STABLE MINERAL OIL COMPOSITIONS

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This invention relates to improved lubricating oil compositions, and more particularly to mineral lubricating oil compositions which are resistant to oxidative deterioration under storage or use in equipment subjected to adverse operating conditions of temperature and pressure.

Lubricating oils such as mineral oils in the lubricating viscosity range tend to deteriorate and break down due to oxidation both in storage and during use, particularly at extremely high temperatures, such as above 400° F. and higher, resulting in the formation of undesirable products such as gums, sludges, resins, acidic products and other deleterious products which decrease the useful life of the oil or render it useless within a short period of time.

Mineral oils of this type include aircraft, truck and automobile mineral lubricating oils, industrial oils such as gear oils, transformer oils, hydraulic oils and the like. It is known that certain aromatic amines are useful as oxidation inhibitors for mineral oils. However, their application is limited because of their tendency to discolor mineral oils and form deposits, particularly at elevated temperatures. Other types of anti-oxidants such as alkyl phenols, such as di- and trialkylphenols, e.g., 2,4-dimethylphenol and 2,6-dimethyl-4-methylphenol are effective only in certain type of mineral oil and are oxidatively unstable at elevated temperatures.

It is an object of this invention to inhibit or prevent oxidation of mineral oil. Still another object is to inhibit or prevent deterioration, discoloration and deposit formation in mineral oil during storage and use over a wide temperature range, particularly at elevated temperatures. Other objects of the invention will be apparent from the following description of the invention.

It has now been discovered that various types of mineral lubricating oil including those which contain substantial amounts of aromatic (5-50%) can be effectively stabilized even at temperatures above 400° F. without undesirable side effects by addition thereto of small amounts (0.001-2%) preferably 0.002-1% by weight) of each of an oil-soluble aromatic amine having the Formula I RR_NH, wherein the R's are the same or different mono- or di- aromatic radicals, and an oil-soluble boron ester having the Formula II (RO)_{2}B, wherein at least one R is an aryl radical having attached thereto at least one and preferably 2 branch-aryl radicals such as tert-alkyl groups and the other R's are the same or different hydrocarbyl radicals such as alkyl, aryl, alkaryl, aralkyl or cycloalkyl radicals. Boron esters represented by Formula II which contain at least two tert-arylphenol R's are preferred.

The oil-soluble aromatic amines represented by Formula I include diphenyl, dinaphthyl, phenyl alpha-naphthyl, phenyl beta-naphthyl amines and mixtures thereof.

The boron esters represented by Formula II (RO)_{2}B are compounds wherein at least one R is a branched-chain aryl radical such as a tert-alkylaryl radical, e.g., tert-butylphenyl, tert-amylphenyl, tert-octylphenyl, dibutylphenyl, diethylamlyphenyl, diethyl-octylphenyl, methyl- tert-butylphenyl, methylisodide- butylphenyl, diethyl-naphthyl, tert-butylphenyl, 2-ethylhexylphenyl, etc.

The additive combination of this invention effectively stabilizes a variety of petroleum lubricating stocks such as paraffinic, naphthenic and mixed base mineral oils having a viscosity range of from 50 SUS at 100° F. to 250 SUS at 210° F. A typical oil is a refined mineral lubricating oil (X) having the following properties:

Pour point, ° F. .................................................. 29-31
Flash point, ° F. (COC) ........................................... Min. 420
Viscosity SUS, 100° F. ........................................... 345-353
Unsulfonated Residue ........................................... Min. 98

Another typical oil (Y) is an Oklahoma neutral petroleum fraction having the following properties:

Specific Gravity .................................................. 0.876
Pour point, ° F. .................................................. +10
Viscosity at 100° F., cs ........................................ 56.88
VI ................................................................. 93.9
Flash point, OCC, ° F. .......................................... 450
Fire point, ° F. .................................................... 490
Aromatics, percent ............................................... 23.7

To illustrate the pronounced superiority of the additive combination in stabilizing and preventing oxidation of mineral oil, the following compositions were prepared and evaluated in a micro-oxidation test of the MIL-L-7808 oxidation test under the following test condition: air flow of 1 liter/hour oxidizing agent, 400° F., solid metal catalyst (Ag, Ti, Cu, Mg, Fe), with the results as shown in Table I.

Table I

<table>
<thead>
<tr>
<th>Inhibitor</th>
<th>Hours to Absorb 1 millimole Oil</th>
<th>Gain Due to Inhibitor, Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) None</td>
<td>31</td>
<td>8</td>
</tr>
<tr>
<td>(2) Phenyl-alpha-naphthylamine</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>(3) Beta-buto-dimethylaminol</td>
<td>37</td>
<td>6</td>
</tr>
<tr>
<td>(4) Diphenylamine</td>
<td>38</td>
<td>7</td>
</tr>
<tr>
<td>(5) 2,6-ditert-butyl-4-methyl-phenyl di-n-butyl borate</td>
<td>38</td>
<td>7</td>
</tr>
<tr>
<td>(6) 4-19</td>
<td>62</td>
<td>31</td>
</tr>
<tr>
<td>(7) 4-15</td>
<td>62</td>
<td>31</td>
</tr>
<tr>
<td>(8) 4-5</td>
<td>46</td>
<td>35</td>
</tr>
</tbody>
</table>

The unexpected results which the additive combinations of the present invention produce were further demonstrated when oil compositions shown in Table II were tested in the Dorro Oxidation Test described in the National Petroleum News, September 17, 1941, pages R-294-296, with the results as shown in Table II.

Table II

<table>
<thead>
<tr>
<th>Inhibitor</th>
<th>Time (hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Phenyl-alpha-naphthylamine</td>
<td>8.294</td>
</tr>
<tr>
<td>(2) 2,6-dibutyl-4-methylphenyl di-n-butyl borate</td>
<td>6.143</td>
</tr>
</tbody>
</table>

Lubricating oil compositions of this invention such as compositions 6, 7, 8, Table I, are not only excellent stable oil compositions, but possess good corrosion and rust inhibiting properties.

The additive combination of this invention can be used in neat mineral oils or with mineral oil compositions which contain pour point depressants, viscosity index improvers, corrosion inhibitors, detergents and the like.
We claim as our invention:

1. A mineral lubricating oil containing from about 0.001% to about 2% each of an aryl amine of the group consisting of phenyl-alpha-naphthylamine and dinaphthylamine and a borate of the group consisting of 2,6-ditert-butylphenyl di-n-butyl borate and 2,6-ditert-butyl-4-methylphenyl di-n-butyl borate.

2. A mineral lubricating oil containing from about 0.001% to about 2% each of phenyl-alpha-naphthylamine and 2,6-ditert-butyl-4-methylphenyl di-n-butyl borate.

3. A mineral lubricating oil containing from about 0.001% to about 2% each of phenyl-alpha-naphthylamine and 2,6-ditert-butyl-4-methylphenyl di-n-butyl borate.

4. A mineral lubricating oil containing from about 0.001% to about 2% each of dinaphthylamine and 2,6-ditert-butylphenyl di-n-butyl borate.

5. A mineral lubricating oil containing from about 0.001% to about 2% each of dinaphthylamine and 2,6-ditert-butyl-4-methylphenyl di-n-butyl borate.

References Cited in the file of this patent

UNITED STATES PATENTS

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2,497,521 Trautman ............................ Feb. 14, 1950
2,813,830 Trautman ............................ Nov. 19, 1957