Claims

1. Process for preparing hydrocarbons from an oxygenated hydrocarbon feedstock, comprising:

a first hydrotreatment reactor containing at least one catalytic zone, in which a hydrotreatment entry stream containing an oxygenated hydrocarbon feedstock and a hydrocarbon diluting agent is introduced into the catalytic zone together with a hydrogen-rich gas, at an inlet temperature and a pressure causing at least hydrodeoxygenation and hydrodenitrification to an extent where a first hydrotreated effluent from the first hydrotreatment reactor contains mainly hydrocarbons, and wherein the oxygenated hydrocarbon feedstock has been converted to ≥95% hydrocarbons;

the first hydrotreated effluent from the first hydrotreatment reactor is subjected to a separation stage where at least part of the first hydrotreated effluent is separated into a gaseous fraction and a first hydrotreated liquid, where the first hydrotreated liquid contains ≥95 wt % hydrocarbons, and >1 wppm nitrogen;

at least part of the first hydrotreated liquid excluding the gaseous fraction and a hydrogen-rich gas is introduced in a second hydrotreatment reactor containing at least one catalytic zone at an inlet temperature that is higher than the inlet temperature in the first hydrotreatment reactor and at a pressure causing hydrodeoxygenation and hydrodenitrification, where the first hydrotreated liquid is not mixed with a feed having an oxygen

content that is higher than the oxygen content of the first hydrotreated liquid and where the first hydrotreated liquid is not mixed with a feed having a nitrogen content higher than the nitrogen content of the first hydrotreated liquid;

a second hydrotreated effluent from the second hydrotreatment reactor is subjected to one or more separation stages, where the second hydrotreated effluent is separated into a gaseous fraction and a second hydrotreated liquid and/or a stripped hydrotreated liquid, where the second hydrotreated liquid and/or the stripped hydrotreated liquid contains ≥99 wt % hydrocarbons and ≤1 wppm nitrogen, measured as elemental nitrogen.

2. Process according to claim **1**, wherein the separation stage to which the second hydrotreated effluent is subjected comprises:

subjecting the second hydrotreated liquid or the second hydrotreated effluent to a stripping stage, where the second hydrotreated liquid or second hydrotreated effluent is stripped with a stripping gas causing the stripped hydrotreated liquid to have ≤0.4 wppm nitrogen, measured as elemental nitrogen;

isomerising the stripped hydrotreated liquid in a first isomerisation reactor containing at least one catalytic zone, in which the stripped hydrotreated liquid and a hydrogen-rich gas having ≤1 ppm (mol/mol) nitrogen,

measured as elemental nitrogen, is introduced into the catalytic zone at a temperature and a pressure causing at least hydroisomerisation to produce a first isomerisation effluent; and

the first isomerised effluent from the first isomerisation reactor is subjected to a separation stage, where the first isomerised effluent is separated into a gaseous fraction and a first isomerised liquid, where the first isomerised liquid contains ≥30 wt % branched hydrocarbons.

3. Process according to claim **1**, further comprising:

isomerising the second hydrotreated liquid or the stripped hydrotreated liquid in a first isomerisation reactor containing at least one catalytic zone, in which the second hydrotreated liquid and a hydrogen-rich gas having ≤1 ppm (mol/mol) nitrogen, measured as elemental nitrogen, is introduced into the catalytic zone at an inlet temperature and a pressure causing at least hydroisomerisation to produce a first isomerisation effluent;

the first isomerised effluent from the first isomerisation reactor is subjected to a separation stage, where the first isomerised effluent is separated into a gaseous fraction and a first isomerised liquid, where the first isomerised liquid contains ≥30 wt % branched hydrocarbons, and/or an increase in branched hydrocarbons of ≥30 wt % compared to the second hydrotreated liquid.

4. Process according to claim **3**, wherein the first isomerised liquid is separated into at least an aviation fuel having a cloud point of −40° C. or lower.

5. Process according to claim **1**, wherein cooling is applied during the separation stage of the first hydrotreated effluent to an extent that the first hydrotreated liquid has a temperature below the inlet temperature of the first catalytic zone of the first hydrotreatment reactor.

6. Process according to claim **1**, where a hydrocarbon diluting agent is not introduced to the second hydrotreatment reactor.

7. Process according to claim **1**, where the extent of hydrodeoxygenation and hydrodenitrification in the first hydrotreatment reactor is controlled in such a manner that in the second hydrotreatment reactor the temperature increase between the reactor inlet and the reactor outlet is not more than 10° C.

8. Process according to claim **1**, wherein the catalytic zone(s) in the first hydrotreatment reactor has a lower hydrodeoxygenation activity than the catalytic zone(s) in the second hydrotreatment reactor.

9. Process according to claim **1**, wherein the hydrogen-rich gas used in the second hydrotreatment reactor contains ≤5 wppm nitrogen impurities, measured as elemental nitrogen.

10. Process according to claim **1**, wherein the inlet temperature and pressure of the first hydrotreatment reactor is 200-400° C. and 10-150 bar.

11. Process according to claim **1**, wherein the first hydrotreatment reactor includes at least three catalytic zones.

12. Process according to claim **1**, wherein the catalytic zones of the first hydrotreatment reactor comprises:

one or more catalyst(s) selected from hydrogenation metal on a support.

13. Process according to claim **1**, wherein the first hydrotreatment reactor is operated at a WHSV in the range from 0.5-3 h^{-1}; and a H_2 flow of 350-900 Nl H_2/l feed.

14. Process according to claim **1**, wherein the inlet temperature and pressure of the second hydrotreatment reactor is 250-450° C. and 10-150 bar.

15. Process according to claim **1**, wherein the second hydrotreatment reactor has a single catalytic zone.

16. Process according to claim **1**, wherein the catalytic zones of the second hydrotreatment reactor comprise:

one or more catalyst(s) selected from hydrogenation metal on a support.

17. Process according to claim **1**, wherein the second hydrotreatment reactor is operated at a WHSV in a range from 0.5-3 h^{-1}; and a H_2 flow of 350-900 Nl H_2/l feed.

18. Process according to claim **3**, wherein the inlet temperature and pressure of the first isomerisation reactor is 280-370° C. and 20-50 bar.

19. Process according to claim **3**, wherein the catalytic zones of the first isomerisation reactor comprise:

one or more catalyst(s) containing a Group VIII metal on a support, where the support is selected from silica, alumina, clays, titanium oxide, boron oxide, zirconia, which is used alone or as a mixture.

20. Process according to claim **19**, wherein the one or more catalyst(s) comprise:

a molecular sieve.

21. Process according to claim **3**, wherein the isomerisation reactor is operated at a WHSV in a range from 0.5-1 h^{-1}; and a H_2 flow of 300-500 Nl H_2/l feed.

22. Process according to claim **3**, wherein the first isomerised liquid has an iso- to n-paraffin ratio above 1.

23. Process according to claim **1**, wherein the hydrotreatment entry stream has a nitrogen impurity of 100 to 500 wppm.

24. Process according to claim **1**, wherein the first hydrotreated effluent from the first hydrotreatment reactor has a nitrogen impurity of 100 to 500 wppm or more.

25. Process according to claim **1**, where the second hydrotreated liquid and/or the stripped hydrotreated liquid contains ≥99 wt % hydrocarbons and ≤0.3 wppm nitrogen, measured as elemental nitrogen.

26. Process according to claim **1**, wherein the hydrocarbon diluting agent is product recycle.

27. Process according to claim **1**, wherein the separation stage to which the first hydrotreated effluent is subjected includes one or more separators.

28. Process according to claim **1**, wherein the separation stage to which the first hydrotreated effluent is subjected includes a hydrogen stripper.

29. Process according to claim **1**, wherein the oxygenated hydrocarbon feedstock has a nitrogen impurity of 300 wppm or more, measured as elemental nitrogen.