

CLAIMS

[Claim 1]

A method for producing a highly aromatic base oil comprising:
5 a step of hydrotreating a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method.

[Claim 2]

10 The method for producing a highly aromatic base oil according to claim 1, wherein the step of hydrotreating a clarified oil is performed under conditions of a hydrogen pressure of 5.0 to 20.0 MPa, a temperature of 280 to 400°C, a hydrogen oil ratio of 300 to 750 NL/L, and a space velocity of 0.3 to 2.0 h⁻¹.

[Claim 3]

15 A method for producing a mixed-base oil comprising:
a first step of hydrotreating a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method; and
a second step of mixing the highly aromatic base oil and one or
20 more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil to obtain a mixed-base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C
25 or less, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5.

[Claim 4]

The method for producing a mixed-base oil according to claim 3, wherein the mixed-base oil has a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 5]

A highly aromatic base oil obtainable by the producing method according to claim 1 or 2, wherein

the highly aromatic base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, %C_A of 30 to 80 according to ASTM D2140, a pour point of +10°C or less, a kinematic viscosity at 40°C of 100 mm²/s or more, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5.

[Claim 6]

A mixed-base oil comprising the highly aromatic base oil according to claim 5 and one or more base oils selected from a mineral

oil and a synthetic oil other than the highly aromatic base oil, wherein

the mixed-base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5.

[Claim 7]

The mixed-base oil according to claim 6, wherein the mixed-base oil has a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 8]

A method for producing a highly aromatic base oil comprising:
a step of hydrotreating a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 9]

The method for producing a highly aromatic base oil according to claim 8, wherein the step of hydrotreating a clarified oil is performed under conditions of a hydrogen pressure of 10.0 to 20.0 MPa, a temperature of 280 to 400°C, a hydrogen oil ratio of 300 to 750 NL/L, and a space velocity of 0.3 to 2.0 h⁻¹.

[Claim 10]

A method for producing a mixed-base oil comprising:

a first step of hydrotreating a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,

- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

5 of 10 ppm by mass or less; and

a second step of mixing the highly aromatic base oil and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil to obtain a mixed-base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 15 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 20 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 11]

25 A highly aromatic base oil obtained by the producing method according to claim 8 or 9, wherein

the highly aromatic base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, %C_A of 30 to 80 according to ASTM D2140, a pour point of +10°C or less, a kinematic viscosity at 40°C of 100 mm²/s or more, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 12]

A mixed-base oil comprising the highly aromatic base oil according to claim 11 and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil, wherein

the mixed-base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of

benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 13]

A method for producing a highly aromatic base oil comprising:

a first step of hydrotreating a clarified oil to obtain a hydrorefined oil; and

a second step of fractionation-treating and/or adsorption-treating the hydrorefined oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,

- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

5 [Claim 14]

The method for producing a highly aromatic base oil according to claim 13, wherein the first step of hydrorefining a clarified oil is performed under conditions of a hydrogen pressure of 5.0 to 20.0 MPa, a temperature of 280 to 400°C, a hydrogen oil ratio of 300 to 750 NL/L, and a space velocity of 0.3 to 2.0 h⁻¹.

10 [Claim 15]

A method for producing a mixed-base oil comprising:

a first step of hydrorefining a clarified oil to obtain a hydrorefined oil;

15 a second step of fractionation-treating and/or adsorption-treating the hydrorefined oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 20 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 25 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,

7) benzo(k)fluoranthene, and

8) dibenzo(a,h)anthracene

of 10 ppm by mass or less; and

5 a third step of mixing the highly aromatic base oil and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil to obtain a mixed-base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C
10 or less, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

1) benzo(a)pyrene,

2) benzo(e)pyrene,

15 3) benzo(a)anthracene,

4) chrysene,

5) benzo(b)fluoranthene,

6) benzo(j)fluoranthene,

7) benzo(k)fluoranthene, and

20 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

[Claim 16]

A highly aromatic base oil obtainable by the producing method according to claim 13 or 14, wherein

25 the highly aromatic base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis

method, an aniline point of 60°C or less, %C_A of 30 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.7.

[Claim 17]

5 A mixed-base oil comprising the highly aromatic base oil according to claim 16 and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil, wherein

10 the mixed-base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5.

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1. A method for producing a mixed-base oil comprising:

hydrorefining a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method; and

mixing the highly aromatic base oil and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil to obtain a mixedbase oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5.

2. The method for producing a mixed-base oil according to claim 1, wherein the mixed-base oil has a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

3. A mixed-base oil comprising:

a highly aromatic base oil, obtained by a method comprising hydrorefining a

clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method,

and having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, %CA of 30 to 80 according to ASTM D2140, a pour point of +10°C or less, a kinematic viscosity at 40°C of 100 mm²/s or more, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5;

and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil, wherein

the mixed-base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %CA of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, and a rate of aromatic carbon of 0.1 to 0.5.

4. The mixed-base oil according to claim 3, wherein the mixed-base oil has a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

5. A method for producing a highly aromatic base oil comprising:

hydrorefining a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, %C_A of 30 to 80 according to ASTM D2140, a pour point of +10°C or less, a kinematic viscosity at 40°C of 100 mm²/s or more, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

6. The method for producing a highly aromatic base oil according to claim 5, wherein hydrorefining a clarified oil is performed under conditions of a hydrogen pressure of 10.0 to 20.0 MPa, a temperature of 280 to 400°C, a hydrogen oil ratio of 300 to 750 NL/L, and a space velocity of 0.3 to 2.0 h⁻¹.

7. A method for producing a mixed-base oil comprising:

hydrorefining a clarified oil to obtain a highly aromatic base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less; and

mixing the highly aromatic base oil and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil to obtain a mixed-base oil having an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %C_A of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

8. A highly aromatic base oil, wherein the highly aromatic base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 60°C or less, %CA of 30 to 80 according to ASTM D2140, a pour point of +10°C or less, a kinematic viscosity at 40°C of 100 mm²/s or more, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,
- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.

9. A mixed-base oil comprising the highly aromatic base oil according to claim 8 and one or more base oils selected from a mineral oil and a synthetic oil other than the highly aromatic base oil, wherein the mixed-base oil has an aromatic content of 50 % by mass or more determined by a column chromatography analysis method, an aniline point of 100°C or less, %CA of 20 to 80 according to ASTM D2140, a pour point of +10°C or less, a glass-transition point of -30°C to -60°C, a rate of aromatic carbon of 0.1 to 0.5, a content of benzo(a)pyrene of 1 ppm by mass or less, and a total content of the following aromatic compounds 1) to 8):

- 1) benzo(a)pyrene,
- 2) benzo(e)pyrene,
- 3) benzo(a)anthracene,
- 4) chrysene,

- 5) benzo(b)fluoranthene,
- 6) benzo(j)fluoranthene,
- 7) benzo(k)fluoranthene, and
- 8) dibenzo(a,h)anthracene

of 10 ppm by mass or less.