Aug. 25, 1953

E. C. DAIGLE

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COLOR STABILIZATION OF FUEL OILS

Filed Nov. 15, 1950

2 Sheets-Sheet 1

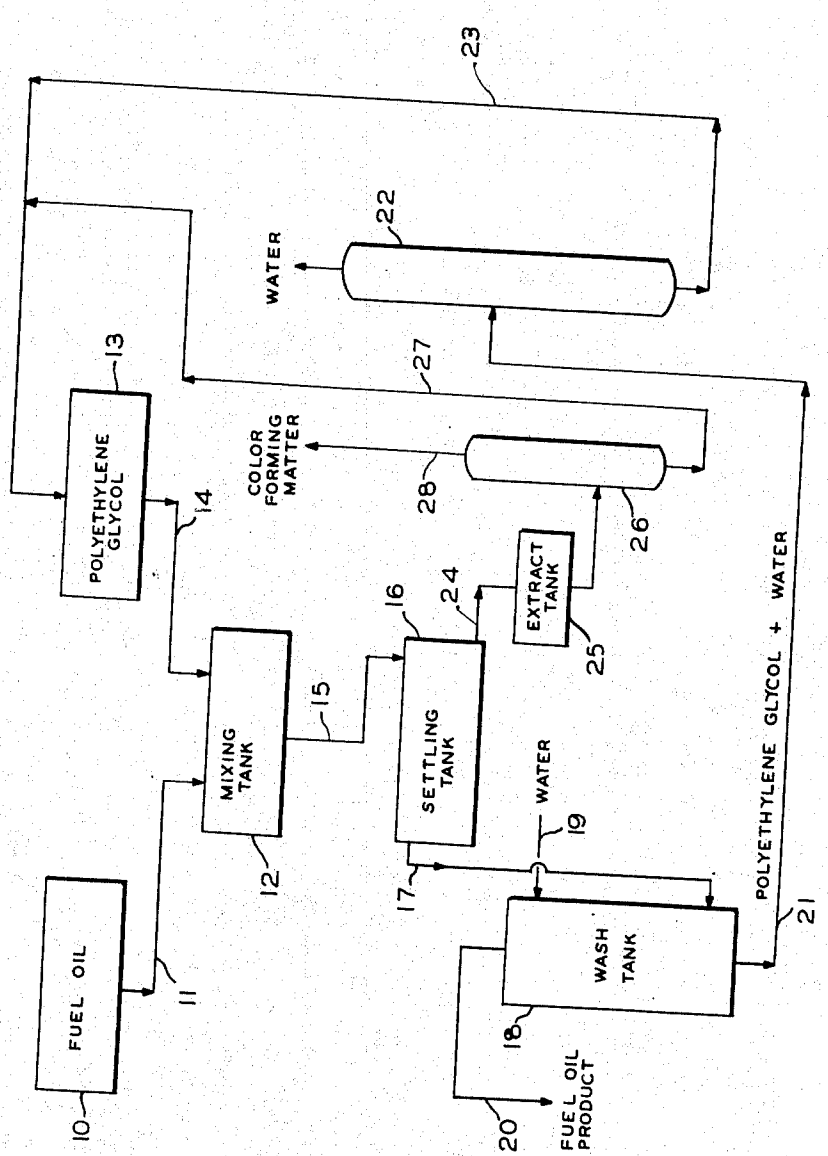


FIG. 1

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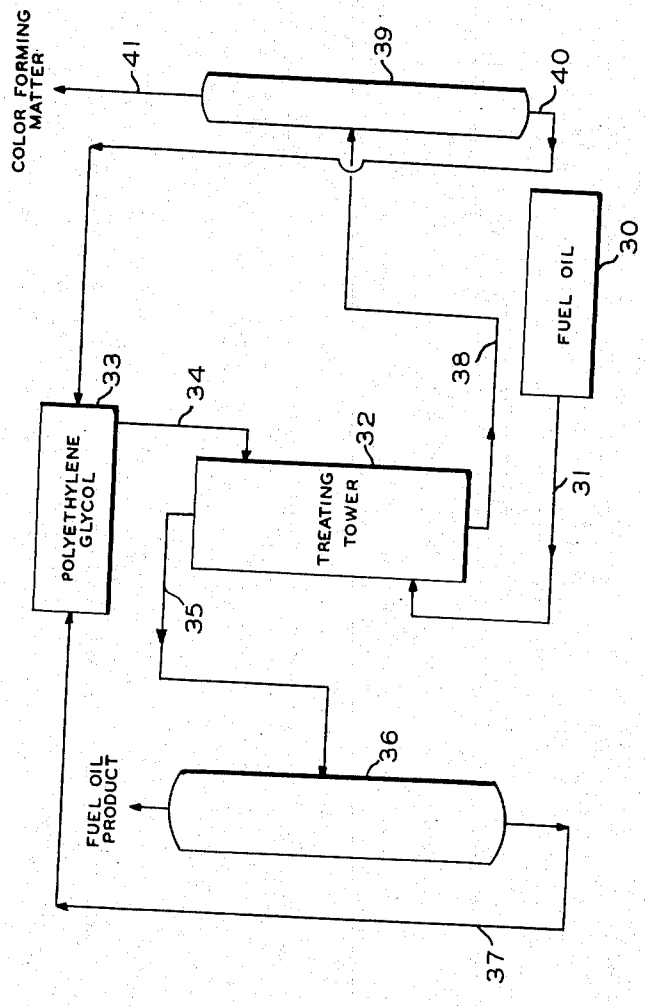


FIG. 2

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COLOR STABILIZATION OF FUEL OILS

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14 Claims. (Cl. 196—14.41)

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This invention relates to a process for stabilizing the color of petroleum fractions and more particularly is directed to a method for inhibiting discoloration and sediment formation in distillate type fuel oils upon storage of the same.

Distillate type fuel oils, i. e., petroleum fractions boiling between about 300° F. and about 700° F. should desirably possess good color stability and be substantially free of sediment in order that the tendency of the oil to corrode or plug the burning equipment in which it is to be employed may be reduced to a minimum.

Heating oil fractions may be obtained by distilling either cracked or crude petroleum products. In the past, such fractions were for the most part obtained from crude petroleum. However, with the increasing production of distillate type fuel oils by catalytic cracking, a product has resulted which goes off color and forms sediment during storage. Stabilization of these heating oils is definitely to be desired.

It is therefore the main object of the present invention to provide a method for reducing the tendency of distillate type fuel oils to become discolored and contaminated by sediment formation upon storage over extended periods of time.

In accordance with the present invention, it has been discovered that treatment of the otherwise finished fuel oil with a small quantity of a high molecular weight polyethylene glycol and subsequent separation of the oil from admixture with the glycol treating agent yields a stabilized oil having an appreciably greater resistance to discoloration and sediment formation than the oil in untreated condition.

The polyethylene glycols contemplated for use in the present process are those which are substantially completely water-soluble at temperatures of 20° C. and higher and possess a molecular weight in the range of 600 to 4000 or higher. These glycols are characterized by having a specific gravity of about 1.0 to 1.25 relative to water at normal room temperature, a melting point of about 20 to about 55° C., a Saybolt-Universal viscosity of about 60 to about 700 seconds at 210° F. and a flash point of about 420 to about 550° F.

Representative polyethylene glycols having the foregoing characteristics and suitable for use in treating distillate type fuel oils in accordance with the method described herein include materials known in the trade as "Polyethylene Glycol 600," "Carbowax 1000," "Carbowax 1500," and "Carbowax 4000." The figure present in these designations represents the average molecular weight of the particular compound.

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Polyethylene Glycol 600 is normally a liquid having a freezing point of about 20 to 25° C. and characterized by a specific gravity of about 1.13, a Saybolt-Universal viscosity of about 60 to 70 seconds at 210° F., and a flash point temperature of about 475° F.

Carbowax 1000 is a soft, waxy solid characterized by a melting point of about 35 to 40° C., a Saybolt-Universal viscosity of about 80 to 100 seconds at 210° F. and a flash point of about 480° F.

Carbowax 1500 is a solid having the consistency of petrolatum and characterized by a melting point of about 35 to 40° C., a specific gravity of about 1.15, a Saybolt Universal viscosity of about 60 to 90 seconds at 210° F. and a flash point of about 430° F.

Carbowax 4000 is a hard paraffin-like solid and characterized by a melting point of about 50 to 55° C., a specific gravity of about 1.20, a Saybolt Universal viscosity of about 500 to 700 seconds at 210° F. and a flash point temperature of about 530° F.

The above compounds have been found to possess the unexpected property of being particularly effective in treatment of distillate type fuel oils to remove deleterious bodies contained therein and capable of forming sediment and discoloring the oil upon storage of the same. Briefly, it has been found that by bringing the fuel oil stock to be treated into contact with a small quantity of polyethylene glycol of the above-recited characteristics, the latter behaves as an extractant for the deleterious, potential sediment and color forming matter contained in the oil and upon subsequent separation of the oil and polyethylene glycol phases, the oil product is distinctly improved in regard to color stability and resistance to sediment formation.

Since the above-described high molecular weight polyethylene glycols are relatively insoluble in the heating oil fractions to be treated and further possess comparatively high boiling points, they have been found to be physically well adapted for use in the instant process. The amount of polyethylene glycol employed in the present method is small in comparison to the amount of fuel oil undergoing treatment. Generally, the minimum amount of polyethylene glycol contemplated for use in the present process will be such as to effect an appreciable improvement in regard to sedimentation and color of the fuel oil product treated therewith. The maximum quantity of polyethylene glycol employed in the present process will generally be

about 25 per cent by weight of the oil charge. Larger quantities have been found to impart no additional improvement to the fuel oil undergoing treatment and, indeed, encumber the process by requiring further facilities for effecting recovery of the relatively expensive polyethylene glycol reagent. Accordingly, under the usual contemplated conditions for operation of the instant process, the amount of polyethylene glycol employed will be between about 2 and about 20 per cent by weight of the fuel oil charge. The weight ratio of polyethylene glycol to fuel oil will thus be between about 0.02 and about 0.2.

The contact between heating oil fraction and polyethylene glycol takes place under temperature and pressure conditions sufficient to maintain the same in the liquid state, thereby effecting formation of two immiscible phases. The extract phase comprises the major portion of polyethylene glycol employed and contains the deleterious potential sediment and color forming matter which it is desired to remove from the fuel oil. The product phase contains the fuel oil mixed with a small amount of polyethylene glycol. These two immiscible phases are separated. The polyethylene glycol reagent is then separated from the product phase by water-washing, distillation, or other feasible means. Likewise, the polyethylene glycol is removed from the extract phase by distillation or other suitable means. The polyethylene glycol so recovered from each of the phases may be re-used for treatment of additional quantities of fuel oil stock.

As a practical matter, it is preferred to effect contact between fuel oil and polyethylene glycol reagent at substantially atmospheric pressure and at a temperature above the melting point of the particular glycol reagent used. Generally, the temperature of contact will accordingly be between about 70° F. and about 150° F., although it is to be realized that lower temperatures may permissibly be used with an increase in pressure.

The method of this invention may be carried out either as a batch operation or as a continuous process. Suitable continuous procedures are shown in the attached flow diagrams.

Referring more particularly to the flow diagram of Figure 1, fuel oil stock to be treated is conducted from tank **10** through pipe **11** into mixing tank **12**. Likewise, polyethylene glycol reagent is led from storage tank **13** through pipe **14** into mixing tank **12**. Thorough agitation of the oil and glycol reagent takes place in this tank. Thereafter, the resulting mixture is conducted through pipe **15** to settling tank **16**. There, phase separation takes place into an upper layer comprising the oil product and a small quantity of the polyethylene glycol and a lower extract layer comprising the major portion of polyethylene glycol, together with the deleterious matter which it is desired to remove from the oil. The upper product layer is withdrawn through conduit **17** and led into wash tank **18** where it is washed with water introduced through conduit **19**. Since the polyethylene glycol is completely soluble in water while the fuel oil is insoluble therein, an effective separation of fuel oil and polyethylene glycol reagent is accomplished during the water washing. The fuel oil product is withdrawn from the upper portion of tank **18** through pipe **20** while the water solution of polyethylene glycol is withdrawn from the bottom of tank **18** through pipe **21**. The aqueous solution of polyethylene glycol is then led into distillation tower **22** where water passes overhead as a vapor and polyethylene glycol is obtained as a bottoms product. The polyethylene glycol so obtained is removed from the bottom of tower **22** and recycled by means of pipe **23** to storage tank **13**.

The lower layer contained in settling tank **16** is withdrawn therefrom through pipe **24** into extract tank **25** from which it is fed into distillation tower **26**. The polyethylene glycol contained in such feed mixture is separated as a bottoms product through conduit **27** and is return to storage tank **13**. The deleterious sediment and color forming matter removed from the fuel oil passes overhead through outlet pipe **28**.

Turning now to the flow diagram of Figure 2, an alternate continuous treating procedure employing counter-current flow is shown. The fuel oil stock to be treated is conducted from tank **30** through pipe **31** into the lower portion of treating tower **32**. There, the oil flowing upwardly through the tower comes in contact with the downflowing polyethylene glycol introduced into the upper portion of the tower from storage tank **33** through conduit **34**. The counter-current flow of polyethylene glycol reagent and oil affords an intimate degree of contact between the two streams and thereby permits the deleterious sediment and color forming matter contained in the fuel oil to be removed by the downflowing polyethylene glycol. A stream of fuel oil so stabilized and containing a small amount of polyethylene glycol is withdrawn from the upper portion of tower **32** through pipe **35** and conducted to distillation tower **36** where the fuel oil product passes overhead while polyethylene glycol collects in the bottom of tower **36** and is withdrawn therefrom through pipe **37** and then returned to storage tank **33**.

The polyethylene glycol stream containing the deleterious matter previously removed from the oil is led from the bottom of treating tower **32** through pipe **38** and conducted to distillation tower **39**. The polyethylene glycol contained therein is separated as a bottoms product through conduit **40** and is recycled to storage tank **33**. The sediment and color forming matter removed from the fuel oil passes overhead through outlet **41**.

The following specific examples will serve to illustrate the results achieved in accordance with the present invention:

Example 1

A heating oil having the following characteristics:

Gravity, A. P. I.	32.8°
Flash point	166° F.
Pour point	0° F.
Viscosity, Saybolt-Universal (100° F.)	35 sec.
Sulfur content	0.42%
Aniline number	136.4° F.
Diesel index	44.7
Distillation:	
IBP	°F. 346
10%	°F. 426
50	°F. 510
90	°F. 587
E. P.	°F. 638
Rec.	per cent 98

was tested for color and found to possess a color of Light 1½ on the NPA scale. This oil, after storage for 24 hours at a temperature of 212° F. was contaminated by heavy sediment and upon testing for color was found to have a color of Dark 4 on the NPA scale.

The same oil was then treated with Carbowax 4000 in the amount of 20 per cent by weight of the oil. Contact was carried out at a temperature of 145° F. and at atmospheric pressure for about 1 minute. After contacting, the extract phase comprising Carbowax 4000 and deleterious matter was separated from the oil phase. The oil phase was then water-washed to remove the small amount of Carbowax 4000 contained in the oil and the water was saved for Carbowax recovery. The resulting oil product, upon testing for color, was found to have a NPA color of 1. After storage of this oil for 24 hours at a temperature of 212° F., the oil was found to contain only a trace of sediment and to have a NPA color of Light 3.

Example 2

A heating oil having the following characteristics:

Gravity, A. P. I.	32.4°.
Flash point	160° F.
Pour point	0° F.
Viscosity, Saybolt-Universal (100° F.)	35 sec.
Sulfur content	0.59%
Aniline number	131.1.
Diesel index	42.5.
Distillation:	
I. B. P.	°F. 350
10%	°F. 416
50	°F. 510
90	°F. 593
E. P.	°F. 644
Rec.	per cent 99

upon testing for color was found to have a NPA color of Light 2. After storage of this oil for 24 hours at 212° F., considerable sediment formed and the color of the oil was 5 on the NPA scale.

The same oil was then treated with Carbowax 4000 in the amount of 10 per cent by weight of the oil. Contact was carried out at a temperature of 145° F. and at atmospheric pressure for about 1 minute. After contacting, the extract phase comprising Carbowax 4000 and sediment and color forming matter was separated from the oil phase. The oil phase was then vacuum-distilled at a maximum temperature of 450° F. and a pressure of 10 mm. of mercury to remove the small amount of Carbowax 4000 contained in the oil. The resulting oil product, upon testing for color, was found to have a NPA color of Dark 1. After storage of this oil for 24 hours at a temperature of 212° F., the oil was found to be substantially free of sediment and to have an improved color 2½ on the NPA scale.

Example 3

A heating oil having the following characteristics:

Gravity, A. P. I.	30.0°.
Flash point	150° F.
Pour point	15° F.
Viscosity, Saybolt-Universal (100° F.)	36 sec.
Sulfur content	0.96%.
Aniline number	122.6° F.
Diesel index	37.0.
Distillation:	
I. B. P.	°F. 344
10%	°F. 418
50	°F. 534
90	°F. 622
E. P.	°F. 658
Rec.	per cent 99

was tested for color and found to possess a color

of Light 2½ on the NPA scale. After storage of this oil for 24 hours at 212° F., the NPA color was 7 and the oil was contaminated by heavy sediment.

The same oil was then treated with Carbowax 4000 in the amount of 25 per cent by weight of the oil. Contact was carried out as in Example 1 to yield an oil having a NPA color of Dark 1½. Storage of this stabilized oil for 24 hours at 212° F. yielded only a trace of sediment and the oil was found to have a NPA color of Dark 3½.

Example 4

A fuel oil having the following characteristics:

Gravity, A. P. I.	29.1°.
Flash point	160° F.
Pour point	20.
Viscosity, Saybolt-Universal (100° F.)	35 sec.
Sulfur content	0.97%.
Aniline number	123.6° F.
Diesel index	36.0.
Distillation:	
I. B. P.	°F. 380
10%	°F. 440
50	°F. 534
90	°F. 616
E. P.	°F. 644
Rec.	per cent 98

was tested for color and found to have a color of 1½ on the NPA scale. After storage of this oil for 24 hours at 212° F., the oil was found to have a NPA color of 6 and to be contaminated by heavy sediment formation.

The same oil was then treated with Carbowax 4000 in the amount of 2 per cent by weight of the oil. Contact was carried out as in Example 1. The resulting stabilized oil had a NPA color of 1½ and after storage for 24 hours at 212° F., was substantially free of sediment and was characterized by a NPA color of Light 4½.

Example 5

A sample of the heating oil employed in Example 4 was treated with Carbowax 4000 in the amount of 10 per cent by weight of the oil. Contact was carried out as in Example 4 and the resulting stabilized oil was stored for 2 months at a temperature of 100° F. At the end of this time, the oil was found to have a NPA color of 4 and to contain 2½ mgs. of sediment per 100 ml. of oil. The unstabilized oil, after storage for 2 months at 100° F., was found to have a NPA color of Dark 7 and to contain 14 mgs. of sediment per 100 ml. of oil.

Example 6

A heating oil having the following characteristics:

Gravity, A. P. I.	29.1°
Flash point	160° F.
Pour point	20
Viscosity, Saybolt-Universal (100° F.)	35 sec.
Sulfur content	0.97%
Aniline number	123.6° F.
Diesel index	36.0
Distillation:	
I. B. P.	°F. 380
10%	°F. 440
50	°F. 534
90	°F. 616
E. P.	°F. 644
Rec.	per cent 98

upon testing was found to have a NPA color of

2½. After storage of this oil for 24 hours at a temperature of 212° F., the oil was found to be contaminated by a heavy formation of sediment and to have a NPA color of Dark 7.

The same oil was then treated with Polyethylene Glycol 600 in the amount of 5 per cent by weight of the oil. Contact was carried out at a temperature of 90° F. and at atmospheric pressure for about 1 minute. After contacting, the extract phase comprising Polyethylene Glycol 600 and deleterious matter was separated from the oil phase. The oil phase was then water-washed to remove the small amount of Polyethylene Glycol 600 contained therein and the water was saved for recovery of the polyethylene glycol. The resulting oil product, upon testing for color, was found to have a NPA color of 2. After storage of this oil for 24 hours at a temperature of 212° F., only slight sediment formation was found to occur and the oil was found to have a NPA color of Dark 4½.

Example 7

A sample of the oil employed in Example 6 was treated with 20 per cent by weight of Polyethylene Glycol 600 at a temperature of 105° F. and atmospheric pressure. Contact was thereafter carried out as in Example 6 and the resulting oil product was found to have a NPA color of 2. After storage of this stabilized oil for 24 hours at a temperature of 212° F., the oil was found to contain only a trace of sediment and to have a NPA color of Light 4.

Example 8

A sample of the oil employed in Example 6 was treated with 20 per cent by weight of Polyethylene Glycol 600 at a temperature of 125° F. and atmospheric pressure. Contact was otherwise carried out as in Example 6 to yield a resulting oil product having a NPA color of 2. After storage of this oil for 24 hours at 212° F., the oil was found to contain only a trace of sediment and to have a NPA color of Light 4½.

Example 9

A sample of the oil employed in Example 6 was treated with 10 per cent by weight of Polyethylene Glycol 600 at a temperature of 145° F. and atmospheric pressure. Contact was otherwise carried out as in Example 6. The resulting oil product was found to have a NPA color of 2. After storage of this oil for 24 hours at a temperature of 212° F., the NPA color was 4½.

Example 10

A sample of the oil employed in Example 6 was treated with Carbowax 1000 in the amount of 5 per cent by weight of the oil. Contact was carried out at a temperature of 120° F. and at atmospheric pressure for about 1 minute. After contacting, the extract phase, comprising Carbowax 1000 and the sediment and color forming matter removed from the oil, was separated from the oil phase. The oil phase was then water-washed to remove the small amount of Carbowax 1000 contained therein and the water saved for Carbowax recovery. The resulting oil product, upon testing for color, was found to have a NPA color of Light 2½. After storage of this oil for 24 hours at a temperature of 212° F., the oil was found to have a NPA color of Dark 4½.

From the foregoing examples, it will be evident that a distillate type fuel oil treated with a polyethylene glycol reagent in accordance with the method described herein affords an effective method for inhibiting sediment formation and stabilizing the oil against discoloration during storage.

The process of this invention as indicated hereinabove may be carried out either as a batch operation or as a continuous method employing concurrent or counter-current flow of polyethylene glycol reagent and the fuel oil undergoing treatment. It is also contemplated that a mixture of polyethylene glycol and water may under certain conditions be used for removing the deleterious matter contained in the fuel oil which gives rise to heavy sediment formation and discoloration of the oil during storage.

It is to be understood that the above description is merely illustrative of preferred embodiments of the invention, of which many variations may be made within the scope of the following claims by those skilled in the art without departing from the spirit thereof.

I claim:

1. A method for reducing sedimentation and stabilizing the color of a distillate type fuel oil boiling between about 300° F. and about 700° F. and subject to sediment formation and discoloration upon storage, which comprises liquid phase contacting of said oil with a polyethylene glycol characterized by a molecular weight of at least about 600 and substantially complete solubility in water, the amount of said polyethylene glycol present being not less than about 2 per cent and not more than about 25 per cent by weight of the oil, forming immiscible phases comprising an oil layer mixed with a small amount of said polyethylene glycol and a second layer comprising the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible phases and recovering oil of improved sedimentation and color stability from said oil layer.

2. A method for reducing sedimentation and stabilizing the color of a distillate type fuel oil boiling between about 300° F. and about 700° F. and subject to sediment formation and discoloration upon storage, which comprises liquid phase contacting of said oil with a polyethylene glycol characterized by a molecular weight of at least 600, a specific gravity of about 1.0 to 1.25, a melting point of about 20 to about 55° C., a Saybolt Universal viscosity of about 60 to about 700 seconds at 210° F. and substantially complete solubility in water, the amount of said polyethylene glycol present being not less than about 2 per cent and not more than about 25 per cent by weight of the oil, forming immiscible phases comprising an oil layer mixed with a small amount of said polyethylene glycol and a second layer comprising the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible phases and recovering oil of improved sedimentation and color stability from said oil layer.

3. A method for removing deleterious sediment and color forming matter from a distillate type fuel oil boiling between about 300° F. and about 700° F., which comprises extracting said matter from said oil with a small amount of a high molecular weight polyethylene glycol at a temperature and pressure sufficient to maintain the same in the liquid state, the molecular weight of said polyethylene glycol being between about 600 and 4000 and the weight ratio of polyethylene glycol to fuel oil being between about 0.02 and about 0.2, whereby two immiscible layers are

formed, one of which comprises the oil mixed with a small amount of said polyethylene glycol and the second of which comprises the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible layers and recovering an oil of improved sediment forming tendencies and improved color stability.

4. A method for removing deleterious sediment and color forming matter from a distillate type fuel oil boiling between 300° F. and 700° F., which comprises extracting said matter from said oil with a high molecular weight polyethylene glycol at a temperature and pressure sufficient to maintain the same in a liquid state, said polyethylene glycol being characterized by an average molecular weight of about 600, a freezing point of about 20 to 25° C., a specific gravity of about 1.13 and a Saybolt-Universal viscosity of about 60–70 seconds at 210° F., the weight ratio of said polyethylene glycol to fuel oil being between about 0.02 and about 0.2, whereby two immiscible layers are formed, one of which comprises the oil mixed with a small amount of said polyethylene glycol and the second of which comprises the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible layers and recovering an oil of improved sediment forming tendencies and improved color stability.

5. A method for removing deleterious sediment and color forming matter from a distillate type fuel oil boiling between 300° F. and 700° F., which comprises extracting said matter from said oil with a high molecular weight polyethylene glycol at a temperature and pressure sufficient to maintain the same in a liquid state, said polyethylene glycol being characterized by an average molecular weight of 1000, a melting point of about 35 to 40° C. and a Saybolt-Universal viscosity of about 80 to 100 seconds at 210° F., the weight ratio of said polyethylene glycol to fuel oil being between about 0.02 and about 0.2, whereby two immiscible layers are formed, one of which comprises the oil mixed with a small amount of said polyethylene glycol and the second of which comprises the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible layers and recovering an oil of improved sediment forming tendencies and improved color stability.

6. A method for removing deleterious sediment and color forming matter from a distillate type fuel oil boiling between 300° F. and 700° F., which comprises extracting said matter from said oil with a high molecular weight polyethylene glycol at a temperature and pressure sufficient to maintain the same in a liquid state, said polyethylene glycol being characterized by an average molecular weight of 1500, a melting point of about 35 to 40° C., a specific gravity of about 1.15 and a Saybolt-Universal viscosity of about 60 to 90 seconds at 210° F., the weight ratio of said polyethylene glycol to fuel oil being between about 0.02 and about 0.2, whereby two immiscible layers are formed, one of which comprises the oil mixed with a small amount of said polyethylene glycol and the second of which comprises the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible layers and recovering an oil of improved sediment forming tendencies and improved color stability.

7. A method for removing deleterious sediment and color forming matter from a distillate type fuel oil boiling between 300° F. and 700° F., which comprises extracting said matter from said oil with a high molecular weight polyethylene glycol at a temperature and pressure sufficient to maintain the same in a liquid state, said polyethylene glycol being characterized by an average molecular weight of 4000, a melting point of about 50 to 55° C., a specific gravity of about 1.20, and a Saybolt-Universal viscosity of about 500 to 700 seconds at 210° F., the weight ratio of said polyethylene glycol to fuel oil being between about 0.02 and about 0.2, whereby two immiscible layers are formed, one of which comprises the oil mixed with a small amount of said polyethylene glycol and the second of which comprises the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible layers and recovering an oil of improved sediment forming tendencies and improved color stability.

8. A method for removing deleterious sediment and color forming matter from a distillate type fuel oil boiling between 300° F. and 700° F., which comprises extracting said matter from said oil with a small amount of a normally solid polyethylene glycol at a temperature and pressure sufficient to maintain the same in a liquid state, the weight ratio of said polyethylene glycol to fuel oil being between about 0.02 and about 0.2, whereby two immiscible layers are formed, one of which comprises the oil mixed with a small amount of said polyethylene glycol and the second of which comprises the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible layers and recovering an oil of improved sediment forming tendencies and improved color stability.

9. A method for reducing sedimentation and stabilizing the color of a distillate type fuel oil boiling between about 300° F. and about 700° F. and subject to sediment formation and discoloration upon storage, which comprises contacting said oil at a temperature between about 70° F. and about 150° F. with a polyethylene glycol characterized by a molecular weight of at least about 600 and substantially complete solubility in water, the amount of said polyethylene glycol present being not less than about 2 per cent and not more than about 25 per cent by weight of the oil, forming immiscible phases comprising an oil layer mixed with a small amount of said polyethylene glycol and a second layer comprising the bulk of said polyethylene glycol together with deleterious matter removed from said oil, separating said immiscible phases and recovering oil of improved sedimentation and color stability from said oil layer.

10. A continuous process for reducing sediment formation and effecting color stabilization of a distillate type fuel oil boiling between about 300° F. and about 700° F., which comprises continuously contacting said oil with a polyethylene glycol of 600 to 4000 molecular weight at a temperature sufficient to insure a liquid phase contact, the amount of said polyethylene glycol being greater than about 2 per cent but less than about 25 per cent by weight of the oil, continuously forming two immiscible phases comprising a lower layer of polyethylene glycol containing deleterious matter extracted from said oil and an overlying layer of oil mixed with a small amount of polyethylene glycol, continuously withdrawing a stream of said overlying oil layer, continuously separating polyethylene glycol from

said stream to yield a fuel oil of improved sediment forming tendencies and improved color stability and recycling said separated polyethylene glycol to contact with a fresh supply of the oil undergoing treatment.

11. A continuous process for reducing sediment formation and effecting color stabilization of a distillate type fuel oil boiling between about 300° F. and about 700° F., which comprises continuously contacting said oil with a polyethylene glycol of 600 to 4000 molecular weight at a temperature sufficient to insure a liquid phase contact, the amount of said polyethylene glycol being greater than about 2 per cent but less than about 25 per cent by weight of the oil, continuously forming two immiscible phases comprising a lower layer of polyethylene glycol containing deleterious matter extracted from said oil and an overlying layer of oil mixed with a small amount of polyethylene glycol, continuously withdrawing a stream of said overlying oil layer, continuously washing polyethylene glycol from said stream with water to yield a fuel oil of improved sediment forming tendencies and improved color stability, separating the resulting aqueous solution into water and polyethylene glycol and recycling the polyethylene glycol so separated to contact with a fresh supply of the oil undergoing treatment.

12. A continuous process for reducing sediment formation and effecting color stabilization of a distillate type fuel oil boiling between about 300° F. and about 700° F., which comprises continuously contacting said oil with a polyethylene glycol of 600 to 4000 molecular weight at a temperature sufficient to insure a liquid phase contact, the amount of said polyethylene glycol being greater than about 2 per cent but less than about 25 per cent by weight of the oil, continuously forming two immiscible phases comprising a lower layer of polyethylene glycol containing deleterious matter extracted from said oil and an overlying layer of oil mixed with a small amount of polyethylene glycol, continuously withdrawing a stream of said overlying oil layer, continuously distilling oil from said stream to yield a fuel oil of improved sediment forming tendencies and improved color stability and recycling the polyethylene glycol so separated to contact with a fresh supply of the oil undergoing treatment.

13. A continuous process for reducing sediment formation and effecting color stabilization of a distillate type fuel oil boiling between about 300° F. and about 700° F., which comprises continuously counter-currently contacting said oil with a polyethylene glycol of 600 to 4000 molecular weight at a temperature between about 70° F. and about 150° F., the weight ratio of said polyethylene glycol to fuel oil being between about 0.02 and about 0.2, continuously forming two immiscible phases comprising a lower layer of polyethylene glycol containing deleterious matter extracted from said oil and an overlying layer of oil mixed with a small amount of polyethylene glycol, continuously withdrawing a stream of said overlying oil layer, continuously separating polyethylene glycol from said stream to yield a fuel oil of improved sediment forming tendencies and improved color stability and recycling said separated polyethylene glycol to contact with a fresh supply of the oil undergoing treatment.

14. A continuous process for reducing sediment formation and effecting color stabilization of a distillate type fuel oil boiling between about 300° F. and about 700° F., which comprises continuously contacting said oil with a polyethylene glycol of 600 to 4000 molecular weight at a temperature sufficient to insure a liquid phase contact, the amount of said polyethylene glycol being greater than about 2 per cent but less than about 25 per cent by weight of the oil, continuously forming two immiscible phases comprising a lower layer of polyethylene glycol containing deleterious matter extracted from said oil and an overlying layer of oil mixed with a small amount of polyethylene glycol, continuously withdrawing a stream of said lower layer, separating polyethylene glycol therefrom and recycling said separated polyethylene glycol to contact with a fresh supply of the oil, continuously withdrawing a stream of said overlying oil layer, continuously separating polyethylene glycol from said stream to yield a fuel oil of improved sediment forming tendencies and improved color stability and recycling said separated polyethylene glycol to contact with a fresh supply of the oil undergoing treatment.

EARL C. DAIGLE.

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