CONVERSION OF FATTY ACIDS TO BASE OILS AND TRANSPORTATION FUELS

TECHNICAL FIELD

[001] The invention relates generally to lubricants and fuels derived from renewable resources, and specifically to methods for efficiently making base oils and transportation fuels from fatty acids.

BACKGROUND

[002] Due to a variety of environmental and energy concerns, there has been a high interest in promoting the use of renewable resources (e.g., biomass) in the manufacture of lubricants and transportation fuels. Fatty acids are a readily available renewable resource.

[003] Conventional processes for hydroprocessing fatty acids generally involve hydrotreating. A disadvantage of direct hydrotreating of fatty acids is its high hydrogen consumption. In addition, the molecular weight of some fatty acids by themselves is too low to prepare base oils.

[004] Additional processes for producing high quality lubricants and transportation fuels from renewable resources are still sought.

SUMMARY ~~OF THE INVENTION~~

[005] In one aspect, the ~~invention~~disclosure relates to a method comprising: contacting a fatty acid feed with a decarboxylation-coupling dimerization catalyst in a decarboxylation-coupling dimerization zone under decarboxylation-coupling dimerization conditions to yield a dimer ketone; hydrocracking the dimer ketone with a hydrocracking catalyst in a hydrocracking zone under hydrocracking conditions to yield a mixture of paraffins comprising a heavy waxy oil component and a diesel fuel component; and distilling the mixture to yield a heavy waxy oil and a diesel fuel.

[005a] In a first aspect, there is provided a method comprising:

a) contacting a fatty acid feed with an alumina catalyst in a decarboxylation-coupling dimerization zone under decarboxylation-coupling dimerization conditions to yield a dimer ketone;

b) hydrocracking the dimer ketone with a hydrocracking catalyst in a hydrocracking zone under hydrocracking conditions to yield a mixture of paraffins comprising a heavy waxy oil component and a diesel fuel component;

c) distilling the mixture to yield a heavy waxy oil and a diesel fuel; and

d) hydroisomerization dewaxing the heavy waxy oil with a hydroisomerization dewaxing catalyst in a catalytic hydroisomerization dewaxing zone under hydroisomerization dewaxing conditions to yield a lubricating base oil.

[006] In another aspect, the ~~invention~~disclosure relates to a method comprising: contacting a fatty acid feed with a decarboxylation-coupling dimerization catalyst in a decarboxylation-coupling dimerization zone under decarboxylation-coupling dimerization conditions to yield a dimer ketone; and hydroisomerization dewaxing the dimer ketone with a hydroisomerization dewaxing

catalyst in a catalytic hydroisomerization zone under hydroisomerization dewaxing conditions to yield a lubricating base oil.

[006a] In a second aspect, there is provided a method comprising:

a) contacting a fatty acid feed with a decarboxylation-coupling dimerization catalyst in a decarboxylation-coupling dimerization zone under decarboxylation-coupling dimerization conditions to yield a dimer ketone; and

b) hydroisomerization dewaxing the dimer ketone with a hydroisomerization dewaxing catalyst in a catalytic hydroisomerization zone under hydroisomerization dewaxing conditions to yield a lubricating base oil,

wherein the decarboxylation-coupling dimerization catalyst is alumina.

BRIEF DESCRIPTION OF THE DRAWINGS

[007] FIG. 1 is an FT-IR spectrum of a dimer ketone of Example 2.

DETAILED DESCRIPTION

[008] The following terms will be used throughout the specification and will have the following meanings unless otherwise indicated.

[009] The prefix "bio" refers to an association with a renewable resource of biological origin, such resources generally being exclusive of fossil fuels.

[010] "Fatty acid" refers to an aliphatic mono-carboxylic acid having at least 4 carbon atoms. The fatty acid can be saturated or unsaturated, branched or unbranched.

[011] "Decarboxylation-coupling dimerization" refers to a chemical reaction in which two molecules, each having a carboxylic acid functional group, combine to form one single molecule having a ketone functional group, with concurrent loss of carbon dioxide and water.

[012] "Diesel fuel" refers to hydrocarbons having boiling points in the range of from 250°F to 700°F (121°C to 371°C).

[013] "Base oil" refers to a hydrocarbon fluid to which other oils or substances are added to produce a lubricant.

[014] "Group III base oil" refers to a base oil which contains greater than or equal to 90% saturates and less than or equal to 0.03% sulfur and has a viscosity index greater than or equal to 120 using the ASTM methods specified in Table E-1 of American Petroleum Institute Publication 1509.

[015] "Viscosity index" (VI) is an empirical, unit-less number indicating the effect of temperature change on the kinematic viscosity of the oil. The higher the VI of an oil, the lower its tendency to change viscosity with temperature. Viscosity index is measured according to ASTM D 2270-10.

[016] "Pour point" is a measurement of the temperature at which a sample will begin to flow under certain carefully controlled conditions, which can be determined as described in ASTM D 5950-02 (reapproved 2007).