

APPARATUS FOR PRODUCING MICROEMULSION

TECHNICAL FIELD

[0001]

The present invention relates to an apparatus for producing a microemulsion in which two types of liquids are mixed to form a microemulsion.

BACKGROUND ART

[0002]

Conventionally, it has been attempted to mix two essentially-immiscible liquids such as water and oil as uniformly as possible for various purposes. For example, a fuel mixture which is formed by uniformly mixing fuel oil such as heavy oil or kerosene with water is known to reduce the cost as compared to non-mixed fuel and to decrease generation of CO₂ and NO_x during combustion which results in preventing pollution.

In order to improve combustion efficiency of the fuel mixture, fuel oil and water are desired to be sufficiently mixed as fine as possible (for example, microparticle level). Thus, in a conventional liquid mixing apparatus, an emulsifier (surfactant) is added to a liquid used for subsequent mixing, and agitated with a stirrer blade to form an emulsion.

[0003]

FIG. 3 is a figure showing an example of the conventional liquid mixing apparatus as described above. In FIG. 3, pipes 201 and 202, a mixing member 203, an agitator actuator 204, a tank 205, a liquid mixture 206, a stirrer blade 207, pipes 208 and 209, and a water softener 210 are shown.

The mixing member 203 includes the tank 205 for receiving the liquid mixture, the stirrer blade 207 for agitating the liquid mixture in the tank 205, and the agitator actuator 204 for rotating the stirrer blade 207.

[0004]

In this example, water (hard water) and oil (fuel oil) are exemplified as liquids to be mixed. Oil is transferred to the tank 205 of the mixing member 203 through the pipe 202. Since hard water is not sufficiently miscible with oil, hard water is firstly

transferred to the water softener 210 for softening the hard water. The softened water is transferred to the tank 205 through the pipe 208.

On the other hand, an emulsifier (surfactant) transferred through the pipe 201 is added to the oil transferred through the pipe 202 and is transferred to the tank 205.

After the emulsifier is added, the resulting liquid mixture is emulsified (opacified). The liquid mixture gradually becomes a homogeneous solution by being agitated with the stirrer blade 207 strongly, and eventually becomes an emulsion. The emulsion of the resulting fuel mixture is discharged from the pipe 209, and then used. The liquid mixture is opacified because the mixture includes large liquid drops, and many visible lights are scattered from the liquid drops. The sizes of the liquid drops in the emulsions are at least about 0.1 μm .

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent Document 1: JP 2006-329438

Patent Document 2: JP 2008-063548

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006]

The liquid mixture produced by the conventional liquid mixing apparatus as described above has the following problems:

1. An emulsifier is required. It is relatively expensive, and the cost becomes higher.
2. Due to the emulsifier, the liquid mixture has milky-white color (opacified). For example, when the fuel mixture is formed, the appearance is not typical for fuel oil.
3. The diameters (particle sizes) of the liquid drops in the mixture are still large, and the mixture has high viscosity. Therefore, the liquid mixture separates over time.

4. The fuel mixture has the calorific value which is smaller than that of the original fuel oil.

The object of the present invention is to solve these problems.

MEANS FOR SOLVING THE PROBLEM

[0007]

In order to solve these problems, the present invention provides an apparatus for producing a microemulsion in which a liquid mixture is in a microemulsion. The microemulsion refers to a liquid mixture including liquid drops having a particle size of 0.05 μm or less. Although the liquid drops are mixed in the microemulsion, the liquid mixture appears to be a solution of the liquid drops and have one liquid phase.

[0008]

The apparatus for producing a microemulsion of the present invention comprises: a water softener (2) for softening water used for subsequent mixing; a water purifier (3) for purifying the soft water from the water softener into pure water; a water ionizer (4) for negatively ionizing the pure water from the water purifier with a first apparatus for magnetic treatment of liquids; an oil ionizer (5) for positively ionizing oil used for subsequent mixing with a second apparatus for magnetic treatment of liquids; a potential applicator (6) for applying a positive potential to the positively ionized oil from the oil ionizer; and a mixing member (7) for crossing an oil mist and an water mist to form a liquid mixture in a microemulsion form, wherein the oil mist is formed by applying a positive potential again to the oil from the potential applicator and by spraying the oil, and wherein the water mist is formed by applying a negative potential to the water from the water ionizer and by spraying the water.

[0009]

In the apparatus for producing a microemulsion as described above, the water ionizer (4) may comprise a first tank (41), which is a tank for receiving the pure water transferred from the water purifier, including an oxidation-reduction potential reducing material for reducing the oxidation-reduction potential of water and a water quality stabilizer for stabilizing the water quality; a first pump and a first pipe (42) for circulating the pure water; a first apparatus for magnetic treatment of liquids (44) mounted on the outer periphery of the intermediate part of the first pipe for applying an

electromagnetic field to the pure water flowing in the first pipe; and a first pulsed power source (45) for supplying a first pulsed power to the first apparatus for magnetic treatment of liquids for negatively ionizing pure water.

[0010]

In the apparatus for producing a microemulsion as described above, the oil ionizer (5) may comprise: a second tank (51) for receiving oil used for subsequent mixing; a second pump (53) and a second pipe (52) for circulating the oil; a second apparatus for magnetic treatment of liquids (54) mounted on the outer periphery of the intermediate part of the second pipe for applying an electromagnetic field to the oil flowing in the second pipe; and a second pulsed power source (55) for supplying a second pulsed power to the second apparatus for magnetic treatment of liquids for positively ionizing oil.

[0011]

In the apparatus for producing a microemulsion as described above, the potential applicator (6) may comprise: a third tank (61) for receiving the oil transferred from the oil ionizer; a third pump (63) and a third pipe (62) for circulating the oil; a first nozzle (64) attached at the end of the third pipe connected to the upper side of the third tank for spraying the oil; and a first high voltage DC power source (65) for supplying a first high voltage straight polarity DC power to the first nozzle in order to apply the positive potential to the oil sprayed from the first nozzle.

[0012]

In the apparatus for producing a microemulsion as described above, the mixing member (7) may comprise: a fifth tank (71) for receiving the liquid mixture; a second nozzle (73) attached at the end of the fourth pipe (20) connected to the upper side of the fifth tank for introducing the water from the water ionizer for spraying the water; a third nozzle (72) attached at the end of the fifth pipe (22) connected to the upper side of the fifth tank for introducing the oil from the potential applicator for spraying the oil; and a second high voltage DC power source (75) for supplying a second high voltage DC power in order to supply a negative potential to the water sprayed from the second nozzle and to supply a positive potential to the oil sprayed from the third nozzle.

[0013]

In the apparatus for producing a microemulsion as described above, the first pulsed power and the second pulsed power may be supplied from one pulsed power source, or the first high voltage DC power and the second high voltage DC power may be supplied from one high voltage DC power source.

EFFECT OF THE INVENTION

[0014]

The apparatus for producing a microemulsion of the present invention provides the following effects:

1. The cost can be reduced.

Since the two types of liquids are mixed without using an emulsifier, the cost for producing the microemulsion can be drastically reduced.

2. The color of the liquid mixture is the same as that of the liquid used in the production.

Since any emulsifier is not added to the mixture in the present invention, the color of the mixture is not milky white but is the same as that of the liquid used in the production. For example, in the microemulsion by mixing fuel oil and water, since the water is transparent, the color of the microemulsion is the same as that of fuel oil, and the appearance of the microemulsion is typical for fuel oil.

3. The diameters (particle sizes) of the liquid drops in the microemulsion are small, and the microemulsion has low viscosity. Therefore, the microemulsion does not separate over time.

4. The calorific value of the fuel mixture is similar to that of the original fuel oil.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1 is a figure showing an example of the apparatus for producing a microemulsion according to the present invention.

FIG. 2 is a figure illustrating an apparatus for magnetic treatment of liquids.

FIG. 3 is a figure showing a conventional liquid mixing apparatus.

MODE FOR CARRYING OUT THE INVENTION

[0016]

Hereinafter, embodiments of the invention will be described in detail with reference to drawings.

FIG. 1 is a figure showing an example of the apparatus for producing a microemulsion according to the present invention. In this example, water and oil (fuel oil such as kerosene, heavy oil, or light oil) are exemplified as two types of liquids for mixing.

FIG. 1, an apparatus for producing a microemulsion 1; a water softener 2; a water purifier 3; a water ionizer 4; an oil ionizer 5; a potential applicator 6; a mixing member 7; a heat reservoir 8; pipes 20 to 24; a tank 41; a pipe 42; a pump 43; an apparatus for magnetic treatment of liquids 44; a pulsed power source 45; a line 46; a tank 51; a pipe 52; a pump 53; an apparatus for magnetic treatment of liquids 54; a pulsed power source 55; a line 56; a tank 61; a pipe 62; a pump 63; a nozzle 64; a high voltage DC power source 65; a line 66; a tank 71; nozzles 72 and 73; a stirrer blade 74; a high voltage DC power source 75; lines 76 and 77; a tank 81; and a heater 82 are shown.

[0017]

(Summary of the apparatus)

Firstly, the summary of the apparatus for producing a microemulsion 1 is described. Water and oil are mixed in the mixing member 7. In order to mix the water and the oil with the mixing member 7 sufficiently, each of the water and the oil are pretreated before supplying to the mixing member.

The water is pretreated with a configuration of the water softener 2, the water purifier 3, and the water ionizer 4. The oil is pretreated with a configuration of the oil ionizer 5 and the potential applicator 6.

[0018]

Hereinafter, each configuration will be described in detail.

(1) Configuration for pretreating water

Although water is often hard water, since pure water is suitable for mixing. Therefore, for pretreating water, water is firstly softened in the water softener 2, and then purified in the water purifier 3. Apparatus for softening hard water and apparatus

for removing impurities such silica from the hard water to form pure water are well known in the art.

In this example, hard water having a higher oxidation-reduction potential (for example, hundreds mV) is converted to pure water having a considerably lower oxidation-reduction potential. That is because the value of the negative potential of water is desirably as large as possible during spraying water in the subsequent step (in the mixing member 7). Oil used for mixing with water is sprayed after applying a positive potential.

[0019]

The water ionizer 4 is composed of the tank 41, the pipe 42, the pump 43, the apparatus for magnetic treatment of liquids 44, the pulsed power source 45, the line 46, and the like. An oxidation-reduction potential reducing material (for example, a specific ceramic) for promoting reducing oxidation-reduction potential of water or a water quality stabilizer (for example, mineral ores such as tourmaline) for stabilizing water quality and preventing degeneration of water are included in the tank 41.

The pipe 42 and the pump 43 are mounted so as to circulate the pure water in the tank 41, and the first apparatus for magnetic treatment of liquids 44 are mounted at the intermediate part of the pipe 42. The apparatus for magnetic treatment of liquids 44 is for applying an electromagnetic field to the pure water flowing in the pipe 42 to ionize the pure water. The pulsed power source 45 is a power source for activating the apparatus for magnetic treatment of liquids 44.

[0020]

FIG. 2 is a figure illustrating an apparatus for magnetic treatment of liquids. In FIG. 2, a pipe 100, an apparatus for magnetic treatment of liquids 101, an electromagnetic field generator 102, and a pulsed power source 103 are shown. The electromagnetic field generator 102 is mounted along the outer periphery of the pipe 100, and generates an electromagnetic field for applying to a liquid flowing in the pipe 100.

When the electromagnetic field is applied to the liquid flowing in the pipe 100, if the frequency of the electromagnetic field is suitable for ionizing one of elements composing the liquid, the element is ionized and eluted. Although a pulsed power is

supplied from the pulsed power source 103 to the apparatus for magnetic treatment of liquids 101, the method for applying the polarity and the frequency of the pulsed power are suitably selected depending on types of the liquid (and the elements composing it).
[0021]

Returning to FIG. 1, the apparatus for magnetic treatment of liquids 44 of the water ionizer 4 generates negative ions from the pure water. For the pulsed power supplied from the pulsed power source 45 to the apparatus for magnetic treatment of liquids 44 through the line 46, the type and the number of the frequency, and the method for applying the polarity are selected so that the apparatus 44 generates negative ions efficiently.

The pure water containing the generated negative ions has a decreased oxidation-reduction level (for example, -300 mV). The pure water in the tank 41 is strongly alkaline as a result of the ionization in addition to the effect of the oxidation-reduction potential reducing material.

The pure water ionized in the water ionizer 4 as described above is transferred to the mixing member 7 through the pipe 20. It is transferred with a pump not shown in the figure. Pipes as described below are similar.

[0022]

(2) Configuration for pretreating oil

Oil is firstly pretreated in the oil ionizer 5, then in the potential applicator 6. The oil ionizer 5 is composed of the tank 51, the pipe 52, the pump 53, the apparatus for magnetic treatment of liquids 54, the pulsed power source 55, the line 56, and the like. The pipe 52 and the pump 53 are mounted so as to circulate the oil in the tank 51, and the apparatus for magnetic treatment of liquids 54 are mounted at the intermediate part of the pipe 52.

The apparatus for magnetic treatment of liquids 54 is for applying an electromagnetic field to the oil flowing in the pipe 52 to ionize the oil. The pulsed power source 55 is a power source for activating the apparatus for magnetic treatment of liquids 54.

[0023]

The apparatus for magnetic treatment of liquids 54 of the oil ionizer 5 generates positive ions from the oil. For the pulsed power supplied from the pulsed power source 55 to the apparatus for magnetic treatment of liquids 54 through the line 56, the type and number of the frequency, and the method for applying the polarity are selected so that the apparatus 54 generates positive ions efficiently.

The oil containing the generated positive ions has an increased oxidation-reduction level (for example, +150 mV).

The oil ionized in the oil ionizer 5 is transferred to the potential applicator 6 through the pipe 21.

[0024]

The potential applicator 6 is composed of the tank 61, the pipe 62, the pump 63, the nozzle 64, the high voltage DC power supply 65, the line 66, and the like. The pipe 62 and the pump 63 are mounted so as to circulate the oil in the tank 61. The nozzle 64 is attached at the upper end of the pipe 62, and converts the oil for circulating to the tank 61 into a mist as small as possible. Therefore, a pump having a feed pressure sufficient to convert the oil into a small mist is used as the pump 63.

A positive potential is applied to the nozzle 64 from the high voltage DC power supply 65 through the line 66. It is for applying the positive potential to the spraying oil. The potential is applied for mixing with water more sufficiently.

[0025]

In the pretreatment of water, a potential applicator corresponding to the potential applicator 6 is not used. However, the potential applicator 6 is essential in the pretreatment of oil. Although the reason is not still known, one study shows that the resulting liquid mixture does not become a microemulsion if the potential applicator 6 is not used in the pretreatment of the oil.

The oil which is ionized in the oil ionizer 5 and applied the positive potential in the potential applicator 6 is transferred to the mixing member 7 through the pipe 22.

[0026]

(3) Mixing of water and oil

The pretreated water and the pretreated oil are mixed in the mixing member 7. The mixing member 7 is composed of the tank 71, the nozzles 72 and 73, the stirrer blade 74, the high voltage DC power supply 75, the lines 76 and 77, and the like.

The pipe 20 which supplies the pretreated water is connected in the mixing member 7, and the nozzle 73 is attached to the end of the pipe 20. A negative potential is applied to the nozzle 73 from the high voltage DC power supply 75 through the line 77. The water is sprayed from the nozzle 73 strongly, and the resulting small mist of water particles is further negatively charged.

[0027]

Similarly, the pipe 22 which supplies the pretreated oil is connected in the mixing member 7, and the nozzle 72 is attached to the end of the pipe 22. A positive potential is applied to the nozzle 72 from the high voltage DC power supply 75 through the line 76. The oil is sprayed from the nozzle 72 strongly, and the resulting small mist of oil particles is further positively charged.

The interval between nozzles 72 and 73 and directions of these nozzles are configured so that these mists sprayed from each nozzles are mixed each other in the air.

The pretreated water and the pretreated oil as described above are sprayed respectively from nozzles 73 and 72 in the tank 71 so as to mix each other. Since the water drops and the oil drops are charged with an opposite polarity, these drops are strongly attracted each other. Therefore, these drops are mixed quite sufficiently during floating in the air.

The stirrer blade 74 is to promote mixing the falling pool of the liquid mixture. Although the liquid mixture has been already mixed sufficiently during falling, mild mixing with the stirrer blade 74 may be sufficient for the purpose.

In the resulting liquid mixture, the particle size of the liquid in the mixture is small in a range of 0.05 μm or less, the liquid mixture is in a microemulsion form.

[0029]

In the microemulsion, since the particle size of the liquid in the microemulsion is small, the light scattering from the liquid is decreased. Therefore, the microemulsion is not opacified, and the color is the same as that of the original liquid.

For example, in the microemulsion of kerosene and water, since the water is transparent, the color of the microemulsion keeps the color of kerosene. Therefore, the appearance of the microemulsion is typical for kerosene, which is preferred.

[0030]

The liquid mixture (microemulsion) obtained in the mixing member 7 is transferred to the heat reservoir 8 through the pipe 23. The heat reservoir 8 is composed of the tank 81, the heater 82, and the like. The heater 82 keeps microemulsion in a stable form. The heater for this purpose may be mounted in a place other than the heat reservoir 8. For example, the heater may be mounted in the tank 41 or 61.

In the example of FIG. 1, although pulsed power sources 45 and 55 are shown as separate devices, they may be one device, and the device may supply the given pulsed powers. Similarly, high voltage DC power supplies 65 and 75 may be one device, and the device may supply the given high voltage DC powers.

[0031]

The apparatus for producing a microemulsion of the present invention has the following effects. Firstly, since no emulsifier (surfactant) is used, the cost is decreased because of saving the cost of the emulsifier. Additionally, since the particle sizes of the liquid in the microemulsion are very small, the microemulsion does not separate to return the original liquids.

The calorific value of the microemulsion of water and fuel oil was similar to that of the original fuel oil. Therefore, the microemulsion produced from water and gasoline can be used for internal-combustion engines of vehicle such as automobile. Conventional fuel mixture could not be used for internal-combustion engines.

There is a need to mix two types of liquids as uniformly as possible in a microparticle level for various applications including paints, cosmetics, and foods in addition to fuel mixtures. Of course, the present invention is applicable in these applications.

DESCRIPTION OF THE REFERENCE NUMERALS

[0032]

1: apparatus for producing a microemulsion; 2: water softener; 3: water purifier; 4: water ionizer; 5: oil ionizer; 6: potential applicator; 7: mixing member; 8: heat reservoir; 20 to 24: pipe; 41: tank; 42: pipe; 43: pump; 44: apparatus for magnetic treatment of liquids; 45: pulsed power source; 46: line; 51: tank; 52: pipe; 53: pump; 54: apparatus for magnetic treatment of liquids; 55: pulsed power source; 56: line; 61: tank; 62: pipe; 63: pump; 64: nozzle; 65: high voltage DC power source; 66: line; 71: tank; 72 and 73: nozzle; 74: stirrer blade; 75: high voltage DC power source; 76 and 77: line; 81: tank; 82: heater; 100: pipe; 101: apparatus for magnetic treatment of liquids; 102: electromagnetic field generator; 103: pulsed power source; 201 and 202: pipe; 203: mixing member; 204: agitator actuator; 205: tank; 206: liquid mixture; 207: stirrer blade; 208 and 209: pipe; 210: water softener.

WHAT IS CLAIMED IS:

1. An apparatus for producing a microemulsion, comprising:
 - a water softener (2) for softening water used for subsequent mixing;
 - a water purifier (3) for purifying the soft water from the water softener into pure water;
 - a water ionizer (4) for negatively ionizing the pure water from the water purifier with a first apparatus for magnetic treatment of liquids;
 - an oil ionizer (5) for positively ionizing oil used for subsequent mixing with a second apparatus for magnetic treatment of liquids;
 - a potential applicator (6) for applying a positive potential to the positively ionized oil from the oil ionizer; and
 - a mixing member (7) for crossing an oil mist and an water mist to form a liquid mixture in a microemulsion form, wherein the oil mist is formed by applying a positive potential again to the oil from the potential applicator and by spraying the oil, and wherein the water mist is formed by applying a negative potential to the water from the water ionizer and by spraying the water.
2. The apparatus for producing a microemulsion according to claim 1, wherein the water ionizer (4) comprising:
 - a first tank (41), which is a tank for receiving the pure water transferred from the water purifier, including an oxidation-reduction potential reducing material for reducing the oxidation-reduction potential of water and a water quality stabilizer for stabilizing the water quality;
 - a first pump and a first pipe (42) for circulating the pure water;
 - a first apparatus for magnetic treatment of liquids (44) mounted on the outer periphery of the intermediate part of the first pipe for applying an electromagnetic field to the pure water flowing in the first pipe; and
 - a first pulsed power source (45) for supplying a first pulsed power to the first apparatus for magnetic treatment of liquids for negatively ionizing pure water.

3. The apparatus for producing a microemulsion according to claim 1 or 2, wherein the oil ionizer (5) comprises:

- a second tank (51) for receiving oil used for subsequent mixing;
- a second pump (53) and a second pipe (52) for circulating the oil;
- a second apparatus for magnetic treatment of liquids (54) mounted on the outer periphery of the intermediate part of the second pipe for applying an electromagnetic field to the oil flowing in the second pipe; and
- a second pulsed power source (55) for supplying a second pulsed power to the second apparatus for magnetic treatment of liquids for positively ionizing oil.

4. The apparatus for producing a microemulsion according to claim 1, 2 or 3, wherein the potential applicator (6) comprises:

- a third tank (61) for receiving the oil transferred from the oil ionizer;
- a third pump (63) and a third pipe (62) for circulating the oil;
- a first nozzle (64) attached at the end of the third pipe connected to the upper side of the third tank for spraying the oil; and
- a first high voltage DC power source (65) for supplying a first high voltage straight polarity DC power to the first nozzle in order to apply the positive potential to the oil sprayed from the first nozzle.

5. The apparatus for producing a microemulsion according to claim 1, 2, 3 or 4, wherein the mixing member (7) comprises:

- a fifth tank (71) for receiving the liquid mixture;
- a second nozzle (73) attached at the end of the fourth pipe (20) connected to the upper side of the fifth tank for introducing the water from the water ionizer for spraying the water;
- a third nozzle (72) attached at the end of the fifth pipe (22) connected to the upper side of the fifth tank for introducing the oil from the potential applicator for spraying the oil; and

a second high voltage DC power source (75) for supplying a second high voltage DC power in order to supply a negative potential to the water sprayed from the second nozzle and to supply a positive potential to the oil sprayed from the third nozzle.

6. The apparatus for producing a microemulsion according to claim 3, 4 or 5, wherein the first pulsed power and the second pulsed power are supplied from one pulsed power source.

7. The apparatus for producing a microemulsion according to claim 4, 5 or 6, wherein the first high voltage DC power and the second high voltage DC power are supplied from one high voltage DC power source.