Claims

1. A process for manufacturing a bio-propylene composition, and optionally a bio-gasoline component, the process comprising the following steps (B′), (C) and (D):

(B`) providing a catalytic cracking feed comprising a hydrotreated bio-based hydrocarbon feed containing less than 1 wt.-%, preferably less than 0.8 wt.-%, more preferably less than 0.5 wt.-%, of gaseous compounds (NTP);

(C) catalytically cracking the catalytic cracking feed in a catalytic cracking reactor at a temperature of at least 450 ˚C using a moving solid catalyst to obtain a cracking effluent; and

(D) recovering from the cracking effluent a fraction rich in bio-propylene as the bio-propylene composition, and optionally a fraction rich in C5-C10 hydrocarbons as the bio-gasoline component.

2. A process for manufacturing a bio-propylene composition, and optionally a bio-gasoline component, the process comprising the following steps (A) to (D):

(A) hydrotreating an oxygen-containing bio-based feedstock to obtain a hydrotreatment effluent comprising oxygen-depleted hydrocarbons, and subjecting the hydrotreatment effluent to a gas-liquid separation, and optionally to a fractionation, to provide a hydrotreated bio-based hydrocarbon feed containing less than 1 wt.-%, preferably less than 0.8 wt.-%, more preferably less than 0.5 wt.-%, of gaseous compounds (NTP);

(B) providing a catalytic cracking feed comprising the hydrotreated bio-based hydrocarbon feed;

(C) catalytically cracking the catalytic cracking feed in a catalytic cracking reactor at a temperature of at least 450 ˚C using a moving solid catalyst to obtain a cracking effluent; and

(D) recovering from the cracking effluent a fraction rich in bio-propylene as the bio-propylene composition, and optionally a fraction rich in C5-C10 hydrocarbons as the bio-gasoline component.

3. The process according to claim 2, wherein the oxygen-containing bio-based feedstock comprises one or more selected from the group consisting of vegetable oils, animal fats, microbial oils, thermally liquefied biomass and enzymatically liquefied biomass, preferably one or more selected from the group consisting of vegetable oils, animal fats and microbial oils.

4. The process according to claim 2 or 3, wherein the hydrotreating in the step (A) comprises at least deoxygenation and isomerization, preferably at least hydrodeoxygenation and isomerization.

5. The process according to any one of the preceding claims, wherein the hydrotreated bio-based hydrocarbon feed comprises iso-paraffins, and the hydrotreated bio-based hydrocarbon feed may comprise, based on the total weight of the hydrotreated bio-based hydrocarbon feed, more than 1 wt.-% isoparaffins, preferably more than 4 wt.-%, such as more than 5 wt.-% isoparaffins, more preferably more than 30 wt.-%, such as more than 40 wt.-% or more than 50 wt.-% or more than 60 wt.-%, even more preferably more than 70 wt.-%, such as 80 wt.-%, particularly more than 85 wt.-% isoparaffins.

6. The process according to any one of the preceding claims, wherein the hydrotreated bio-based hydrocarbon feed comprises isoparaffins and n-paraffins and the sum of the wt.-% amounts of isoparaffins and n-paraffins in the hydrotreated bio-based hydrocarbon feed is at least 40 wt.-%, preferably more than 50 wt.-%, such as more than 60 wt.-%, more preferably more than 70 wt.-%, such as more than 80 wt.-%, particularly more than 90 wt.-% or even more than 95 wt.-%, based on the total weight of the hydrotreated bio-based hydrocarbon feed.

7. The process according to any one of the preceding claims, wherein the hydrotreated bio-based hydrocarbon feed comprises less than 25 wt.-%

total aromatics, preferably less than 15 wt.-%, more preferably less than 5 wt.-%, most preferably less than 1 wt.-% total aromatics, based on the total weight of the hydrotreated bio-based hydrocarbon feed; and/or

the hydrotreated bio-based hydrocarbon feed comprises, based on the total weight of the hydrotreated bio-based hydrocarbon feed, less than 80 wt.-% naphthenes, preferably less than 50 wt.-%, such as less than 30 wt.-%, more preferably less than 10 wt.-%, most preferably less than 5 wt.-%, particularly less than 1 wt.-% naphthenes.

8. The process according to any one of the preceding claims, wherein

the hydrotreated bio-based hydrocarbon feed comprises, based on the total weight of the hydrotreated bio-based hydrocarbon feed, more than 50 wt.-%, preferably more than 60 wt.-%, further preferably more than 70 wt.-%, more preferably more than 80 wt.-%, and even more preferably more than 90 wt.-% hydrocarbons having a carbon number of at least C11, preferably at least C14.

9. The process according to any one of the preceding claims, wherein

(a) the hydrotreated bio-based hydrocarbon feed comprises, based on the total weight of the hydrotreated bio-based hydrocarbon feed:

isoparaffins and n-paraffins and the sum of the wt.-% amounts of isoparaffins and n-paraffins in the hydrotreated bio-based hydrocarbon feed is at least more than 80 wt.-%, preferably more than 90 wt.-% or even more than 95 wt.-%;

more than 80 wt.-%, preferably more than 90 wt.-% hydrocarbons having a carbon number of at least C11, preferably at least C14; and

more than 4 wt.-%, such as more than 5 wt.-%, preferably more than 30 wt.-% isoparaffins, and/or

(b) the hydrotreated bio-based hydrocarbon feed comprises, based on the total weight of the hydrotreated bio-based hydrocarbon feed:

isoparaffins and n-paraffins and the sum of the wt.-% amounts of

isoparaffins and n-paraffins in the hydrotreated bio-based hydrocarbon feed is at least more than 80 wt.-%, preferably more than 90 wt.-% or even more than 95 wt.-%;

more than 80 wt.-%, preferably more than 90 wt.-%, more preferably more than 95 wt.-% hydrocarbons having a carbon number in the range from C5 to C10; and

more than 30 wt.-%, preferably more than 40 wt.-%, more preferably more than 50 wt.-% isoparaffins.

10. The process according to any one of the preceding claims, wherein the hydrotreated bio-based hydrocarbon feed comprises, based on the total weight of the hydrotreated bio-based hydrocarbon feed, at most 5 wt.-%, preferably at most 3 wt.-%, more preferably at most 2 wt.-%, even more preferably at most 1 wt.-% hydrocarbons having a carbon number of at least C22.

11. The process according to any one of the preceding claims, wherein the hydrotreated bio-based hydrocarbon feed has a biogenic carbon content, as determined in accordance with EN 16640 (2017), of more than 50 wt.-%, especially more than 60 wt.-% or more than 70 wt.-%, preferably more than 80 wt.-%, more preferably more than 90 wt.-% or more than 95 wt.-%, even more preferably about 100 wt.-%, based on the total weight of carbon in the hydrotreated bio-based hydrocarbon feed.

12. The process according to any one of the preceding claims, wherein the catalytic cracking feed further comprises a cracking effluent recycle feed.

13. The process according to claim 12, wherein

(a) the wt.-% amount of the cracking effluent recycle feed in the catalytic cracking feed is at least 10 wt.-% or more than 20 wt.-% or more than 30 wt.-% or more than 40 wt.-% or more than 50 wt.-% or more than 60 wt.-% or more than 70

wt.-% or more than 80 wt.-% or more than 90 wt.-%, and less than 99 wt.-% or less than 90 wt.-% or preferably less than 80 wt.-% or less than 70 wt.-% or less than 60 wt.-% or less than 50 wt.-% or less than 40 wt.-% or less than 30 wt.-% or less than 20 wt.-%, based on the total weight of the catalytic cracking feed, preferably from 10 wt.-% to 80 wt.-%; and/or

(b) wherein the sum of the wt.-% amounts of the hydrotreated bio-based hydrocarbon feed and the cracking effluent recycle feed in the catalytic cracking feed is more than 80 wt.-%, such as more than 85 wt.-% or more than 90 wt.-%, preferably more than 95 wt.-% such as more than 97 wt.-%, more preferably at least 99 wt.-%, based on the total weight of the catalytic cracking feed; and/or

(c) wherein the weight ratio of the hydrotreated bio-based hydrocarbon feed to the cracking effluent recycle feed (hydrotreated bio-based hydrocarbon feed : cracking effluent recycle feed) in the catalytic cracking feed is at least 10:90, preferably at least 20:80, more preferably at least 50:50, such as at least 80:20; and/or at most 99:1, such as at most 90:10, preferably at most 80:20, such as at most 50:50, or at most 20:80.

14. The process according to any one of the preceding items, wherein the process comprises recovering from the cracking effluent a fraction of hydrocarbons having a carbon number of at least C5, and recycling at least a portion of said fraction to the catalytic cracking feed as a cracking effluent recycle feed.

15. The process according to any one of claims 12 to 14, wherein the cracking effluent recycle feed comprises, based on the total weight of the cracking effluent recycle feed, more than 50 wt.-%, preferably more than 60 wt.-%, further preferably more than 70 wt.-%, more preferably more than 80 wt.-%, and even more preferably more than 90 wt.-% hydrocarbons having a carbon number of at least C5, preferably at least C11, or at least C14.

16. The process according to any one of the preceding claims, wherein the wt.-%

amount of the hydrotreated bio-based hydrocarbon feed in a catalytic cracking fresh feed (cracking feed other than optional cracking effluent recycle feed) is more than 80 wt.-%, such as more than 90 wt.-%, preferably more than 95 wt.-%, more preferably at least 99 wt.-%, based on the total weight of the catalytic cracking fresh feed.

17. The process according to any one of the preceding claims, further comprising recovering from the cracking effluent a fraction rich in aromatics as a bio-aromatics component.

18. The process according to any one of the preceding claims, further comprising recovering from the cracking effluent a fraction rich in bio-ethylene as a bio-ethylene composition, preferably comprising more than 50 wt.-% of ethylene, based on the total weight of the bio-ethylene composition, and/or a fraction rich in C4 hydrocarbons as a bio-C4 composition, preferably comprising more than 50 wt.-% of C4 hydrocarbons, based on the total weight of the bio-C4 composition, such as a fraction rich in C4 olefins as a bio-butylene composition, preferably comprising more than 50 wt.-% of C4 olefins, based on the total weight of the bio-butylene composition.

19. The process according to any one of the preceding claims, wherein the recovering, especially in step (D), comprises one or more of distilling, fractionating, separating, evaporating, flash-separating, membrane separating, extracting, using extractive-distillation, using chromatography, using molecular sieve adsorbents, using thermal diffusion, complex forming, crystallizing, preferably at least one or more of fractionating, distilling, extracting, and using extractive-distillation, more preferably at least fractionating.

20. The process according to any one of the preceding claims, wherein the weight ratio of propylene to ethylene in the cracking effluent is more than 1.0,

such as at least 1.5, preferably more than 2.0, more preferably more than 2.5, or more than 3.0.

21. The process according to any one of the preceding claims, wherein the weight ratio of propylene to total-C3 (100% x propylene / {summed amount of propylene and propane}) in the cracking effluent is at least 65 wt.-%, such as at least 70 wt.-%, or at least 80 wt.-%, preferably at least 85 wt.-%, more preferably at least 90 wt.-%.

22. A bio-propylene composition comprising bio-propylene and bio-propane, wherein the total content of the bio-propylene is at least 80 wt.-%, based on the total weight of the bio-propylene composition, and the weight ratio of bio-propylene to bio-propane is at least 4.5, and, preferably, the total content of the bio-propylene is at least 85 wt.-%, based on the total weight of the bio-propylene composition, and the weight ratio of bio-propylene to bio-propane is at least 5.3, or, more preferably, wherein the total content of the bio-propylene is at least 90 wt.-%, such as at least 99 wt.-%, based on the total weight of the bio-propylene composition, and the weight ratio of bio-propylene to bio-propane is at least 9.0, and wherein the bio-propylene composition is preferably obtainable by the process according to any one of claims 1 to 21.

23. A method for producing a (co)polymer composition comprising:

producing a bio-propylene composition according to any one of claims 1 to 21, optionally purifying the bio-propylene composition, and/or optionally derivatising at least a part of the bio-propylene molecules in the optionally purified bio-propylene composition to obtain a polymerizable composition of bio-monomer(s), and (co)polymerizing a monomer composition comprising the polymerizable composition of bio-monomers to obtain the (co)polymer composition.

24. The method according to claim 23, wherein

(a) the polymerizable composition of bio-monomer(s) comprises or consists of olefinically unsaturated bio-monomers or epoxide bio-monomers; and/or

(b) the polymerizable composition of bio-monomer(s) comprises or consists of at least one olefinically unsaturated bio-monomer selected from the group consisting of bio-propylene, bio-acrylic acid, bio-acrylonitrile, and bio-acrolein, or at least one epoxide bio-monomer selected from the group consisting of bio-propylene oxide; and/or

(c) the monomer composition further comprises other (co)monomer(s) and/or additive(s).

25. The method according to claim 23 or 24, wherein

(a) the weight ratio of propylene to ethylene in the cracking effluent is more than 1.0, such as at least 1.5, preferably more than 2.0, more preferably more than 2.5, or more than 3.0; and/or

(b) the weight ratio of propylene to total-C3 (100% x propylene / {summed amount of propylene and propane}) in the cracking effluent is at least 65 wt.-%, such as at least 70 wt.-%, or at least 80 wt.-%, preferably at least 85 wt.-%, more preferably at least 90 wt.-%.

26. A bio-gasoline component comprising at least 75 wt.-%, preferably at least 85 wt.-%, more preferably at least 90 wt.-% C5-C10 hydrocarbons; at least 8 wt.-%, preferably at least 10 wt.-%, more preferably at least 15 wt.-% cyclic hydrocarbons; n-paraffins, and at least 7 wt.-%, preferably at least 12 wt.-%, more preferably at least 20 wt.-% isoparaffins; and wherein the sum of the wt.-% amounts of isoparaffins and n-paraffins in the bio-gasoline component is at most 65 wt.-%, preferably at most 60 wt.-%, more preferably at most 55 wt.-%, based on the total weight of the bio-gasoline component.

27. The bio-gasoline component according to claim 26, wherein

(a) wherein the bio-gasoline component is obtainable by the process according to any one of claims 1 to 21; and/or

(b) the bio-gasoline component has a RON value of at least 60; and/or

(c) the bio-gasoline component has a MON value of at least 50, and/or

(d) the bio-gasoline component has a RON minus MON value of at least 5; and/or

(e) the bio-gasoline component has a 5% boiling point of 50˚C or more and a 95% boiling point of 220˚C or less, as determined in accordance with ENISO3405; and/or

(f) the bio-gasoline component comprises at most 1 wt.-% benzene, preferably at most 1 wt.-% total aromatics, more preferably at most 0.01 wt.-% total aromatics.