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(54) Title: PROCESS TO MAKE A RENEWABLE PRODUCT FROM BIOFEEDSTOCK

(57) **Abstract:** A process for making a renewable product from a biofeedstock, in which a biofeedstock is contacted with a hydroconversion catalyst under hydroconversion conditions, the biofeedstock comprising one or more biocomponents having a C_{20+} content of at least about 10 wt.%, and the hydroconversion catalyst comprising a hydroisomerization catalyst.

PROCESS TO MAKE A RENEWABLE PRODUCT FROM BIOFEEDSTOCK

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is related to and claims the benefit of priority to U.S. Provisional Patent Appl. Ser. No. 63/471,911 filed on 08 June 2023, entitled "PROCESS TO MAKE A RENEWABLE PRODUCT FROM BIOFEEDSTOCK", the disclosure of which is herein incorporated in its entirety.

FIELD OF THE INVENTION

[0002] Described herein are processes for hydroconversion of biofeedstocks to produce renewable products, such as renewable base oils and/or process fluids.

BACKGROUND

[0003] The use of renewable resources has garnered significant attention and effort in the drive to develop fossil fuel alternatives. The variety, availability, and versatility of various biofeedstocks has been of great interest, particularly certain lipid sources, leading to the development and commercial use of a number of bio-based fuel technologies. Ongoing economic interests, and the desire to reduce fossil fuel use, have provided incentives for improvements in existing technologies, and the development of new processes for utilizing renewable biofeedstocks to produce renewable fuels and other renewable products.

[0004] Renewable fuels (biofuels) and other products are seen as being important to reduce carbon and greenhouse emissions. Bioproducts derived from food are products typically made from food sources produced on arable land, while bioproducts derived from non-food sources are typically produced from lignocellulosic biomass like forestry residuals or agricultural residues and waste. Typical biofeedstocks in the food source category include a wide variety of lipids (e.g., vegetable oil, including used cooking oil, seed oils, animal fats, waste oils, algae oils, and the like). Typical non-food source feedstocks include wood, grasses, algae, crop byproduct, municipal solid waste, and the like. While renewable products derived from non-food sources are sometimes preferred over similar bioproducts derived from food sources, there remains an ongoing need for improvements in hydroconversion processes for all feedstock sources to produce renewable products.

SUMMARY OF THE INVENTION

[0005] This invention relates to processes for making renewable products from biofeedstocks, e.g., feeds containing biocomponents of biological origin. Various renewable products may be produced, including diesel, aviation and other fuels and distillates, as well as base oils or components thereof, and process fluids.

[0006] In one aspect, a process for making a renewable product from a biofeedstock is provided, the process comprising contacting a biofeedstock with a hydroconversion catalyst under hydroconversion conditions, wherein the biofeedstock comprises one or more biocomponents having a C_{20+} content of at least about 10 wt.%, and the hydroconversion catalyst comprises a hydroisomerization catalyst.

[0007] In another aspect, use of an isomerization catalyst to produce a renewable product is described, in which a hydroconversion catalyst is contacted with a biofeedstock comprising one or more biocomponents having a C_{20+} content of at least about 10 wt.%, or an intermediate product derived from a biofeedstock, under hydroconversion conditions to produce the renewable product, wherein the hydroconversion comprises hydroisomerization.

[0008] In some embodiments, products such as base oils, lubricating oils, and/or process fluids may be made according to the process.

[0009] Except where mutually exclusive, a feature described in relation to any aspect or embodiment described herein may be applied *mutatis mutandis* to any other aspect and/or embodiment. Furthermore, except where mutually exclusive, any feature described herein may be applied to any aspect/embodiment and/or combined with any other feature described herein.

DETAILED DESCRIPTION

[0010] Although illustrative embodiments of one or more aspects are provided herein, the disclosed processes may be implemented using any number of techniques. The disclosure is not limited to the illustrative or specific embodiments, any drawings, and any techniques illustrated herein, including any exemplary designs and embodiments illustrated and described herein, and may be modified within the scope of the appended claims along with their full scope of equivalents.

[0011] The following description of embodiments provides non-limiting representative examples referencing numerals to particularly describe features and teachings of different aspects of the invention. The embodiments described should be recognized as capable of implementation separately, or in combination, with other embodiments from the description of the embodiments. A person of ordinary skill in the art reviewing the description of embodiments is able to learn and understand the different described aspects of the invention. The description of embodiments should facilitate understanding of the invention such that other implementations, not specifically covered but within the ability of a person of skill in the art having read the description of embodiments, will be understood as being consistent with an application of the invention.

[0012] Unless otherwise indicated, the following terms have the meanings as defined hereinbelow.

[0013] The term “hydroconversion” refers to processes or steps performed in the presence of hydrogen for the hydrocracking, hydrogenation, hydrodeoxygenation, hydrodesulfurization, hydrodenitrogenation, hydrodemetallation, hydrodechlorination, hydrodecarboxylation, hydrodecarbonylation and/or hydrodearomatization of a hydrocarbon or biomass feedstock, and/or for the hydrogenation of unsaturated compounds in the feedstock. Depending on the type of hydroprocessing and the reaction conditions, products of hydroprocessing may have improved aromatic content, oxygen content, viscosities, viscosity indices, saturates content, cold flow and other low temperature properties, and volatilities, for example.

[0014] The term “hydrotreating” refers to processes or steps performed in the presence of hydrogen for the hydrodesulfurization, hydrodenitrogenation, hydrodeoxygenation, hydrodemetallation, and/or hydrodearomatization of components of a feedstock, and/or for the hydrogenation of unsaturated compounds in the feedstock.

[0015] The term “biofeedstock” as used herein refers to biocomponent feeds that are from or are derived from a biological source. Exemplary biofeedstocks include lipids, pyrolysis oils, biomass derived feeds, and the like. Triglycerides are a component of some biofeedstocks, such as lipids. The biofeedstock typically has a boiling range suitable for producing a diesel, aviation or other fuel, distillate, base oil, and/or process fluid therefrom. In the case of some biofeedstocks comprising triglycerides, such feedstocks have an “apparent” boiling temperature range (based on the GC elution time of the triglyceride peaks according to Simdist method ASTM D-2887) suitable for producing a diesel, aviation or other fuel, or distillate therefrom. The biofeedstock boiling range (or apparent boiling range) may also be suitable for producing a base oil or a component thereof. Suitable biofeedstocks are those which, upon hydrotreating, result in hydrocarbons with a boiling point range of about 250°F (121°C) to about 900°F (482°C), for example about 300°F (149°C) to about 900°F (482°C), or about 250°F (121°C) to about 800°F (427°C). While the apparent boiling range of the lipids before hydrotreatment may, in some cases, be higher than 900°F, upon hydrotreatment, such lipids are converted into hydrocarbons having lower boiling temperatures or temperature ranges, as described herein. In some cases, e.g., for typical lipids after hydrotreating, an upper boiling point of about 900°F (482°C) includes hydrocarbon molecules having a number of carbon atoms and chain length making them suitable for the applications described herein. In general, at least one biofeedstock, or a biocomponent thereof, used in the process has a C_{20+} content of at least about 10 wt.%.

[0016] The term “biocomponent feed” as used herein refers to a feedstock derived from a biocomponent-containing source, such as a plant-based oil or fat, an animal-based oil or fat, a fish-based oil or fat, or algae-based oil or fat. Such feedstocks are generally hydrotreated products derived from biological sources. In some embodiments, suitable biocomponent feeds may have a boiling point range of about 250°F (121°C) to about 900°F (482°C), for example about 300°F (149°C) to about 900°F (482°C), about 400°F to about 900°F (about 204°C to about 482°C), about 500°F to about 900°F (about 260°C to about 482°C), about 600°F (316°C) to about 900°F (482°C), or about 700°F (371°C) to about 900°F (482°C) at atmospheric pressure. The biocomponent feed may have a 90 % distillation temperature of less than about 1000°F (538°C), or 900°F (482°C), or 800°F (427°C) or 700°F (371°C), or less than about 650°F (343°C). In some embodiments, the biocomponent feed has a 90% distillation temperature in the range of about 550°F (288°C) to about 750°F (399°C), for example about 550°F (288°C) to about 700°F (371°C), or about 600°F (316°C) to about 700°F (371°C). The 90% distillation temperature may be determined in accordance with ASTM D-2887. In some embodiments, the biocomponent feed has a 5%

distillation temperature in the range of about 250°F (121°C) to about 600°F (316°C), for example about 300°F (149°C) to about 600°F (316°C), or about 400°F (about 204°C) to about 600°F (316°C). The 5 % distillation temperature may be determined in accordance with ASTM D 2887. In some embodiments, the biocomponent feed has a 90 % distillation temperature in the range of about 550°F (about 288°C) to about 750°F (about 399°C) and a 5% distillation temperature in the range of about 250°F (121°C) to about 600°F (316°C). In some embodiments, the biocomponent feed has a 90% distillation temperature in the range of about 550°F (288°C) to about 700°F (371°C) and a 5% distillation temperature in the range of about 300°F (149°C) to about 600°F (316°C). In some embodiments, the biocomponent feed has a 90% distillation temperature which is greater than about 600°F (316°C), for example from about 605°F (about 318°C) to about 675°F (357°C), and a 5% distillation temperature which is less than about 600°F (316°C), for example from about 540°F (282°C) to about 580°F (304°C). In some embodiments, the biocomponent feed has a 90 % distillation temperature in the range of equal to or greater than about 600°F (316°C) to about 700°F (371°C) and a 5 % distillation temperature in the range of about 400°F (204°C) to equal to or less than about 600°F (316°C). In some cases, e.g., for typical lipids after hydrotreating, an upper boiling point of about 900°F (482°C) includes hydrocarbon molecules having a number of carbon atoms that makes them suitable for the applications described herein.

[0017] The term “renewable product” is used herein to refer to a product produced wholly or in-part from a non-fossil fuel source. Suitable feedstocks to produce renewable products are generally derived from materials of biological origin. Renewable products may comprise one or more renewable components, e.g., products derived from feedstocks from more than one biological source.

[0018] The term “Fischer-Tropsch feed” as used herein refers to refer to a synthetic feedstock produced via a Fischer-Tropsch process and generally having a 90 % distillation temperature of less than about 1350°F (732°C), or less than about 1100°F (593°C), or less than about 1000°F (538°C), or less than about 900°F (482°C), or less than about 800°F (427°C), or less than about 750°F (399°C), or less than about 700°F (371°C). In some embodiments, the Fischer-Tropsch feed has a 90 % distillation temperature in the range of about 550°F (288°C) to about 750°F (399°C), for example about 550°F (288°C) to about 700°F (371°C), or about 600°F (316°C) to about 700°F (371°C). The 90 % distillation temperature may be determined in accordance with ASTM D 2887. In some embodiments, the Fischer-Tropsch feed has a 5 % distillation temperature in the range of about 250°F (121°C) to about 600°F (316°C), for example about 300°F (149°C) to about 600°F (316°C), or about 340°F (171°C) to about 600°F (316°C), or about 340°F (171°C) to about 500°F (260°C), or about 340°F (171°C) to about 400°F (204°C). The 5% distillation temperature may be determined in accordance with ASTM D-2887. In some embodiments, the Fischer-Tropsch feed has a 90% distillation temperature in the range of about 550°F (288°C) to about 750°F (399°C) and a 5% distillation temperature in the range of about 250°F (121°C) to about 600°F (316°C). In some embodiments, the Fischer-Tropsch feed has a 90% distillation temperature in the range of about 550°F (288°C) to about 700°F (371°C) and a 5% distillation temperature in the range of about 300°F (149°C) to about 600°F (316°C). In some embodiments, the Fischer-Tropsch feed has a 90% distillation temperature in the range of about 600°F (316°C) to about 700°F (371°C) and a 5% distillation temperature in the range of about 340°F (171°C) to about 600°F (316°C). In some embodiments, the Fischer-Tropsch feed has a 90% distillation temperature in the range of about 600°F (316°C) to about 700°F (371°C) and a 5% distillation temperature in the range of about 340°F (171°C) to about 500°F (260°C). In some embodiments, the Fischer-Tropsch feed has a 90% distillation temperature in the range of about 600°F (316°C) to about 700°F (371°C) and a 5% distillation temperature in the range of about 340°F (171°C) to about 400°F (204°C). In some embodiments, a “Fischer-Tropsch feed” may have boiling points in the range of about 250°F (121°C) to about 900°F (482°C), for example about 250°F (121°C) to about 800°F (427°C) at atmospheric pressure.

[0019] The term “diesel fuel” is used herein to refer to a hydrocarbon product having boiling points in the range of about 300°F to about 800°F (about 149°C to about 427°C) at atmospheric pressure.

[0020] The term “fossil fuel component” is used herein to refer to a component produced wholly or in-part from a fossil fuel source.

[0021] The term “process fluid” is used herein to refer to a fluid used as a working or other fluid in a process or device that is not generally part of a final or intermediate product made by the process or device, including devices used in chemical, electrical, and/or mechanical processes. While not limited thereto, process fluid examples include drilling fluids, transformer fluids, thermal oils, hydraulic fluids, transmission fluids and/or gear oils, metal working fluids, or a combination thereof.

[0022] The term “active source” means a reagent or precursor material capable of supplying at least one element in a form that can react, and which can be incorporated into the molecular sieve structure. The terms “source” and “active source” can be used interchangeably herein.

[0023] The term “molecular sieve” and "zeolite" are synonymous and include (a) intermediate and (b) final or target molecular sieves and molecular sieves produced by (1) direct synthesis or (2) post-crystallization treatment (secondary modification). Secondary synthesis techniques allow for the synthesis of a target material from an intermediate material by heteroatom lattice substitution or other techniques. For example, an aluminosilicate can be synthesized from an intermediate borosilicate by post-crystallization heteroatom lattice substitution of the Al for B. Such techniques are known, for example as described in U.S. Patent No. 6,790,433 to C.Y. Chen and Stacey Zones, issued September 14, 2004.

[0024] The terms “*MRE-type molecular sieve”, "EUO-type molecular sieve" and “MTT-type molecular sieve” includes all molecular sieves and their isotypes that have been assigned the International Zeolite Association framework, as described in the *Atlas of Zeolite Framework Types*, eds.

Ch. Baerlocher, L.B. McCusker and D.H. Olson, Elsevier, 6th revised edition, 2007 and the Database of Zeolite Structures on the International Zeolite Association's website (http://www.iza-online.org).

[0025] SiO_2/Al_2O_3 Ratio (SAR): determined by ICP elemental analysis. A SAR of infinity (∞) represents the case where there is no aluminum in the zeolite, i.e., the mole ratio of silica to alumina is infinity. In that case, the molecular sieve is comprised essentially of silica.

[0026] As used herein, the term “pour point” refers to the temperature at which an oil will begin to flow under controlled conditions. The pour point may be determined by ASTM D5950.

[0027] As used herein, “cloud point” refers to the temperature at which a sample begins to develop a haze as the oil is cooled under specified conditions. Cloud point may be determined by ASTM D5773.

[0028] “Group 2, 8, 9 and 10 metals” refers to elemental metal(s) selected from Groups 2, 8, 9 and 10 of the Periodic Table of the Elements and/or to metal compounds comprising such metal(s). “Group 6 metals” refers to elemental metal(s) selected from Group 6 of the Periodic Table of the Elements and/or to metal compounds comprising such metal(s).

[0029] The term “Periodic Table” refers to the version of IUPAC Periodic Table of the Elements dated 1 December 2018.

[0030] Unless otherwise specified, the “feed rate” of a feedstock being fed to a catalytic reaction zone is expressed herein as the volume of feed per volume of catalyst per hour, which may be referred to as liquid hourly space velocity (LHSV) with units of reciprocal hours (h^{-1}).

[0031] For the purposes of this specification and appended claims, unless otherwise indicated, all numbers expressing quantities, percentages or proportions, and other numerical values used in the specification and claims, are to be understood as being modified in all instances by the term “about.” Accordingly, unless indicated to the contrary, the numerical parameters set forth in the following specification and attached claims are approximations that can vary depending upon the desired properties sought to be obtained. It is noted that, as used in this specification and the appended claims, the singular forms “a,” “an,” and “the,” include plural references unless expressly and unequivocally limited to one referent. As used herein, the term “include” and its grammatical variants are intended to be non-limiting, such that recitation of items in a list is not to the exclusion of other like items that can be substituted or added to the listed items. As used herein, the term “comprising” means including elements or steps that are identified following that term, but any such elements or steps are not exhaustive, and an embodiment can include other elements or steps.

[0032] Unless otherwise specified, the recitation of a genus of elements, materials or other components, from which an individual component or mixture of components can be selected, is intended to include all possible sub-generic combinations of the listed components and mixtures thereof. In addition, all number ranges presented herein are inclusive of their upper and lower limit values.

[0033] If a standard test is mentioned herein, unless otherwise stated, the version of the test to be referred to is the most recent at the time of filing this patent application.

[0034] The patentable scope is defined by the claims, and can include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims. To an extent not inconsistent herewith, and in jurisdictions where permitted, all citations referred to herein are hereby incorporated by reference.

[0035] Biofeedstocks described herein comprise or are a biocomponent feed. In some embodiments, the biofeedstock comprises, consists essentially of, or consists of a biocomponent feed. In some embodiments, the biocomponent feed constitutes at least about 5 wt.% of the biofeedstock, for example, at least about 10 wt.%, at least about 20 wt.%, at least about 30 wt.%, at least about 40 wt.%, at least about 50 wt.%, at least about 60 wt.%, at least about 70 wt.%, at least about 80 wt.%, at least about 90 wt.%, at least about 95wt.%, at least about 98 wt.%, or at least about 99 wt.% of the biofeedstock. In some embodiments, the biocomponent feed constitutes 5 wt.% to 100 wt.% of the biofeedstock, for example 10 wt.% to 100 wt.%, 50 wt.% to 100 wt.%, 80 wt.% to 100 wt.%, or 95 wt.% to 100 wt.% of the biofeedstock.

[0036] In some embodiments, the biofeedstock comprises, consists essentially of, or consists of a biocomponent feed. For example, the biocomponent feed may constitute at least about 5 wt.% of the biofeedstock, such as at least about 10 wt.%, at least about 20 wt.%, at least about 30 wt.%, at least about 40 wt.%, at least about 50 wt.%, at least about 60 wt.%, at least about 70 wt.%, at least about 80 wt.%, at least about 90 wt.%, at least about 95 wt.%, at least about 98 wt.%, or at least about 99 wt.% of the biofeedstock. In some embodiments, the Fischer-Tropsch feed may constitute 5 wt.% to 100 wt.% of the biofeedstock, for example 10 wt.% to 100 wt.%, 50 wt.% to 100 wt.%, 80 wt.% to 100 wt.%, or 95 wt.% to 100 wt.% of the biofeedstock.

[0037] In some embodiments, the biofeedstock is a blended feedstock comprising a biocomponent feed, or also comprising a FischerTropsch feed, in combination with another feedstock, such as a blend feed. For example, the blended feedstock may comprise a blend feed selected from gas oils, vacuum gas oils, long residues, vacuum residues, atmospheric distillates, heavy fuels, oils, waxes and paraffins, used oils, deasphalted residues or crudes, charges resulting from thermal or catalytic conversion processes, or a combination thereof. In some embodiments, the blend feed is selected from whole crude petroleum, reduced crudes, vacuum tower residua, cycle oils, synthetic crudes, gas oils, vacuum gas oils, foots oils, Fischer-Tropsch derived waxes, lubricating oil stocks, heating oils, heavy neutral feeds, hydrotreated gas oils, hydrocracked gas oils, hydrotreated lubricating oil raffinates, brightstocks, lubricating oil stocks, synthetic oils, high pour point polyolefins (for example, polyolefins having a pour point of about 0°C or above); normal alpha olefin waxes, slack waxes, deoiled waxes, microcrystalline waxes, residuum fractions from atmospheric pressure distillation processes, solvent-deasphalted petroleum residua, shale oils, cycle oils, petroleum wax, slack wax, and waxes produced in chemical plant processes. In some embodiments, the feedstock is a blended feedstock comprising a biocomponent feed and a Fischer-Tropsch feed. In some embodiments, the feedstock is a blended feedstock comprising a biocomponent feed, a Fischer-Tropsch feed and a blend feed (for example, a blend feed, *supra*). The blended feedstock, blend feed, and/or biofeedstock may also comprise a recycled product and/or intermediate process stream. As previously noted, such biofeedstocks or biocomponents are generally hydrotreated products derived from biological sources, wherein the biocomponents are hydrotreated by themselves or hydrotreated together with other feedstock components.

[0038] In some embodiments, the feedstock is a blended feedstock comprising a biocomponent feed and a blend feed, where the blended feedstock comprises at least about 5 wt.% of the biocomponent feed and up to about 95 wt.% of a blend feed component, for example, at least about 10 wt.% of the biocomponent feed and up to about 90 wt.% of a blend feed component, at least about 50 wt.% of the biocomponent feed and up to about 50 wt.% of a blend feed component, at least about 80 wt.% of the biocomponent feed and up to about 20 wt.% of a blend feed component, or at least about 95 wt.% of the biocomponent feed and up to about 5 wt.% of a blend feed component.

[0039] The Fischer-Tropsch feed (if used) will typically have a paraffin content of at least about 90 wt.%, for example, at least about 95 wt.%, or at least about 97.5 wt.%. The Fischer-Tropsch (FT) feed typically comprises only very minor amounts of olefins and cycloparaffins, for example, less than about 1.0 wt.% olefin, or less than about 0.5 wt.% olefin, and/or less than about 1.0 wt.% cycloparaffin, less than about 0.5 wt.% cycloparaffin, or less than about 0.1 wt.% cycloparaffin. In some embodiments, the FT feed has a sulfur (S) content of less than about 50 ppm, for example less than about 20 ppm. In some embodiments, the FT feed has a nitrogen (N) content of less than about 50 ppm, for example less than about 20 ppm. In some embodiments, the FT feed has a metal content of less than about 10 ppm, for example less than about 5 ppm. The paraffin content and cylcoparaffin content of the FT feed may be determined by GC-FIMS analysis as described in "Diesel Fuel Analysis by GC-FIMS: Normal Paraffins, Isoparaffins and Cycloparaffins", Briker, Y., et al., Energy Fuels 2001, 15, 4, 996-1002. The nitrogen content of the FT feed may be determined in accordance with ASTM D3228-20. The sulfur content of the FT feed may be determined in accordance with ASTM D4629. The metal content of the FT feed may be measured by inductively coupled plasma atomic emission spectroscopy (ICP-AES).

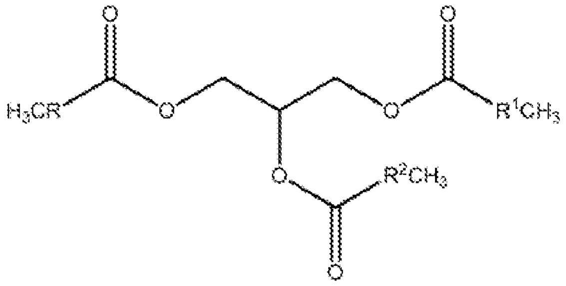
[0040] In some embodiments, the feedstock is a blended feedstock comprising a Fischer-Tropsch (FT) feed in combination with a blend feed, where the blended feedstock comprises at least about 5 wt.% of the FT feed and up to about 95 wt.% of a blend feed, for example at least about 10 wt.% of the FT feed and up to about 90 wt.% of a blend feed, at least about 50 wt.% of the FT feed and up to about 50 wt.% of a blend feed, at least about 80 wt.% of the FT feed and up to about 20 wt.% of a blend feed, or at least about 95 wt.% of the FT feed and up to about 5 wt.% of a blend feed.

[0041] In some embodiments, the biofeedstock comprises, consists essentially of or consists of a biocomponent feed. Plant-based oils and fats include vegetable oils and fats, such as rapeseed (canola) oil, soybean oil, coconut oil, sunflower oil, palm oil, palm kernel oil, peanut oil, linseed oil, colza oil, tall oil, corn oil, castor oil, jatropha oil, jojoba oil, olive oil, flaxseed oil, hempseed oil, cottonseed oil, camelina oil, safflower oil, mustard oil, carinata oil, cuphea oil, curcas oil, crambe oil, babassu oil, tallow oil, and rice bran oil. Animal oils and fats, and other sources, include beef fat (tallow), hog fat (lard), turkey fat, fish fat/oil, and chicken fat), yellow and brown greases, including algae and fish fats/oils, fats in milk, sewage sludge, and the like.

[0042] In certain embodiments, the biofeedstock comprises or is a biocomponent feed selected from carinata oil, rapeseed oil, peanut oil, mustard oil, tallow, rice bran wax, carnauba wax, or a combination thereof. While not limited thereto, the biofeedstock or biocomponent may be obtained from a plant family selected from Brassicaceae (formerly Cruciferaceae), Limnanthaceae, Simmondsiaceae, Tropaeolaceae, Olocaceae, Copernicia, or a combination thereof.

[0043] In some embodiments, the biocomponent feed may include feed components selected from vegetable oils and animal fats comprising, or consisting essentially of, triglycerides and free fatty acids (FFA). In some embodiments, the biofeedstock comprises or is a biocomponent feed selected from lipids, vegetable oils, seed oils, and animal fats which comprise triglycerides and free fatty acids. For example, suitable biocomponent feeds may be selected from canola oil, corn oil, soy oils, castor oil, camelina oil, palm oil and a combination thereof.

[0044] In some embodiments, the triglycerides and FFAs contain aliphatic hydrocarbon chains in their structure having 6-32 carbon atoms (for example, 6 to 22, 24, 26, 28, 30, or 32 carbon atoms; 8 to 22, 24, 26, 28, 30, or 32 carbon atoms; 10 to 22, 24, 26, 28, 30, or 32 carbon atoms; 12 to 22, 24, 26, 28, 30, or 32 carbon atoms; 14 to 22, 24, 26, 28, 30, or 32 carbon atoms; 16 to 22, 24, 26, 28, 30, or 32 carbon atoms; and/or 18 to 22, 24, 26, 28, 30, or 32 carbon atoms). In some embodiments, the biocomponent feed may comprise triglycerides having the general formula (1):



(1)

[0045] where R, R^1 and R^2 are independently aliphatic hydrocarbon chains having from 6-32 carbon atoms (for example, 6 to 24, 8 to 24, 12 to 24, 16 to 32, 16 to 24, 18 to 24, 20 to 24, 6 to 20, 8 to 20, 10 to 20, 6 to 18, 8 to 18, 10 to 18, or 6 to 16, 8 to 16, 10 to 16 carbon atoms). In some embodiments, R, R^1 and R^2 are independently branched or un-branched, substituted or unsubstituted, completely saturated or contain one or more (for example 1-4, 1-3 or 1 or 2) unsaturated carbon-carbon bonds. In some embodiments, R, R^1 and R^2 are unsubstituted. In some embodiments, R, R^1 and R^2 are independently completely saturated or contain one or more (e.g., 1 to 4, 1 to 3 or 1 or 2) unsaturated carbon-carbon bonds. In some embodiments, R, R^1 and R^2 are un-branched.

[0046] The biofeedstock or biocomponent feed component may comprise free fatty acids (FFAs) having aliphatic hydrocarbon tails (substituent groups) of 6 to 32 carbon atoms, for example 6, 8, 10, 12, 14, 16, or 18 to 24 carbon atoms, 6, 8, 10, 12, 14, 16, 18 or 20 to 32 carbon atoms, 6, 8, 10, or 12 to 20 carbon atoms, 6, 8, 10, or 12 to 18 carbon atoms, and/or 6, 8, or 10 to 16 carbon atoms, and the like. The FFAs may comprise unsaturated or saturated aliphatic hydrocarbon tails. The FFAs may comprise unbranched or branched aliphatic hydrocarbon tails.

[0047] The biofeedstock may comprise or be a biocomponent feed wherein the biofeedstock comprises one or more biocomponents having a C_{20+} content of at least about 10 wt.%. In some cases, the C_{20+} content of the biofeedstock and/or a biocomponent thereof may be less than about 80 wt.%, 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, or 20 wt.%. The C_{20+} content of the biofeedstock or a biocomponent may also be greater about 20 wt.%, 30 wt.%, 40 wt.%, 50 wt.%, 60 wt.%, or 70 wt.%, or a combination thereof. In some cases, a content range for the biofeedstock or a biocomponent may include a C_{20+} content in the range of about 10 to 80 wt.%, 10 to 70 wt.%, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 80 wt.%, 30 to 80 wt.%, 40 to 80 wt.%, 50 to 80 wt.%,20 to 70 wt.%, 20 to 60 wt.%, 20 to 50 wt.%, 20 to 40 wt.%, 30 to 80 wt.%, 30 to 70 wt.%, 30 to 60 wt.%, 30 to 50 wt.%, 40 to 80 wt.%, 40 to 70 wt.%, 40 to 60 wt.%, 50 to 80 wt.%, 50 to 70 wt.%, or 60 to 80 wt.%.

[0048] In addition to the C_{20+} content of the biofeedstock and/or a biocomponent thereof, the C_{16} content of the biofeedstock or a biocomponent thereof may be less than about 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, 20 wt.%, 10 wt.%, 8 wt.%, 5 wt.%, 2 wt.%, 1 wt.%. The C_{16} content of the biofeedstock or a biocomponent thereof may be greater about 1 wt.%, 2 wt.%, 5 wt.%, 8 wt.%, or 10 wt.%, or a combination thereof. The C_{16} content of the biofeedstock or a biocomponent thereof may be in the range of about 0 to 70 wt. %, 0 to 60 wt.%, 0 to 50 wt.%, 0 to 40 wt.%, 5 to 70 wt. %, 5 to 60 wt.%, 5 to 50 wt.%, 5 to 40 wt.%, 10 to 70 wt. %, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 70 wt. %, 20 to 60 wt.%, 20 to 50 wt.%, or 20 to 40 wt.%.

[0049] In addition to the C_{20+} content of the biofeedstock and/or a biocomponent thereof, and in addition to or separate from the C_{16} content limits or ranges noted hereinabove, the C_{18} content of the biofeedstock or a biocomponent thereof may be less than about 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, 20 wt.%, 10 wt.%, or 5 wt.%. The C_{18} content of the biofeedstock or a biocomponent thereof may be greater than about 5 wt.%, 10 wt.%, 20 wt.%, 30 wt.%, 40 wt.%, 50 wt.%, or 60 wt.%, or a combination thereof. The C_{18} content of the biofeedstock or a biocomponent thereof may be in the range of about 0 to 70 wt. %, 0 to 60 wt.%, 0 to 50 wt.%, 0 to 40 wt.%, 5 to 70 wt. %, 5 to 60 wt.%, 5 to 50 wt.%, 5 to 40 wt.%, 10 to 70 wt. %, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 70 wt. %, 20 to 60 wt.%, 20 to 50 wt.%, or 20 to 40 wt.%.

[0050] In addition to the C_{20+} content of the biofeedstock and/or a biocomponent thereof, and in addition to or separate from the C_{16} and/or C_{18} content limits or ranges noted hereinabove, the C_{20} content of the biofeedstock or a biocomponent thereof may be less than about 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, 20 wt.%, 10 wt.%, or 5 wt.%. The C_{20} content of the biofeedstock or a biocomponent thereof may be greater than about 5 wt.%, 10 wt.%, 20 wt.%, 30 wt.%, 40 wt.%, 50 wt. %, or 60 wt.%, or a combination thereof. The C_{20} content of the biofeedstock or a biocomponent thereof may be in the range of about 0 to 70 wt. %, 0 to 60 wt.%, 0 to 50 wt.%, 0 to 40 wt.%, 5 to 70 wt. %, 5 to 60 wt.%, 5 to 50 wt.%, 5 to 40 wt.%, 10 to 70 wt. %, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 70 wt. %, 20 to 60 wt.%, 20 to 50 wt.%, or 20 to 40 wt.%.

[0051] In addition to the C_{20+} content of the biofeedstock and/or a biocomponent thereof, and in addition to or separate from the C_{16}, C_{18}, and/or C_{20} content limits or ranges noted hereinabove, the C_{22+} content of the biocomponent may be less than about 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, 20 wt.%, 10 wt.%, or 5 wt.%. The C_{22+} content of the biofeedstock and/or a biocomponent thereof may be greater than about 5 wt.%, 10 wt.%, 20 wt.%, 30 wt.%, 40 wt.%, 50 wt.%, or 60 wt.%, or a combination thereof. The C_{22+} content of the biofeedstock and/or a biocomponent thereof may be in the range of about 0 to 70 wt. %, 0 to 60 wt.%, 0 to 50 wt.%, 0 to 40 wt.%, 5 to 70 wt. %, 5 to 60 wt.%, 5 to 50 wt.%, 5 to 40 wt.%, 10 to 70 wt. %, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 70 wt. %, 20 to 60 wt.%, 20 to 50 wt.%, or 20 to 40 wt.%.

[0052] In addition to the C_{20+} content of the biofeedstock and/or a biocomponent thereof, and in addition to or separate from the C_{16}, C_{18}, C_{20}, and/or C_{22+} content limits or ranges noted hereinabove, the C_{24+} content of the biofeedstock and/or a biocomponent thereof may be less than about 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, 20 wt.%, 10 wt.%, or 5 wt.%. The C_{24+} content of the biofeedstock and/or a biocomponent thereof may be greater than about 5 wt.%, 10 wt.%, 20 wt.%, 30 wt.%, 40 wt.%, 50 wt.%, or 60 wt.%, or a combination thereof. The C_{24+} content of the biofeedstock and/or a biocomponent thereof may be in the range of about 0 to 70 wt. %, 0 to 60 wt.%, 0 to 50 wt.%, 0 to 40 wt.%, 5 to 70 wt. %, 5 to 60 wt.%, 5 to 50 wt.%, 5 to 40 wt.%, 10 to 70 wt. %, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 70 wt. %, 20 to 60 wt.%, 20 to 50 wt.%, or 20 to 40 wt.%.

[0053] In some cases, the C_{20} to C_{32} content of the biofeedstock and/or a biocomponent thereof may be at least about 10 wt.%, or 15 wt.%, or 20 wt.%, or 30 wt.%, or 40 wt.%, or 50 wt.%, or 60% wt.%, or

70 wt.%, or 80 wt.%, or in the range of about 10 to 80 wt.%, or 15 to 80 wt.%, or 20 to 80 wt.%, or 30 to 80 wt.%, or 40 to 80 wt.%, or 50 to 80 wt.%, or 60% to 80 wt.%, or 70 to 80 wt. %.

[0054] In general, and in addition to the C_{20+} content of the biofeedstock and/or a biocomponent thereof, the C_{16} content of the biocomponent is about 0 to 70 wt.%; the C_{18} content of the biocomponent may be about 0 to 70 wt.%; the C_{20} content of the biocomponent may be about 0 to 70 wt.%; the C_{22} content of the biocomponent may be about 0 to 70 wt.%; the C_{22+} content of the biocomponent may be about 0 to 70 wt.%; the C_{24} content of the biocomponent may be about 0 to 70, 60, 50, or 40 wt.%; and the C_{24+} content of the biocomponent may be about 0 to 70, 60, 50, or 40 wt.%, or a combination thereof.

[0055] In general, the biofeedstock may comprise or be a biocomponent feed wherein the biofeedstock comprises one or more biocomponents having a C_{20+} content of at least about 10 wt.%. For example, suitable biocomponents may include carinata oil, rapeseed oil, peanut oil, mustard oil, tallow, rice bran wax, carnauba wax, or a combination thereof. In some embodiments, the biocomponent feed is or may comprise one or more other biocomponents that typically do not have a high C_{20+} content, e.g., such bioomponents may include canola oil, corn oil, soy oils, castor oil, camelina oil, palm oil, combinations thereof, and the like.

[0056] The biocomponent feed may have an oxygenate content of at least about 0.5 wt.% by total weight of the biocomponent feed, for example, at least about 1.0 wt.%, at least about 2.0 wt.%, at least about 3.0 wt.%, at least about 4.0 wt.%, or at least about 5.0 wt.% by total weight of the biocomponent feed. The biocomponent feed may, e.g., have an oxygenate content of up to about 15 wt.% by total weight of the biocomponent feed, or up to about 10 wt.% by total weight of the biocomponent feed, or up to about 5 wt.% by total weight of the biocomponent feed. In some embodiments, the biocomponent feed has an oxygenate content in the range of about 1-15 wt.% by total weight of the biocomponent feed, for example, in the range of about 5-15 wt.%, or about 10-15 wt.%, by total weight of the biocomponent feed. The oxygenate content of the biocomponent feed may be measured by neutron activation analysis, for example, in accordance with ASTM E385-90(2002).

[0057] The biocomponent feed may be hydrotreated prior to being contacted with a hydroconversion catalyst for further hydroprocessing, e.g., with the hydroisomerization/hydrodewaxing catalyst. In some cases, the biocomponent feed may have a sulfur (S) content of less than about 200 ppm, for example less than about 100 ppm, less than about 50 ppm or less than about 20 ppm. In some cases, the biocomponent feed may have a nitrogen (N) content of less than about 50 ppm, for example less than about 20 ppm, or less than about 10 ppm. In some cases, the hydrotreated biocomponent feed may have an oxygenate content that is typically about 0 wt.%, or, alternatively, of less than about 2 wt.%, or 5 wt.%. The nitrogen content of the biocomponent feed may be determined in accordance with ASTM D4629. The sulfur content of the biocomponent feed may be determined in accordance with ASTM D2622.

[0058] The hydroconversion catalyst may comprise a hydrotreating catalyst and/or a hydroisomerization catalyst and may include a precious metal catalyst as the hydroconversion catalyst. In some cases, the hydroconversion catalyst may include a base metal catalyst, or a combination of a base metal catalyst and a precious metal catalyst. While not limited thereto, the base metal catalyst typically includes a base metal selected from Mo, Ni, W, Co, and combinations thereof, or Mo, or a combination of Mo and Ni. Similarly, while not limited thereto, the precious metal catalyst typically includes a precious metal selected from Pt, Pd, or a combination thereof.

[0059] The term “hydroisomerization catalyst” as used herein refers to a catalyst that facilitates the skeletal isomerization of hydrocarbon molecules. In some embodiments, suitable hydroisomerization catalysts include catalysts comprising zeolite SSZ-91, SSZ-32, SSZ-32x, and the like. Other hydroisomerization catalysts may also be suitable, including, e.g., catalysts based on zeolite ZSM-48 and/or combinations of ZSM-48 with other hydroisomerization catalysts. Combinations of suitable hydroisomerization catalysts based on the same or different zeolite supports may also be used.

[0060] While not limited thereto, the hydroisomerization catalyst may comprise zeolite SSZ-91, or from about 5 to about 95 wt.% zeolite SSZ-91 by total weight of the hydroisomerization catalyst, or from about 10 to about 95 wt.% zeolite SSZ-91, from about 20 to about 90 wt.% zeolite SSZ-91, or from about 25 to about 85 wt.% zeolite SSZ-91, or from about 30 to about 80 wt.% zeolite SSZ-91, or from about 35 to about 75 wt.% zeolite SSZ-91, or from about 35 to about 65 wt.% zeolite SSZ-91, or from about 35 to about 55 wt.% zeolite SSZ-91, or from about 45 to about 75 wt.% zeolite SSZ-91, or from about 55 to about 75 wt.% zeolite SSZ-91 by total weight of the hydroisomerization catalyst.

[0061] The hydroisomerization catalyst may further comprise a metal modifier, for example a metal modifier selected from Group 2, 8, 9 and 10 metals or combinations thereof. In some embodiments, the metal modifier is selected from Group 8, 9 or 10 metals and combinations thereof, for example the metal modifier may be selected from Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt and combinations thereof. In some embodiments, the metal modifier is selected from Group 10 metals and combinations thereof. In some embodiments, the hydroisomerization catalyst comprises platinum, palladium, or a combination thereof. Base metals, such as Mo, Ni, W, Co, and combinations thereof, may be included in the catalyst.

[0062] The hydroisomerization catalyst may comprise from about 0.05 to about 10 wt.%, or 5 wt.% or 2.0 wt.% of a metal modifier (e.g., selected from Group 2, 8, 9 and 10 metals, or a Group 8, 9 or 10 metal, for example a Group 10 metal such as platinum) by total weight of the hydroisomerization catalyst, for example, about 0.1 to about 1.5 wt.%, or about 0.2 to about 1.5 wt.%, or about 0.1 to about 1 wt.%, by total weight of the hydroisomerization catalyst. In some cases, e.g., where base metals are included, the metal content may be higher, e.g., at least about 5 wt.%, or 10 wt.%, or 15 wt.% or

20 wt.%, or 25 wt.%, or at least about 30 wt.%, or in the range of about 2 wt. % or 5 wt.% to about 25 wt.% or 30 wt.%.

[0063] The hydroisomerization catalyst may further comprise an oxide binder. Suitable oxide binders include an inorganic oxide, e.g., the oxide binder may be selected from alumina, silica, ceria, titania, tungsten oxide, zirconia, and combinations thereof. The hydroisomerization catalyst may comprise an oxide binder comprising alumina. Suitable aluminas are commercially available, including, e.g., Catapal® aluminas and Pural® aluminas from Sasol® or Versal® aluminas from UOP®. In general, the alumina can be any alumina known for use as a matrix material in a catalyst base. For example, the alumina can be boehmite, bayerite, γ-alumina, η-alumina, θ-alumina, δ-alumina, χ-alumina, or a mixture thereof. The hydroisomerization catalyst may comprise from about 5 to about 95 wt.% oxide binder by total weight of the hydroisomerization catalyst, for example about 5 to about 80 wt.% oxide binder, about 10 to about 70 wt.% oxide binder, about 20 to about 70 wt.% oxide binder, for example about 25 to about 65 wt.% oxide binder by total weight of the hydroisomerization catalyst.

[0064] The hydroisomerization catalyst may comprise from about 5 to about 95 wt.% zeolite SSZ-91, from about 0.05 to about 2.0 wt.% of a Group 8-10 metal; and from about 5 to about 95 wt.% oxide binder by total weight of the hydroisomerization catalyst. The hydroisomerization catalyst may comprise from about 30 to about 80 wt.% zeolite SSZ-91, from about 0.1 to about 1.5 wt.% of a Group 8-10 metal; and from about 20 to about 70 wt.% oxide binder by total weight of the hydroisomerization catalyst.

[0065] Zeolite SSZ-91 and methods for making zeolite SSZ-91 are described in US-A-9920260 which is incorporated herein by reference in its entirety. Zeolite SSZ-91 may also be referred to as SSZ-91 molecular sieve.

[0066] Zeolite SSZ-91 has a SiO_2/Al_2O_3 mole ratio (SAR) of 40 to 220. In some embodiments, zeolite SSZ-91 has a SiO_2/Al_2O_3 mole ratio (SAR) of 40 to 200, for example, 70 to 200, 80 to 200, 70 to 180, 80 to 180, 70 to 160, 80 to 160, 70 to 140, 80 to 140, 100 to 160, 100 to 140, or 120 to 140. The SAR is determined by inductively coupled plasma (ICP) elemental analysis.

[0067] Zeolite SSZ-91 is composed of at least 70% polytype 6 of the total ZSM-48-type material present in the product. The proportion of polytype 6 of the total ZSM-48-type material present in the product is determined by DIFFaX simulation and as described by Lobo and Koningsveld in J. Am. Chem. Soc. 2012, 124, 13222-13230, where the disorder was tuned by three distinct fault probabilities. It should be noted the phrase “at least X%” includes the case where there are no other ZSM-48 polytypes present in the structure, i.e., the material is 100% polytype 6. The structure of polytype 6 is as described by Lobo and Koningsveld. (<u>See,</u> J. Am. Chem. Soc. 2002, 124, 13222-13230). In some embodiments, the SSZ-91 material is composed of at least 80% polytype 6 of the total ZSM-48-type material present in the product. In some embodiments, the SSZ-91 material is composed of at least 90% polytype 6 of the total

ZSM 48-type material present in the product. The polytype 6 structure has been given the framework code *MRE by the Structure Commission of the International Zeolite Association.

[0068] Zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio in the range of 1 to 8. In some embodiments, Zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio in the range of 1 to 6, for example 1 to 5, 1 to 4 or 1 to 3.

[0069] In some embodiments, zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates having a diameter of between about 100 nm and 1.5 μm, each of the aggregates comprising a collection of crystallites collectively having an average aspect ratio in the range of 1 to 8. In some embodiments, zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates having a diameter of between about 100 nm and 1.5 μm, each of the aggregates comprising a collection of crystallites collectively having an average aspect ratio in the range of 1 to 6, for example 1 to 5, 1 to 4 or 1 to 3. As used herein, the term diameter refers to the shortest length on the short end of each crystallite examined.

[0070] Zeolite SSZ-91 is a substantially phase pure material. As used herein, the term "substantially phase pure material" means the material is completely free of zeolite phases other than those belonging to the ZSM-48 family of zeolites, or are present in quantities that have less than a measurable effect on, or confer less than a material disadvantage to, the selectivity of the material. Two common phases that co-crystalize with SSZ-91 are EUO-type molecular sieves such as EU-1, as well as Magadiite and Kenyaite. These additional phases may be present as separate phases, or may be intergrown with the SSZ-91 phase.

[0071] Zeolite SSZ-91 may comprise an EUO-type molecular sieve phase in an amount in the range of 0 to 7 wt.% by weight of the total zeolite SSZ-91 product. In some embodiments, zeolite SSZ-91 comprises an EUO-type molecular sieve phase in an amount in the range of 0 to 5.0 wt.%, for example, 0 to 4.0 wt.%, or 0 to 3.5 wt.%. In some embodiments, zeolite SSZ-91 comprises an EUO-type molecular sieve phase in an amount in the range of 0.1 to 7.0 wt.%, for example, 0.1 to 5.0 wt.%, 0.1 to 4.0 wt.%, or 0.1 to 3.5 wt.%. In some embodiments, zeolite SSZ-91 comprises 0 to 7 wt.% EU-1, for example 0 to 5.0 wt.% EU-1, 0 to 4.0 wt.% EU-1, 0 to 3.5 wt.% EU-1, 0.1 to 7.0 wt.% EU-1, 0.1 to 5.0 wt.% EU-1, 0.1 to 4.0 wt.% EU-1, 0.1 to 3.5 wt.% EU-1, 0.1 to 2 wt.% EU-1, or 0.1 to 1 wt.% EU-1.

[0072] It is known that the ratio of powder XRD peak intensities varies linearly as a function of weight fractions for any two phases in a mixture: $(I\alpha/I\beta) = (RIR\alpha/RIR\beta)^{*} (x\alpha/x\beta)$, where the RIR (Reference Intensity Ratio) parameters can be found in The International Centre for Diffraction Data's Powder Diffraction File (PDF) database (http://www.icdd.com/products/). The weight percentage of the EUO phase in zeolite SSZ-91 may therefore be calculated by measuring the ratio between the peak intensity of the EUO phase and that of the SSZ-91 phase.

[0073] In general, zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 40 to 220; at least 70% polytype 6 of the total ZSM-48-type material; 0 to 7.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 8. In some embodiments, zeolite SSZ-91 comprises a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 40 to 220; at least 70% polytype 6 of the total ZSM-48-type material; 0 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 8. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 40 to 220; at least 70% polytype 6 of the total ZSM-48-type material; 0 to 3.5 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 8. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 40 to 200; at least 70% polytype 6 of the total ZSM-48-type material; 0 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 8. In some embodiments, zeolite SSZ-91 comprises a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 70 to 200; at least 70% polytype 6 of the total ZSM-48-type material; 0 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 70% polytype 6 of the total ZSM-48-type material; 0.1 to 7.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 70% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 70% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% EU-1; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 70% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between

1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 160; at least 70% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 70 to 160; at least 70% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 70 to 200; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 6. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 7.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 4. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 200; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 4. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 80 to 160; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 4. In some embodiments, zeolite SSZ-91 comprises a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 100 to 140; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of an EUO-type molecular sieve phase; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 4. Zeolite SSZ-91 may comprise a silicon oxide (SiO_2) to aluminum oxide (Al_2O_3) mole ratio (SAR) of 100 to 140; at least 80% polytype 6 of the total ZSM-48-type material; 0.1 to 4.0 wt.% of EU-1; wherein the zeolite SSZ-91 has a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of between 1 and 4.

[0074] Zeolite SSZ-91 synthesized as described herein can be characterized by XRD pattern. The powder XRD lines of Table 1 are representative of as-synthesized zeolite SSZ-91. Minor variations in the diffraction pattern can result from variations in the mole ratios of the framework species of the particular sample due to changes in lattice constants. In addition, sufficiently small crystals will affect the shape and intensity of peaks, leading to significant peak broadening. Minor variations in the diffraction pattern can also result from variations in the organic compound used in the preparation and from variations in the Si/Al mole ratio from sample to sample. Calcination can also cause minor shifts in the XRD pattern. Notwithstanding these minor perturbations, the basic crystal lattice structure remains unchanged.

TABLE 1

Characteristic Peaks for As-Synthesized SSZ-91

2-Theta[(a)]	d-spacing (nm)	Relative Intensity[(b)]
7.55	1.170	W
8.71	1.015	W
12.49	0.708	W
15.12	0.586	W
21.18	0.419	VS
22.82	0.390	VS
24.62	0.361	W
26.39	0.337	W
29.03	0.307	W
31.33	0.285	W

(a) ± 0.20

(b) The powder XRD patterns provided are based on a relative intensity scale in which the strongest line in the X-ray pattern is assigned a value of 100: W = weak (> 0 to ≤ 20); M = medium (> 20 to ≤ 40); S = strong (> 40 to ≤ 60); VS = very strong (> 60 to ≤ 100).

[0075] The X-ray diffraction pattern lines of Table 2 are representative of calcined SSZ-91.

TABLE 2

Characteristic Peaks for Calcined SSZ-91

2-Theta[(a)]	d-spacing (nm)	Relative Intensity[(b)]
7.67	1.152	M
8.81	1.003	W
12.61	0.701	W
15.30	0.579	W
21.25	0.418	VS
23.02	0.386	VS
24.91	0.357	W
26.63	0.334	W

29.20	0.306	W
31.51	0.284	W

[a] ± 0.20

[b] The powder XRD patterns provided are based on a relative intensity scale in which the strongest line in the X-ray pattern is assigned a value of 100: W = weak (> 0 to ≤ 20); M = medium (> 20 to ≤ 40); S = strong (> 40 to ≤ 60); VS = very strong (> 60 to ≤ 100).

[0076] The powder X-ray diffraction patterns presented herein were collected by standard techniques. The radiation was CuK_α radiation. The peak heights and the positions, as a function of 2θ where θ is the Bragg angle, were read from the relative intensities of the peaks (adjusting for background), and d, the interplanar spacing corresponding to the recorded lines, can be calculated.

[0077] Zeolite SSZ-91 can be used as-synthesized, but typically will be thermally treated (calcined). The term “as-synthesized” refers to the zeolite SSZ-91 in its form after crystallization, prior to removal of the SDA cation. The SDA can be removed by thermal treatment (e.g., calcination), for example in an oxidative atmosphere (e.g., air, gas with an oxygen partial pressure of greater than 0 kPa) at a temperature readily determinable by one skilled in the art sufficient to remove the SDA from the molecular sieve. The SDA can also be removed by ozonation and photolysis techniques (e.g., exposing the SDA-containing molecular sieve product to light or electromagnetic radiation that has a wavelength shorter than visible light under conditions sufficient to selectively remove the organic compound from the molecular sieve) as described in U.S. Patent No. 6,960,327.

[0078] Zeolite SSZ-91 can be subsequently calcined in steam, air or inert gas at temperatures ranging from 200°C to 800°C for periods of time ranging from 1 hour to a number of days, for example 1 to 48 hours. Usually, it is desirable to remove the extra-framework cation (e.g., Na^+) by ion exchange and replace it with hydrogen, ammonium, or any desired metal-ion.

[0079] Where the molecular sieve formed is an intermediate molecular sieve, the target molecular sieve (e.g., zeolite SSZ-91) can be achieved using post-synthesis techniques such as heteroatom lattice substitution techniques. The target molecular sieve (e.g., zeolite SSZ-91) can also be achieved by removing heteroatoms from the lattice by known techniques such as acid leaching.

[0080] Zeolite SSZ-91 made from the process disclosed herein can be formed into a wide variety of physical shapes. Zeolite SSZ-91 can be in the form of a powder, a granule, or a molded product, such as extrudate having a particle size sufficient to pass through a 2-mesh (Tyler) screen and be retained on a 400-mesh (Tyler) screen. In cases where the catalyst is molded, such as by extrusion with an organic binder, the zeolite SSZ-91 can be extruded before drying, or, dried or partially dried and then extruded.

[0081] Zeolite SSZ-91 can be composited with other materials resistant to the temperatures and other conditions employed in organic conversion processes. Such matrix materials include active and inactive materials and synthetic or naturally occurring molecular sieves as well as inorganic materials such as clays, silica, and metal oxides. Examples of such materials and uses are disclosed in U.S. Patent Nos. 4,910,006 and 5,316,753.

[0082] The hydroisomerization catalyst, such as zeolite SSZ-91, may be in as-synthesized or calcined form. In some embodiments, the hydroisomerization catalyst is formed from zeolite SSZ-91 in calcined form. In some embodiments, the hydroisomerization catalyst comprises a molecular sieve selected from zeolite SSZ-91 and a Group 2, 8, 9 or 10 metal (for example, a Group 8-10 metal such as Pt).

[0083] In some embodiments, the hydroisomerization catalyst is formed by compositing molecular sieve zeolite SSZ-91 (in as-synthesized or calcined form) with an oxide binder such as alumina. In some embodiments, compositing molecular sieve zeolite SSZ-91 (in as-synthesized or calcined form) with an oxide binder comprises mixing a molecular sieve selected from zeolite SSZ-91 (in as-synthesized or calcined form) with an oxide binder and extruding the product. The mixture of the molecular sieve and the oxide binder may be formed into a particle or extrudate having a wide range of physical shapes and dimensions. In some embodiments, the extrudate or particle may be dried and calcined prior to metal loading. In some embodiments, the extrudate or particle is impregnated with a metal, e.g., a Group 2, 8, 9 or 10 metal (for example, a Group 8-10 metal such as Pt).and then dried and calcined. In some embodiments, the extrudate or particle is dried and calcined prior to metal loading.

[0084] The hydroisomerization catalyst may be prepared by compositing a molecular sieve (such as zeolite SSZ-91) with an oxide binder to form an extrudate base; impregnating the extrudate base with an impregnation solution containing a metal, e.g., a Group 2, 8, 9 or 10 metal (e.g., a Group 8-10 metal such as Pt), to form a metal-loaded extrudate; drying the metal-loaded extrudate; and calcining the dried metal-loaded extrudate.

[0085] The hydroisomerization catalyst may be formed by impregnating a molecular sieve (such as zeolite SSZ-91) with a solution containing a metal, e.g., a Group 2, 8, 9 or 10 metal (for example a Group 8-10 metal such as Pt). In some embodiments, the hydroisomerization catalyst may be formed by impregnating the molecular sieve in calcined form with a solution containing a Group 2, 8, 9 or 10 metal (e.g., a Group 8-10 metal such as Pt). In some embodiments, the hydroisomerization catalyst is formed by impregnating an extrudate base comprising the molecular sieve and an oxide binder. In some embodiments, the extrudate base is exposed to an impregnation solution (e.g., soaked in an impregnation solution) containing a metal (e.g., a Group 2, 8, 9 or 10 metal (for example, a Group 8-10 metal such as Pt) for 0.1 to 10 hours.

[0086] The extrudate base may be dried (e.g., at a temperature in the range of about 100°F (38°C) to about 300°F (149°C) for about 0.1 to about 10 hours) and calcined (at a temperature in the range of about 390°F (199°C) to about 1200°F (649°C), or about 600°F (316°C) to about 1200°F (649°C) for about 0.1 to about 10 hours) prior to impregnation.

[0087] The extrudate base may be formed by compositing the molecular sieve (such as from zeolite SSZ-91) and an oxide binder is dried and calcined prior to impregnation. The dried and calcined extrudate base may be impregnated with an impregnation solution to form a metal-loaded extrudate before being dried and calcined again to form the hydroisomerization catalyst.

[0088] The impregnated extrudate base comprising, e.g., zeolite SSZ-91, may be dried at a temperature in the range of about 100°F (38°C) to about 300°F (149°C) for about 0.1 to about 10 hours. The dried metal-loaded extrudate may be calcined at a temperature in the range of about 600°F (316°C) to about 1200°F (649°C) for about 0.1 to about 10 hours. In some embodiments, calcination takes place in air.

[0089] The process of hydroconverting a biofeedstock comprises contacting a biofeedstock with a hydroconversion catalyst under hydroconversion conditions. Hydroconversion takes place in the presence of hydrogen and may include hydroisomerization and/or hydrotreating and hydroisomerization processes. Hydroconversion may include other processes as well, including hydrocracking.

[0090] The hydroconversion may take place in the presence of a hydroconversion catalyst comprising SSZ-91. In some embodiments, the hydroisomerization catalyst comprises SSZ-91. The biofeedstock may contain only renewable biocomponents and/or may exclude, or not purposely include, fossil fuel components. The biofeedstock may also be utilized by itself, i.e., wherein no fossil fuel component or other non-biofeedstock component is added along with the biofeedstock.

[0091] The process generally makes use of a biofeedstock comprising one or more biocomponents having a C_{20+} content of at least about 10 wt.% and the hydroconversion catalyst comprises a hydroisomerization catalyst. In some cases, the biofeedstock may comprise one or more biocomponents having a C_{20} to C_{24} content of at least about 10 wt.%. While not limited thereto, the C_{20} to C_{24} content of the biocomponent may be at least about 15 wt.%, or 20 wt.%, or 30 wt.%, or 40 wt.%, or 50 wt.%.

[0092] The process may also be a single stage process, e.g., wherein no intermediate and/or final products are removed between stages or catalyst beds. The process may be advantageously carried out within a single reactor in some embodiments. The process may also be carried out in two or more reactors connected in series, e.g., with a first reactor, or catalyst section, comprising a hydrotreating section and a reactor, or catalyst section, and a section or reactor downstream from the first reactor or catalyst section comprising a hydroisomerization section. All of the products from the hydrotreating section are or may be directly passed to the hydroisomerization section, i.e., wherein no intermediate products are removed between the sections. A separate hydrocracking catalyst is not required to be used, or is not used, within the process to produce a renewable product. The skilled artisan will appreciate that various reactor configurations and catalyst loading arrangements are possible according to the invention.

[0093] The hydroconversion conditions may typically comprise a temperature in the range of about 300°F to about 800°F (149°C to 427°C); a pressure in the range of about 15 to about 3000 psig (0.10 to 20.68 MPa gauge); a feed rate of biofeedstock in the range from about 0.1 to about 20 h^{-1} LHSV; and hydrogen and biofeedstock feed rates in a ratio from about 1000 or 1500, or 2000 to about 10,000 standard cubic feet H_2 per barrel biofeedstock (from about 180 to about 1800 m^3 H_2/m^3 feed).

[0094] In some cases, the hydroisomerization conditions may include a temperature in the range of about 300°F to about 800°F (149°C to 427°C), e.g., about 550°F to about 700°F (288°C to 371°C). The hydroisomerization conditions may include a pressure in the range of about 15 to about 3000 psig (0.10 to 20.68 Mpa gauge), for example about 100 to about 2500 psig (0.69 to 17.24 Mpa). The hydroisomerization conditions may include a feed rate of the biofeedstock to the reactor containing the hydroisomerization catalyst at a rate in the range from about 0.1 to about 20 h^{-1} LHSV, e.g., from about 0.1 to about 5 h^{-1} LHSV.

[0095] In some cases, the hydroisomerization conditions may include hydrogen and biofeedstock fed to the reactor in a ratio from about 1000, or 1500, or 2000 to about 10,000 standard cubic feet H_2 per barrel feedstock (from about 180 to about 1800 m^3 H_2/m^3 feed, e.g., from about 2500 to about 5000 scf H_2 per barrel feedstock (from about 440 to about 890 m^3 H_2/m^3 feed).

[0096] In some embodiments, hydroisomerization conditions are as follows: temperature in the range of about 300°F (149°C), or 325°F (163°C), or 350°F (177°C), or 375°F (191°C), or 390°F (199°C) to about 800°F (427°C), e.g., about 550°F to about 750°F (288°C to 399°C), or 570°F to about 675°F (299°C to 357°C); pressure in the range of about 15 to about 3000 psig (0.10 to 20.68 Mpa gauge), e.g., about 100 to about 2500 psig (0.69 to 17.24 Mpa); feed rate of feedstock to the reactor containing the hydroisomerization catalyst at a rate in the range from about 0.1 to about 20 h^{-1} LHSV, e.g., from about 0.1 to about 5 h^{-1} LHSV; and hydrogen and feedstock fed to the reactor in a ratio from about 1000, or 1500, or 2000 to about 10,000 standard cubic feet H_2 per barrel feedstock (from about 180 to about 1800 m^3 H_2/m^3 feed, e.g., from about 2500 to about 5000 scf H_2 per barrel feedstock (from about 440 to about 890 m^3 H_2/m^3 feed).

[0097] The process may be generally used to provide a variety of renewable products. In some cases, renewable products such as base oils, base oil components, lubricating oils, process fluids, or a combination thereof may be produced. Other products may also be produced during the process. While not limited thereto, process fluids that may be produced include drilling fluids, transformer fluids, thermal oils, hydraulic fluids, transmission fluids, metal working fluids, or a combination thereof.

[0098] Contacting the biofeedstock and the hydroisomerization catalyst according to the process may provide a base oil or a component thereof comprising an increased ratio of isoparaffins to normal paraffins compared to the biofeedstock that has been hydrotreated. In some embodiments, contacting the biofeedstock and the hydroisomerization catalyst under hydroisomerization conditions provides a base oil or a component thereof exhibiting a lower cloud point and a lower pour point compared to the cloud point and pour point of the biofeedstock that has been hydrotreated.

[0099] In some embodiments, contacting the biofeedstock and the hydroisomerization catalyst under hydroisomerization conditions provides a base oil or a component thereof exhibiting a lower cloud point and a lower pour point compared to the cloud point and pour point of the hydrotreated biofeedstock, wherein the base oil exhibits a cloud point at least 2, or 4, or 6, or 8, or 10°C lower than the cloud point of the hydrotreated biofeedstock and/or a pour point at least 2, or 4, or 6, or 8, or 10°C lower than the pour point of the hydrotreated biofeedstock, or a cloud point at least 20°C lower than the cloud point of the hydrotreated biofeedstock and/or a pour point at least 20°C lower than the pour point of the hydrotreated biofeedstock, or a cloud point at least 30°C lower than the cloud point of the hydrotreated biofeedstock and/or a pour point at least 30°C lower than the pour point of the hydrotreated biofeedstock.

[00100] In some cases, the base oil product, or a component thereof, may meet Group III+ base oil specifications, e.g., a base oil having a VI greater than 130. While not limited thereto, base oils may be produced having a pour point of -10°C, -15°C, -20°C, -25°C, -30°C, - 33°C or -35°C, or -38°C or less; and/or a viscosity at 100°C of 1.5, or 1.6, or 1.7, or 1.8 cSt or greater; and/or a VI of 105, or 107, or 109, or 113, or 117, or 121, or 125, or 129, or greater; or a combination thereof.

[00101] The biofeedstock may be contacted with a hydrotreating catalyst under hydrotreating conditions prior to contacting the biofeedstock with the hydroisomerization catalyst. In some embodiments, the hydrotreating conditions include a temperature in the range of about 300°F (149°C), or 325°F (163°C), or 350°F (177°C), or 375°F (191°C), or 390°F to about 800°F (199°C to 427°C), e.g., about 500°F (260°C) or 550°F (288°C) to about 750°F (399°C), 590°F to about 675°F (310°C to 357°C); a pressure in the range of about 15 to about 3000 psig (0.10 to 20.68 MPa gauge), e.g., about 100 to about 2500 psig (0.69 to 17.24 MPa); a feed rate of feedstock to the reactor containing the hydroisomerization catalyst at a rate in the range from about 0.1 to about 20 h^{-1} LHSV, e.g., from about 0.1 to about 5 h^{-1} LHSV; and hydrogen and feedstock fed to the reactor in a ratio from about 1000, or 1500, or 2000 to about 10,000 standard cubic feet H_2 per barrel feedstock (from about 180 to about 1800 m^3 H_2/m^3 feed), for example, from about 2500 to about 5000 scf H_2 per barrel feedstock (from about 440 to about 890 m^3 H_2/m^3 feed).

[00102] Hydrotreating catalysts may generally comprise a refractory inorganic oxide support and a Group 6 metal modifier and/or a Group 8-10 metal modifier. The hydrotreating catalyst may comprise a refractory inorganic oxide support, a Group 6 metal modifier and a Group 8-10 metal modifier. The oxide support may also be referred to herein as a binder. The support of the hydrotreating catalyst may be prepared from or comprise alumina, silica, silica/alumina, titania, magnesia, zirconia, and the like, or combinations thereof. The hydrotreating catalyst support may comprise amorphous materials,

crystalline materials, or combinations thereof. Examples of amorphous materials include, but are not limited to, amorphous alumina, amorphous silica, amorphous silica-alumina, and the like.

[00103] The hydrotreating support may comprise amorphous alumina. When using a combination of silica and alumina, the distribution of silica and alumina in the support may be either homogeneous or heterogeneous. In some embodiments, the support may comprise an alumina gel in which is dispersed the silica, silica/alumina, or alumina base material. The support may also contain refractory materials other than alumina or silica, such as other inorganic oxides or clay particles, provided that such materials do not adversely affect the hydrogenation activity of the final catalyst or lead to deleterious cracking of the feedstock.

[00104] Silica and/or alumina may comprise at least about 90 wt.% of the support of the hydrotreating catalyst. The support may be at least substantially all silica or all alumina.

[00105] In some cases, the Group 8-10 metal modifier(s) of the hydrotreating catalyst comprises Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, or combinations thereof. The Group 8-10 metal modifier of the hydrotreating catalyst may comprise a Group 9 metal, a Group 10 metal, or combinations thereof. The Group 8-10 metal modifier of the hydrotreating catalyst may comprise or be Co and/or Ni. The Group 8-10 metal modifier of the hydrotreating catalyst may comprise or be Ni. The Group 8-10 metal modifier of the hydrotreating catalyst may comprise Co and Ni. The Group 8-10 metal modifier may be an oxide, hydroxide or salt. In some cases, the Group 8-10 metal modifier is a salt. The amount of the Group 8-10 metal modifier in the hydrotreating catalyst is generally from 0.1 to 20 wt.% (for example, from 1.0, or 2.0 to 10 wt.%), based on the bulk dry weight of the catalyst, calculated as the metal oxide. The Group 6 metal modifier of the hydrotreating catalyst may be selected from Cr, Mo, W, and combinations thereof. The Group 6 metal modifier of the hydrotreating catalyst may comprise or be Mo. The Group 6 metal modifier may be an oxide, an oxo acid, or an ammonium salt of an oxo or polyoxoanion. The amount of the Group 6 metal modifier employed in the hydrotreating catalyst is generally from 5 to 50 wt.% (e.g., from 10 to 40 wt.%, or from 15 to 30 wt.%), based on the bulk dry weight of the catalyst, calculated as the metal oxide. In some cases, the hydrotreating catalyst comprises Ni and Mo.

[00106] The Group 8-10 metal modifier and/or the Group 6 metal modifier of the hydrotreating catalyst may be dispersed on the inorganic oxide support. A number of methods are known in the art to deposit Group 8-10 and/or Group 6 metals, or compounds comprising such metals, onto the support; such methods include, but are not limited to, ion exchange, impregnation, and co-precipitation. In some embodiments, the impregnation of the support with Group 8-10 and Group 6 metal modifiers may be performed at a controlled pH value. The Group 8-10 and Group 6 metal modifiers may be added to the impregnating solution as a metal salt, such as a halide salt, and/or an amine complex, and/or a salt of a mineral acid. Other examples of metal salts that may be used include nitrates, carbonates, and bicarbonates, as well as carboxylic acid salts such as acetates, citrates, and formates.

[00107] The impregnated support may be optionally allowed to stand with the impregnating solution, e.g., for a period in the range from about 2 to about 24 hours. Following impregnation of the oxide support with the Group 8-10 metal modifier and/or Group 6 metal modifier, the impregnated support can be dried and/or calcined. After the hydrotreating catalyst has been dried and calcined, the prepared catalyst may be reduced with hydrogen or sulfided with a sulfur-containing compound, as is conventional in the art, and placed into service, e.g., in a reactor positioned upstream of the hydroisomerization reactor.

Example 1

[00108] A simulated feed replicating a typical carinata oil composition was prepared with 3.2 wt.% nC16, 39.8 wt.% nC18, 11.7 wt.% nC20, 43.4 wt.% nC22 and 1.9 wt.% nC24.

[00109] Feeding this simulated hydrotreated carinata oil over an SSZ-91 zeolite based catalyst at 650°F and 1000 psig with a 2.0 LHSV (liquid hourly space velocity), resulted in a process fluid product with a pour point of -39°C (ASTM D97), a highly desirable viscosity index (VI, ASTM D2270-04) of 138 and KV100 (ASTM D445-06, kinematic viscosity at 100°C, in units of cSt or mm^2/s) of 2.09 cSt. A typical pour point spec for process fluids of this viscosity range is ≤30°C or in some cases, ≤-35°C. The process fluid yield was 40.3 wt.%. While not limited thereto, the remainder liquid product may be used to produce renewable fuels or as components thereof.

[00110] For the avoidance of doubt, the present application is directed to the subject-matter described in the following numbered paragraphs:

1. A process for making a renewable product from a biofeedstock, the process comprising contacting a biofeedstock with a hydroconversion catalyst under hydroconversion conditions, wherein the biofeedstock comprises one or more biocomponents having a C_{20+} content of at least about 10 wt.% and the hydroconversion catalyst comprises a hydroisomerization catalyst.

2. A process according to paragraph 1, wherein the biofeedstock comprises one or more biocomponents having a C_{20} to C_{32} content of at least about 10 wt.%.

3. A process according to paragraph 1 or 2, wherein the C_{20} to C_{32} content of the biocomponent is at least about 10 wt.%, or 15 wt.%, or 20 wt.%, or 30 wt.%, or 40 wt.%, or 50 wt.%, or 60% wt.%, or 70 wt.%, or 80 wt.%, or in the range of about 10 to 80 wt.%, or 15 to 80 wt.%, or 20 to 80 wt.%, or 30 to 80 wt.%, or 40 to 80 wt.%, or 50 to 80 wt.%, or 60% to 80 wt.%, or 70 to 80 wt.%.

4. A process according to any of paragraphs 1-3, wherein the C_{20+} content of the biocomponent is less than about 80 wt.%, 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, or 20 wt.%, or wherein the C_{20+} content of the biocomponent is greater than about 20 wt.%, 30 wt.%, 40 wt.%, 50 wt.%, 60 wt.%, or 70 wt.%, or a combination thereof, or wherein the C_{20+} content is in the range of about 10 to 80

wt.%, 10 to 70 wt.%, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 80 wt.%, 30 to 80 wt.%, 40 to 80 wt.%, 50 to 80 wt.%,20 to 70 wt.%, 20 to 60 wt.%, 20 to 50 wt.%, 20 to 40 wt.%, 30 to 80 wt.%, 30 to 70 wt.%, 30 to 60 wt.%, 30 to 50 wt.%, 40 to 80 wt.%, 40 to 70 wt.%, 40 to 60 wt.%, 50 to 80 wt.%, 50 to 70 wt.%, or 60 to 80 wt.%.

5. A process according to any of paragraphs 1-4, wherein the C_{16} content of the biocomponent is about 0 to 70 wt.%; the C_{18} content of the biocomponent is about 0 to 70 wt.%; the C_{20} content of the biocomponent is about 0 to 70 wt.%; the C_{22} content of the biocomponent is about 0 to 70 wt.%; the C_{22+} content of the biocomponent is about 0 to 70 wt.%; the C_{24} content of the biocomponent is about 0 to 70, or 60, or 50, or 40 wt.%; and the C_{24+} content of the biocomponent is about 0 to 70, or 60, or 50, or 40 wt.%; or a combination thereof.
6. A process according to any of paragraphs 1-3, wherein the biofeedstock contains only renewable biocomponents.
7. A process according to any of paragraphs 1-4, wherein a fossil fuel component is not used along with the biofeedstock in the process.
8. A process according to any of paragraphs 1-5, wherein the process is a single-stage or a two-stage process.
9. A process according to paragraph 6, wherein the single stage process is carried out in a single reactor.
10. A process according to paragraph 6, wherein the single-stage process is carried out in two or more reactors connected in series, with a first reactor comprising a hydrotreating section and a reactor downstream from the first reactor comprising a hydroisomerization section.
11. A process according to any of paragraphs 1-8, wherein the renewable product comprises a base oil, a base oil component, a process fluid, or a combination thereof.
12. A process according to paragraph 9, wherein the process fluid is a drilling fluid, transformer fluid, thermal oil, hydraulic fluid, transmission fluid and/or gear oil, metal working fluid, or a combination thereof.
13. A process according to any of paragraphs 1-10, wherein the hydroconversion catalyst comprises zeolite SSZ-91, SSZ-32, SSZ-32x, ZSM-48, or a combination thereof.
14. A process according to any of paragraphs 1-11, wherein the hydroisomerization catalyst comprises SSZ-91.
15. A process according to any of paragraphs 1-12, wherein the hydroconversion catalyst is or comprises a precious metal catalyst or a combination of a base metal catalyst and a precious metal catalyst.

16. A process according to any of paragraphs 1-13, wherein the hydroconversion catalyst comprises a base metal catalyst and a precious metal catalyst.

17. A process according to any of paragraphs 13-14, wherein the base metal is selected from Mo, Ni, W, Co, and combinations thereof.

18. A process according to any of paragraphs 13-15, wherein the base metal is Mo or a combination of Mo and Ni.

19. A process according to any of paragraphs 12-15, wherein the precious metal is selected from Pt, Pd, and a combination thereof.

20. A process according to any of paragraphs 1-17, wherein the process comprises a hydrotreating section and a hydroisomerization section and all or part of the products from the hydrotreating section are directly passed to the hydroisomerization section.

21. A process according to any of paragraphs 1-18, wherein the renewable product comprises a middle distillate product, a base oil product, or a combination thereof.

22. A process according to paragraph 19, wherein the renewable product comprises a naphtha, kerosene, jet fuel, diesel fuel, base oil, or a combination thereof.

23. A process according to any of paragraphs 1-20, wherein a hydrocracking catalyst is not used to produce the renewable product.

24. A process according to any of paragraphs 1-21, wherein the hydroconversion conditions comprise:

a temperature in the range of about 300°F to about 800°F (149°C to 427°C);
a pressure in the range of about 15 to about 3000 psig (0.10 to 20.68 MPa gauge);
a feed rate of biofeedstock in the range from about 0.1 to about 20 h^{-1} LHSV;
hydrogen and biofeedstock feed rates in a ratio from about 1000 to about 10,000 standard cubic feet H_2 per barrel biofeedstock (from about 180 to about 1800 m^3 H_2/m^3 feed);
or a combination thereof.

25. A process according to paragraph 22, wherein the hydroconversion conditions are hydrotreating or hydroisomerization.

26. A process according to any of paragraphs 1-22, wherein the hydroconversion catalyst comprises zeolite SSZ-91 and a Group 8-10 metal.

27. A process according to any of paragraphs 1-24, wherein the hydroconversion catalyst comprises zeolite SSZ-91, wherein the zeolite SSZ-91 has, in its calcined form, an X-ray diffraction pattern substantially as shown in the following Table:

2-Theta[(a)]	d-spacing (nm)	Relative Intensity[(b)]
7.67	1.152	M
8.81	1.003	W
12.61	0.701	W
15.30	0.579	W
21.25	0.418	VS
23.02	0.386	VS
24.91	0.357	W
26.63	0.334	W
29.20	0.306	W
31.51	0.284	W

(a) ± 0.20

(b) wherein powder XRD patterns provided are based on a relative intensity scale in which the strongest line in the X-ray pattern is assigned a value of 100: W = weak (> 0 to ≤ 20); M = medium (> 20 to ≤ 40); S = strong (> 40 to ≤ 60); VS = very strong (> 60 to ≤ 100).

28. A process according to any of paragraphs 1-25, wherein the hydroconversion catalyst comprises zeolite SSZ-91 having a silicon oxide to aluminum oxide molar ratio of 40 to 220, or 70 to 160, or 80 to 160, or 80 to 140, or 100 to 160.

29. A process according to any of paragraphs 1-26, wherein the hydroconversion catalyst comprises zeolite SSZ 91 having at least about 80% polytype 6 of the total ZSM-48-type material present in the zeolite SSZ-91, or at least about 90% polytype 6 of the total ZSM-48-type material present in the zeolite SSZ-91.

30. A process according to any of paragraphs 1-27, wherein the hydroconversion catalyst comprises zeolite SSZ-91 and the zeolite SSZ-91 comprises 0.1 to 4.0 wt.% EUO-type molecular sieve phase.

31. A process according to any of paragraphs 1-28, wherein the hydroconversion catalyst comprises zeolite SSZ-91 comprising 0.1 to 4.0 wt.% EU-1.

32. A process according to any of paragraphs 1-29, wherein the hydroconversion catalyst comprises zeolite SSZ-91 having a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of 1 to 4.

33. A process according to any of paragraphs 1-30, wherein the hydroconversion catalyst comprises zeolite SSZ-91 having:

a silicon oxide to aluminum oxide molar ratio of 40 to 220 or 70 to 160;

a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio in the range of 1 to 4;

at least about 80% polytype 6 of the total ZSM-48-type material present in the zeolite SSZ-91; and, 0.1 to 4.0 wt.% EUO-type molecular sieve phase.

34. A process according to any of paragraphs 1-31, wherein the hydroconversion catalyst comprises from about 5 to about 95 wt.% zeolite SSZ-91, and from about 0.05 to about 2.0 wt.% of a metal modifier.

35. A process according to any of paragraphs 1-32, wherein the biofeedstock comprises or is a biocomponent feed selected from lipids, vegetable oils, seed oils, animal fats which comprise triglycerides and free fatty acids, or a combination thereof.

36. A process according to any of paragraphs 1-33, wherein the biofeedstock or biocomponent is obtained from a plant family selected from Brassicaceae (formerly Cruciferaceae), Limnanthaceae, Simmondsiaceae, Tropaeolaceae, Olocaceae, or a combination thereof.

37. A process according to any of paragraphs 1-34, wherein the biofeedstock comprises or is a biocomponent feed selected from canola oil, corn oil, soy oils, castor oil, camelina oil, palm oil, rapeseed oil, soybean oil, colza oil, tall oil, sunflower oil, hempseed oil, olive oil, linseed oil, coconut oil, castor oil, peanut oil, palm oil, mustard oil, carinata oil, carnauba wax, rice bran oil, cottonseed oil, tallow, yellow and brown greases, lard, train oil, fats in milk, fish oil, algal oil, sewage sludge, cuphea oil, camelina oil, jatropha oil, curcas oil, babassu oil, palm kernel oil, crambe oil, and the like.

38. A process according to any of paragraphs 1-35, wherein the biofeedstock comprises or is a biocomponent feed selected from carinata oil, rapeseed oil, peanut oil, mustard oil, tallow, carnauba wax, rice bran oil, or a combination thereof.

39. A process according to any of paragraphs 1-36, wherein the process produces a base oil exhibiting a lower cloud point compared to the cloud point of the same biofeedstock that has been hydrotreated.

40. A base oil, or a base oil component, produced according to the process of any of paragraphs 1-37.

41. A base oil according to paragraph 40, wherein the base oil is a Group III+ base oil having a VI greater than 130.

42. A base oil according to paragraph 40 or 41, wherein the base oil has a pour point of -10°C, -15°C, -20°C, -25°C -30°C, -33°C or -35°C, or -38°C or less; a viscosity at 100°C of 1.5, or 1.6, or 1.7, or 1.8 cSt or greater; a VI of 105, or 107, or 109, or 113, or 117, or 121, or 125, or 129, or greater; or a combination thereof.

43. Use of the base oil component according to paragraph 40 for making a base oil or a lubricating oil.

[00111] It will be understood that the invention is not limited to the embodiments described above and various modifications and improvements can be made without departing from the concepts

described herein. Except where mutually exclusive, any of the features may be employed separately or in combination with any other features and the disclosure extends to and includes all combinations and sub-combinations of one or more features described herein.

[00112] The foregoing description of one or more embodiments of the invention is primarily for illustrative purposes, it being recognized that variations might be used which would still incorporate the essence of the invention. Reference should be made to the following claims in determining the scope of the invention.

[00113] For the purposes of U.S. patent practice, and in other patent offices where permitted, all patents and publications cited in the foregoing description of the invention are incorporated herein by reference to the extent that any information contained therein is consistent with and/or supplements the foregoing disclosure.

WHAT IS CLAIMED IS:

1. A process for making a renewable product from a biofeedstock, the process comprising contacting a biofeedstock with a hydroconversion catalyst under hydroconversion conditions, wherein the biofeedstock comprises one or more biocomponents having a C_{20+} content of at least about 10 wt.% and the hydroconversion catalyst comprises a hydroisomerization catalyst.

2. A process according to claim 1, wherein the biofeedstock comprises one or more biocomponents having a C_{20} to C_{32} content of at least about 10 wt.%.

3. A process according to claim 1 or 2, wherein the C_{20} to C_{32} content of the biocomponent is at least about 10 wt.%, or 15 wt.%, or 20 wt.%, or 30 wt.%, or 40 wt.%, or 50 wt.%, or 60% wt.%, or 70 wt.%, or 80 wt.%, or in the range of about 10 to 80 wt.%, or 15 to 80 wt.%, or 20 to 80 wt.%, or 30 to 80 wt.%, or 40 to 80 wt.%, or 50 to 80 wt.%, or 60% to 80 wt.%, or 70 to 80 wt.%.

4. A process according to any of claims 1-3, wherein the C_{20+} content of the biocomponent is less than about 80 wt.%, 70 wt.%, 60 wt.%, 50 wt.%, 40 wt.%, 30 wt.%, or 20 wt.%, or wherein the C_{20+} content of the biocomponent is greater than about 20 wt.%, 30 wt.%, 40 wt.%, 50 wt.%, 60 wt.%, or 70 wt.%, or a combination thereof, or wherein the C_{20+} content is in the range of about 10 to 80 wt.%, 10 to 70 wt.%, 10 to 60 wt.%, 10 to 50 wt.%, 10 to 40 wt.%, 20 to 80 wt.%, 30 to 80 wt.%, 40 to 80 wt.%, 50 to 80 wt.%,20 to 70 wt.%, 20 to 60 wt.%, 20 to 50 wt.%, 20 to 40 wt.%, 30 to 80 wt.%, 30 to 70 wt.%, 30 to 60 wt.%, 30 to 50 wt.%, 40 to 80 wt.%, 40 to 70 wt.%, 40 to 60 wt.%, 50 to 80 wt.%, 50 to 70 wt.%, or 60 to 80 wt.%.

5. A process according to any of claims 1-4, wherein the C_{16} content of the biocomponent is about 0 to 70 wt.%; the C_{18} content of the biocomponent is about 0 to 70 wt.%; the C_{20} content of the biocomponent is about 0 to 70 wt.%; the C_{22} content of the biocomponent is about 0 to 70 wt.%; the C_{22+} content of the biocomponent is about 0 to 70 wt.%; the C_{24} content of the biocomponent is about 0 to 70, or 60, or 50, or 40 wt.%; and the C_{24+} content of the biocomponent is about 0 to 70, or 60, or 50, or 40 wt.%; or a combination thereof.

6. A process according to any of claims 1-3, wherein the biofeedstock contains only renewable biocomponents.

7. A process according to any of claims 1-4, wherein a fossil fuel component is not used along with the biofeedstock in the process.

8. A process according to any of claims 1-5, wherein the process is a single-stage or a two-stage process.

9. A process according to claim 6, wherein the single stage process is carried out in a single reactor.

10. A process according to claim 6, wherein the single-stage process is carried out in two or more reactors connected in series, with a first reactor comprising a hydrotreating section and a reactor downstream from the first reactor comprising a hydroisomerization section.

11. A process according to any of claims 1-8, wherein the renewable product comprises a base oil, a base oil component, a process fluid, or a combination thereof.

12. A process according to claim 9, wherein the process fluid is a drilling fluid, transformer fluid, thermal oil, hydraulic fluid, transmission fluid and/or gear oil, metal working fluid, or a combination thereof.

13. A process according to any of claims 1-10, wherein the hydroconversion catalyst comprises zeolite SSZ-91, SSZ-32, SSZ-32x, ZSM-48, or a combination thereof.

14. A process according to any of claims 1-11, wherein the hydroisomerization catalyst comprises SSZ-91.

15. A process according to any of any of claims 1-12, wherein the hydroconversion catalyst is or comprises a precious metal catalyst or a combination of a base metal catalyst and a precious metal catalyst.

16. A process according to any of any of claims 1-13, wherein the hydroconversion catalyst comprises a base metal catalyst and a precious metal catalyst.

17. A process according to any of any of claims 13-14, wherein the base metal is selected from Mo, Ni, W, Co, and combinations thereof.

18. A process according to any of claims 13-15, wherein the base metal is Mo or a combination of Mo and Ni.

19. A process according to any of claims 12-15, wherein the precious metal is selected from Pt, Pd, and a combination thereof.

20. A process according to any of claims 1-17, wherein the process comprises a hydrotreating section and a hydroisomerization section and all or part of the products from the hydrotreating section are directly passed to the hydroisomerization section.

21. A process according to any of claims 1-18, wherein the renewable product comprises a middle distillate product, a base oil product, or a combination thereof.

22. A process according to claim 19, wherein the renewable product comprises a naphtha, kerosene, jet fuel, diesel fuel, base oil, or a combination thereof.

23. A process according to any of claims 1-20, wherein a hydrocracking catalyst is not used to produce the renewable product.

24. A process according to any of claims 1-21, wherein the hydroconversion conditions comprise:

    a temperature in the range of about 300°F to about 800°F (149°C to 427°C);

    a pressure in the range of about 15 to about 3000 psig (0.10 to 20.68 MPa gauge);

    a feed rate of biofeedstock in the range from about 0.1 to about 20 h^{-1} LHSV;

    hydrogen and biofeedstock feed rates in a ratio from about 1000 to about 10,000 standard cubic feet H_2 per barrel biofeedstock (from about 180 to about 1800 m^3 H_2/m^3 feed);

    or a combination thereof.

25. A process according to claim 22, wherein the hydroconversion conditions are hydrotreating or hydroisomerization.

26. A process according to any of claims 1-22, wherein the hydroconversion catalyst comprises zeolite SSZ-91 and a Group 8-10 metal.

27. A process according to any of claims 1-24, wherein the hydroconversion catalyst comprises zeolite SSZ-91, wherein the zeolite SSZ-91 has, in its calcined form, an X-ray diffraction pattern substantially as shown in the following Table:

2-Theta[(a)]	d-spacing (nm)	Relative Intensity[(b)]
7.67	1.152	M
8.81	1.003	W
12.61	0.701	W
15.30	0.579	W
21.25	0.418	VS
23.02	0.386	VS
24.91	0.357	W
26.63	0.334	W
29.20	0.306	W
31.51	0.284	W

(a) ± 0.20

(b) wherein powder XRD patterns provided are based on a relative intensity scale in which the strongest line in the X-ray pattern is assigned a value of 100: W = weak (> 0 to ≤ 20); M = medium (> 20 to ≤ 40); S = strong (> 40 to ≤ 60); VS = very strong (> 60 to ≤ 100).

28. A process according to any of claims 1-25, wherein the hydroconversion catalyst comprises zeolite SSZ-91 having a silicon oxide to aluminum oxide molar ratio of 40 to 220, or 70 to 160, or 80 to 160, or 80 to 140, or 100 to 160.

29. A process according to any of claims 1-26, wherein the hydroconversion catalyst comprises zeolite SSZ 91 having at least about 80% polytype 6 of the total ZSM-48-type material present in the zeolite SSZ-91, or at least about 90% polytype 6 of the total ZSM-48-type material present in the zeolite SSZ-91.

30. A process according to any of claims 1-27, wherein the hydroconversion catalyst comprises zeolite SSZ-91 and the zeolite SSZ-91 comprises 0.1 to 4.0 wt.% EUO-type molecular sieve phase.

31. A process according to any of claims 1-28, wherein the hydroconversion catalyst comprises zeolite SSZ-91 comprising 0.1 to 4.0 wt.% EU-1.

32. A process according to any of claims 1-29, wherein the hydroconversion catalyst comprises zeolite SSZ-91 having a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio of 1 to 4.

33. A process according to any of claims 1-30, wherein the hydroconversion catalyst comprises zeolite SSZ-91 having:

    a silicon oxide to aluminum oxide molar ratio of 40 to 220 or 70 to 160;

    a morphology characterized as polycrystalline aggregates comprising crystallites collectively having an average aspect ratio in the range of 1 to 4;

    at least about 80% polytype 6 of the total ZSM-48-type material present in the zeolite SSZ-91; and, 0.1 to 4.0 wt.% EUO-type molecular sieve phase.

34. A process according to any of claims 1-31, wherein the hydroconversion catalyst comprises from about 5 to about 95 wt.% zeolite SSZ-91, and from about 0.05 to about 2.0 wt.% of a metal modifier.

35. A process according to any of claims 1-32, wherein the biofeedstock comprises or is a biocomponent feed selected from lipids, vegetable oils, seed oils, animal fats which comprise triglycerides and free fatty acids, or a combination thereof.

36. A process according to any of claims 1-33, wherein the biofeedstock or biocomponent is obtained from a plant family selected from Brassicaceae (formerly Cruciferaceae), Limnanthaceae, Simmondsiaceae, Tropaeolaceae, Olocaceae, or a combination thereof.

37. A process according to any of claims 1-34, wherein the biofeedstock comprises or is a biocomponent feed selected from canola oil, corn oil, soy oils, castor oil, camelina oil, palm oil, rapeseed oil, soybean oil, colza oil, tall oil, sunflower oil, hempseed oil, olive oil, linseed oil, coconut oil, castor oil, peanut oil, palm oil, mustard oil, carinata oil, carnauba wax, rice bran oil, cottonseed oil, tallow, yellow and brown greases, lard, train oil, fats in milk, fish oil, algal oil, sewage sludge, cuphea oil, camelina oil, jatropha oil, curcas oil, babassu oil, palm kernel oil, crambe oil, and the like.

38. A process according to any of claims 1-35, wherein the biofeedstock comprises or is a biocomponent feed selected from carinata oil, rapeseed oil, peanut oil, mustard oil, tallow, carnauba wax, rice bran oil, or a combination thereof.

39. A process according to any of claims 1-36, wherein the process produces a base oil exhibiting a lower cloud point compared to the cloud point of the same biofeedstock that has been hydrotreated.

40. A base oil, or a base oil component, produced according to the process of any of claims 1-37.

41. A base oil according to claim 40, wherein the base oil is a Group III+ base oil having a VI greater than 130.

42. A base oil according to claim 40 or 41, wherein the base oil has a pour point of -10°C, -15°C, -20°C, -25°C -30°C, -33°C or -35°C, or -38°C or less; a viscosity at 100°C of 1.5, or 1.6, or 1.7, or 1.8 cSt or greater; a VI of 105, or 107, or 109, or 113, or 117, or 121, or 125, or 129, or greater; or a combination thereof.

43. Use of the base oil component according to claim 40 for making a base oil or a lubricating oil.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/032846

A. CLASSIFICATION OF SUBJECT MATTER
INV. C10G3/00 C10G45/64
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C10G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2022/146734 A1 (CHEVRON USA INC [US]) 7 July 2022 (2022-07-07)	1-39
A	claims 1-4, 6-11, 31, 32 paragraphs [0034], [0035], [0162], [0166] -----	40-43
X	WO 2022/051576 A1 (CHEVRON USA INC [US]) 10 March 2022 (2022-03-10) claims 1-5, 17-19 paragraph [0040] -----	1-43
X	EP 2 881 452 A1 (NESTE OIL OYJ [FI]) 10 June 2015 (2015-06-10)	40-43
A	table 3 -----	1-39

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 24 September 2024	Date of mailing of the international search report 04/10/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Ruiz Martínez, C

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2024/032846

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2022146734 A1	07-07-2022	CA 3206681 A1	07-07-2022
		CN 116745393 A	12-09-2023
		EP 4271779 A1	08-11-2023
		JP 2024503603 A	26-01-2024
		KR 20230124730 A	25-08-2023
		TW 202235598 A	16-09-2022
		US 2022204867 A1	30-06-2022
		US 2024141237 A1	02-05-2024
		WO 2022146734 A1	07-07-2022
WO 2022051576 A1	10-03-2022	CA 3193590 A1	10-03-2022
		CN 116323871 A	23-06-2023
		EP 4208523 A1	12-07-2023
		JP 2023540523 A	25-09-2023
		KR 20230058436 A	03-05-2023
		US 2023265350 A1	24-08-2023
		WO 2022051576 A1	10-03-2022
EP 2881452 A1	10-06-2015	BR PI0619740 A2	11-10-2011
		CN 101360809 A	04-02-2009
		DK 1966356 T3	15-04-2019
		EP 2881452 A1	10-06-2015
		ES 2718083 T3	27-06-2019
		HU E043068 T2	28-08-2019
		MY 144543 A	30-09-2011
		PT 1966356 T	03-04-2019
		TR 201904864 T4	22-04-2019
		ZA 200804741 B	25-03-2009