

LIQUEFIED FUEL GAS COMPOSITION

[Field of the Invention]

The present invention relates to liquefied fuel gas compositions and in particular to liquefied fuel gas compositions comprising a hydrocarbon produced by contacting a feedstock comprising a hydrocarbon fraction containing an animal or vegetable fat and a component originating therefrom, with a hydrocracking catalyst comprising at least one or more metals selected from the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

[Background of the Invention]

In recent years, the regulations on the exhaust gas of automobiles have been strengthened due to the deterioration of the air environment, and thus a situation arises wherein the use of gas fuel-powered diesel automobiles, in particular trucks has been restricted. In order to deal with the regulations, the development of an exhaust gas purifying system for a diesel vehicle has been advanced, and also a substitution to a low emission vehicle whose exhaust gas is clean, has been studied. In this connection,

a truck running on liquefied petroleum gas (LPG) has been expected to be a substitute for a diesel truck. For taxis, the LPG has been used as their main fuel over the past 40 years (see, for example, non-patent document 1). There have been some examples that the quality of a liquefied petroleum gas for automobile (auto gas) has been studied to further reduce exhaust gas emissions (see, for example, patent document 1). However, there has been no example that a reduction in carbon oxide emissions is studied.

Patent Document 1: Japanese Patent Laid-Open

Publication No. 10-121070

Non-Patent Document 1: "LP Gas/Data Hikkei (by LP Gas/Data Hikkei Member of Editorial Board)" under the editorship of the Resource Bureau of the Science and Technology Agency, Japan, 1964, page 166

About 1/4 of the LPG used in Japan has been provided by domestic production while about 3/4 has been provided by import. Nowadays, in order to diversify the supply source of the LPG, an attempt has been made in which the sources from which the LPG is imported have been expanded. With regard to the LPG produced domestically, it is produced through separation upon distillation of crude oil at a refinery

as well as produced from by-products produced in various petroleum refinery plants or petrochemical plants. A situation is going to arise, where the quality of the LPG is not necessarily the same as that of the conventional LPG. However, such a situation is restricted to the LPG originating from fossil fuel.

In order to reduce exhaust gas and deal with the global warming issue, fuel properties effective to reduce carbon dioxide emissions has been required. As one example to satisfy the requirement, it has been studied to use a biomass-originating fuel that is reproducible, as an alternate fuel. Currently, an alternative fuel such as bioethanol, ETBE, or biodiesel which can be directly blended with conventional fossil fuels such as gasoline and gas oil has been studied. However, there exists no study or discovery concerning a biomass-originating liquefied fuel gas which can be blended directly with a conventional liquefied petroleum gas.

[Disclosures of the Invention]

As a result of extensive research and study, the present invention was achieved on the basis of the finding a liquefied fuel gas composition comprising a hydrocarbon produced by contacting a feedstock

comprising a hydrocarbon fraction containing an animal or vegetable fat and a component originating therefrom, with a hydrocracking catalyst comprising at least one or more metals selected from the group consisting of the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

That is, the present invention relates to a liquefied fuel gas composition comprising a hydrocarbon containing 10 ppm by mass or less of sulfur components, 1.0 percent by mole or more and 99 percent by mole or less of a C3 hydrocarbon, and 1 percent by mole or more and 99 percent by mole or less of a C4 hydrocarbon, the hydrocarbon being produced by contacting a feedstock comprising a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom, with a hydrocracking catalyst comprising at least one or more metals selected from the group consisting of the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

The present invention also relates to a liquefied fuel gas composition comprising a hydrocarbon containing 10 ppm by mass or less of sulfur components, 1.0 percent by mole or more and 99 percent by mole or

less of a C3 hydrocarbon, and 1 percent by mole or more and 99 percent by mole or less of a C4 hydrocarbon, the hydrocarbon being produced by contacting a feedstock comprising a mixed oil of a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom and a petroleum hydrocarbon fraction containing a kerosene fraction produced by refining crude oil, mixed at any ratio, with a hydrocracking catalyst comprising at least one or more metals selected from the group consisting of the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

[Best Mode for Carrying out the Invention]

The present invention will be described in detail below.

In the present invention, a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom is used as a feedstock.

In the present invention, a mix oil of a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom and a petroleum hydrocarbon fraction containing a kerosene fraction produced by refining crude oil, mixed at any ratio is also used as a feedstock.

The animal or vegetable fat and/or the component originating therefrom denote natural or artificially made or produced animal or vegetable fats and/or components originating therefrom. Examples of raw materials of animal fats and animal oils include beef tallow, milk fat (butter), lard, mutton tallow, whale oil, fish oil, and liver oil. Examples of raw materials of vegetable fats and vegetable oils include the seeds and other parts of coconut, palm tree, olive, safflower, rape (rape blossoms), rice bran, sunflower, cotton seed, corn, soy bean, sesame, and flaxseed. Fats or oils other than those produced from these materials may also be used in the present invention. The feedstocks may be of solid or liquid but are preferably produced from vegetable fats or vegetable oils with the objective of easy handling, carbon dioxide absorptivity, and high productivity. Alternatively, waste oils resulting from the use of these animal and vegetable oils for household, industry and food preparation purposes may be used as the feedstock after the residual matters are removed from these oils.

Examples of the typical composition of the fatty acid part of the glyceride compounds contained in these feedstocks include fatty acids, so-called saturated fatty acids having no unsaturated bond in the molecules,

such as butyric acid (C_3H_7COOH), caproic acid ($C_5H_{11}COOH$), caprylic acid ($C_7H_{15}COOH$), capric acid ($C_9H_{19}COOH$), lauric acid ($C_{11}H_{23}COOH$), myristic acid ($C_{13}H_{27}COOH$), palmitic acid ($C_{15}H_{31}COOH$), stearic acid ($C_{17}H_{35}COOH$), and so-called unsaturated fatty acids having one or more unsaturated bonds in the molecules, such as oleic acid ($C_{17}H_{33}COOH$), linoleic acid ($C_{17}H_{31}COOH$), linolenic acid ($C_{17}H_{29}COOH$) and ricinoleic acid ($C_{17}H_{32}(OH)COOH$). In general, the hydrocarbon parts of these fatty acids contained in substances existing in nature are mostly of straight chain. However, the fatty acid may be any of those having a side chain structure, i.e., isomers as long as the properties defined by the present invention are satisfied. The unsaturated fatty acid may be any of those existence of which are generally recognized in nature as well as those having an unsaturated bond per molecule, the position of which is adjusted through chemical synthesis as long as the properties defined by the present invention are satisfied.

The above-described feedstocks (animal or vegetable fats and components originating therefrom) contain one or more of these fatty acids, which vary depending on the raw materials. For example, coconuts oil contains a relatively large amount of saturated

fatty acids such as lauric acid and myristic acid while soy bean oil contains a large amount of unsaturated fatty acids such as oleic acid and linoleic acid.

The petroleum hydrocarbon fraction containing a kerosene fraction produced by refining crude oil, mixed with the hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom may be a fraction produced through the general petroleum refining processes. For example, the hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom may be mixed with any of fractions with a predetermined boiling point range produced in an atmospheric distillation unit or a vacuum distillation unit and fractions with a predetermined boiling range produced in a hydrodesulfurization unit, a hydrocracking unit, a residual oil direct desulfurization unit, or a fluid catalytic cracking unit, or may be mixed with a plurality of fractions with such a boiling point range produced in these units. The petroleum hydrocarbon fraction preferably contains a fraction with a boiling point of at least 300°C or higher and more preferably contains no heavier fraction with a boiling point of higher than 700°C. If the petroleum hydrocarbon contains no fraction with a boiling point of 300°C or

higher, a sufficient liquid yield may not be obtained due to excessive cracking. If the petroleum hydrocarbon contains a fraction with a boiling point of higher than 700°C, the formation of carbonaceous material is accelerated on a catalyst thereby covering the active sites thereof, possibly leading to a reduction in the activity. The boiling point range used herein denotes a value measure in accordance with JIS K 2254 "Petroleum products-Determination of distillation characteristics" or the method described in ASTM-D86.

The feedstock comprising a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom or comprising a mix oil of a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom and a petroleum hydrocarbon fraction containing a kerosene fraction produced by refining crude oil, mixed at any ratio is then brought into contact with a hydrocracking catalyst comprising at least one or more metals selected from the Groups 6A and 8 metals of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

The hydrocracking catalyst contains at least one metal, preferably two or more metals selected from the

Groups 6A and 8 metals of the periodic table. Example of such metals include Co-Mo, Ni-Mo, Ni-Co-MO, and Ni-W. Preferred examples include Ni-Mo, Ni-Co-MO, and Ni-W. Upon hydrocracking, these metals are converted to be in the form of sulfides before being used.

Employed for the support of the hydrocracking catalyst are inorganic oxides with acidic properties. Preferably, the support contains at least two selected from silica, alumina, boria, zirconia, magnesia, and zeolite. Preferred examples include silica-alumina, titania-alumina, boria-alumina, zirconia-alumina, titania-zirconia-alumina, silica-boria-alumina, silica-zirconia-alumina, silica-titania-alumina, and silica-titania-zirconia-alumina. More preferred examples include silica-alumina, boria-alumina, zirconia-alumina, titania-zirconia-alumina, silica-boria-alumina, silica-zirconia-alumina, and silica-titania-alumina. More preferred examples include silica-alumina and silica-zirconia-alumina. Preferably, these complex oxides contain zeolite. In the case where alumina is contained, alumina can be contained in any percentage to other components on the basis of the support. However, the content of alumina is preferably 96 percent by mass or less and more preferably 90 percent by mass or less of the support

mass. If the content is more than 96 percent by mass, the catalyst would fail to exert the desired hydrocracking activity because sufficient acidic properties are not attained.

Examples of components other than silica, forming the crystalline structure of zeolite used for the hydrocracking catalyst include alumina, titania, boria, and gallium. Preferred zeolites include those containing silica and alumina, i.e., alumino-silicate. There have been reported many types of zeolite crystalline structure, such as faujasite, beta, mordenite, and pentasil types. In the present invention, more preferred are faujasite, beta, and pentasil types because zeolites of these types exert a sufficient hydrocracking activity. Particularly preferred are faujasite and beta types. These zeolites may be adjusted in alumina content correspondingly to the stoichiometric ratio of the raw materials upon initiation of the synthesis of the zeolites or may be subjected to a hydrothermal treatment and/or an acid treatment. Among these zeolites, most preferred are ultra-stable Y type zeolites ultra-stabilized by a hydrothermal treatment and/or an acid treatment. It is assumed that the ultra-stable Y type zeolites have a micro porous structure peculiar thereto, so-called

micro pores of 20 Å or smaller and also newly formed pores in the range of 20 to 100 Å, which pores provide reaction sites excellent for converting the oxygen components contained in fat components. The volume of the pore with a pore diameter in this range is preferably from 0.03 ml/g or larger and more preferably from 0.04 ml/g or larger. The pore volume used herein is generally determined by mercury intrusion method. The hydrothermal treatment may be carried out under the known conditions. The molar ratio of silica to alumina defined as the physical properties of the ultra-stable Y type is preferably from 10 to 120, more preferably from 15 to 70, and more preferably from 25 to 50. If the molar ratio is greater than 120, the resulting catalyst is reduced in acidic properties and thus would fail to exert a sufficient hydrocracking activity. If the molar ratio is less than 10, the resulting catalyst would be too strong in acidic properties and thus encounter a rapid reduction in the activity due to the accelerated formation of coke. The content of the zeolite is preferably from 2 to 80 percent by mass and more preferably from 4 to 75 percent by mass, of the support mass. If the content is less than the lower limit, the resulting catalyst would fail to exert a sufficient hydrocracking activity. If the content is

more than the upper limit, the resulting catalyst would be too strong in acidic properties and thus accelerate coke formation.

In the present invention, when the feedstock is subjected to a catalytic treatment under hydrogen pressure, the feedstock is preferably brought into contact with the hydrocracking catalyst under hydrogen pressure after being contacted with a hydropretreating catalyst containing at least one or more metals selected from the Groups 6A and 8 metals of the periodic table, under hydrogen pressure.

The hydropretreating catalyst contains at least one metal, preferably two or more metals selected from the Groups 6A and 8 metals of the periodic table. Example of such metals include Co-Mo, Ni-Mo, Ni-Co-MO, and Ni-W. Upon hydropretreatment, these metals are converted to be in the form of sulfides before being used.

The support of the hydropretreating catalyst is a porous inorganic oxide. The support is generally an alumina-containing porous inorganic oxide. Examples of other components constituting the support include silica, titania, zirconia, and boria. The support is preferably a composite oxide containing alumina and at least one or more components selected from the other

constituting components. The support may further contain phosphorus in addition to these components. The total content of the components other than alumina is preferably from 1 to 20 percent by mass and more preferably 2 to 15 percent by mass. If the total content is less than 1 percent by mass, the resulting catalyst fails to obtain a sufficient catalytic surface area and thus would be reduced in the activity. If the total content is more than 20 percent by mass, the acidic properties of the support is increased, possibly leading to a reduction in the activity caused by the formation of coke. When phosphorus is contained as a support constituting component, the content of phosphorus is from 1 to 5 percent by mass and more preferably from 2 to 3.5 percent by mass in terms of oxide.

There is no particular restriction on the raw materials which are precursors of silica, titania, zirconia, and boria. Therefore, a solution containing silicon, titanium, zirconium, or boron is generally used. For silicon, silicic acid, sodium silicate, and silica sol may be used. For titanium, titanium sulfate, titanium tetrachloride, and various alkoxide salts may be used. For zirconium, zirconium sulfate and various alkoxide salts may be used. For boron, boric acid may

be used. For phosphorus, phosphoric acid and alkali metal salts thereof may be used.

The raw materials of these support constituting components other than alumina are preferably added at any stage prior to calcination of the support. For example, the raw materials may be added to an aluminum aqueous solution which is then formed into an aluminum oxide gel containing these support constituting components, or may be added to a prepared aluminum oxide gel. Alternatively, the raw materials may be added at a step of kneading a mixture of water or an acid aqueous solution and a commercially available alumina intermediate or boehmite powder. Preferably, these support constituting components are contained in an aluminum oxide gel during the process of preparation thereof. Although the mechanism exhibiting advantageous effects attained by addition of these support constituting components other than alumina has not been elucidated, it is assumed that these components form a complex oxide state together with aluminum. It is thus presumed that this increase the surface area of the support and cause some interaction with the active metals, thereby giving influences to the activity of the catalyst.

The total supported amount of the active metals,

for example, W and Mo is preferably from 12 to 35 percent by mass and more preferably from 15 to 30 percent by mass, in terms of oxide, of the catalyst mass. If the amount is less than the lower limit, the catalytic activity would be reduced because the number of active sites is reduced. If the amount is more than the upper limit, the metals fail to disperse effectively, possibly leading to a reduction in the catalytic activity. The total supported amount of Co and Ni is preferably from 1.5 to 10 percent by mass and more preferably from 2 to 8 percent by mass, in terms of oxide, of the catalyst mass. If the amount is less than 1.5 percent by mass, a sufficient co-catalytic effect can not be attained, possibly leading to a reduction in the catalytic activity. If the amount is more than 10 percent by mass, the metals fail to disperse effectively, possibly leading to a reduction in the catalytic activity.

The catalytic reaction under hydrogen pressure is preferably carried out preferably under conditions of a hydrogen pressure of 5 to 20 MPa, a liquid hourly space velocity (LHSV) of 0.1 to 2.2 h^{-1} , and a hydrogen/oil ratio of 300 to 1500 NL/L, more preferably under conditions of a hydrogen pressure of 6.5 to 18 MPa, a liquid hourly space velocity of 0.2 to 2.0 h^{-1} , and a

hydrogen/oil ratio of 300 to 1500 NL/L, and more preferably under conditions of a hydrogen pressure of 8 to 15 MPa, a liquid hourly space velocity of 0.3 to 1.5 h⁻¹, and a hydrogen/oil ratio of 350 to 1000 NL/L.

The catalytic treatment under hydrogen pressure results in the production of a hydrocarbon containing 10 ppm by mass or less of sulfur components, 1.0 percent by mole or more and 99 percent by mole or less of a C3 hydrocarbon, and 1 percent by mole or more and 99 percent by mole or less of a C4 hydrocarbon.

The liquefied fuel gas composition of the present invention comprises the aforesaid hydrocarbon. The content of the hydrocarbon is 1.0 percent by volume or more, preferably 20.0 percent by volume or more, and more preferably 98.0 percent by volume or more.

The liquefied fuel gas composition is mainly composed of a mixture of propane which is a C3 hydrocarbon and a mixture of butane which is a C4 hydrocarbon. The ratio of the mixtures may be arbitrarily determined depending on the districts and seasons where the gas is used. The propane mixture is mainly composed of propane and propylene while the butane mixture is mainly composed of butane and butylene. The liquefied fuel gas oil may contain slight amounts of an ethane mixture, butadiene, and

pentane. The ethane mixture is composed of ethane and ethylene and contained in an amount of preferably 5 percent by mole or less in the liquefied fuel gas. The butadiene content of the liquefied fuel gas is preferably 0.5 percent by mole or less while the pentane content is 2 percent by mole or less.

The content of the residue at 105°C of the liquefied fuel gas is preferably 10 ppm by mass or less. With the objective of reducing the rate of deposit formation and the number of times of draining, the 105°C residue content is more preferably 5 ppm by mass or less and particularly preferably 2 ppm by mass or less.

The 105°C residue content is a value measured in accordance with the method described by ASTM D2158 but a value measured by the method wherein the amount of an initial sample is changed from 100 mL to 4 L, the test temperature is increased from 38°C to 75°C and then 105°C, and the residue remaining at 105°C is weighed. Thereupon, the time for keeping the sample at each temperature is not 5 minutes as defined in the ASTM method but is a sufficient time consumed until substantially no evaporation of the sample is not recognized at each temperature.

The pH of the 105°C residue of the liquefied fuel gas is preferably 6 or greater. If the pH is less than

6, deposits in a vapor riser would be increased. Further, with the objective of preventing corrosion of a fuel line and a vapor riser, the pH is preferably 8 or less, more preferably from 6 to 7, and more preferably 7.

The 105°C residue pH referred herein is a value obtained by adding to the 105°C residue obtained by the above method, distillation water 1000 times of the amount of the residue (if the residue is 1 mg or less, 1 mL of distillation water is added), stirring the mixture and then measuring the pH of the water phase with a pH test paper.

The sulfur content of the liquefied fuel gas is preferably 0.02 percent by mass or less, more preferably 0.015 percent by mass or less, more preferably 0.005 percent by mass or less and most preferably 0.001 percent by mass or less, on the basis of the total mass of the liquefied fuel gas with the objective of preventing corrosion of a fuel line and discharge of sulfur oxides to exhaust gas.

The sulfur content referred herein denotes a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Determination of sulfur content".

The vapor pressure at 40°C of the liquefied fuel gas is preferably 0.28 MPa or greater and more

preferably 0.38 MPa or greater with the objective of ensuring low temperature startability. The vapor pressure is also preferably 1.55 MPa or less, more preferably 1.25 MPa or less, and most preferably 0.52 MPa or less in view of safety handling.

The vapor pressure at 40°C referred herein denotes a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Determination of vapor pressure".

The density at 15°C of the liquefied fuel gas is preferably 0.500 g/cm³ or greater with the objective of improving fuel efficiency. The density is also preferably 0.620 g/cm³ or less and more preferably 0.600 g/cm³ or less with the objective of preventing contamination of heavy factions.

The density at 15°C referred herein denotes a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Determination of density".

The corrosiveness to copper of the liquefied fuel gas is preferably 1 or less and more preferably 1a with the objective of preventing corrosion of the conduits of a fuel system.

The corrosiveness to copper referred herein denotes a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Corrosiveness to

copper-Copper strip test".

The liquefied fuel gas composition may be a mixture of the hydrocarbon produced by contacting the feedstock with the hydrocracking catalyst and 1 percent by mole or more of a hydrocarbon originating from fossil oil.

The liquefied fuel gas composition of the present invention can be used suitably as an automobile fuel.

[Effects of the Invention]

The liquefied fuel gas composition of the present invention can reduce exhaust gas and carbon dioxide emissions because it contains a hydrocarbon produced by contacting a feedstock comprising a hydrocarbon fraction containing an animal or vegetable fat and a component originating therefrom with a hydrocracking catalyst comprising at least one or more metals selected from the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

[Examples]

Hereinafter, the present invention will be described in more details by way of the following examples and comparative example, which should not be

construed as limiting the scope of the invention.

[Examples 1 and 2, and Comparative Example]

The liquefied fuel gas compositions of Examples 1 and 2, and Comparative Example were prepared using hydrocarbons each produced by contacting a feedstock comprising a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom with a hydrocracking catalyst comprising at least one or more metals selected from the Group 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure. On the other hand, the liquefied fuel gas composition of Comparative Example 1 was prepared using butane and propane, produced in a refinery, and imported butane and propane. The properties of each composition are set forth in Table 1. Each of the liquefied fuel gas composition was subjected to an exhaust gas test, and the evaluation of the exhaust gas was carried out by the method described below. The results are set forth in Table 2. The life cycle assessment (LCA) of the exhausted CO₂ was carried out for Examples and Comparative Example, and the amount of the exhausted CO₂ was calculated.

(a) Properties determination

The properties of each of the liquefied fuel gas

compositions were determined by the following method.

The results of analysis of the composition such as propane and butane are values measured in accordance with JIS K 2240 "Liquefied petroleum gases-Method for chemical composition analysis (gas chromatograph method)".

Residues at 105°C is a value measured in accordance with the method described by ASTM D2158 but a value measured by the method wherein the amount of an initial sample is changed from 100 mL to 4 L, the test temperature is increased from 38°C to 75°C and then 105°C, and the residue remaining at 105°C is weighed.

The pH of residues at 105°C is a value obtained by adding to the 105°C residue obtained by the above method, distillation water 1000 times of the amount of the residue (if the residue is 1 mg or less, 1 mL of distillation water is added), stirring the mixture and then measuring the pH of the water phase with a pH test paper (manufactured by TOYO ROSHI Kaisha, Ltd.).

Sulfur content is a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Determination of sulfur content".

Vapor pressure at 40°C is a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Determination of vapor pressure".

Density at 15°C is a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Determination of density".

Corrosiveness to copper referred herein denotes a value measured in accordance with JIS K 2240 "Liquefied petroleum gases-Corrosiveness to copper-Copper strip test".

(b) Exhaust gas evaluation

Exhaust gas measurement in 10/15 mode was carried out using the following vehicle described below. The results of the measurement and those of LCA of CO₂ emission evaluation are set forth in Table 2 below.

(Test Vehicle)

Engine: in-line four-cylinder

Displacement: 1998 cc

Fuel supply mode: electronic controlled carburetor

Transmission: automatic transmission

As apparent from the results set forth in Table 2, the liquefied fuel gas compositions of the present invention can reduce exhaust gas components (THC, CO, and NO_x) more than the conventional LPG.

Life cycle assessment (LCA) of exhausted CO₂ is carried out in Examples and Comparative Example, and the amount of the exhausted CO₂ was calculated. In

Examples, the amount of CO₂ generated by combustion of biomass is counted as zero, and thus the liquefied fuel gas oils of Examples achieved a drastic reduction in CO₂ emissions.

[Applicability in the Industry]

According to the present invention, there is provided a liquefied fuel gas composition produced from an animal or vegetable fat-originating component, which composition is excellent in effects to reduce exhaust gas and CO₂ emissions.

Table 1

			Example 1	Example 2	Comparative Example 1
Ratio of Biomass in Feedstock		vol %	100	20	0
Ratio of Biomass Origin in Product		vol %	100	20	0
Composition	Propane	vol %	15.3	24.7	27.1
	Propylene	vol %	0.1	0.0	0.0
	Isobutane	vol %	27.8	21.8	21.8
	N-butane	vol %	56.2	52.5	50.4
	Butylene	vol %	0.4	0.2	0.3
	Pent	vol %	0.2	0.8	0.4
105°C Residue		mms ppm	1	2	1
pH of 105°C Residue		—	7	7	1
Sulfur Content		mms ppm	1	1	46
Vapor Pressure	@40°C	MPa	0.44	0.56	0.59
Density	@15°C	g/cm ²	0.568	0.563	0.561
Corrosiveness to Copper		—	1a	1a	1a

Table 2

		Example 1	Example 2	Comparative Example 1
CO	g/km	0.174	0.158	0.184
THC	g/km	0.011	0.014	0.029
NOx	g/km	0.034	0.054	0.068
Well to Tank	gCO ₂ /MJ	17.6	7.6	9.9
Tank to Wheel	gCO ₂ /MJ	0.0	47.8	59.8
Well to Wheel	gCO ₂ /MJ	17.6	55.4	69.7

Claims

1. A liquefied fuel gas composition comprising a hydrocarbon containing 10 ppm by mass or less of sulfur components, 1.0 percent by mole or more and 99 percent by mole or less of a C3 hydrocarbon, and 1 percent by mole or more and 99 percent by mole or less of a C4 hydrocarbon, the hydrocarbon being produced by contacting a feedstock comprising a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom, with a hydrocracking catalyst comprising at least one or more metals selected from the group consisting of the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

2. A liquefied fuel gas composition comprising a hydrocarbon containing 10 ppm by mass or less of sulfur components, 1.0 percent by mole or more and 99 percent by mole or less of a C3 hydrocarbon, and 1 percent by mole or more and 99 percent by mole or less of a C4 hydrocarbon, the hydrocarbon being produced by contacting a feedstock comprising a mixed oil of a hydrocarbon fraction containing an animal or vegetable fat and/or a component originating therefrom and a petroleum hydrocarbon fraction containing a kerosene

fraction produced by refining crude oil, mixed at any ratio, with a hydrocracking catalyst comprising at least one or more metals selected from the group consisting of the Groups 6A and 8 of the periodic table and an inorganic oxide with acidic properties, under hydrogen pressure.

3. The liquefied fuel gas composition according to claim 1 or 2 wherein the feedstock is brought into contact with the hydrocracking catalyst under hydrogen pressure after being contacted with a hydropretreating catalyst containing at least one or more metals selected from the Groups 6A and 8 metals of the periodic table, under hydrogen pressure.

4. The liquefied fuel gas composition according to claim 1 or 2 wherein it is a mixture of said hydrocarbon and 1 percent by mole or more of a hydrocarbon originating from fossil oil in an amount of.

5. The liquefied fuel gas composition according to any one of claims 1 to 4 wherein it is used as a fuel for automobiles.

6. The liquefied fuel gas composition according to any one of claims 1 to 5 wherein the content of the residue at 105°C is 10 ppm by mass or less and the pH of the residue is 6 or greater and 8 or less.