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(54) **Title:**
DIESEL FUEL COMPOSITION

(57) **Abstract:**
A diesel fuel composition which essentially comprises only paraffins, and wherein the proportion of the content of paraffins of 15 or fewer carbons is made not less than 28% by volume and the proportion of normal paraffins of 18 or more carbons is made not more than 11% by volume. The diesel fuel composition has improved rubber swellability.

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(54) Title: DIESEL FUEL COMPOSITION

(57) Abstract: A diesel fuel composition which essentially comprises only paraffins, and wherein the proportion of the content of paraffins of 15 or fewer carbons is made not less than 28% by volume and the proportion of normal paraffins of 18 or more carbons is made not more than 11% by volume. The diesel fuel composition has improved rubber swellability.

DIESEL FUEL COMPOSITION

The present invention relates to a diesel fuel composition for use in diesel engines and the like.

Various kinds of research have been undertaken in recent years to make use of Fischer-Tropsch fuels (referred to below as FT fuels) to fuel cars in Japan. What is meant by FT fuels are fuels obtained by synthesis from raw materials such as natural gas, coal or biomass, using the Fischer-Tropsch process via synthesis gas, a mixture of carbon monoxide and hydrogen. They are often used under names corresponding to the raw material. For example, for those where natural gas is the raw material the name GTL is often used, if coal is the raw material the name CTL may be used, and if biomass is the raw material, the name BTL may be used. The term GTL is also sometimes used as a generic name for fuels obtained by the Fischer-Tropsch process, but in the present invention the term FT fuels is used for fuels obtained by the Fischer-Tropsch process and FT fuels are deemed to include GTL, CTL and BTL.

As mentioned above, these FT fuels are expected to be used as alternatives to petroleum because they are synthesised from raw materials such as natural gas, coal and biomass, and also, because they do not contain sulphur or aromatic hydrocarbons, they are expected to be used as diesel fuels which are better for the environment, in that they limit the emission of sulphur oxides and particulate matter (PM) from engines. They have already been made available commercially in some areas, as reported for example in "The marketability

of liquid fuels from natural gas (GTL)", [Energy Economics], November 2001 issue.

However, several problems have been pointed out as regards the use of FT fuels as diesel fuels within Japan. One problem that may be mentioned is their deleterious impact on rubber materials. For example, in the aforementioned "The marketability of liquid fuels from natural gas (GTL)", there are indications to the effect that a problem with FT diesel fuels (FT fuels where the density and distillation characteristics correspond to diesel fuels) is that they are rich in paraffins and have a small aromatic component, so that the swelling of seals of rubber materials and the like is low, but there is a suggestion that this can be countered by changing the design of seals. Methods of resolving this problem of seal behaviour without changing the design of seals have also been considered. For example, JP-A-2006-16541 proposes a fuel composition which compares favourably with existing diesel fuels and their function of causing rubber materials to swell (referred to below as rubber swellability) by incorporating an aromatic component in a GTL diesel oil.

However, one of the features of FT diesel oils is that they do not give rise to the environmental problems associated with aromatics and sulphur, and that feature is attributable to their being formed only of paraffins. There have been problems in the prior art in blending in fuel compositions other than FT diesel oils to deal with the nature of FT diesel oils being such that they are deficient in rubber swellability, in that this basic feature of FT diesel oils is not sufficiently brought out.

The aim of the present invention, therefore, is to offer a diesel fuel composition with improved rubber swellability while being constituted essentially only of paraffins.

The diesel fuel composition according to the present invention essentially comprises only paraffins, and the proportion of the content of paraffins of 15 or fewer carbons is made not less than 28% by volume, while the proportion of normal paraffins of 18 or more carbons is made not more than 11% by volume. The proportion of paraffins with 15 or fewer carbons is preferably not less than 40% by volume and more preferably not less than 50% by volume. The proportion of normal paraffins with 18 or more carbons is preferably not more than 8% by volume and more preferably not more than 5% by volume.

For the content of paraffins with 15 or fewer carbons and the content of normal paraffins of 18 or more carbons, gas chromatography in accordance with ASTM D 2887 "Standard test method for boiling point range distribution of petroleum fractions by gas chromatography" was used, and the content of each was obtained by calculating the amount of hydrocarbons of each carbon number from the chromatograms thus obtained.

In addition, what is meant in the present invention by essentially comprising only paraffins is that the main constituent does not contain styrene compounds or diene compounds, or condensed polycyclic aromatics. Containing compositions of other than paraffins as impurities is tolerated. An FT diesel oil in which the total mass or volume of isoparaffins and normal paraffins is not less than 99% of the whole, excluding tiny impurities, is a diesel fuel composition constituted essentially only of paraffins suitable for the present invention. As to the

method of manufacturing fuels comprising only paraffins, apart from the aforementioned Fischer-Tropsch process there are methods in which animal and plant oils and fats, being biomass raw materials, are hydrorefined. Of the fuels thus produced, those corresponding to diesel fuels are called, for example, second-generation biomass diesel fuels, and these second-generation biomass diesel fuels are also fuel compositions, essentially comprising only paraffins, suitable for the present invention.

The addition of additives does not prevent a diesel fuel composition from essentially comprising only paraffins. Compositions in which additives have been added are also encompassed by the diesel fuel composition of the present invention.

For example, it is possible to add low-temperature fluidity improvers in order to prevent feed problems caused by separation of waxes at low temperatures, or plugging of the filters installed in the fuel systems of vehicles. For low-temperature fluidity improvers it is possible to use any known low-temperature fluidity improvers provided they are miscible with paraffins. Typical low-temperature fluidity improvers are commercial low-temperature fluidity improvers such as ethylene-vinyl acetate copolymers, ethylene-alkylacrylate copolymers, alkenyl succinamides, chlorinated polyethylenes, or polyalkyl acrylates. These compounds may be used singly or in combinations of two or more kinds. Of these, ethylene-vinyl acetate copolymers and alkenyl succinamides are especially preferred. As to the amount of the low temperature fluidity improver, for example a suitable amount may be blended in so as to satisfy the pour points and cold filter plugging points specified in JIS K 2204, which is the JIS standard for diesel fuel,

but normally the amount will be 50 to 1000 ppm. The pour point here refers to the pour point obtained in accordance with JIS K 2269 "Testing methods for pour point and cloud point of crude oil and petroleum products", and the cold filter plugging point refers to the cold filter plugging point obtained by JIS K 2288 "Petroleum products - Diesel fuel - Determination of cold filter plugging point".

It is also possible to add lubricity improvers in order to inhibit wear of, for example, fuel feed-pump parts. Any known lubricity improvers may be used as lubricity improvers provided they are miscible with FT oils. Typical lubricity improvers are commercial acid-based lubricity improvers which have fatty acids as their main constituent and ester-based lubricity improvers which have as their main constituent glycerin mono fatty acid esters. These compounds may be used singly or in combinations of two or more kinds. The fatty acids used in these lubricity improvers are preferably those that have as their main constituent a mixture of unsaturated fatty acids of approximately 12 to 22 carbons, but preferably about 18 carbons, that is oleic acid, linolic acid and linolenic acid. The lubricity improver may be added so that the wear scar WS 1.4 value in an HFRR (High Frequency Reciprocating Rig) of the fuel composition after addition of the lubricity improver is not more than 500 μm, but preferably not more than 460 μm, and the concentration thereof is usually 50 to 1000 ppm. The WS 1.4 value in an HFRR here refers to the value obtained in accordance with the Japanese Petroleum Institute standard JPI-5S-50-98 "Gas oil - Method for testing lubricity".

In addition, for the diesel fuel composition relating to the present invention it is preferable if the 10% distillation temperature is not more than 250°C and the 50% distillation temperature is not more than 300°C, and if the proportion of the total peak area of the peak group at chemical shifts of 1.45 to 2.25 ppm relative to the total peak area of the peak group at chemical shifts of 1.00 to 1.45 ppm in proton nuclear magnetic resonance spectra is not less than 2.5%, and it is even more preferable if the 10% distillation temperature is not more than 200°C and the 50% distillation temperature is not more than 250°C.

In addition, for the diesel fuel composition according to the present invention it is preferable if the value of Z as expressed by the following formula (1) is greater than -3.5, and even more preferable if it is greater than -1.5.

$$Z = 3.6988 + 0.0448\times A - 0.0056\times B - 0.0166\times C - 0.0032\times D \quad (1)$$

wherein A is the proportion of the total peak area of the peak group at chemical shifts of 1.45 to 2.25 ppm relative to the total peak area of the peak group at chemical shifts of 1.00 to 1.45 ppm in proton nuclear magnetic resonance spectra, %; B is the 10% distillation temperature, °C; C is the 50% distillation temperature, °C; and D is the 90% distillation temperature, °C.

According to the present invention, it is possible to obtain a diesel fuel composition with improved rubber swellability, although essentially comprised only of paraffins, by ensuring that the proportion of paraffins with 15 or fewer carbons is not less than 28% by volume and that the proportion of normal paraffins with 18 or more carbons is not more than 11% by volume. In the prior art, it has been considered that paraffins have the

nature of having poor rubber swellability, but experiments have revealed that the nature of having poor swellability is a characteristic of normal paraffins while isoparaffins tend rather to have high rubber swellability. It has also been discovered that the tendency of isoparaffins to cause swelling of rubber differs according to the number of carbons. The present invention is based on these novel findings.

In addition, due to the said experiments, it was discovered that the rubber swellability of a diesel fuel composition essentially comprising only paraffins is influenced by the proportion of isoparaffins and the distillation characteristics. It was discovered that, provided the proportion of the total peak area of the peak group at chemical shifts of 1.45 to 2.25 ppm relative to the total peak area of the peak group at chemical shifts of 1.00 to 1.45 ppm in proton nuclear magnetic resonance spectra, which show the hydrogen isotopes in paraffins, and the distillation characteristics (10%, 50% and 90% distillation temperatures) are within specified ranges, the rubber swellability of a diesel fuel composition essentially comprising only paraffins is further enhanced, and that the value obtained by a specified formula in which the variables are the aforementioned ratio of the peak total areas and the distillation characteristics is an indicator of rubber swellability of a diesel fuel composition essentially comprising only paraffins. The present invention is based on these novel findings.

Before describing the Examples of the present invention, an explanation is first given of the results of an experiment (referred to below as a confirmation

experiment) to demonstrate the fact that isoparaffins have high rubber swellability.

This confirmation experiment used three kinds of isoparaffin solvents, A, B and C, which have different distillation ranges, as shown in Table 1, and, for comparison, two kinds of normal paraffin solvents, D and E, which have different distillation ranges.

Table 1

	Units	Solvent A	Solvent B	Solvent C	Solvent D	Solvent E
Density @ 15°C	g/cm^3	0.759	0.769	0.796	0.750	0.774
Distillation characteristics						
Initial boiling point	°C	157.0	180.5	216.0	189.5	258.5
10%	°C	165.5	188.5	225.0	199.0	264.5
50%	°C	167.0	189.5	231.5	207.0	270.5
90%	°C	171.0	192.5	243.0	221.5	285.5
Final boiling point	°C	177.0	198.5	250.0	233.5	294.5
Paraffins of 15 or fewer carbons	Mass %	100.0	100.0	99.7	99.8	53.3
n-paraffins of 18 or more carbons	Mass %	0.0	0.0	0.0	0.0	4.1

The various characteristics shown in Table 1 were measured by the methods below.

Density @ 15°C

Density at 15°C measured in accordance with JIS K 2249 "Crude oil and petroleum products - Determination of density and density/mass/volume conversion tables".

Distillation Characteristics

Distillation characteristics obtained in accordance with JIS K 2254 "Petroleum products - Distillation test methods".

Normal Paraffin and Isoparaffin Contents

Gas chromatography in accordance with ASTM D 2887 "Standard test method for boiling point range distribution of petroleum fractions by gas chromatography" was used, and the hydrocarbon content for each carbon number was calculated from the chromatograms thus obtained. In other words, retention times were investigated using a mixture of normal paraffins of different carbon numbers as a standard, and the normal paraffin content was obtained from the peak area values of the normal paraffins. The content of isoparaffin of carbon number N was obtained as the sum of the chromatogram area values of the peaks between the peaks due to normal paraffins of carbon number N-1 and peaks due to normal paraffins of carbon number N. The gas chromatography detector was a hydrogen flame ionisation detector (FID), so that the measurement sensitivity was proportionate to the number of carbons of the paraffins. Taking this sensitivity into account, therefore, the molar ratios were obtained from the area values and finally mass ratios were obtained.

The type of column in the gas chromatography was HP5 (length: 30m, inside diameter: 0.32mm, liquid layer thickness: 0.25 μm), and the analysis conditions were as follows.

Column tank temperature rise conditions : 35°C (5 minutes) → 10°C/minute (temperature rise) → 320°C (11.5 minutes)

Specimen volatilisation chamber conditions: 320°C fixed, split ratio 150 : 1

Detector part: 320°C

Test pieces of hydrogenated nitrile butadiene rubber (HNBR) were immersed in these solvents A to E, and their percentage change in volume was measured. The immersion conditions were as shown in Table 2. These conditions were set on the basis of the method in the evaluation test for compatibility of materials in synthetic gas oils in "Research and development of high-efficiency clean-energy cars" undertaken by the Japan Automobile Research Institute under commission from the independent New Energy and Industrial Technology Development Organisation (New Energy and Industrial Technology Development Organisation: 1999 report on results of research and development of high-efficiency clean-energy cars, Japan Automobile Research Institute (March 2000)).

Table 2

	Evaluation test for compatibility of materials	Examples of Embodiment
Engine	Diesel engine	Diesel engine
Test fuel	JIS No. 2 diesel oil, synthetic diesel oil	GTL diesel oil
Immersion temperature	55 and 85°C	85°C
Duration of immersion	24, 48 and 72 hours	72 hours
Test conditions	Immersion of test piece in liquid	Immersion of test piece in liquid

The results of these experiments are shown in Table 3.

Table 3

	Solvent A	Solvent B	Solvent C	Solvent D	Solvent E
Change in volume (%)	0.6	0.5	-0.2	-1.2	-2.2

As shown in Table 3, the test pieces immersed in solvent D and solvent E, which comprised normal paraffins, showed a decrease in volume, whereas in the case of the test pieces immersed in solvent A and solvent B, which were made up of isoparaffins the volume increased. In the case of the test piece immersed in solvent C, which was likewise made up of isoparaffins, there was a reduction but the amount of the change was extremely small. Indeed, it may be said that it did not show a tendency to shrink. On the basis of these results, it was confirmed that the nature of having poor rubber swellability is a characteristic of normal paraffins, and

isoparaffins instead tend to have high rubber swellability. Also, on the basis that these solvents, while being made up of the same isoparaffins and normal paraffins, gave different results, it was confirmed that the impact on rubber materials differs according to the number of carbons. In other words, it is evident that normal paraffins and isoparaffins with lower molecular weights have superior rubber swellability.

Next, by using oil mixtures of normal paraffins and isoparaffins manufactured by the SMDS (Shell Middle Distillate Synthesis) process and isoparaffin solvents and normal paraffin solvents to adjust the distillation characteristics and make-up, diesel fuel compositions were obtained that were comprised of the regulated oil mixtures. The characteristics and make-up of the diesel fuel compositions obtained are shown in Tables 4 to 6. What is meant by the SMDS process is a process in which natural gas is partially oxidised, and after synthesising heavy paraffins by means of Fischer-Tropsch synthesis, the heavy paraffin oil is hydrocracked and distilled so as to obtain naphtha, kerosene and gas oil fractions. Table 4 also shows, by way of a reference example, the characteristics of an FT diesel oil already made available commercially overseas. However, the present invention is not limited in any way by these Examples.

Table 4

	Units	Ex. 1	Ex. 2	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Ref. Ex.
Density @ 15°C	g/cm^3	0.777	0.737	0.801	0.792	0.788	0.785
Distillation characteristics							
Initial boiling pt.	°C	204.0	156.0	-	257.5	250.0	208.5
10%	°C	226.0	162.5	336.5	280.5	274.0	244.0
50%	°C	261.5	170.0	350.0	306.5	304.5	295.0
90%	°C	305.0	186.0	363.0	357.0	357.5	341.0
Final boiling pt.	°C	315.5	204.5	374.5	368.0	368.0	358.0
Cetane index		83.4	68.0	109.6	92.7	93.7	89.9
Sulphur component	Mass ppm	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Paraffin component	Vol. %	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99
Aromatic component	Vol. %	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Paraffins of 15 or fewer carbons	Mass %	54.2	100.0	2.2	14.1	27.7	27.5
n-paraffins of 18 or more carbons	Mass %	4.7	0.0	22.1	11.7	13.1	13.3
Ratio of total peak areas	%	3.0	2.5	1.7	1.8	1.2	2.9

Table 5

	Units	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9	Ex. 10	Ex. 11	Ex. 12
Density @ 15°C	g/cm^3	0.751	0.760	0.772	0.784	0.795	0.795	0.802	0.783	0.763	0.771
Distillation characteristics											
IBP	°C	162.0	163.5	168.0	204.0	205.0	212.0	211.5	149.0	158.5	155.0
10%	°C	174.5	175.0	175.0	229.5	229.0	243.5	241.5	187.0	168.5	171.0
50%	°C	197.0	195.5	196.5	265.0	267.0	295.5	294.5	246.5	194.5	256.0
90%	°C	242.5	240.5	240.0	300.0	300.5	341.5	342.0	312.0	325.0	354.0
FBP	°C	259.5	258.0	255.0	310.5	310.5	355.0	355.5	332.0	348.0	366.5
Cetane index		71.2	65.1	59.0	80.8	74.5	83.4	78.4	70.5	56.6	76.2
Sulphur component	Mass ppm	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Paraffin component	Vol. %	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99	≥ 99
Aromatic component	Vol. %	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Paraffins of 15 or fewer carbons	Mass %	93.4	95.4	98.3	47.3	45.6	28.1	28.5	55.6	71.4	49.9
n-paraffins of 18 or more carbons	Mass %	0.0	0.0	0.0	4.5	3.0	7.9	6.4	3.7	2.6	10.0
Ratio of total peak areas	%	2.6	9.2	18.5	9.1	14.4	9.2	13.8	13.3	7.0	2.5

Table 6

	Units	Comp. Ex. 4	Comp. Ex. 5
Density @ 15°C	g/cm^3	0.794	0.787
Distillation characteristics			
Initial boiling pt.	°C	222.5	167.0
10%	°C	269.5	194.0
50%	°C	331.5	342.5
90%	°C	357.5	360.0
Final boiling pt.	°C	368.0	369.5
Cetane index		97.9	98.9
Sulphur component	Mass ppm	≤ 1	≤ 1
Paraffin component	Vol. %	≥ 99	≥ 99
Aromatic component	Vol. %	≤ 1	≤ 1
Paraffins of 15 or fewer carbons	Mass %	15.7	29.6
n-paraffins of 18 or more carbons	Mass %	17.5	15.5
Ratio of total peak areas	%	2.6	2.0

Of the characteristics shown in Tables 4 to 6, the density and distillation characteristics are the same as in Table 1, but the other characteristics are based on the following methods of measurement.

Cetane Index

Refers to the cetane index measured in accordance with JIS K 2280 "Petroleum products - Fuel oils - Determination of octane number and cetane number, and method for calculation of cetane index, 8. Method of calculating cetane index using the four-variable equation". However, reference values were recorded in the case of FT fuels because they lie outside the recommended appropriate scope of the cetane index calculation.

Sulphur Component

Sulphur content obtained in accordance with JIS K 2541-2 "Crude petroleum and petroleum products - Determination of sulphur content, Part 2: The microcoulometric titration-type oxidation method".

Paraffin Component

Paraffin component measured in accordance with JPI-5S-49-97 "Petroleum products - Determination of hydrocarbon types - High performance liquid chromatography".

Aromatic Component

Sum of monocyclic aromatic and dicyclic aromatic and tri- or higher cyclic aromatic hydrocarbon components measured in accordance with JPI-5S-49-97 "Petroleum products - Determination of hydrocarbon types - High performance liquid chromatography".

Ratio Of Total Peak Areas

Analysis of proton nuclear magnetic resonance

(^{1}H-NMR) spectra was carried out and the spectra gave the proportion of the total peak area of the peak group at chemical shifts of 1.45 to 2.25 ppm relative to the total peak area of the peak group at chemical shifts of 1.00 to 1.45 ppm.

Next, the influence of these diesel fuel compositions on rubber materials under the same conditions as for the aforementioned confirmation experiment was investigated. Tables 7 and 8 show the difference between the percentage change in volume of rubber materials after the experiment of immersing them in each diesel fuel composition and the percentage change in volume of the reference example (Δ percentage change in volume), together with the Z value obtained by means of Formula (1).

Table 7

	Ex. 1	Ex. 2	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Ref. Ex.
Δ Change in volume (%)	1.4	3.2	-1.7	-0.7	-0.5	Base
Z value	-2.1	-0.3	-5.2	-4.2	-4.0	-3.5

Table 8

	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9	Ex. 10	Ex. 11	Ex. 12	Comp. Ex. 4	Comp. Ex. 5	Ref. Ex.
Δ change i volume (%)	2.0	2.4	3.3	1.1	1.3	0.2	0.4	1.7	2.1	0.8	-0.5	-0.6	Base
z value	-1.2	-0.9	-0.5	-2.5	-2.3	-3.3	-2.7	-1.8	-1.2	-2.5	-4.3	-4.1	-3.5

As shown in Tables 7 and 8, Examples 1 to 12 all showed an increase in percentage volume change compared with the reference example, which was an FT diesel oil of the prior art. It was therefore confirmed, as can be seen from Tables 4 to 6 and these results, that it is possible to improve rubber swellability even when the diesel fuel composition is composed essentially only of paraffins, by ensuring that the proportion of paraffins with 15 or fewer carbons is not less than 28% by volume and that the proportion of normal paraffins with 18 or more carbons is not more than 11% by volume. The ratio of total peak areas for Example 2, Example 3 and Example 12 was lower than for the Reference Example, but because the content of paraffins of 15 or fewer carbons and the content of normal paraffins of 18 or more carbons satisfy the conditions of the present invention, the percentage change in volume increased compared to the comparative examples and the reference example. In other words, the point that from the standpoint of increasing the percentage change in volume a high proportion of isoparaffins is preferable is as discussed above, but even though, for example, the ratio of total peak areas in proton nuclear magnetic resonance spectra of paraffins is lower than the comparative examples and reference example, it was confirmed that an increase in percentage volume change can be achieved provided the proportions of content of paraffins with 15 or fewer carbons and content of normal paraffins with 18 or more carbons satisfy the conditions of the present invention.

In addition, Examples of Embodiment 2 to 5, where the 10% distillation temperature was less than 200°C and the 50% distillation temperature was less than 250°C,

confirmed that the increase in the percentage change in volume was larger, which is to be preferred.

Furthermore, as shown in Tables 7 and 8, it was confirmed that, provided the relationship of the distillation characteristics and the ratio of total peak areas in proton nuclear magnetic resonance spectra satisfies the condition that the Z value obtained by means of the aforementioned Formula (1) is greater than -3.5, an improvement in the percentage change in volume compared to FT diesel oils of the prior art can be achieved.

C L A I M S

1. A diesel fuel composition which essentially comprises only paraffins, and wherein the proportion of the content of paraffins of 15 or fewer carbons is made not less than 28% by volume and the proportion of normal paraffins of 18 or more carbons is made not more than 11% by volume.

2. A diesel fuel composition according to claim 1, wherein the proportion of the content of paraffins of 15 or fewer carbons is made not less than 40% by volume.

3. A diesel fuel composition according to claim 2, wherein the proportion of the content of paraffins of 15 or fewer carbons is made not less than 50% by volume.

4. A diesel fuel composition according to claim 1, 2 or 3, wherein the proportion of normal paraffins of 18 or more carbons is made not more than 8% by volume.

5. A diesel fuel composition according to claim 4, wherein the proportion of normal paraffins of 18 or more carbons is made not more than 5% by volume.

6. A diesel fuel composition according to any one of the preceding claims, wherein the 10% distillation temperature is not more than 250°C and the 50% distillation temperature is not more than 300°C, and in that the proportion of the total peak area of the peak group at chemical shifts of 1.45 to 2.25 ppm relative to the total peak area of the peak group at chemical shifts of 1.00 to 1.45 ppm in proton nuclear magnetic resonance spectra is not less than 2.5%.

7. A diesel fuel composition according to claim 6, wherein the 10% distillation temperature is not more than 200°C.

8. A diesel fuel composition according to claim 6 or 7, wherein the 50% distillation temperature is not more than 250°C.

9. A diesel fuel composition according to any one of the preceding claims, wherein the value of Z as expressed by Formula (1) below is greater than -3.5.

$$Z = 3.6988 + 0.0448 \times A - 0.0056 \times B - 0.0166 \times C - 0.0032 \times D \quad (1)$$

wherein A is the proportion of the total peak area of the peak group at chemical shifts of 1.45 to 2.25 ppm relative to the total peak area of the peak group at chemical shifts of 1.00 to 1.45 ppm in proton nuclear magnetic resonance spectra, %; B is the 10% distillation temperature, °C; C is the 50% distillation temperature, °C; and D is the 90% distillation temperature, °C.

10. A diesel fuel composition according to claim 9, wherein the value of Z is greater than -1.5.

11. A diesel fuel composition according to any one of the preceding clams, wherein the main constituent thereof does not contain styrene compounds or diene compounds, or condensed polycyclic aromatics.

12. A diesel fuel composition according to any one of the preceding claims, wherein the total mass or volume of isoparaffins and normal paraffins is not less than 99% of the composition.