

ADDITIVE COMPOSITION FOR PRODUCING NEW WATER-OIL MIXED FUEL

TECHNICAL FIELD

[0001]

The present invention relates to an additive composition for producing a new water-oil mixed fuel having a higher calorific value and a low density.

BACKGROUND ART

[0002]

Recently, a new water-oil mixed fuel produced by dispersing water into petroleum-based fuel such as gasoline, kerosene, light oil, or heavy oil is paid attention to. Since the new water-oil mixed fuel generates less toxic substances, the mixture is considered to contribute to the protection of environment.

[0003]

A typical method for uniformly mixing water with fuel includes a method utilizing an additive, whose representative example is an emulsifier. Patent Document 1 discloses an apparatus for producing an emulsion fuel by mixing water and an emulsifier with fuel oil. Patent Document 2 discloses an emulsion fuel oil produced by mixing vegetable waste edible oil and distilled spirit (shochu) vinasse liquid in a volume ratio of about 1:1.

[0004]

Additionally, an apparatus for sufficiently mixing fuel and water as fine as possible (for example, microparticle level) without an additive such as an emulsifier is also developed.

[0005]

Patent Document 3 discloses an apparatus for producing a mixed fuel, which has a first injector for injecting fuel oil or mixed oil of fuel oil and water; a second injector for injecting water; a high voltage DC generator for applying a positive high potential to the liquid injected from the first injector and a negative high potential to the

water injected from the second injector; and a mixed oil processing member for receiving the resulting mixed oil produced by the collision of the injected fuel oil or the mixed oil with the injected water and for transferring the mixed oil to the first injector.

[0006]

Patent Document 4 discloses an apparatus for producing a microemulsion, including: a water softener for softening water used for subsequent mixing; a water purifier for purifying the soft water from the water softener into pure water; a water ionizer for negatively ionizing the pure water from the water purifier with a first apparatus for magnetic treatment of liquids; an oil ionizer for positively ionizing oil used for subsequent mixing with a second apparatus for magnetic treatment of liquids; a potential applicator for applying a positive potential to the positively ionized oil from the oil ionizer; and a mixing member for crossing an oil mist and an water mist to form a liquid mixture in a microemulsion form, in which the oil mist is formed by applying a positive potential again to the oil from the potential applicator and by spraying the oil, and in which the water mist is formed by applying a negative potential to the water from the water ionizer and by spraying the water.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0007]

Patent Document 1: JP 2007-197648 A

Patent Document 2: JP 2008-174699 A

Patent Document 3: JP 5711186 B

Patent Document 4: JP 5619204 B

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0008]

The water-oil mixed fuels as disclosed in Patent Documents 1 and 2 have

problems that the mixture has milky-white color and that the appearance is not typical for fuel oil. Further, the water-oil mixed fuels have problems that the total calorific value (calorie) is decreased and the density is increased due to the added water.

Although the new apparatuses for producing a microemulsion as disclosed in Patent Documents 3 and 4 have excellent versatility, the composition of the additive used is not optimized.

[0009]

Therefore, an object of the invention is to provide an additive composition for producing a new water-oil mixed fuel which has transparent appearance and has a higher calorific value and a low density.

MEANS FOR SOLVING THE PROBLEM

[0010]

The present invention is an additive composition for producing a new water-oil mixed fuel comprising, in a hydrocarbon based solvent:

an ingredient (a): castor oil or olive oil;

an ingredient (b): a nonionic surfactant having an HLB of 8.0 to 15.5; and

an ingredient (c): carbon;

wherein the content of the ingredient (a) is from 3 to 10 wt%, the content of the ingredient (b) is from 3 to 10 wt%, and the content of the ingredient (c) is from 20 to 40 wt%.

[0011]

Further, the present invention is an additive composition for producing a new water-oil mixed fuel comprising, in a hydrocarbon based solvent:

an ingredient (a): castor oil or olive oil;

an ingredient (b): a nonionic surfactant having an HLB of 8.0 to 15.5;

an ingredient (c): carbon; and

an ingredient (d) a detergent having a surface tension of 25 to 70 dyne/cm at 25°C.

[0012]

Further, the present invention is an additive composition for producing a new water-oil mixed fuel comprising:

, in a hydrocarbon based solvent:

an ingredient (a): castor oil or olive oil;

an ingredient (b): a nonionic surfactant having an HLB of 8.0 to 15.5; and

an ingredient (c): a porous carbon having an average particle size of 10 to 70 μm .

EFFECT OF THE INVENTION

[0013]

The present invention can provide an additive composition for producing a new water-oil mixed fuel which has transparent appearance and has a higher calorific value and a low density.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is a figure showing an example of the configuration of a new fuel production apparatus.

FIG. 2 is a figure showing an example of the configuration of a first micronization device.

FIG. 3 is a figure showing an example of the configuration of a high pressure nozzle.

FIG. 4 is a figure showing an example of the configuration of a micronization mixing device.

FIG. 5 is a figure showing an example of a cut hole formed on a soft thin film layer.

FIG. 6 is a figure showing an example of the configuration of a second micronization device.

FIG. 7 is a figure showing an example of the configuration of a Venturi tube.

MODE FOR CARRYING OUT THE INVENTION

[0015]

The additive composition for producing a new water-oil mixed fuel of the present invention includes, in a hydrocarbon based solvent, castor oil or olive oil (ingredient (a)), a nonionic surfactant having an HLB of 8.0 to 15.5 (ingredient (b)), and carbon (ingredient (c)). The additive composition for producing a new water-oil mixed fuel is useful for producing a new water-oil mixed fuel which has transparent appearance and has a higher calorific value and a low density.

[0016]

As the ingredient (a), castor oil or olive oil is used. Inclusion of the ingredient (a) allows improved heat solubility. From the view point that the heat solubility is improved by the carbon length and the substituent group, the ingredient (a) is preferably castor oil.

[0017]

As the ingredient (b), a nonionic surfactant (non-ionic surfactant) having an HLB of 8.0 to 15.5 is used. Inclusion of the ingredient (b) allows improved miscibility of water and fuel (oil). Specific examples of the nonionic surfactant include ester type nonionic surfactants such as glyceryl laurate, glyceryl monostearate, sorbitan fatty acid esters, and sucrose fatty acid esters; ether type nonionic surfactants such as polyoxyethylene alkyl ethers, pentaethylene glycol monododecyl ether, octaethylene glycol monododecyl ether, polyoxyethylene alkyl phenyl ethers, octylphenol ethoxylate, nonylphenol ethoxylate, and polyoxyethylene polyoxypropylene glycols; ester ether type nonionic surfactants such as polyoxyethylene sorbitan fatty acid esters, polyoxyethylene hexytane fatty acid esters, and sorbitan fatty acid ester polyethylene glycols; alkanol amide type nonionic surfactants such as lauric acid diethanolamide, oleic acid diethanolamide, stearic acid diethanolamide, and cocamide DEA; alkyl glucoside type nonionic surfactants such as octyl glucoside, decyl glucoside, and lauryl glucoside; and higher alcohol type nonionic surfactant such as lauryl alcohol, cetyl alcohol, cetostearyl alcohol, stearyl alcohol, oleyl alcohol, capryl alcohol, and ethylene adducts of these alcohols.

[0018]

The HLB is a value expressing the compatibility level of a surfactant for water and oil, which ranges from 0 to 20. The value means that the nearer zero the value is, the more lipophilic the surfactant is, and that the nearer 20 the value is, the more hydrophilic the surfactant is. For example, the HLB can be calculated by Griffin method. By selecting a nonionic surfactant having an HLB of 8.0 to 15.5 as the ingredient (b), the present invention can provide a transparent new water-oil mixed fuel without emulsification. The HLB of the nonionic surfactant of the ingredient (b) is preferably from 9.0 to 14.2, more preferably from 10.8 to 13.2.

[0019]

As the ingredient (c), carbon is used. Inclusion of the ingredient (c) allows improved compatibility for water. From the view point of improving the compatibility via the ingredient (c) for water, a porous carbon having an average particle size of 10 to 70 μm is preferably used as the ingredient (c). The ingredient (c) is removed from the new water-oil mixed fuel to be finally produced, and is reused as a solid fuel.

[0020]

As the hydrocarbon based solvent, the fuel raw material of the new water-oil mixed fuel produced is preferably used. Specific examples include gasoline, kerosene, light oil, and heavy oils (including heavy oil A, heavy oil B, and heavy oil C).

[0021]

The content of each ingredient can suitably be selected. The content of the ingredient (a) is preferably from 3 to 10 wt%, is more preferably from 5 to 8 wt%, and can be 6 wt%, for example. The content of the ingredient (b) is preferably from 3 to 10 wt%, is more preferably from 5 to 8 wt%, and can be 6 wt%, for example. The content of the ingredient (c) is preferably from 20 to 40 wt%, is more preferably from 25 to 35 wt%, and can be 30 wt%, for example.

[0022]

Preferably, the additive composition for producing a new water-oil mixed fuel of the present invention further comprises a detergent having a surface tension of 25 to

70 dyne/cm at 25°C as the ingredient (d). Inclusion of the ingredient (d) allows improved wettability of water against oil. The surface tension of the detergent as the ingredient (d) at 25°C is preferably from 28 to 50 dyne/cm, and is more preferably from 30 to 40 dyne/cm. The specific example of the ingredient (d) includes fluorinated detergents (for example, trade name: Elnova series from Asahi Kasei Chemicals Corporation), semi-water based detergents (for example, trade name: Elease M series from Asahi Kasei Chemicals Corporation), water based detergents (for example, trade name: Elease K series from Asahi Kasei Chemicals Corporation).

[0023]

The content of the ingredient (d) is preferably 2 wt% or less, is more preferably from 0.5 to 1.5 wt%, and can be 1 wt%, for example.

[0024]

The additive composition for producing a new water-oil mixed fuel of the present invention as described above can be utilized as an additive for producing a new water-oil mixed fuel. As the apparatus for producing a new water-oil mixed fuel, for example, the apparatuses as disclosed in the Patent Documents 3 and 4 can be used. Further, a new fuel production apparatus as shown in FIG. 1 can also be used.

[0025]

In the fuel production apparatus in FIG. 1, a first mixing tank 20, a second mixing tank 30, a powder separating device 40, and a storage tank 50 are connected in this order. The storage tank 50 may be connected as needed.

[0026]

In the first mixing tank 20, a powder feeding device for supplying powder, a fuel raw material feeding device for supplying a fuel raw material, and an additive feeding device for supplying an additive are mounted. In the fuel production apparatus in FIG. 1, a hopper 10, a conveyor 11, a powder measuring device 12, and a heater 13 are mounted as the powder feeding device, and a fuel raw material feed line 22 and a pump 22p are mounted as the fuel raw material feeding device, and an additive feed line 23 and a pump 23p are mounted as the additive feeding device.

[0027]

Powder is transferred from the hopper 10 to the powder measuring device 12 with the conveyor 11 to measure the required amount of the powder. Powder is then transferred to the heater 13 for heating, and then charged to the first mixing tank 20. Examples of the powder include porous powders such as carbon, silica, and alumina, and a porous carbon is preferred.

[0028]

The fuel raw material is charged from a fuel raw material tank (not shown) connected at the upstream of the fuel raw material feed line 22 to the first mixing tank 20 through the pump 22p. Examples of the fuel raw material include petroleum fuels such as gasoline, kerosene, light oil, and heavy oils (including heavy oil A, heavy oil B, and heavy oil C).

[0029]

The additive is charged from an additive tank (not shown) connected at the upstream of the additive feed line 23 to the first mixing tank 20 through the pump 23p. As the additive, an additive composition for producing a new water-oil mixed fuel according to the above-mentioned present invention is used. As described above, the hydrocarbon based solvent included in the additive is preferably the same as that of the fuel raw material.

[0030]

In the first mixing tank 20, the charged powder, the fuel raw material, and the charged additive are stirred and mixed with a stirring bar (homomixer) 21 to form a first mixture. The compounding ratio of the powder, the fuel raw material, and the additive can be suitably selected depending on the applications. Preferably, from 0.1 to 10 weight parts of the powder and from 0.1 to 10 weight parts of the additive are added with respect to 100 weight parts of the fuel raw material.

[0031]

In the second mixing tank 30, a first mixture feeding device for supplying the first mixture produced from the first mixing tank 20, a water feeding device for

supplying water, and a circulating device for circulating the contents of the second mixing tank 30 are mounted. In the fuel production apparatus in FIG. 1, a first mixture transfer line 24 and a pump 24p are mounted as the first mixture feeding device, and a water feed line 32 and a pump 32p are mounted as the water feeding device, and a circulating line 33 and a pump 33p are mounted as the circulating device. As shown in FIG. 1, a micronization mixing device (NanoBox) 26 for enhancing the mixing of oil and the additive in the first mixture is preferably mounted at the intermediate part of the first mixture transfer line 24.

[0032]

As the fuel production apparatus shown in FIG. 1, for example, a first micronization device 36 for micronizing water is connected at the intermediate part of the water feed line 32 in the water feeding device. As the first micronization device 36, for example, the device connecting a high pressure nozzle 36a and a micronization mixing device 36b in series as shown in FIG. 2 can be used. A set of three to five devices as described above can also be used. Thus, the water is micronized.

[0033]

As the high pressure nozzle 36a, for example, the nozzle having the configuration as shown in FIG. 3 can be used. Water is introduced to the high pressure nozzle 36a with the pump 32p, for example, at a pressure of 1 to 12 MPa.

[0034]

As the micronization mixing device 36b, for example, the mixing apparatus (NanoBox) as described in Patent Documents 1 and 2 can be used. More specifically, NanoBox includes a soft thin film layer 6 positioned in an outer casing 5 as shown in FIG. 4, and inner spaces 1 and 2 defined from the outer casing 5 are sealed. The inner spaces 1 and 2 are communicated with a cut hole 6a (FIG. 5) formed on the soft thin film layer 6. For example, the cut hole 6a is preferably formed in a cross shape as shown in FIG. 5. The size W1 of the cut hole is preferably from 1 to 20 μm , is more preferably from 5 to 15 μm , is further more preferably from 8 to 12 μm , and can be 10 μm , for example. The width w1 of the cut hole is preferably from one fifth to one

twentieth of the size W1 of the cut hole, and can be one tenth of the size W1 of the cut hole, for example.

[0035]

The water supplied has preferably a pH of 10 to 13.5 and an oxidation-reduction potential of -600 to -100 mV. For example, the pH of the water can be adjusted by adding ceramics to the water.

[0036]

In the circulating device, as the fuel production apparatus shown in FIG. 1, for example, a second micronization device 37 for micronizing contents in the second mixing tank 30 is connected at the intermediate part of the circulating line 33. As the second micronization device 37, for example, the device connecting a micronization mixing device 37a and a Venturi tube 37b in series as shown in FIG. 6 can be used. The device connecting a micronization mixing device 37a and two or three of Venturi tubes 37b in series can also be used.

[0037]

As the micronization mixing device 37a, the device similar to the above-mentioned micronization mixing device 36b can be used. The size W1 of the cut hole is preferably from 50 to 500 μm , is more preferably from 100 to 300 μm , is further more preferably from 130 to 200 μm , and can be 150 μm , for example.

[0038]

As the Venturi tube 37b, for example, the tube having the configuration as shown in FIG. 7 can be used. As shown in FIG. 7, spherical objects are preferably included in the Venturi tube 37b. By including spherical objects, the flow velocity in the Venturi tube 37b is increased depending on the decrease of the pipe area, resulting in homogenization effect. The content in the second mixing tank 30 is introduced to the Venturi tube 37b with the pump 33p, for example, at a pressure of 0.1 to 1.0 MPa.

[0039]

In the second mixing tank 30, the first mixture produced in the first mixing tank 20 and water micronized in the first micronization device 36 are stirred and mixed

with a stirring bar (homomixer) 31 to form a second mixture. The second mixture is then circulated with the circulating device, and is micronized with the second micronization device. The compounding ratio of the second mixture and the water can be suitably selected depending on the applications. Preferably, from 10 to 70 ml of water are mixed with respect to 100 ml of the fuel raw material, and more preferably, from 30 to 50 ml of water are mixed.

[0040]

The powder separating device is connected to the second mixing tank 30 so as to supply the second mixture obtained in the second mixing tank 30. In the fuel production apparatus in FIG. 1, three micronization stabilizing devices 40 are connected in parallel with a second mixture transfer line 34 and a pump 34p for transferring the second mixture obtained in the second mixing tank 30. If necessary, as shown in FIG. 1, a storage tank 50 with a filtering device 42 and a pump 43 is connected through a product transfer line 41 for transferring the resulting product at the downstream of the three micronization stabilizing devices 40.

[0041]

As the powder separating device, devices being capable of separating and removing powders in the second mixture may be used, and the device may be a filtering device, or a centrifugal separator. The ingredient (c) used as the additive, which is included in the additive composition for producing a new water-oil mixed fuel according to the present invention, is also separated and removed with the powder separating device. In FIG. 1, the micronization stabilizing device 40 is used as a kind of static device. That is, the device has a function of enhancing the mixing level by adjusting the size W1 of the cut hole in the micronization mixing device 36b or the micronization mixing device 37a. Specifically, the size W1 of the cut hole is preferably from 0.1 to 50 μm , is more preferably from 0.5 to 30 μm , is further more preferably from 8 to 12 μm , and can be 10 μm , for example. The pressure can be, for example, from 0.1 to 1.0 MPa, and is preferably from 0.2 to 0.6 MPa.

[0042]

Since the properties of the second mixture are improved by keep the mixture for one day or longer, the condition (the flow amount of the second mixture, the volume of the powder separating device 40, or the like) is preferably set so that the second mixture remains in the powder separating device (micronization stabilizing device 40).
[0043]

The condition for obtaining a new water-oil mixed fuel kept in the micronization stabilizing device 40 is satisfied. The new water-oil mixed fuel obtained is transferred via the filtering apparatus 42 through the fuel transfer line 41 to the tank 50 with the pump 43p. The mixture is stored as the new fuel.
[0044]

The new water-oil mixed fuel obtained has a comparative total calorific value with the fuel raw material even though the predetermined amount of water is mixed in the fuel raw material. Further, the new water-oil mixed fuel has a comparative density with the fuel raw material. In other words, the new water-oil mixed fuel which has a higher calorific value and a low density can be produced.

EXAMPLES

[0045]

<Example 1>

A new water-oil mixed fuel was produced with the apparatus as shown in FIG. 1. Heavy oil A was used as the fuel raw material, and a porous carbon (the apparent density: 0.33 kg/l) was used as the powder, and an additive composition containing the following ingredients was used as the additive. The compounding ratio of heavy oil A : water : additive : powder was 70:30:0.35:0.12 (by volume).

- ingredient (a): castor oil	6 wt%
- ingredient (b): nonionic surfactant (HLB: 8.0)	6 wt%
- ingredient (c): porous carbon (average particle size: 50 μ m)	30 wt%
- ingredient (d): detergent (surface tension at 25°C: 33)	1 wt%
- hydrocarbon based solvent: heavy oil A	57 wt%

[0046]

The new water-oil mixed fuel obtained was transparent with a total calorific value of 45.6 MJ/kg and a density of 0.8428 g/cm³. Since a typical heavy oil A has a total calorific value of about 45 MJ/kg and a density of about 0.87 g/cm³, it is found that the new water-oil mixed fuel obtained has a comparative total calorific value and a low density with the heavy oil A.

[0047]

<Example 2>

A new water-oil mixed fuel was produced in the same manner of Example 1 except that an additive composition containing a nonionic surfactant (HLB: 10.8) as the ingredient (b) was used. The new water-oil mixed fuel obtained was transparent with a total calorific value of 44.5 MJ/kg and a density of 0.865 g/cm³.

[0048]

<Example 3>

A new water-oil mixed fuel was produced in the same manner of Example 1 except that an additive composition containing a nonionic surfactant (HLB: 15.5) as the ingredient (b) was used. The new water-oil mixed fuel obtained was transparent with a total calorific value of 44.6 MJ/kg and a density of 0.867 g/cm³.

[0049]

<Comparative Example 1>

A new water-oil mixed fuel was produced in the same manner of Example 1 except that an additive composition containing a nonionic surfactant (HLB: 4.0) as the ingredient (b) was used. The water-oil mixed fuel obtained has milky-white color with a total calorific value of 39.3 MJ/kg and a density of 0.893 g/cm³.

[0050]

<Comparative Example 2>

A new water-oil mixed fuel was produced in the same manner of Example 1 except that an additive composition containing a nonionic surfactant (HLB: 16.7) as the ingredient (b) was used. The water-oil mixed fuel obtained has milky-white color with a total calorific value of 39.2 MJ/kg and a density of 0.905 g/cm³.

DESCRIPTION OF THE REFERENCE NUMERALS

[0051]

- 1 first inner space
- 2 second inner space
- 5 outer casing
- 6 soft thin film layer
- 6a cut hole
- W1 size of cut hole
- w1 width of cut hole
- 10 hopper
- 11 conveyor
- 12 powder measuring device
- 13 heater
- 20 first mixing tank
- 21 stirring bar (homomixer)
- 22 fuel raw material feed line
- 22p pump
- 23 additive feed line
- 23p pump
- 24 first mixture transfer line
- 24p pump
- 26 micronization mixing device (NanoBox)
- 30 second mixing tank
- 31 stirring bar (homomixer)
- 32 water feed line
- 32p pump
- 33 circulating line
- 33p pump

- 34 second mixture transfer line
- 34p pump
- 36 first micronization device
- 36a high pressure nozzle
- 36b micronization mixing device
- 37 second micronization device
- 37a micronization mixing device
- 37b Venturi tube
- 40 micronization stabilizing device (or static device)
- 41 fuel transfer line
- 42 filtering apparatus
- 43p pump
- 50 storage tank

WHAT IS CLAIMED IS:

1. An additive composition for producing a new water-oil mixed fuel comprising, in a hydrocarbon based solvent:

an ingredient (a): castor oil or olive oil;

an ingredient (b): a nonionic surfactant having an HLB of 8.0 to 15.5; and

an ingredient (c): carbon;

wherein the content of the ingredient (a) is from 3 to 10 wt%, the content of the ingredient (b) is from 3 to 10 wt%, and the content of the ingredient (c) is from 20 to 40 wt%.

2. The additive composition for producing a new water-oil mixed fuel according to claim 1, further comprising:

an ingredient (d): a detergent having a surface tension of 25 to 70 dyne/cm at 25°C.

3. An additive composition for producing a new water-oil mixed fuel comprising, in a hydrocarbon based solvent:

an ingredient (a): castor oil or olive oil;

an ingredient (b): a nonionic surfactant having an HLB of 8.0 to 15.5;

an ingredient (c): carbon; and

an ingredient (d) a detergent having a surface tension of 25 to 70 dyne/cm at 25°C.

4. The additive composition for producing a new water-oil mixed fuel according to claim 2 or 3, wherein the content of the ingredient (d) is 2 wt% or less.

5. The additive composition for producing a new water-oil mixed fuel according to any one of claim 1 to 4, wherein the ingredient (c) is a porous carbon having an average

particle size of 10 to 70 μm .

6. An additive composition for producing a new water-oil mixed fuel comprising:

, in a hydrocarbon based solvent:

an ingredient (a): castor oil or olive oil;

an ingredient (b): a nonionic surfactant having an HLB of 8.0 to 15.5; and

an ingredient (c): a porous carbon having an average particle size of 10 to 70 μm .

7. The additive composition for producing a new water-oil mixed fuel according to any one of claim 1 to 6, wherein the hydrocarbon based solvent is gasoline, kerosene, light oil, or heavy oil.