small amounts of anti-oxidants and dyes.

It is not intended that this invention be limited to the specific examples which have been recited as illustrative of the invention, but only by the

appended claims in which it is intended to claim all novelty inherent in the invention.

We claim:

1. A steam cylinder lubricant comprising a major proportion of mineral lubricating oil having a flash point at least as high as 500° F. and a viscosity of about 100 to 250 seconds Saybolt at 210° F., about 0.1–2.0% of polymerized ester of an acrylic acid, plus about 1 to 15% of acidless tallow.

2. A steam cylinder lubricant having good adhesivity to the cylinder walls, valve stems, and other contacted parts of the steam engine, and having the property of separating rapidly from water in the steam emulsion test, comprising at least 80% of mineral lubricating oil having a flash point of at least 500° F. at a viscosity of about 100–250 seconds Saybolt at 210° F., about 0.5–1.0% of polymerized methacrylate ester and about 5 to 10% of acidless tallow.

3. A steam cylinder lubricant comprising at least 80% by weight of a mineral lubricating oil base stock having a flash point of at least 500° F. and a viscosity of 100–250 seconds Saybolt at 210° F., about 0.1 to 2.0% of an oxygen-containing polymer having a molecular weight of at least 1,000, depolymerizable at elevated temperatures without producing charred or other undesirable residue, and about 1–15% by weight of acidless tallow.

4. The process of preparing steam cylinder lu-

bricants which comprises dissolving in a major proportion of mineral lubricating oil base stock having a flash point at least as high as 500° F. and a viscosity of about 100–250 seconds Saybolt at 210° F., about 1–15% by weight of tallow, and at least 0.1% of oxygen-containing polymer having a molecular weight of at least 1,000, depolymerizable at elevated temperatures without leaving charred or other undesirable residue, the amount of said polymer being sufficient to impart the desired adhesivity to the resulting composition and to cause the composition to settle out from water sufficiently rapidly in the steam emulsion test.

5. A steam cylinder lubricant comprising a major proportion of mineral lubricating oil having a flash point at least as high as 500° F. and a viscosity of about 100–250 seconds Saybolt at 210° F., about 0.1% to 2.0% of a polymerized acrylic acid ester of a monohydric alcohol containing more than 4 carbon atoms and about 1% to 15% of tallow.

6. Lubricant according to claim 5 in which the polymer is a polymerized methacrylic acid ester of a saturated monohydric alcohol having about 5 to 18 carbon atoms.

7. Steam cylinder lubricant according to claim 2 in which the polymer is polymerized octal methacrylate.

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