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(71) Applicant: **Marinex Corporation**
Nagasaki 857-0852 (JP)

(72) Inventors:
- **FUKUDA, Toshiro**
  Sasebo-shi
  Nagasaki 857-0851 (JP)
- **SHIGEMATSU, Toshinobu**
  Sasebo-shi
  Nagasaki 857-1193 (JP)
- **SHIMADA, Hideki**
  Sasebo-shi
  Nagasaki 857-1193 (JP)

(74) Representative: **Winter, Brandl, Fürniss, Hübner, Röss, Kaiser, Polte - Partnerschaft**
Alois-Steinecker-Strasse 22
85354 Freising (DE)

(54) WATER-MIXED FUEL AND METHOD FOR PRODUCING SAME

(57) An object is to provide a water-mixed fuel in which a fuel oil and water are mixed, and a method for producing the same. The present invention is a water-mixed fuel oil which contains a fuel oil, water, and a metal oxide powder, and which is produced by mixing the fuel oil, water, and a metal oxide powder. With the water-mixed fuel oil, the metal oxide powder serves as a catalyst to reduce activation energy of the water, so that the water is eventually burned with the fuel oil, which enables the water to be used as energy.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a water-mixed fuel in which a fuel oil and water are mixed, and a method for producing the same.

BACKGROUND ART

[0002] It is conventionally known that the mixing of water into fuel can reduce engine output. Burning of water is, on the other hand, studied. For example, Non-patent Document 1 discloses an engine capable of providing thermal energy by allowing water and magnesium to react. In addition, an emulsion fuel produced by adding water and a surfactant to a fuel oil is also developed (see, for example, Patent Documents 1 to 3).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0003]

Patent Document 1: Japanese Patent Laid-open Publication No. 2001-348579
Patent Document 2: Japanese Patent Laid-open Publication No. 2000-263062
Patent Document 3: Japanese Patent Laid-open Publication No. 6-346071

NON-PATENT DOCUMENT

[0004] Non-Patent Document 1: "Tenkenkun no Omosiro Shin Gijutsu 4 "MAGIC ENGINE" - a circulating clean energy system", SEIBI in Tokyo, July 2006, [online], TOSSNET, [searched on September 15, 2010], Internet <URL: http://tossnet.or.jp/staticContents/public_html/mtou_tokyoweb/gallery/2006/omosiro20 0607.pdf>

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] An object of the present invention is to provide a water-mixed fuel in which a fuel oil and water are mixed through a completely different approach from the above-mentioned conventional methods, and a method for producing the same.

SOLUTIONS TO THE PROBLEMS

[0006] The water-mixed fuel of the present invention contains a fuel oil, water, and a metal oxide powder. The method for producing the water-mixed fuel according to the present invention is characterized by mixing the fuel oil, water, and the metal oxide powder. With the water-mixed fuel of the present invention, the metal oxide powder serves as a catalyst to reduce activation energy of the water, so that the water is eventually burned with the fuel oil.

[0007] In order to turn water into energy, water must be decomposed into hydrogen and oxygen to cause the hydrogen to explode. For the decomposition of water, activation energy for exciting water from a ground state to a transition state must be provided to water. The activation energy is represented by the following Arrhenius equation:

$$E_a = k_B T^2 \frac{d}{dt}\left(\ln \frac{k}{A}\right)$$

k_B: Boltzmann constant, A: Frequency factor, k: Reaction constant, T: Absolute temperature

[0008] The activation energy changes its value depending on the control of the reaction constant or the frequency factor by the catalyst. The explosive energy of hydrogen is approximately 250 kJ/mol (up to 5000°C). That is, an inequality $E_1 < E_2$ is satisfied, where E_1 is energy for decomposing water into hydrogen and oxygen, and E_2 is explosive energy. With the water-mixed fuel of the present invention, the metal oxide powder serves as a catalyst, thereby allowing the activation energy E_1 of the water to be lowered.

[0009] Here, it is possible to use titanium oxide, magnesium oxide, or sodium oxide as the metal oxide powder.

[0010] The metal oxide powder should preferably have a particle size of 10 μm or less. The particle size of 10 μm or less allows the water and the metal oxide in the water-mixed fuel to be sufficiently in contact with each other, so that the metal oxide powder can function as a catalyst with high efficiency. Such particle size can further prevent the metal oxide powder from damaging the inside of an engine which burns the water-mixed fuel. The particle size of more than 10 μm may deteriorate the function of the catalyst.

EFFECTS OF THE INVENTION

[0011]

(1) With the water-mixed fuel containing a fuel oil, water, and a metal oxide powder, the metal oxide powder serves as a catalyst to reduce activation energy of the water, so that the water is eventually burned with the fuel oil, which enables the water to be used as energy.
(2) When the metal oxide powder has a particle size of 10 μm or less, the water and the metal oxide in the water-mixed fuel are sufficiently in contact with

each other, so that the metal oxide powder can function as a catalyst with high efficiency, which in turn improves combustion efficiency. Such particle size can further prevent the powder from damaging the inside of a motor which bums the water-mixed fuel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a graph showing experimental results obtained in the case where water in the water-mixed fuel is set from 0.04 to 1.00 wt%, and titanium oxide powder is set to 0.02 wt%, 0.04 wt%, and 0.06%.
FIG. 2 is a graph showing experimental results obtained in the case where water in the water-mixed fuel is set from 0.04 to 1.00 wt%, and titanium oxide powder is set to 0.08 wt%, 0.10 wt%, and 0.12%.
FIG. 3 is a graph showing experimental results obtained in the case where water in the water-mixed fuel is set from 0.04 to 1.00 wt%, and titanium oxide powder is set to 0.14 wt%, 0.16 wt%, and 0.18%.

EMBODIMENTS OF THE INVENTION

[0013] The water-mixed fuel according to an embodiment of the present invention is produced by mixing a fuel oil, water, and a metal oxide powder. Light oil or gasoline can be used as the fuel oil. As the metal oxide powder, powder having a particle size of 10 μm or less obtained by grinding titanium oxide, magnesium oxide, or sodium oxide in a mortar or the like can be used. Water in the water-mixed fuel is set to 0.04 to 1.00 wt%, and the metal oxide is set to 0.02 to 0.14 wt%.

[0014] When the water-mixed fuel is used as a fuel oil for an engine or a boiler, such as a diesel engine or a gasoline engine, the metal oxide powder serves as a catalyst to reduce activation energy of the water, so that the water is eventually burned with the fuel oil, which enables the water to be used as energy. Further, the metal oxide powder has a particle size of 10 μm or less, so that it may not damage the inside of the engine.

EXAMPLES

[0015] A measurement test for engine efficiency was conducted with the water-mixed fuel according to an embodiment of the present invention. The water-mixed fuel in this Example was produced by the following process: water was supplied in a specified amount to 1 liter of light oil, the mixed fluid was stirred with a stirrer, titanium oxide as a metal oxide was ground in a mortar to a powder, the powdered metal oxide was further supplied in a specified amount to the stirred fluid, and the mixture was then stirred. In Comparative Example, a water-mixed fuel in which water but no titanium oxide was mixed was used.

[0016] The engine efficiency was determined by measuring the acceleration of an actual vehicle.

$$F = m\frac{d^2x}{dt^2}$$

Referring to the equation above, the acceleration is in proportion to the engine output. m is not merely a mass but a synthesized mass including output efficiency and friction of the engine. Therefore, the measurement of the acceleration also means that the amount proportional to the engine output has been measured. It should be noted that the measured value is not an absolute value but a relative value.

[0017] The measuring method follows the procedures below.

(1) Supply a fuel into a diesel engine of an actual vehicle.
(2) Measure the acceleration under conditions of full depression of an accelerator pedal in first gear.
(3) Drain the fuel.
(4) Supply an additive-free light oil into the engine and warm the engine.
(5) Drain the fuel.
(6) Change the conditions of the water-mixed fuel and repeat the steps (1) to (5).

[0018] The experimental results are shown in FIGS. 1 to 3. FIG. 1 is a graph showing experimental results obtained in the case where water in the water-mixed fuel is set from 0.04 to 1.00 wt%, and titanium oxide powder is set to 0.02 wt%, 0.04 wt%, and 0.06%; FIG. 2 is a graph showing experimental results obtained in the case where water in the water-mixed fuel is set from 0.04 to 1.00 wt%, and titanium oxide powder is set to 0.08 wt%, 0.10 wt%, and 0.12%; and FIG. 3 is a graph showing experimental results obtained in the case where water in the water-mixed fuel is set from 0.04 to 1.00 wt%, and titanium oxide powder is set to 0.14 wt%, 0.16 wt%, and 0.18%. As a Comparative Example, experimental results of a water-mixed fuel in which water alone is mixed are shown in FIGS. 1 to 3.

[0019] As shown in FIG. 1, in the case of the titanium oxide powder of 0.02 to 0.06 wt%, the acceleration of the water-mixed fuel of the Example in the range from 0.2 to 1.00 wt% of water was approximately higher than that of the water-mixed fuel of the Comparative Example in which water alone was mixed, so that it was possible to confirm the improvement of the engine output. As shown in FIG. 2, in the case of the titanium oxide powder of 0.08 to 0.12 wt%, the acceleration of the water-mixed fuel of the Example was higher than that of the water-mixed fuel of the Comparative Example in which water alone is mixed, so that the improvement of the engine output was expected. Depending on the water content, however, the engine output was reduced below that of the Comparative Example in some cases.

[0020] As shown in FIG. 3, in the case of the titanium oxide powder of 0.14 wt%, it was confirmed that depending on the water content, the acceleration of the water-mixed fuel of the Example was higher than that of the water-mixed fuel of the Comparative Example in which water alone was mixed. In the case of the titanium oxide powder of 0.16 wt% and 0.18 wt%, however, the acceleration of the water-mixed fuel of the Example was less than that of the water-mixed fuel of the Comparative Example, so that the improvement of the engine output was not confirmed.

INDUSTRIAL APPLICABILITY

[0021] The water-mixed fuel and the method for producing the same according to the present invention are useful as a fuel oil for an engine or a boiler, such as a diesel engine or a gasoline engine and as a method for producing the fuel oil.

Claims

1. A water-mixed fuel comprising a fuel oil, water, and a metal oxide powder.
2. The water-mixed fuel according to claim 1, wherein the metal oxide is titanium oxide.
3. The water-mixed fuel according to claim 2, wherein the water is in an amount of 0.04 to 1.00 wt%, and the metal oxide is in an amount of 0.02 to 0.14 wt%.
4. The water-mixed fuel according to claim 1, wherein the water is in an amount of 0.04 to 1.00 wt%, and the metal oxide is in an amount of 0.02 to 0.14 wt%.
5. The water-mixed fuel according to any one of claims 1 to 4, wherein the metal oxide powder has a particle size of 10 μm or less.
6. A method for producing a water-mixed fuel comprising the step of mixing a fuel oil, water, and a metal oxide powder.
7. The method for producing a water-mixed fuel according to claim 6, wherein the metal oxide is titanium oxide.
8. The method for producing a water-mixed fuel according to claim 7, wherein the water is in an amount of 0.04 to 1.00 wt%, and the metal oxide is in an amount of 0.02 to 0.14 wt%.
9. The method for producing a water-mixed fuel according to claim 6, wherein the water is in an amount of 0.04 to 1.00 wt%, and the metal oxide is in an amount of 0.02 to 0.14 wt%.
10. The method for producing a water-mixed fuel according to any one of claims 6 to 9, wherein the metal oxide powder has a particle size of 10 μm or less.

Amended claims under Art. 19.1 PCT

1. (Currently amended) A water-mixed fuel oil for a diesel engine comprising a light oil, 0.2 to 1.0 wt% of water, and 0.02 to 0.06 wt% of a titanium oxide powder.
2. (Cancelled)
3. (Cancelled)
4. (Cancelled)
5. (Cancelled)
6. (Currently amended) A method for producing a water-mixed fuel oil for a diesel engine comprising the step of mixing a light oil, 0.2 to 1.0 wt% of water, and 0.02 to 0.06 wt% of a titanium oxide powder.
7. (Cancelled)
8. (Cancelled)
9. (Cancelled)
10. (Cancelled)

FIG. 1

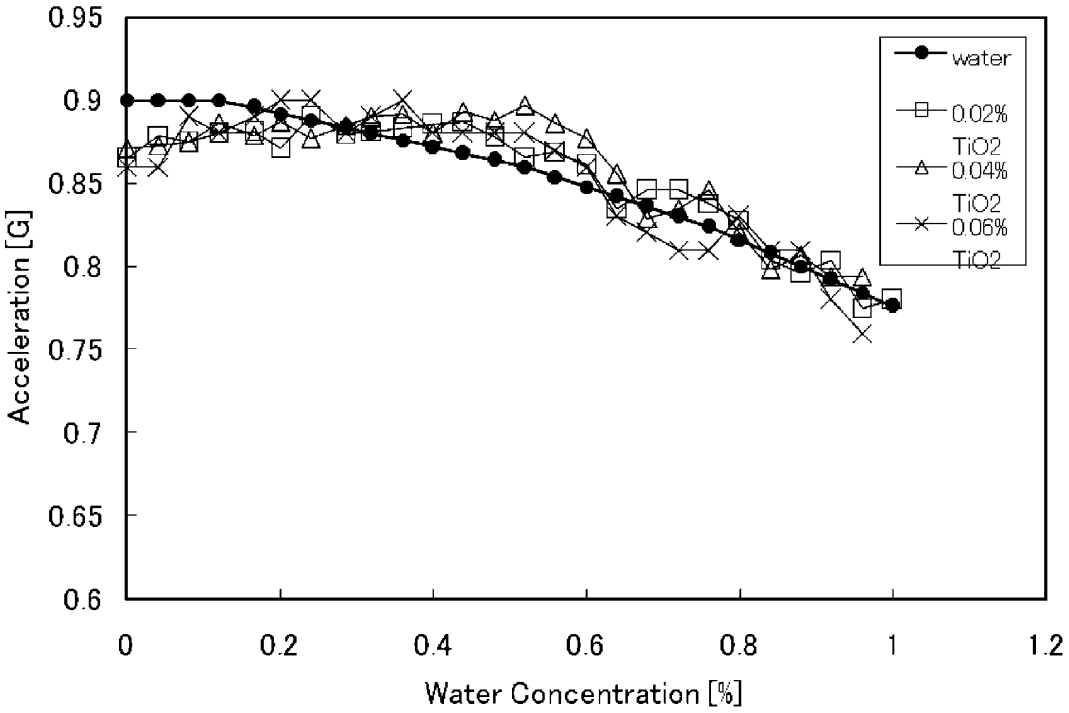
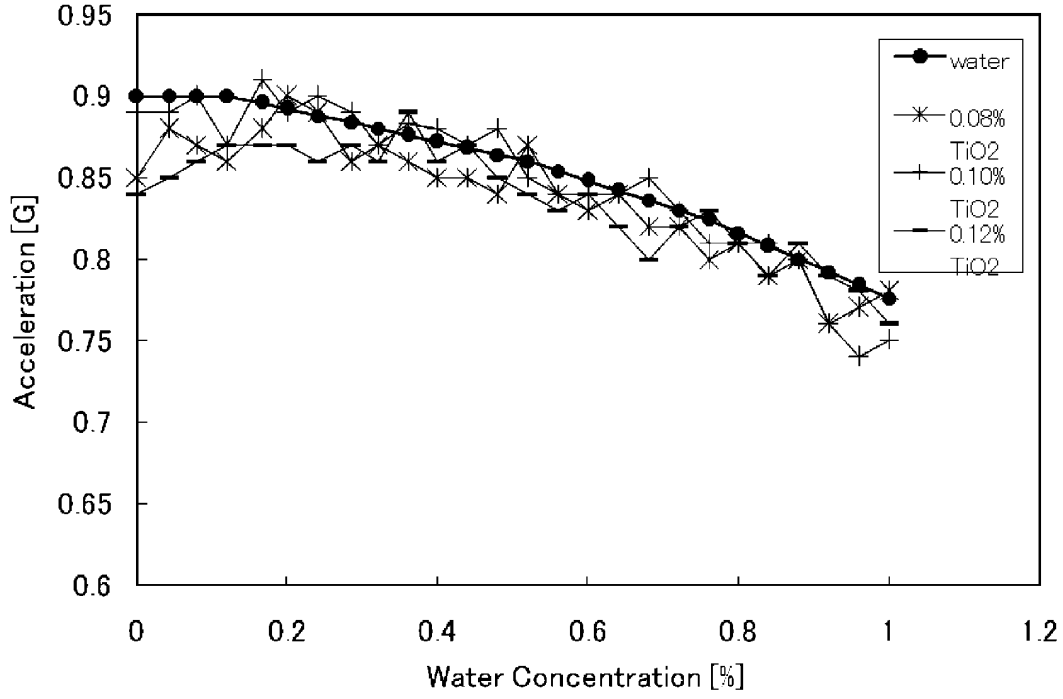

0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Acceleration [G]
0
0.2
0.4
0.6
0.8
1
1.2
Water Concentration [%]
water
0.02% TiO2
0.04% TiO2
0.06% TiO2

FIG. 2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0.8
0.75
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0.65
0.6
Acceleration [G]
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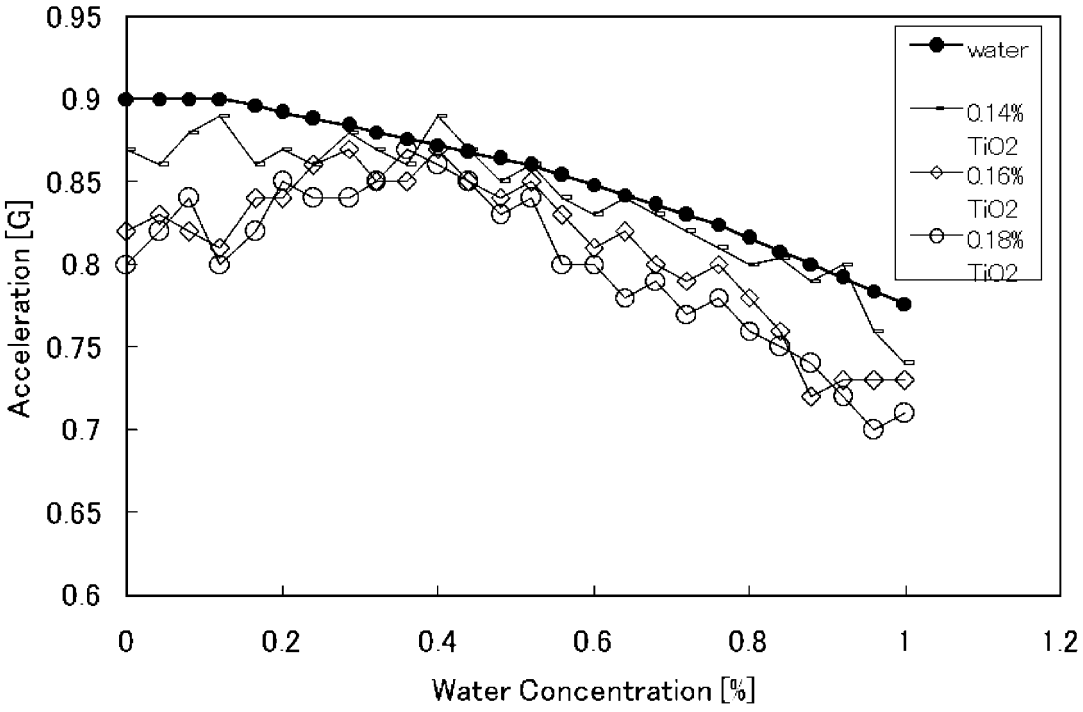
0.2
0.4
0.6
0.8
1
1.2
Water Concentration [%]
water
0.08% TiO2
0.10% TiO2
0.12% TiO2

FIG. 3


0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Acceleration [G]
0
0.2
0.4
0.6
0.8
1
1.2
Water Concentration [%]
water
0.14% TiO2
0.16% TiO2
0.18% TiO2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/071503

A. CLASSIFICATION OF SUBJECT MATTER
C10L1/32(2006.01)i, *C10L1/12*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C10L1/32, C10L1/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 62-167391 A (Taiho Industries Co., Ltd.), 23 July 1987 (23.07.1987), entire text & KR 10-1993-0011927 B	1-10
X	JP 58-213091 A (Radeitsukusu Kabushiki Kaisha), 10 December 1983 (10.12.1983), entire text (Family: none)	1,2,6,7
X	JP 62-106992 A (Mitsubishi Heavy Industries, Ltd.), 18 May 1987 (18.05.1987), entire text (Family: none)	1,4-6,9,10

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 November, 2011 (18.11.11)	29 November, 2011 (29.11.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/071503

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 6-33373 B2 (Mitsubishi Heavy Industries, Ltd.), 02 May 1994 (02.05.1994), entire text (Family: none)	1,4-6,9,10
X	JP 58-24478 B2 (Taiho Industries Co., Ltd.), 21 May 1983 (21.05.1983), entire text (Family: none)	1,4-6,9,10
X	JP 2007-125475 A (Kabushiki Kaisha Tenpa), 24 May 2007 (24.05.2007), entire text (Family: none)	1,5,6,10
A	JP 53-43706 A (Taiho Industries Co., Ltd.), 20 April 1978 (20.04.1978), (Family: none)	1-10
A	JP 2009-126874 A (JGC Catalysts and Chemicals Ltd.), 11 June 2009 (11.06.2009), (Family: none)	1-10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001348579 A **[0003]**
- JP 2000263062 A **[0003]**
- JP 6346071 A **[0003]**

Non-patent literature cited in the description

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