Claims

1. Process for preparing hydrocarbons from an oxygenated hydrocarbon feedstock, ~~having a nitrogen impurity of 300 wppm or more, measured as elemental nitrogen,~~ comprising:
- a first hydrotreatment reactor ~~(101) comprising~~containing at least one catalytic zone ~~(105),~~, in which a hydrotreatment entry stream ~~comprising~~containing an oxygenated hydrocarbon feedstock ~~(104)~~ and a hydrocarbon diluting agent ~~(126)~~ is introduced into the catalytic zone together with a hydrogen-rich gas ~~(120),~~, at an inlet temperature and a pressure causing at least hydrodeoxygenation and hydrodenitrification to an extent where a first hydrotreated effluent ~~(106)~~ from the first hydrotreatment reactor contains mainly hydrocarbons, and wherein the oxygenated hydrocarbon feedstock has been converted to ~~>~~≥95% hydrocarbons;
- the first hydrotreated effluent ~~(106)~~ from the first hydrotreatment reactor is subjected to a separation stage ~~(107)~~ where at least part of the first hydrotreated effluent ~~(106)~~ is separated into a gaseous fraction ~~(121)~~ and a first hydrotreated liquid ~~(108),~~, where the first hydrotreated liquid contains ~~>~~≥95 wt % hydrocarbons, and >1 wppm nitrogen;
- at least part of the first hydrotreated liquid ~~(108)~~excluding the gaseous fraction and a hydrogen-rich gas ~~(120)~~ is introduced in a second hydrotreatment reactor ~~(102)~~ ~~comprising~~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;
~~- the~~ a second hydrotreated effluent ~~(130)~~ from the second hydrotreatment reactor ~~(102)~~ is subjected to one or more separation stages ~~(111 and/or 114),~~, where the second hydrotreated effluent ~~(130)~~ is separated into a gaseous fraction ~~(113)~~ and a second hydrotreated liquid ~~(112)~~ and/or a stripped hydrotreated liquid ~~(115),~~, where the second hydrotreated liquid ~~(112)~~ and/or ~~a~~the stripped hydrotreated liquid ~~(115)~~ contains ~~>~~≥99 wt % hydrocarbons and ~~<~~≤1 wppm nitrogen, ~~preferably <~~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;
~~- optionally~~ isomerising the ~~second hydrotreated liquid (112) or the~~ stripped hydrotreated liquid ~~(115)~~ in a first isomerisation reactor ~~(103) comprising~~containing at least one catalytic zone, in which the ~~second~~stripped hydrotreated liquid and a hydrogen-rich gas ~~(120)~~ 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 ~~(116);~~ -; the first isomerised effluent ~~(116)~~ from the first isomerisation reactor ~~(103)~~ is subjected to a separation stage ~~(117),~~, where the first isomerised effluent ~~(116)~~ is separated into a gaseous fraction ~~(118)~~ and a first isomerised liquid ~~(119),~~, 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.

~~2.Process according to claim 1, wherein the separation stage include subjecting the second hydrotreated liquid (112) or the second hydrotreated effluent (130) to a stripping stage (114), where the second hydrotreated liquid or second hydrotreated effluent is stripped with a stripping gas (120) causing the stripped hydrotreated liquid (115) to have ≤0.4 wppm nitrogen, measured as elemental nitrogen;~~
~~- isomerising the stripped hydrotreated liquid (115) in a first isomerisation reactor (103) comprising at least one catalytic zone, in which the stripped hydrotreated liquid (115) and a hydrogen-rich gas (120) 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 (116);~~
~~- the first isomerised effluent (116) from the first isomerisation reactor (103) is subjected to a separation stage (117), where the first isomerised effluent (116) is separated into a gaseous fraction (118) and a first isomerised liquid (119), where the first isomerised liquid contains ≥30 wt% branched hydrocarbons.~~

~~3.Process according to any one of the preceding claims, wherein the first isomerised liquid (119) is separated into at least an aviation fuel having a cloud point of -40 °C or lower, such as -47°C or lower.~~

~~4.Process according to any one of the preceding claims, wherein~~ 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 ~~(106)~~ to an extent that the first hydrotreated liquid ~~(108)~~ has a temperature below the inlet temperature of the first catalytic zone of the first hydrotreatment reactor~~, preferably, where the first hydrotreated liquid (108) has a temperature at least 50 °C below the inlet temperature of the first catalytic zone of the first hydrotreatment reactor.~~.

~~5.~~6. Process according to ~~any one of the preceding claims~~claim 1, where a hydrocarbon diluting agent is not introduced to the second hydrotreatment reactor ~~(102).~~.

~~6.~~7. Process according to ~~any one of the preceding claims~~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.

~~7.~~8. Process according to ~~any one of the preceding claims~~claim 1, wherein the catalytic zone(s) in the first hydrotreatment reactor ~~(**101**)~~ has a lower hydrodeoxygenation activity than the catalytic zone(s) in the second hydrotreatment reactor ~~(**102**).~~.

~~8.~~9. Process according to ~~any one of the preceding claims~~claim 1, wherein the hydrogen-rich gas ~~(**120**)~~ used in the second hydrotreatment reactor ~~(**102**)~~ contains ~~<~~≤5 wppm nitrogen impurities, measured as elemental nitrogen.

~~9.~~10. Process according to ~~any one of the preceding claims~~claim 1, wherein the inlet temperature and pressure of the first hydrotreatment reactor ~~(**101**)~~ is 200-400 ~~-~~°° C. and 10-150 bar~~, such as 250-380 °C and 20-120 bar, such as 280-360 °C and 30-100 bar.~~.

~~10.~~11. Process according to ~~any one of the preceding claims~~claim 1, wherein the first hydrotreatment reactor ~~(**101**) comprise~~includes at least three catalytic zones.

~~11.~~12. Process according to ~~any one of the preceding claims~~claim 1, wherein the catalytic zones of the first hydrotreatment reactor ~~comprise~~comprises: one or more catalyst(s) selected from hydrogenation metal on a support~~, such as for example a catalyst selected from a group consisting of Pd, Pt, Ni, Co, Mo, Ru, Rh, W or any combination of these, preferably the catalytic zones comprise one or more catalyst(s) selected from CoMo, NiMo, NiW, CoNiMo on a support, for example an alumina support.~~.

~~12.~~13. Process according to ~~any one of the preceding claims~~claim 1, wherein the first hydrotreatment reactor ~~(**101**)~~ is operated at a WHSV in the range from 0.5-3 h~~-~~.sup.~~–~~1; and a ~~H_2~~H.sub.2 flow of 350-900 Nl ~~H_2~~H.sub.2/l feed.

~~13.~~14. Process according to ~~any one of the preceding claims~~claim 1, wherein the inlet temperature and pressure of the second hydrotreatment reactor ~~(**102**)~~ is 250-450 ~~-~~°° C. and 10-150 bar~~, such as 300-430 °C and 20-120 bar, such as 330-410 °C and 30-100 bar.~~.

~~14.~~15. Process according to ~~any one of the preceding claims~~claim 1, wherein the second hydrotreatment reactor ~~(**102**)~~ has a single catalytic zone.

~~15.~~16. Process according to ~~any one of the preceding claims~~claim 1, wherein the catalytic zones of the second hydrotreatment reactor comprise: one or more catalyst(s) selected from hydrogenation metal on a support~~, such as for example a catalyst selected from a group consisting of Pd, Pt, Ni, Co, Mo, Ru, Rh, W or any combination of these, preferably the catalytic zones comprise one or more catalyst(s) selected from CoMo, NiMo, NiW, CoNiMo on a support, for example an alumina support.~~.

~~16.~~17. Process according to ~~any one of the preceding claims~~claim 1, wherein the second hydrotreatment reactor ~~(102)~~ is operated at a WHSV in ~~the~~a range from 0.5-3 h~~-~~.sup.–1; and a ~~H2~~H.sub.2 flow of 350-900 Nl ~~H2~~H.sub.2/l feed.

~~17.~~18. Process according to ~~any one of the preceding claims~~claim 3, wherein the inlet temperature and pressure of the first isomerisation reactor ~~(103)~~ is 280-370 ~~°~~° C. and 20-50 bar.

~~18.~~19. Process according to ~~any one of the preceding claims~~claim 3, wherein the catalytic zones of the first isomerisation reactor comprise: one or more catalyst(s) ~~comprising~~containing a Group VIII metal on a support, where the support is selected from silica, alumina, clays, titanium oxide, boron oxide, zirconia, which ~~can be~~is used alone or as a mixture~~, preferably silica and/or alumina~~.

~~19.~~20. Process according to claim ~~18~~19, wherein the one or more catalyst(s) ~~further~~ comprise: a molecular sieve~~, such as a zeolite~~.

~~20.~~21. Process according to ~~any one of the preceding claims~~claim 3, wherein the isomerisation reactor ~~(103)~~ is operated at a WHSV in ~~the~~a range from 0.5-1 h~~-~~.sup.–1; and a ~~H2~~H.sub.2 flow of 300-500 Nl ~~H2~~H.sub.2/l feed.

~~21.~~22. Process according to ~~any one of the preceding claims~~claim 3, wherein the first isomerised liquid has an iso- to n-paraffin ratio above 1~~, such as from 1 to 2.5~~.

~~22.~~23. Process according to ~~any one of the preceding claims, wherein~~claim 1, wherein the hydrotreatment entry stream has a nitrogen impurity of 100 to 500 wppm.

~~23.~~24. Process according to ~~claims~~claim 1~~-21~~, wherein the first hydrotreated effluent ~~(106)~~ from the first hydrotreatment reactor has a nitrogen impurity of 100 to 500 wppm or more.

~~24.~~25. Process according to ~~any one of the preceding claims~~claim 1, where the second hydrotreated liquid ~~(112)~~ and/or ~~a~~the stripped hydrotreated liquid ~~(115)~~ contains ~~>~~≥99 wt % hydrocarbons and ~~<~~≤0.3 wppm nitrogen, measured as elemental nitrogen.

~~25.~~26. Process according to ~~any one of the preceding claims~~claim 1, wherein the hydrocarbon diluting agent ~~(126)~~ 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.