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[54] ELECTRICAL INSULATING OIL

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[57] **ABSTRACT**

The invention relates to an electrical insulating oil, resistant to oxidation and sludging, which consists essentially of a blend of about 1 to about 25 percent by volume of a solvent-extracted residue of a naphthenic petroleum distillate oil and about 75 to about 99 percent by volume of a hydrogenated naphthenic petroleum distillate oil. The solvent-extracted residue is obtained by contacting a naphthenic petroleum distillate oil with a solvent such as furfural or nitrobenzene. The hydrogenated naphthenic petroleum distillate oil is obtained by contacting a naphthenic petroleum distillate oil with hydrogen in the presence of a catalyst such as, for example, sulfides or oxides of molybdenum and at least two iron group metals.

10 Claims, No Drawings

ELECTRICAL INSULATING OIL

This invention relates to an electrical insulating oil, and more particularly to a transformer oil which is highly resistant to oxidation and sludging.

An insulating oil to be acceptable for use in transformers must have a relatively low viscosity, usually not greater than about 85 SUS at 100° F., to facilitate removal of heat from transformers by convection; a relatively high flashpoint to minimize fire hazard and evaporation losses; and a low pour point to assure fluidity in cold weather. In view of its use in electrical equipment, an insulating oil should also have a relatively high dielectric strength and a low power factor. Moreover, an electrical insulating oil should be relatively free from acid, alkali, moisture, dirt and harmful sulfur compounds which could corrode or injure metal parts. Finally, a transformer oil of acceptable quality must exhibit a high degree of stability against the formation of deposits formed by deterioration under service conditions. Formation of deposits in a transformer oil is undesirable since such deposits tend to collect on the transformer windings, thereby causing overheating, and a decrease in dielectric strength, eventually to the point of complete failure of the oil.

Transformer oils ordinarily are distillate oils refined in such manner as to secure the specified characteristics to as great an extent as possible. While most of the desirable characteristics of an insulating oil can be obtained from a mineral oil distillate by subjecting it to various refining procedures, considerable difficulty has been encountered in producing an oil which is highly resistant to oxidation and sludging over prolonged periods of time. Many materials have been developed which when added to a transformer oil greatly improve the oxidation resistance of the oil. However, a preferred transformer oil is one which is highly resistant to oxidation and sludging without the addition of an oxidation inhibitor.

It has previously been proposed to produce an electrical insulating oil by selectively extracting the aromatic components from a mineral oil distillate with a solvent such as liquid sulfur dioxide or furfural and acid treating the raffinate with concentrated sulfuric acid or oleum. The acid treated raffinate is usually subjected to a finishing treatment with a solid adsorbent such as clay. It has also been proposed to produce an electrical insulating oil by hydrogenating a highly naphthenic distillate. Combinations of solvent extraction, acid treating and hydrogenation with and without further finishing as with a solid adsorbent have also been proposed for producing an insulating oil. It has also been proposed to produce an insulating oil by blending an acid treated naphthenic distillate with a hydrofinished naphthenic distillate. Still further it has been proposed to produce an insulating oil by blending a naphthenic distillate hydrogenated at a low temperature, i.e., 550° to 595° F., with a naphthenic distillate hydrogenated at a high temperature, i.e., 630° to 670° F. Since insulating oils obtained by these refining methods are the product of one or more treating procedures, disadvantages associated with such treatments are encountered. These treatments, for example, are rather costly and they give rise to the loss of considerable amounts of oil. Furthermore, some treated oils have a greater tendency to oxidize than untreated oils. There is some evidence, for example, that naturally occurring oxidation inhibitors in distillate oils are destroyed during some hydrogenation processes and that materials are formed during some hydrogenations which give rise to oxidation instability.

We have discovered that an electrical insulating oil which is highly resistant to oxidation and sludging can be obtained by blending a solvent-extracted residue of a naphthenic petroleum distillate oil with a hydrogenated naphthenic petroleum distillate oil. While improved oxidation resistance and antisludging properties are obtained by blending the solvent-extracted residue and the hydrogenated distillate without further treatment, optimum improvement is obtained by contacting the blended residue and hydrogenated distillate with clay.

The solvent-extracted residue employed in the composition of the invention has a viscosity of about 35 to about 50 SUS at 210° F. The residue is obtained by contacting a naphthenic petroleum distillate oil with a solvent capable of removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils. Suitable solvents for this purpose are furfural, nitrobenzene, sulfur dioxide, phenol and the like. The naphthenic petroleum distillate oil which is subjected to extraction is preferably one having an API gravity in the range of about 17° to about 27° , a boiling range within the range of about 550° to about 900° F., a viscosity at 100° F. in the range of about 90 to about 120 SUS, a pour point below −25° F. and a naphthene content of at least about 70 percent by volume. An example of a preferred naphthenic distillate oil which can be subjected to solvent extraction to obtain the solvent-extracted residue has an API gravity of about 24° , a boiling range of about 560° to about 875° F., a viscosity of about 100 to about 110 SUS at 100° F., a pour point below about −40° F., a naphthene content of about 85 percent by volume and an aromatic content of about 15 percent by volume. The residue is advantageously used in an amount of about 1 to about 25 percent by volume based on the volume of the total composition.

Solvent extraction processes for refining petroleum distillate oils are well known in the petroleum industry. Furfural, for example, has been used as a selective solvent in removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils. Such a process has been described in a paper entitled "Furfural as a Selective Solvent in Petroleum Refining" by L. C. Kemp, Jr., G. B. Hamilton and H. H. Gross, Industrial and Engineering Chemistry, Vol. 40, pages 220–227 (1948). In treating a lubricating oil with furfural, the raffinate, i.e., the lubricating oil product, has improved oxidation characteristics and an improved viscosity index. The raffinate comprises about 60 to 90 percent by volume of the original distillate charge depending upon its makeup. The material removed by the furfural, i.e., the residue, has been considered to consist of undesirable constituents possessing low oiliness, low viscosity index, poor oxidation stability, high carbon residue and poor color. It is this so-called "undesirable material," i.e., the solvent-extracted residue which is removed from a naphthenic petroleum distillate oil that is used to give an improved electrical insulating oil of the present invention. The residue comprises about 10 to about 40 percent by volume of the original charge depending upon its makeup.

The conditions employed in extracting the residue from the naphthenic petroleum distillate oil can vary over a wide range. The solvent to oil volume ratio, for example, can be within the range of 1:1 to 3:1, solvent to oil, respectively. The extraction temperature will depend to some extent upon the solvent which is used. Good results are obtained with furfural in a countercurrent tower extraction process wherein the temperature is within the range of about 140° to 200° F. A residue having excellent properties for use in the electrical insulating oil composition of the invention is obtained in the countercurrent extraction of a 100 Texas distillate oil with furfural. The volume ratio of furfural to oil, respectively, is 1.5 to 1. The temperature in the bottom of the tower is about 160° F. The temperature in the top of the tower is about 200° F. The raffinate obtained from the top of the tower comprises about 60 to about 70 percent by volume of the distillate charge. The residue obtained after the furfural is stripped from the extract comprises about 30 to about 40 percent by volume of the distillate charge.

The naphthenic petroleum distillate oils which are subjected to solvent extraction and hydrogenation to obtain the solvent-extracted residue and hydrogenated napthenic petroleum distillate oil, respectively, for use in the electrical insulating oil composition of the invention can be derived by conventional atmospheric distillation from any napthenic crude oil base stock. Suitable napthenic crude oil base stocks, for example, can be obtained from the coastal fields of Texas and Louisiana. Examples of other crude oils from which the naphthenic distillates used in the present invention can be obtained are Bachaquero, Taparito and Tia Juana crude oils, all of which are produced in western Venezuela. The naphthenic

petroleum distillate oils which are subjected to solvent extraction and hydrogenation can be derived from the same or different crude oil base stock. However, the distillates advantageously are derived from the same crude oil base stock. The distillate which is subjected to hydrogenation is preferably one having a higher API gravity, a narrower boiling range and a lower SUS viscosity at 100° F. than the distillate which is subjected to solvent extraction.

The naphthenic petroleum distillate oil which is subjected to hydrogenation is preferably one having an API gravity in the range of about 25° to about 30°, a boiling range within the range of about 500° to about 750° F., a viscosity at 100° F. in the range of about 50 to about 85 SUS, a pour point below about −40° F. and a naphthene content of at least about 70 percent by volume. An example of a preferred naphthenic distillate oil which can be subjected to hydrogenation to form the hydrogenated naphthenic petroleum distillate oil has an API gravity of about 26° , a boiling range of about 545° to about 710° F., a viscosity of about 58 to about 63 SUS at 100° F., a pour point below about −60° F., a naphthene content of about 80 percent by volume and an aromatic content of about 20 percent by volume. The hydrogenated petroleum distillate oil is advantageously used in an amount of about 75 to about 99 percent by volume based on the volume of the total composition.

The solvent-extracted residue and the hydrogenated naphthenic petroleum distillate oil according to this invention are blended in proportions of about 1 to about 25 percent by volume of the solvent-extracted residue with about 75 to about 99 percent by volume of the hydrogenated distillate. Especially preferred blends are those containing about 5 to about 15 percent by volume of the solvent-extracted residue and about 85 to about 95 percent by volume of the hydrogenated distillate. The proportion of the solvent-extracted residue and the hydrogenated distillate depends somewhat upon the properties desired in the ultimate composition.

The hydrogenated naphthenic petroleum distillate oil is prepared by contacting the naphthenic distallate with hydrogen in the presence of a catalyst comprising at least one hydrogenating component selected from the group consisting of sulfides and oxides of (a) a combination of about 2 to about 25 percent [preferably 4 to 16 precent] by weight molybdenum and at least two iron group metals where the iron group metals are present in such amounts that the atomic ratio of each iron group metal with respect to molybdenum is less than about 0.4, and (b) a combination of about 5 to about 40 percent [preferably 10 to 25 percent] by weight of nickel and tungsten where the atomic ratio of tungsten to nickel is about 1:0.1 to 5 [preferably 1:0.3 to 4], said hydrogenating component being composited with an alumina support. Specific examples of preferred catalysts are those containing about 2 percent nickel, 1.5 percent cobalt and 10 percent molybdenum supported on alumina, or 6 percent nickel and 19 percent tungsten supported on alumina, these catalysts being preferably employed in sulfided form, although they also may be employed in the oxide form. When a sulfided catalyst is used, the catalyst can be sulfided prior to contact with the naphthenic distillate by contacting the catalyst with a sulfiding mixture of hydrogen and hydrogen sulfide at a temperature in the range of about 550° to 650° F. either at atmospheric or elevated pressures. The catalytic hydrogenating components can be used with a variety of porous bases or supports which may or may not have catalytic activity of their own. Examples of such supports are alumina, bauxite, silica gel, as well as aluminas stabilized with small amounts of silica. Halogens, such as fluorine or chlorine, can be present in the support in combined form in amounts ranging up to 0.2 or 0.5 percent by weight or more. Other suitable supports can also be used. These catalyst components can be prepared in known manner. Especially advantageous results are obtained when the hydrogenation treatment is carried out at an average catalyst bed temperature of about 575° to about 645° F., especially 600° to 635° F., and under a combination of conditions effective to produce appreciable consumption of hydrogen but no substantial cracking. However, the process can be carried out at higher temperatures, up to about 750° F. with acceptable results. It is preferred to employ reaction pressures in the range of about 1,000 to about 2,000 p.s.i.g., but other pressures in the range of about 500 to about 3,000 p.s.i.g. can be used. The oil is preferably contacted with the catalyst in a ratio of about 1.5 to about 3 volumes of liquid per hour per volume of catalyst, but other ratios in the range of about 0.5 to about 4 liquid volumes per hour per volume of catalyst can be used. The reaction conditions employed in the catalyst bed are interrelated to the extent that the more severe treating conditions of temperature and pressure are normally more useful with higher space velocities. Conversely, less severe conditions of temperature and pressure are normally more useful with space velocities in the lower part of the range disclosed. By way of example, excellent results are obtainable at an average catalyst bed temperature of about 600° F., an operating pressure of about 1,000 p.s.i.g. and at a space velocity of about 1.5 liquid volumes of oil per hour per volume of catalyst; similarly, good results are also obtainable at an average catalyst bed temperature of about 640° F., a reaction pressure of about 1,735 p.s.i.g. and at a space velocity of about 3 liquid volumes of oil per hour per volume of catalyst. The hydrogen-containing gas to oil ratio employed in the hydrogenation reaction is preferably in the range of about 1,000 to 3,000 SCF/Bbl., but other ratios can be used, for example, the gas to oil ratio can be as low as 500 SCF/Bbl. or as great as 4,000 SCF/Bbl. Very satisfactory results have been obtained with hydrogen of about 80 to 85 percent purity that has been generated in a platinum reforming reaction, but the hydrogen employed in the process need not be of this purity and, in fact, can be as low as 70 percent hydrogen or less, for example, 60 percent.

Following hydrogenation of the naphthenic distillate oil, the hydrogenated oil is degassed to remove light hydrocarbons and dissolved gases including hydrogen sulfide and ammonia. The degassed hydrogenated distillate is preferably dried to give a low moisture content.

The dried hydrogenated distillate can be clay treated and then blended with the solvent-extracted residue or the clay treating can be performed after the components have been blended. We prefer to blend the solvent-extracted residue with the hydrogenated distillate and then subject the entire blend to clay contacting or percolation.

Clay contacting and percolation are well-known petroleum processes and involve decolorizing and stabilizing the oils by contact with finely divided clays. Clay contacting consists of rapid batch mixing of the oil and finely ground (> 200 mesh) activated clay followed by filtration to remove the clay. Clay percolation comprises filtering or percolating the oil through a bed of rather coarse (16 to 60 mesh) clay. In clay contacting, the clay life may be in the order of 30 to 100 barrels of oil per ton of clay at temperatures up to about 300° F. In clay percolation or filtration, the clay life may be in the order of 100 to 400 barrels of oil per ton of clay at ambient or moderately elevated, i.e., 100° to 200° F., temperatures. Clays of the kind normally used in clay finishing, including fuller's earth, bauxite, Millwhite, Attapulgus or Filtrol can be employed.

The preparation of a suitable hydrogenated petroleum distillate oil for use in the insulating oil of the present invention is illustrated by the following specific embodiment. In this embodiment, the charge stock is a naphthenic distillate oil boiling in the range of about 546° to about 710° F. derived from a coastal (Texas) crude oil. The naphthenic distillate oil charge stock has the following typical inspections:

Naphthenic Distillate Charge Stock for Hydrogenation

Inspections	
Gravity, ° API	25.9
Viscosity: SUS	

at 100° F.		59.4
at 210° F.		34.3
Interfacial Tension,		
77° F., Dynes/cm.		37.2
Flashpoint: OC, ° F.		300
Fire Point: OC, ° F.		325
Pour Point, ° F.		<−60
Color, ASTM D1500		1.0
Sulfur, ASTM D1552, %		0.19
Bomb Sludge, ASTM D1313, %		0.19
Neutralization No., ASTM D974		
Total Acid No.		1.3
Iodine No.		11.5
Aniline Point, ° F.		149
Hydrocarbon Type Analysis: %	By weight	
Alkanes		0.0
Noncondensed Cycloalkanes		44.5
Condensed Cycloalkanes		35.0
Aromatics		20.5

In this embodiment, the naphthenic charge stock is contacted with hydrogen in a reactor wherein the average reactor temperature is 600° F., the pressure is 1,000 p.s.i.g., the space velocity is 1.5 liquid volumes of oil per hour per volume of catalyst and the gas circulation rate is 2,000 SCF/Bbl. The catalyst employed is 1/12-inch diameter extrudates of nickel, cobalt and molybdenum on an alumina support. A typical sample of the fresh catalyst has about 2.4 percent nickel, about 1.28 percent cobalt, about 9.85 percent molybdenum and about 0.03 percent chlorine. The catalyst is prepared by impregnation of the alumina support with water-soluble salts of the metals and calcining. The catalyst is sulfided by contact at reaction conditions with a West Texas furnace oil containing about 0.8 percent sulfur. This catalyst typically has a density of about 51.2 lbs./cu.ft. After degasification of the hydrogenated product, it is filtered through Attapulgus clay at room temperature in a proportion of about 100 barrels of oil per ton of clay at a rate of about 0.5 barrel of oil per hour per ton of clay. Typical inspections of the unfiltered and the clay filtered hydrogenated naphthenic distillate are as follows:

Hydrogenated Naphthenic Distillates Inspections	Unfiltered	Clay Filtered
Gravity, ° API	27.2	27.2
Viscosity, SUS		
at 100° F.	58.3	58.3
at 210° F.	34.1	34.1
Interfacial Tension,		
77° F., Dynes/cm.	44	51
Flashpoint, OC, ° F.	315	300
Fire Point: OC, ° F.	325	320
Pour Point, ° F.	<−65	<−65
Power Factor,		
ASTM D924, %		
at 77° F.	0.01	0.01
at 212° F.	0.16	0.09
Dielectric Strength,		
ASTM D877, KV.	38	45
Color, ASTM D1500	0.5	0.5
Sulfur, ASTM D1552, %	0.05	0.05
Bomb Sludge,		
ASTM D1313, %	3.40	0.18
Neutralization No.		
ASTM D974		
Total Acid No.	0.03	0.01
Iodine No.	9.0	9.4
Aniline Point, ° F.	154.4	154.4
Oxidation Test,		
ASTM D2440		
164 hrs.:		
Sludge, %	9.9	4.4
Neutralization No.	7.4	5.4

From the foregoing data, it will be noted that clay treating the hydrogenated distillate improves its power factor at 212° F. and dielectric strength, also its bomb sludge and oxidation stability by ASTM D2440. It is to be particularly noted that the charge stock distillate had a bomb sludge of 0.19 percent and that the hydrogenated distillate prior to clay filtration had a bomb sludge of 3.4 percent. After clay filtering, the hydrogenated distillate had a bomb sludge (0.18 percent) about the same as the charge stock initially.

The preparation of a suitable solvent-extracted residue for use in the insulating oil composition of the present invention is illustrated by the following specific embodiment. In this embodiment, the charge stock is a naphthenic distillate oil boiling in the range of about 560° to about 872° F. derived from a coastal (Texas) crude oil. The naphthenic distillate charge stock has the following typical inspections:

Naphthenic Distillate
Charge Stock for Solvent Extraction

Inspections	
Gravity, ° API	23.8
Viscosity: SUS	
at 100° F.	107.1
at 210° F.	38.5
Interfacial Tension,	
77° F., Dynes/cm.	32.0
Flashpoint: OC, ° F.	320
Fire point, ° F.	
Pour point, ° F.	−50
Color, ASTM D1500	3.5
Sulfur, ASTM D1552 , %	0.17
Bomb Sludge, ASTM D1313, %	0.20
Neutralization No., ASTM D974	
Total Acid No.	1.8
Iodine No.	13.2
Aniline Point, ° F.	158
Hydrocarbon Type Analysis:	
% By weight	
Alkanes	0
Noncondensed Cycloalkanes	43
Condensed Cycloalkanes	42
Aromatics	15

In this embodiment, the naphthenic charge stock is introduced into a packed, vertical extraction tower wherein countercurrent flow with furfural takes place. The furfural is introduced near the top of the tower. Naphthenic charge stock is introduced near the bottom of the tower. The temperature at the bottom of the tower is about 160° F. The temperature at the top of the tower is about 200° F. The furfural to naphthenic charge stock volume ratio is about 1.5 to 1, furfural to naphthenic charge stock, respectively. The yield of raffinate is 63 percent by volume. The yield of extracted-residue after removal of the furfural is 37 percent by volume. The extracted residue has the following typical properties:

Inspections	Solvent-Extracted Residue
Gravity, ° API	16.8
Viscosity: SUS	
at 100° F.	144
210° F.	40
Flashpoint: OC, ° F.	315
Fire point: OC, ° F.	345
Pour point, ° F.	−35
Sulfur, ASTM D1552, %	0.29
Iodine No.	13.1
Aniline point, ° F.	97

The oxidation resistance of a composition obtained by blending 10 parts by volume of a solvent-extracted residue with 90 parts by volume of a hydrogenated naphthenic petroleum distillate oil is shown by the data in Table I. The solvent-extracted residue is one which has been obtained in accordance with the specific embodiment disclosed hereinabove. The hydrogenated naphthenic petroleum distillate oil is one which has been obtained in accordance with the specific embodiment disclosed hereinabove. Data are given for the hydrogenated distillate with and without clay filtering

and also for the clay-filtered blend of solvent-extracted residue (10 percent by volume) and hydrogenated distillate (90 percent by volume).

TABLE I

	A	B*	C*
Oil composition, percent by volume:			
Hydrogenated naphthenic distillate	100	100	90
Solvent-extracted residue			10
Inspections:			
Gravity, ° API	27.2	27.2	26.1
Viscosity, SUS at:			
100° F	58.3	58.3	60.9
210° F	34.1	34.1	34.5
Interfacial tension, 77° F., dynes/cm	44	51	45
Flash point: OC, ° F	315	300	300
Fire point: OC, ° F	325	320	315
Pour point, ° F	<−65	<−65	<−65
Power factor, ASTM D924, percent at:			
77° F	0.01	0.01	0.01
212° F	0.16	0.09	0.10
Dielectric strength, ASTM D877, kv	38	45	53
Color, ASTM D1500	0.5	0.5	1.0
Sulfur, ASTM D1552, percent	0.05	0.05	0.08
Bomb sludge, ASTM D1313, percent	3.40	0.18	0.04
Neutralization No. ASTM D974, total acid No.	0.03	0.01	0.06
Iodine No.	9.0	9.4	10.0
Aniline point, ° F	154.4	154.4	152.1
Oxidation test, ASTM D2440 164 hrs:			
Sludge, percent	9.9	4.4	0.13
Neutralization No.	7.4	5.4	0.54

*Clay filtered—100 barrels of oil composition per ton of clay at ambient temperature at a rate of about 0.5 barrel of oil per hour per ton of clay.

It is evident from the test results reported in Table I that the oxidation stability of the blended composition of the invention (Composition C) is greater than the oxidation stability of either the hydrogenated oil (Composition A) or the clay filtered hydrogenated oil (Composition B). It is to be noted further that the dielectric strength (ASTM D877) and the bomb sludge (ASTM D1313) of the composition of the invention (Composition C) are improved over the corresponding inspections on the hydrogenated oil (Composition A) and clay filtered hydrogenated oil (Composition B).

Although the electrical insulating oils prepared according to the present invention are highly resistant to oxidation and sludging, the oils have good response to the addition of an oxidation inhibitor and such an inhibitor can be employed if desired. Examples of suitable oxidation inhibitors which can be employed include the polyalkyl aryl hydroxy compounds, e.g., 2,6-ditertiary butyl-4-methylphenol, 2,4-dimethyl-6-tertiary octylphenol and bis(2-hydroxy-3-*t*-butyl-5-methylphenyl)methane, etc., as well as the various amines, e.g., diphenylamine, phenyl beta naphthylamine, etc. When these oxidation inhibitors are used, they are generally employed in amounts of about 0.01 to about 1.0 percent by weight or more.

While the oil compositions of the invention are primarily useful as electrical insulating oils, it will be understood that they can be used as lubricants in some instances. When used as lubricants they may also contain an oxidation inhibitor and other additives normally used in lubricating oils including a detergent, an oiliness and extreme pressure agent, a viscosity index improver, a pour point depressant, an antirust agent, a corrosion inhibitor, an antifoam agent and the like in varying proportions.

While our invention has been described with reference to various specific examples and embodiments, it will be understood that the invention is not limited to such examples and embodiments and may be variously practiced within the scope of the claims hereinafter made.

We claim:

1. An electrical insulating oil consisting essentially of a blend of:

A. about 1 to about 25 percent by volume of a residue having a viscosity of about 35 to about 50 SUS at 210° F., said residue being the product which remains after removing solvent from the extract obtained by extracting a naphthenic petroleum distillate oil having an API gravity in the range of about 17° to about 27°, a boiling range within the range of about 550° to about 900° F., a viscosity at 100° F. in the range of about 90 to about 120 SUS, a pour point below −25° F. and a naphthene content of at least about 70 percent by volume with a solvent capable of removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils and

B. about 75 to about 99 percent by volume of a hydrogenated naphthenic petroleum distillate oil, said hydrogenated naphthenic petroleum distillate oil being obtained by contacting a naphthenic petroleum distillate oil having an API gravity in the range of about 25° to about 30°, a boiling range within the range of about 500° to about 750° F., a viscosity at 100° F. in the range of about 50 to about 85 SUS, a pour point below about −40° F. and a naphthene content of at least about 70 percent by volume with hydrogen in the presence of a catalyst comprising at least one hydrogenating component selected from the group consisting of sulfides and oxides of (a) a combination of about 2 to about 25 percent by weight of molybdenum and at least two iron group metals where the iron group metals are present in such amounts that the atomic ratio of each iron group metal with respect to molybdenum is less than about 0.4, and (b) a combination of about 5 to about 40 percent by weight of nickel and tungsten where the atomic ratio of tungsten to nickel is about 1:0.1 to 5, said hydrogenating component being composited with an alumina support, said contacting being carried out at an average catalyst temperature of about 575° to about 750° F., at a space velocity of about 0.5 to about 4 liquid volumes of oil per volume of catalyst per hour, and at a pressure of about 500 to about 3,000 p.s.i.g.

2. An electrical insulating oil in accordance with claim 1 wherein the blend consists of about 5 to about 15 percent by volume of the solvent-extracted residue and about 85 to about 95 percent by volume of the hydrogenated distillate.

3. An electrical insulating oil in accordance with claim 1 wherein the blend of solvent-extracted residue and the hydrogenated distillate is contacted with clay.

4. An electrical insulating oil in accordance with claim 1 wherein the solvent used in obtaining the solvent-extracted residue is furfural and the hydrogenating component of the catalyst used in obtaining the hydrogenated naphthenic petroleum distillate is a sulfided combination of nickel, cobalt and molybdenum.

5. An electrical insulating oil in accordance with claim 1 wherein the solvent used in obtaining the solvent-extracted residue is furfural and the hydrogenating component of the catalyst used in obtaining the hydrogenated naphthenic petroleum distillate is a sulfided combination of nickel and tungsten.

6. An electrical insulating oil consisting essentially of a clay treated blend of:

A. about 5 to about 15 percent by volume of a residue having a viscosity of about 35 to about 50 SUS at 210° F., said residue being the product which remains after removing furfural from the extract obtained by extracting a naphthenic petroleum distillate oil having an API gravity of about 24°, a boiling range within the range of about 560° to about 875° F., a viscosity at 100° F. in the range of about 100 to about 110 SUS, a pour point below about −40° F. and a naphthene content of about 85 percent by volume with furfural and

B. about 85 to about 95 percent by volume of a hydrogenated naphthenic petroleum distillate oil, said naphthenic petroleum distillate oil having an API gravity of about 26°, a boiling range of about 545° to about 710° F., a viscosity at 100° F. in the range of about 58 to about 63 SUS, a pour point below about −60° F. and a naphthene content of about 80 percent by volume; said hydrogenated naphthenic petroleum distillate oil being produced by contacting a naphthenic petroleum distillate oil with hydrogen in the presence of a catalyst comprising

a sulfided combination of about 4 to 16 percent by weight of nickel, cobalt and molybdenum, said contacting being carried out at an average catalyst temperature of about 575° to about 645° F., at a space velocity of about 1.5 to about 3 liquid volumes of oil per volume of catalyst per hour, and at a pressure of about 1,000 p.s.i.g.

7. An electrical insulating oil in accordance with claim 6 wherein the solvent-extracted residue and the hydrogenated distillate are derived from the same naphthenic crude oil base stock.

8. An electrical insulating oil in accordance with claim 6 wherein the clay treated blend is obtained by filtering the combined solvent-extracted residue and hydrogenated distillate at ambient temperature through a body of 16 to 60 mesh clay in a proportion of about 100 to about 400 barrels of oil per ton of clay.

9. An electrical insulating oil comprising a major proportion of the clay treated blend of claim 8 and from 0.01 to 1.0 percent by weight of an oxidation inhibitor.

10. An electrical insulating oil comprising a major proportion of the clay treated blend of claim 8 and a minor oxidation inhibiting amount of 2,6-ditertiary butyl-4-methylphenol.

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