

[54] **STABILIZATION OF HYDROCARBON OILS**

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Related U.S. Application Data

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[51] Int. Cl.**C10I 1/22**
[58] Field of Search.....**44/72; 252/403, 51.5 R**

[56]

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[57]

ABSTRACT

Stabilizing hydrocarbon oil with an N-substituted alkoxyalkylamine. The invention is particularly advantageous to prevent sediment formation in fuel oil.

16 Claims, No Drawings

STABILIZATION OF HYDROCARBON OILS

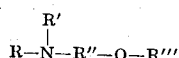
CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of application Ser. No. 543,008 filed Apr. 18, 1966, now U.S. Pat. No. 3,478,096, issued Nov. 11, 1969.

DESCRIPTION OF THE INVENTION

This invention relates to the stabilization of hydrocarbon oil and particularly the stabilization of fuel oil to prevent sediment formation therein. The fuel oil also is marketed as burner oil, range oil, etc. The invention also may be used for stabilizing other hydrocarbon distillates including gasoline, naphtha, kerosene, diesel fuel, marine fuel, lubricating oil, etc.

Stabilization of the hydrocarbon oil is effected by incorporating therein an N-substituted alkoxyalkylamine. The N-substituted alkoxyalkylamine for use in the present invention is of the following structure:



where R is sec-alkyl or cycloalkyl, R' is hydrogen, sec-alkyl or cycloalkyl, R'' is alkylene, and R''' is alkyl or hydroxyalkyl.

In a particularly preferred embodiment, R is sec-alkyl of from three to about 20 carbon atoms or cyclohexyl, R' is hydrogen, sec-alkyl of from three to about 20 carbon atoms or cyclohexyl, R'' is alkylene of from two to about 10 carbon atoms and R''' is alkyl of from one to about 10 carbon atoms or hydroxyalkyl of from one to about 10 carbon atoms.

Illustrative compounds in which R' contains two carbon atoms include N-isopropyl-2-methoxyethylamine, N-sec-butyl-2-methoxyethylamine, N-sec-pentyl-2-methoxyethylamine, N-sec-hexyl-2-methoxyethylamine, N-sec-heptyl-2-methoxyethylamine, N-sec-octyl-2-methoxyethylamine, N-sec-nonyl-2-methoxyethylamine, N-sec-decyl-2-methoxyethylamine, N-sec-undecyl-2-methoxyethylamine, N-sec-dodecyl-2-methoxyethylamine, N-sec-tridecyl-2-methoxyethylamine, N-sec-tetradecyl-2-methoxyethylamine, N-sec-pentadecyl-2-methoxyethylamine, N-sec-hexadecyl-2-methoxyethylamine, N-sec-heptadecyl-2-methoxyethylamine, N-sec-octadecyl-2-methoxyethylamine, N-sec-nonadecyl-2-methoxyethylamine, N-sec-eicosyl-2-methoxyethylamine, etc.; N,N-di-isopropyl-2-methoxyethylamine, N,N-di-sec-butyl-2-methoxyethylamine, N,N-di-sec-pentyl-2-methoxyethylamine, N,N-di-sec-hexyl-2-methoxyethylamine, N,N-di-sec-heptyl-2-methoxyethylamine, N,N-di-sec-octyl-2-methoxyethylamine, N,N-di-sec-nonyl-2-methoxyethylamine, N,N-di-sec-decyl-2-methoxyethylamine, etc.; N-cyclopropyl-2-methoxyethylamine, N-cyclobutyl-2-methoxyethylamine, N-cyclopentyl-2-methoxyethylamine, N-cyclohexyl-2-methoxyethylamine, N-cycloheptyl-2-methoxyethylamine, N-cyclooctyl-2-methoxyethylamine, etc.; N,N-dicyclopropyl-2-methoxyethylamine, N,N-dicyclobutyl-2-methoxyethylamine, N,N-dicyclopentyl-2-methoxyethylamine, N,N-dicyclohexyl-2-methoxyethylamine, N,N-dicycloheptyl-2-methoxyethylamine, N,N-dicyclooctyl-2-methoxyethylamine, etc., as well as N,N-di-sec-alkyl-2-methoxyethylamines in which the sec-alkyl groups are different, N,N'-di-cycloalkyl-2-methoxyethylamines in which the cycloalkyl groups are different, and N,N-di-substituted 2-methoxyethylamines in which one substituent is sec-alkyl and the other substituent is cycloalkyl, the sec-alkyl and cycloalkyl groups being selected from those hereinbefore set forth.

The specific compounds set forth above comprise those in which R''' is an alkyl of one carbon atom. When R''' contains a larger number of carbon atoms, the correspondingly N-substituted-alkoxyethylamines will be N-substituted-2-ethoxyethylamine, N-substituted-2-propoxyethylamine, N-substituted-2-butoxyethylamine, N-substituted-2-pentoxethylamine, N-substituted-2-hexoxyethylamine, N-substituted-2-heptoxyethylamine, N-substituted-2-octoxyethylamine, N-substituted-2-nonoxethylamine, N-sub-

stituted-2-decoxy-ethylamine, etc. While R''' preferably is an alkyl group, in another embodiment R''' is a cycloalkyl group. Illustrative compounds in this embodiment include N-substituted-cyclopentoxethylamine, N-substituted-cyclohexoxethylamine, N-substituted-cycloheptoxethylamine, N-substituted-cyclooctoxethylamine, etc. Illustrative compounds in which R'' and R''' each contain two carbon atoms include N-isopropyl-2-ethoxyethylamine, N-sec-butyl-2-ethoxyethylamine, N-sec-pentyl-2-ethoxyethylamine, N-sec-hexyl-2-ethoxyethylamine, N-sec-heptyl-2-ethoxyethylamine, N-sec-octyl-2-ethoxyethylamine, N-sec-nonyl-2-ethoxyethylamine, N-sec-decyl-2-ethoxyethylamine, etc., N-sec-di-isopropyl-2-ethoxyethylamine, N,N-di-sec-butyl-2-ethoxyethylamine, N,N-di-sec-pentyl-2-ethoxyethylamine, N,N-di-sec-hexyl-2-ethoxyethylamine, N,N-di-sec-heptyl-2-ethoxyethylamine, N,N-di-sec-octyl-2-ethoxyethylamine, N,N-di-sec-nonyl-2-ethoxyethylamine, N,N-di-sec-decyl-2-ethoxyethylamine, etc., N-cyclopropyl-2-ethoxyethylamine, N-cyclobutyl-2-ethoxyethylamine, N-cyclopentyl-2-ethoxyethylamine, N-cyclohexyl-2-ethoxyethylamine, N-cycloheptyl-2-ethoxyethylamine, N-cyclooctyl-2-ethoxyethylamine, etc. N,N-di-cyclopropyl-2-ethoxyethylamine, N,N-di-cyclopentyl-2-ethoxyethylamine, N,N-di-cyclohexyl-2-ethoxyethylamine, N,N-di-cycloheptyl-2-ethoxyethylamine, N,N-di-cyclooctyl-2-ethoxyethylamine, etc. Illustrative compounds in which R'' is isopropyl include N-isopropyl-2-methoxyisopropylamine, N-sec-butyl-2-methoxyisopropylamine, N-sec-pentyl-2-methoxyisopropylamine, N-sec-hexyl-2-methoxyisopropylamine, N-sec-heptyl-2-methoxyisopropylamine, N-sec-octyl-2-methoxyisopropylamine, N-sec-nonyl-2-methoxyisopropylamine, N-sec-decyl-2-methoxyisopropylamine, etc., N,N-di-isopropyl-2-methoxyisopropylamine, N,N-di-sec-butyl-2-methoxyisopropylamine, N,N-di-sec-pentyl-2-methoxyisopropylamine, N,N-di-sec-hexyl-2-methoxyisopropylamine, N,N-di-sec-heptyl-2-methoxyisopropylamine, N,N-di-sec-octyl-2-methoxyisopropylamine, N,N-di-sec-nonyl-2-methoxyisopropylamine, N,N-di-sec-decyl-2-methoxyisopropylamine, etc. N-cyclopropyl-2-methoxyisopropylamine, N-cyclobutyl-2-methoxyisopropylamine, N-cyclopentyl-2-methoxyisopropylamine, N-cyclohexyl-2-methoxyisopropylamine, N-cycloheptyl-2-methoxyisopropylamine, N-cyclooctyl-2-methoxyisopropylamine, etc., N,N-di-cyclopropyl-2-methoxyisopropylamine, N,N-di-sec-octyl-2-methoxyisopropylamine, N,N-di-cyclobutyl-2-methoxyisopropylamine, N,N-di-cyclopentyl-2-methoxyisopropylamine, N,N-di-cyclohexyl-2-methoxyisopropylamine, N,N-di-cycloheptyl-2-methoxyisopropylamine, N,N-di-cyclooctyl-2-methoxyisopropylamine, etc.

Similarly where R'' contains more than two carbon atoms, the compound will comprise the correspondingly N-substituted alkoxy-3-propylamine, 2-butylamine, 3-butylamine, 4-butylamine, 2-pentylamine, 3-pentylamine, 4-pentylamine, 5-pentylamine, 2-hexylamine, 3-hexylamine, 4-hexylamine, 5-hexylamine, 6-hexylamine, etc.

It is understood that, when R'' and/or R''' is an alkyl group of three or more carbon atoms, the alkyl group may be of straight or branched chain, and also that R'' and/or R''' may be of primary, secondary or tertiary alkyl configuration. Illustrative compounds in the last-mentioned embodiment include N-substituted-isopropoxyalkylamine, N-substituted-tert-butoxyalkylamine, N-substituted-tert-pentoxalkylamine, N-substituted-tert-hexoxalkylamine, etc.

When R''' is a hydroxyalkyl, the hydroxyalkyl group preferably contains from one to about 10 carbon atoms and thus this group will be selected from hydroxymethyl, hydroxyethyl, hydroxypropyl, hydroxybutyl, hydroxypentyl, hydroxyhexyl, hydroxyheptyl, hydroxyoctyl, hydroxynonyl and hydroxydecyl. Illustrating but not limiting examples of compounds in this embodiment include N-sec-alkyl-hydroxymethoxyalkylamine, NN-di-sec-alkylhydroxymethoxyalkylamine, N-cycloalkylhydroxymethoxyalkylamine, N,N-dicycloalkyl hydroxymethoxyalkylamine and corresponding

compounds in which the alkoxy group contains from two to about 10 carbon atoms.

The novel compounds of the present invention may be prepared in any suitable manner. In a preferred method, the alkoxyalkylamine is subjected to reductive alkylation with a ketone in the presence of hydrogen and a reductive alkylation catalyst. The ketone will be selected to produce the desired substitution or substitutions on the nitrogen atom. Illustrative but not limiting ketones include acetone, methylethylketone, methylpropylketone, methylbutylketone and corresponding methylalkyl ketones in which the alkyl group contains from five to about 18 carbon atoms, diethylketone, ethylpropylketone, ethylbutylketone, ethylpentylketone and corresponding ethylalkylketones in which the alkyl group contains from six to about 17 carbon atoms, dipropylketone, propylbutylketone, propylpentylketone, propylhexylketone and corresponding propylalkylketones in which the alkyl group contains from seven to 16 carbon atoms. Other higher molecular weight ketones may be used. It is understood that a mixture of these ketones may be employed.

When the substituent is a cycloalkyl group, cycloalkyl ketones are used and include cyclopropanone, cyclobutanone, cyclopentanone, cyclohexanone, cycloheptanone, cyclooctanone, etc. Here again it is understood that a mixture of cycloalkylketones may be used, as well as a mixture of the alkyl and cycloalkylketones.

The reductive alkylation is effected in any suitable manner and either in a single- or multiple-step operation. In a particularly preferred method, the reductive alkylation is effected in a single step employing a hydrogen pressure of from about 100 to 3,000 p.s.i.g. or more. Any suitable catalyst is employed including those containing nickel, cobalt, platinum, palladium, molybdenum, etc., or a mixture of these or of the oxides of chromium, copper and barium, preferably composited with a suitable support. A particularly preferred catalyst comprises a composite of platinum and alumina, containing from about 0.1 to about 2 percent by weight of platinum, which may or may not contain chlorine and/or fluorine in a total halogen content of from about 0.1 percent by about 5 percent by weight. When using the platinum catalyst, the temperature generally will be in the range of about 200° to about 500° F. In a preferred continuous operation the catalyst is deposited as a fixed bed in a reaction zone and the reactants, at the desired temperature and pressure, are passed therethrough, in either upward or downward flow. Generally, an excess of ketone to alkoxyalkylamine is used and this excess may range from 1.5 to 20 mols of ketone per mol of alkoxyalkylamine.

The alkoxyalkylamine may be obtained from any suitable source or prepared in any suitable manner. Alkoxyethylamine may be prepared by reacting hydroxyacetonitrile with a suitable etherifying agent, including dialkyl sulfates, alkyl halides and in some cases alcohols and ethers, followed by reduction. Thus, methoxyethylamine may be prepared by reacting hydroxyacetonitrile with dimethylsulfate, methyl iodide, methylbromide or methylchloride, in the presence of caustic, or with methylalcohol or dimethylether under high temperature (300° to 450° F.) and high pressure (100-2,000 p.s.i.g.). The mol ratio of hydroxyacetonitrile to etherifying agent will be within the range of 0.8:1 to about 1.25:1. Similarly, alkoxypropylamine is prepared by the etherification of hydroxyacrylonitrile, followed by reduction. The reduction is effected in any suitable manner by reacting with hydrogen in the presence of a hydrogenation catalyst including nickel, chromia, molybdena, platinum, palladium, etc., or mixtures thereof, preferably composited with a suitable support. The hydrogenation is effected at a temperature of from about 100° F. to 500° F. and a pressure of from 100 to about 3,000 p.s.i.g. Other alkoxyalkylamines are prepared in the same general manner as set forth above or in any other suitable manner.

The preparation of the novel compounds of the present invention may be effected in the presence of a suitable solvent in any stage of preparation. Particularly preferred solvents comprise hydrocarbons and more particularly aromatic hydrocar-

bon including benzene, toluene, xylene, ethylbenzene, cumene, etc., or mixtures thereof, paraffin hydrocarbon including particularly pentane, hexane, heptane, octane, etc., or mixtures thereof, or mixtures of paraffin and aromatic hydrocarbons, as well as mixtures such as gasoline, naphtha. In some cases the solvent may comprise an alcohol including methanol, ethanol, propanol, butanol, etc.

In one embodiment the novel compound of the present invention may be recovered in admixture with the solvent and used in this manner. In another embodiment the solvent may be removed in any suitable manner and particularly by vacuum distillation.

The concentration of the compound of the present invention to be employed as an additive will depend upon particular substrate in which it is to be used. For example, when used as an additive in hydrocarbon distillate and particularly fuel oil to prevent sediment formation, the additive is used in as low a concentration as practical for economic reasons. In some cases, this may range as low as 0.0005 percent and may go as high as 0.5 percent and even up to 1 percent by weight of the hydrocarbon distillate. In fuel oil the amount of additive can be within the range of from about 0.001 percent to about 0.01 by weight.

It is understood that the novel compounds of the present invention may be used along with other additives normally incorporated in the substrate. For example, when used in fuel oil, the compound of the present invention may be used along with an antioxidant, which generally will be a phenol, including 2,6-di-tertiarybutyl-4-methylphenol, 2,4-dimethyl-6-tertiarybutylphenol, etc., or an amine, including N,N'-diisopropyl-p-phenylenediamine, N,N'-di-secbutyl-p-phenylenediamine, N,N'-di-secocetyl-p-phenylenediamine, etc., and/or a metal deactivator including disalicylal diaminopropane, ethylenediaminetetracarboxylic acid or its alkali metal salt, etc. When used in gasoline, other additives comprise antiknock agent, dye, etc. In addition, the composition may contain detergent and/or dispersing agents. When desired, the novel compound of the present invention may be prepared as a mixture with one or more of these other additives and used in this manner.

The following examples are introduced to illustrate further the novelty and utility of the present invention but not with the intention of unduly limiting the same.

EXAMPLE I

The compound of this example is N-sec-butyl-3-ethoxypropylamine and was prepared by the reductive alkylation of ethoxypropylamine with methylethyl ketone. Specifically, 200 g. of ethoxypropylamine and 240 g. of methylethyl ketone were reductively alkylated at 250° F. under a hydrogen pressure of about 125 atmospheres in the presence of a platinum-alumina catalyst containing 0.3 percent by weight of platinum. The reaction was effected in a rotating bomb for about 4 hours. After completion of the reaction, the contents were filtered to remove catalyst, and excess ketone was removed by vacuum distillation. N-sec-butyl-3-ethoxypropylamine was recovered as a light-colored liquid having a basic nitrogen content of 6.03 meq./g., a mole equivalent weight of 165.7 and a refractive index n_D^{20} of 1.4227. The boiling point at 9 mm. Hg was 66° C. and at 10.2 mm. it was 68.2° C.

EXAMPLE II

The compound of this example is N,N-dicyclohexyl-3-methoxypropylamine, and was prepared by reductive alkylation of 178 g. (2 moles) of 3-methoxypropylamine with 392 g. (4 moles) of cyclohexanone in the presence of a platinum-alumina catalyst, the catalyst being substantially the same as described in example I. The reduction alkylation was conducted at about 320° F. using a hydrogen pressure of about 100 atmospheres. Following completion of the reaction, the reaction mixture was filtered to remove the catalyst and the filtrate was distilled under water pump vacuum to remove any

unreacted cyclohexanone. N,N-dicyclohexyl-3-methoxypropylamine was recovered as a clear liquid having an index of refraction n_D^{20} of 1.4835, a basic nitrogen of 4.05 meq./g. and a basic equivalent weight of 248, the latter corresponding to the theoretical basic equivalent weight of 247. The noncorrected boiling point was 130° C. at 0.15 mm. Hg.

EXAMPLE III

The compound of this example is N-sec-octyl-2-hydroxyethoxyethylamine. This compound was prepared by the reductive alkylation of 434 g. (2 moles) of 2-hydroxyethoxyethylamine with 381 g. (3 moles) of ethylhexyl ketone. The reductive alkylation was effected at a temperature of about 320° F. and under a hydrogen pressure of about 120 atmospheres in the presence of a platinum-alumina catalyst. The reduction was effected in a rotating bomb for about 5 hours. Following completion of the reaction, the effluent products were filtered to remove the catalyst, N-sec-octyl-2-hydroxyethoxyethylamine was recovered as a light-colored liquid having an index of refraction n_D^{20} of 1.4543, a basic nitrogen content of 4.65 meq./g. and a molecular weight of 215 which corresponds to the theoretical molecular weight of 217. The boiling point was 146° C. at 4.2 mm. Hg and 162° C. at 9.5 mm. Hg.

EXAMPLE IV

The compound of this example is N-sec-butyl-2-ethoxyethylamine and was prepared by the reductive alkylation of 2-ethoxyethylamine with methylethylketone. Specifically 400 g. of 2-ethoxyethylamine and 500 g. of methylethylketone were reductively alkylated at a temperature of 302° F. under a hydrogen pressure of about 100 atmospheres in the presence of 100 g. of a platinum-alumina catalyst containing about 0.3 percent by weight of platinum. Following completion of the reaction, the products were filtered to remove the catalyst and excess ketone was removed by vacuum distillation. N-sec-butyl-2-ethoxyethylamine was recovered as a clear liquid having a boiling point of 333° F. at atmospheric pressure.

EXAMPLE V

The compound of this example is N,N-di-isopropyl-2-ethoxyethylamine and was prepared in substantially the same manner as described above by reductively alkylating 2-ethoxyethylamine with acetone at 320° F. under hydrogen pressure in the presence of a platinum-alumina catalyst. Following completion of the reaction, the products were filtered and distilled under vacuum to remove excess acetone. N,N-di-isopropyl-2-ethoxyethylamine was recovered as a clear liquid having a basic nitrogen of 5.7 meq./g. and a mole combining weight of 175.5 which corresponds to the theoretical mole combining weight of 173.

EXAMPLE VI

The compound of this example is N,N-di-cyclohexyl-2-ethoxyethylamine and was prepared in substantially the same manner as described above. In this reaction, 200 g. of 2-ethoxyethylamine and 500 g. of cyclohexanone were subjected to reductive alkylation in the presence of 100 g. of the platinum-alumina catalyst. In order to insure complete reaction, the products were subjected to further reductive alkylation in the presence of 100 g. of platinum-alumina catalyst, following which the products were filtered and washed with acetone and excess ketone was removed by vacuum distillation. N,N-dicyclohexyl-2-ethoxyethylamine was recovered as a clear liquid having a basic nitrogen content of 5.23 percent which corresponds to the theoretical nitrogen content of 5.56 percent.

EXAMPLE VII

The compound of this example is N-sec-butyl-2-methoxyisopropylamine and was prepared by reductive alkylation in

substantially the same manner as heretofore described. The reductive alkylation was effected by subjecting 216 g. of 2-methoxy-isopropylamine and 300 g. of methylethylketone to reaction at temperature of 320° F. under a hydrogen pressure of about 120 atmospheres presence of the platinum-alumina catalyst. Following completion of the reaction the products were filtered to remove catalyst and distilled to remove unreacted ketone. N-sec-butyl-2-methoxy-isopropylamine was recovered as a clear liquid having a basic nitrogen content of 6.55 meq./g. and a mole combining weight of 153 which corresponds to the theoretical mole combining weight of 145.

EXAMPLE VIII

As hereinbefore set forth, the compounds of the present invention are of exceptional utility as additives to prevent sediment formation in fuel oil. In this example the additive was evaluated in different commercial fuel oils by the standard 1-day fuel oil test. In this test samples of the fuel oil are maintained for 16 hours at 212° F. in an oxygen atmosphere, after which the amount of sediment is determined. It has been found that if the sediment formed in this manner is less than 1.6 mg./100 ml., the oil is usually considered stable. Also, it has been found that this method correlates very well with the 3-month storage test at 110° F.

The fuel oil used in this example is a light catalytically cracked cycle oil. When a control sample of this oil (not containing an inhibitor) was evaluated in the above manner, 15.4 mg./100 ml. of sediment formed.

In contrast, another sample of this oil containing 32 parts by million of N-sec-butyl-3-ethoxypropylamine, prepared as described in example I, when evaluated in the above manner, formed only 0.4 mg./100 ml. of sediment.

Still another sample was evaluated containing 29 parts per million of N-sec-butyl-3-ethoxypropylamine and 2.88 parts per million of copper deactivator (disalicylal diaminopropane). When evaluated in the same manner, this sample formed only 0.3 mg./100 ml. of sediment.

Another evaluation was made in a different fuel oil. The fuel oil of this example is a commercial No. 2 fuel oil which, when evaluated in the above manner, formed 4.4 mg./100 ml. of sediment. Another sample of this fuel oil containing 23 parts per million of N-sec-butyl-3-ethoxypropylamine and 2.56 parts per million of disalicylal diaminopropane formed only 0.8 mg./100 ml. of sediment when evaluated in the above manner.

EXAMPLE IX

N,N-dicyclohexyl-3-methoxypropylamine, prepared as described in example II, also was evaluated in another sample of the light catalytically cracked oil described in example IV. The addition of 29 parts per million of N,N-dicyclohexyl-3-methoxypropylamine and 2.88 parts per million of disalicylal diaminopropane reduced the sediment formation from 15.4 to 0.3 mg./100 ml. when evaluated in the same manner as described above.

EXAMPLE X

N-sec-octyl-2-hydroxyethoxyethylamine, prepared as described in example III, also was evaluated in another sample of the light catalytically cracked cycle oil described in example VIII. A sample of the oil containing 32 parts per million of N-sec-octyl-2-hydroxyethoxyethylamine reduced the sediment formation from 15.4 to 0.8 mg./100 ml. when evaluated in the same manner as described above.

Another sample of the oil containing 29 parts per million of N-sec-octyl-2-hydroxyethoxyethylamine and 2.88 parts per million of disalicylal diaminopropane, when evaluated in the same manner as described above, reduced the sediment formation from 15.4 to 0.8 mg./100 ml.

EXAMPLE XI

A number of evaluations were made in a long-term storage test in which samples of the fuel oil are stored in the dark for 3 months at 110° F. in vented Pyrex flasks, after which the sediment formation is determined.

The oil used in this example is the No. 2 fuel oil which formed 4.4 mg./100 ml. of sediment in the 1-day stability test. When a sample of this oil was stored for 3 months, it formed 1.4 mg./100 ml. of sediment. However, another sample of this No. 2 fuel oil containing 23 parts per million of N-sec-butyl-3-ethoxypropylamine, prepared as described in example I, and 2.32 parts per million of disalicylal diaminopropane, when evaluated in the 3-month storage test, formed only 0.2 mg./100 ml. of sediment.

N-sec-butyl-3-ethoxypropylamine also was evaluated in the 3-month storage test in another uninhibited commercial No. 2 fuel oil. The uninhibited sample of this oil formed 3.1 mg./100 ml. of sediment after 3 months storage. In contrast, a sample containing 60 parts per million of N-sec-butyl-3-ethoxypropylamine and 1 part per million of disalicylal diaminopropane formed only 0.1 mg./100 ml. of sediment after 3 months storage.

EXAMPLE XII

N,N-dicyclohexyl-3-methoxypropylamine prepared as described in example II, also was evaluated in another sample of the commercial No. 2 fuel oil described in example XI. The N,N-dicyclohexyl-3-methoxypropylamine was used in a concentration of 23 parts per million together with 2.32 parts per million of disalicylal diaminopropane and this served to reduce the sediment formation from 1.4 to 0.2 mg./100 ml.

EXAMPLE XIII

N-sec-octyl-2-hydroxyethoxyethylamine also was evaluated in another sample of the No. 2 fuel oil described in example XII. A sample of the fuel oil containing 23 parts per million of N-sec-octyl-2-hydroxyethoxyethylamine and 2.32 parts per million of disalicylal diaminopropane reduced the sediment formation from 1.4 to 0.3 mg./100 ml. after storage for 3 months in the manner described above.

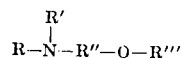
EXAMPLE XIV

N-sec-butyl-2-methoxy-isopropylamine prepared as described in example VII, was evaluated by the standard 1-day fuel oil test described in example IV. However, in this evalua-

tion, a different commercial No. 2 fuel oil was used. A control sample (not containing additive) of this fuel oil, when evaluated in the above manner, formed 3.6 mg./100 ml. of sediment. In contrast, another sample of this fuel oil containing 20 parts per million of N-sec-butyl-2-methoxy-isopropylamine and 2 parts per million of disalicylal diaminopropane, formed only 1.6 mg./100 ml. of sediment when evaluated in the above manner.

I claim as my invention:

1. Hydrocarbon oil containing from about 0.0005 percent to about 1 percent by weight of an N-substituted alkoxyalkylamine of the following structure:



where R is sec-alkyl or cycloalkyl, R' is hydrogen, sec-alkyl or cycloalkyl, R'' is alkylene, and R''' is alkyl or hydroxyalkyl.

2. The oil of claim 1 being fuel oil.

3. The oil of claim 2 in which the said alkoxyalkylamine is in an amount of from about 0.001 percent to about 0.01 percent by weight of the fuel oil.

4. The oil of claim 1 in which said alkoxyalkylamine is N-sec-alkyl-3-alkoxypropylamine.

5. The compound of claim 4 being N-sec-butyl-3-ethoxypropylamine.

6. The oil of claim 1 in which said alkoxyalkylamine is N,N-dicycloalkyl-3-alkoxypropylamine.

7. The oil of claim 6 in which alkoxyalkylamine is N,N-dicyclohexyl-3-methoxypropylamine.

8. The oil of claim 1 in which said alkoxyalkylamine is N-sec-alkyl-2-alkoxyisopropylamine.

9. The oil of claim 8 in which said alkoxyalkylamine is N-sec-butyl-2-methoxyisopropylamine.

10. The oil of claim 1 in which said alkoxyalkylamine is N-di-sec-alkyl-2-ethoxyethylamine.

11. The oil of claim 10 in which said alkoxyalkylamine is N,N-di-isopropyl-2-ethoxyethylamine.

12. The oil of claim 1 in which said alkoxyalkylamine is N,N-di-cyclohexyl-2-ethoxyethylamine.

13. The oil of claim 1 in which said alkoxyalkylamine is N-sec-alkyl-2-hydroxyalkoxyethylamine.

14. The oil of claim 13 in which said alkoxyalkylamine is N-sec-octyl-2-hydroxyethoxyethylamine.

15. The oil of claim 1 in which R' is sec-alkyl or cycloalkyl.

16. The oil of claim 1 in which R is cycloalkyl.

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