

CLAIMS:

~~1. A method for processing a hydrocarbon feedstock, comprising:~~

~~mixing a hydrocarbon feed having a T5 boiling point of at least about 340°C with a conversion stage effluent having a sulfur content of about 50 wppm or less to produce a mixed hydrocarbon feed;~~

~~hydrotreating the mixed hydrocarbon feed in a hydrotreating stage by exposing the mixed hydrocarbon feed to a hydrotreating catalyst under hydrotreatment conditions to produce a hydrotreated effluent having a sulfur content of about 50 wppm or less;~~

~~fractionating the hydrotreated effluent to produce at least a kerosene fraction having a sulfur content of about 10 wppm or less, a diesel fraction having a sulfur content of about 20 wppm or less, and a bottoms fraction;~~

~~forming a bottoms feed fraction from the bottoms fraction, the bottoms feed fraction having a T5 boiling point of at least about 355°C; and~~

~~converting the bottoms feed fraction in a conversion stage by exposing the bottoms feed fraction to a dewaxing catalyst under conversion conditions to produce the conversion stage effluent,~~

~~wherein a boiling point profile of the hydrotreated effluent corresponds to at least about 40% conversion of the hydrocarbon feed relative to a conversion threshold, the conversion threshold corresponding to the T5 boiling point of the bottoms feed fraction, and the hydrocarbon feed has a sulfur content from 200 to 20,000 wppm.~~

~~2. The method of claim 1, wherein the conversion stage effluent does not undergo separation prior to mixing with the hydrocarbon feed.~~

~~3. The method of claim 1 or claim 2, wherein the mixed hydrocarbon feed does not undergo separation prior to hydrotreatment.~~

~~4. The method of any one of the previous claims, wherein hydrogen included in the conversion stage effluent corresponds to at least about 70% of hydrogen introduced into the hydrotreating stage.~~

~~5. The method of any one of the previous claims, wherein the hydrotreating further comprises exposing the hydrotreating feed to hydrocracking catalyst under the hydrotreating conditions.~~

6. The method of any one of the previous claims, wherein the bottoms feed fraction comprises from about 25% to about 90% of the bottoms fraction.

7. The method of any one of the previous claims, wherein exposing the bottoms feed fraction to a dewaxing catalyst under effective conversion conditions comprises exposing the bottoms feed fraction to a catalyst comprising a hydrogenation metal and molecular sieve, the molecular sieve comprising ZSM-5, ZSM-23, ZSM-35, ZSM-48, zeolite Beta, or a combination thereof.

8. The method of claim 7, wherein the hydrogenation metal is selected from Pt, Pd, Pt and Pd, Ni and W, Ni and Mo, and Ni and Mo and W.

9. The method of any one of the previous claims, wherein exposing the bottoms feed fraction to a dewaxing catalyst under effective conversion conditions further comprises exposing the bottoms feed fraction to a hydrocracking catalyst under conversion conditions.

10. The method of any one of the previous claims, wherein the conversion conditions comprise a temperature from about 200°C to about 450°C, a total pressure from about 5 barg (about 0.5 MPag) to about 300 barg (about 30 MPag), a hydrogen-containing treat gas ratio from about 100 scf/bbl (about 17 Nm³/m³) to about 5000 scf/bbl (about 840 Nm³/m³), and an LHSV from about 0.05 hr⁻¹ to about 10 hr⁻¹.

11. The method of any one of the previous claims, wherein the hydrotreatment conditions comprise an LHSV from about 0.3 hr⁻¹ to about 5.0 hr⁻¹, a total pressure from about 500 psig (about 3.4 MPag) to about 3000 psig (about 20.7 MPag), a hydrogen-containing treat gas ratio from about 100 scf/bbl (17 Nm³/m³) to about

~~5000 scf/bbl (840 Nm³/m³), and a temperature from about 500°F (about 260°C) to about 800°F (about 427°C).~~

12. The method of any one of the preceding claims, wherein the T5 boiling point of the bottoms feed fraction is at least about 370°C.

13. A method for processing a hydrocarbon feedstock, comprising:

hydrotreating a diesel boiling range hydrocarbon feedstock having a cloud point of at least -10°C in a hydrotreating reactor by exposing the hydrocarbon feedstock to a hydrotreating catalyst having a hydrotreating catalyst cycle length in the presence of a hydrogen treat gas under hydrotreatment conditions comprising a hydrotreating weight average bed temperature to produce a hydrotreated effluent having a sulfur content of about 10 wppm or less; and

cascading the hydrotreated effluent directly to a dewaxing reactor, separate from the hydrotreating reactor and thus with independent temperature control therefrom, to contact a dewaxing catalyst in the presence of hydrogen under dewaxing conditions comprising a dewaxing weight average bed temperature to form a hydrotreated and dewaxed effluent having (i) a cloud point of at most -26°C, (ii) a cloud point at least 17°C lower than the cloud point of the diesel boiling range hydrocarbon feedstock, or (iii) both (i) and (ii),

wherein the dewaxing weight average bed temperature is at least 20°C greater than the hydrotreating weight average bed temperature.

CLAIMS

1. A method for processing a hydrocarbon feedstock, comprising:
 - mixing a mineral hydrocarbon feed having a T5 boiling point of at least about 340°C and a sulfur content of at least about 200 wppm with a dewaxed conversion stage effluent having a sulfur content of about 50 wppm or less to produce a mixed hydrocarbon feed;
 - hydrotreating the mixed hydrocarbon feed in a hydrotreating stage by exposing the mixed hydrocarbon feed to a hydrotreating catalyst under effective hydrotreatment conditions to produce a hydrotreated effluent having a sulfur content of about 50 wppm or less;
 - fractionating the hydrotreated effluent to produce at least a kerosene fraction having a sulfur content of about 10 wppm or less, a diesel fraction having a sulfur content of about 20 wppm or less, and a bottoms fraction having a T5 boiling point of at least about 355°C;
 - forming a bottoms feed fraction comprising about 50% to about 90% of the bottoms fraction; and
 - converting the bottoms feed fraction in a hydrodewaxing/conversion stage by contacting the bottoms feed fraction with a dewaxing/conversion catalyst comprising a combination of zeolite USY and zeolite ZSM-48 in the presence of hydrogen under effective dewaxing/conversion conditions to produce the dewaxed conversion stage effluent, the dewaxed conversion stage effluent being cascaded to the hydrotreating stage,
 - wherein a boiling point profile of the hydrotreated effluent corresponds to at least about 40% conversion of the hydrocarbon feed relative to a conversion threshold corresponding to the T5 boiling point of the bottoms feed fraction.
2. The method of claim 1, wherein hydrogen included in the conversion stage effluent corresponds to at least about 70% of hydrogen introduced into the hydrotreating stage.

3. The method of claim 1, wherein the bottoms feed fraction is contacted with the dewaxing/conversion catalyst comprising a hydrogenation metal and a combination of zeolite USY and zeolite ZSM-48.
4. The method of claim 3, wherein the hydrogenation metal of the dewaxing/conversion catalyst is selected from Pt, Pd, or Pt and Pd.
5. The method of claim 1, wherein the effective conversion conditions comprise a temperature from about 200°C to about 450°C, a total pressure from about 5 barg (about 0.5 MPag) to about 300 barg (about 30 MPag), a hydrogen-containing treat gas ratio from about 100 scf/bbl (about 17 Nm³/m³) to about 5000 scf/bbl (about 840 Nm³/m³), and an LHSV from about 0.05 hr⁻¹ to about 10 hr⁻¹, and/or wherein the effective hydrotreatment conditions comprise an LHSV from about 0.3 hr⁻¹ to about 5.0 hr⁻¹, a total pressure from about 500 psig (about 3.4 MPag) to about 3000 psig (about 20.7 MPag), a hydrogen-containing treat gas ratio from about 100 scf/bbl (17 Nm³/m³) to about 5000 scf/bbl (840 Nm³/m³), and a temperature from about 500°F (about 260°C) to about 800°F (about 427°C).
6. The method of claim 1, wherein the T5 boiling point of the bottoms feed fraction is at least about 370°C.
7. The method of claim 1, wherein the boiling point profile of the hydrotreated effluent corresponds to at least about 50% conversion of the hydrocarbon feed relative to the conversion threshold.
8. The method of claim 1 in which the hydrotreating catalyst includes a hydrogenation component selected from Ni and W, Ni and Mo, or Ni and Mo and W.
9. A method for processing a hydrocarbon feedstock, comprising:
contacting a bottoms feed fraction having a T5 boiling point of at least about

355°C with a dewaxing/conversion catalyst comprising a combination of zeolite USY and zeolite ZSM-48 and a hydrogenation metal under effective dewaxing/conversion conditions in the presence of hydrogen in a conversion stage to form a dewaxed conversion stage effluent;

cascading the dewaxed conversion stage effluent to a hydrotreating stage;

hydrotreating a mixture of the dewaxed conversion stage effluent and a mineral hydrocarbon feed, the hydrocarbon feed having a T5 boiling point of at least about 340°C and a sulfur content of at least about 200 wppm, in the hydrotreating stage by exposing the dewaxed conversion stage effluent and the hydrocarbon feed to a hydrotreating catalyst in the presence of a hydrogen treat gas under effective hydrotreatment conditions to produce a hydrotreated effluent having a sulfur content of about 50 wppm or less;

fractionating the hydrotreated effluent to produce at least a kerosene fraction having a sulfur content of about 10 wppm or less, a diesel fraction having a sulfur content of about 20 wppm or less, and a bottoms fraction; and

recycling at least about 25% of the bottoms fraction to the conversion stage as the bottoms feed fraction,

wherein a boiling point profile of the hydrotreated effluent corresponds to at least about 40% conversion of the hydrocarbon feed relative to a conversion threshold corresponding to the T5 boiling point of the bottoms feed fraction.

10. The method of claim 9, wherein the bottoms feed fraction comprises about 50% to about 90% of the bottoms fraction.

11. The method of claim 9, wherein the hydrogenation metal is selected from Pt, Pd, or Pt and Pd.

12. The method of claim 9, wherein the effective conversion conditions comprise a temperature from about 200°C to about 450°C, a total hydrogen pressure from about 5 barg (about 0.5 MPag) to about 300 barg (about 30 MPag), a treat gas ratio from about 100 scf/bbl (about 17 Nm³/m³) to about 5000 scf/bbl (about 840 Nm³/m³), and an LHSV

from about 0.05 hr^{-1} to about 10 hr^{-1} , and/or wherein the effective hydrotreatment conditions comprise an LHSV from about 0.3 hr^{-1} to about 5.0 hr^{-1} , a total hydrogen pressure from about 500 psig (about 3.4 MPag) to about 3000 psig (about 20.7 MPag), a treat gas ratio from about 100 scf/bbl ($17 \text{ Nm}^3/\text{m}^3$) to about 5000 scf/bbl ($840 \text{ Nm}^3/\text{m}^3$), and a temperature from about 500°F (about 260°C) to about 800°F (about 427°C).

13. The method of claim 9, wherein the boiling point profile of the hydrotreated effluent corresponds to at least about 50% conversion of the hydrocarbon feed relative to the conversion threshold corresponding to the T5 boiling point of the bottoms feed fraction.

14. The method of claim 9 in which the hydrotreating catalyst includes a hydrogenation component selected from Ni and W, Ni and Mo, or Ni and Mo and W.

15. A method for processing a hydrocarbon feedstock, comprising:

contacting a bottoms feed fraction having a T5 boiling point of at least about 355°C with a dewaxing/conversion catalyst comprising a combination of zeolite USY and zeolite ZSM-48 and a hydrogenation metal under effective dewaxing/conversion conditions in the presence of hydrogen in a conversion stage to form a dewaxed conversion stage effluent, the hydrogenation metal comprising Pt, Pd, or a combination thereof;

cascading the dewaxed conversion stage effluent to a hydrotreating stage;

hydrotreating a mixture of the dewaxed conversion stage effluent and a mineral hydrocarbon feed, the hydrocarbon feed having a T5 boiling point of at least about 340°C and a sulfur content of at least about 200 wppm, in the hydrotreating stage by exposing the dewaxed conversion stage effluent and the hydrocarbon feed to a hydrotreating catalyst in the presence of a hydrogen treat gas under effective hydrotreatment conditions to produce a hydrotreated effluent having a sulfur content of about 50 wppm or less, the hydrotreating catalyst including a hydrogenation component selected from Ni and W, Ni and Mo, or Ni and Mo and W;

fractionating the hydrotreated effluent to produce at least a kerosene fraction having a sulfur content of about 10 wppm or less, a diesel fraction having a sulfur content of about 20 wppm or less, and a bottoms fraction; and

recycling at least about 25% of the bottoms fraction to the conversion stage as the bottoms feed fraction,

wherein a boiling point profile of the hydrotreated effluent corresponds to at least about 40% conversion of the hydrocarbon feed relative to a conversion threshold corresponding to the T5 boiling point of the bottoms feed fraction.