Claims

What is claimed:

1. A process for producing propylene and a low-sulfur marine fuel oil component, comprising the steps of:

(1) contacting a heavy feedstock oil with a solvent for extraction separation to obtain a light deasphalted oil, a heavy deasphalted oil and a deoiled asphalt;

(2) contacting the light deasphalted oil and optionally a light feedstock oil with a catalytic conversion catalyst for reaction in a catalytic conversion reactor in the absence of hydrogen to obtain a reaction product comprising propylene, and controlling a conversion rate of the catalytic conversion process at 50% to 70%;

(3) separating the reaction product from step (2) to obtain a catalytic cracking distillate oil, wherein the catalytic cracking distillate oil has an initial boiling point of no less than 200 ºC, a final boiling point of no greater than 550 ºC, and a hydrogen content of no greater than 12.0 wt%;

(4) subjecting the catalytic cracking distillate oil to hydrodesulfurization to obtain a low-sulfur hydrogenated distillate oil having a sulfur content of no greater than 0.1%, and

(5) blending the low-sulfur hydrogenated distillate oil with one or more fuel oil components selected from the heavy deasphalted oil, a vacuum residue, and the deoiled asphalt to obtain the low-sulfur marine fuel oil,

wherein the catalytic conversion catalyst used in step (2) comprises 1-50 wt% zeolite, 5-99 wt% inorganic oxide, and 0-70 wt% clay, based on the total weight of the catalyst, and

the reaction conditions of the step (2) include: a reaction temperature of 460-750 ºC, and preferably 480-700 ºC; a weight hourly space velocity of 10-100 h^{-1}, preferably 30-100 h^{-1}, or a reaction time of 1-10 seconds, preferably 2-8 seconds; and a catalyst-to-oil weight ratio of 4-20, preferably 5-12.

2. The process according to claim 1, wherein said zeolite comprises 51-100 wt% of a mesoporous zeolite and 0-49 wt% of a macroporous zeolite, based on the total weight of the zeolite in the catalytic conversion catalyst, wherein said mesoporous zeolite has a silica-alumina ratio of greater than 10, more preferably greater than 50, and particularly preferably greater than 100,

preferably, the mesoporous zeolite is selected from the group consisting of ZSM-type zeolites and ZRP zeolites; the macroporous zeolite is a Y-type zeolite.

3. The process according to claim 1, wherein step (2) is carried out to such an extent that

the resulting reaction product has a propylene/propane mass ratio of no less than 4, preferably no less than 6, most preferably no less than 8; and/or an isobutene/isobutane mass ratio of no less than 1, preferably no less than 1.5, most preferably no less than 1.8.

4. The process according to claim 1, wherein step (2) is carried out to such an extent that the yield of the catalytic cracking distillate oil in the resulting reaction product is not less than 15%, preferably not less than 20%, more preferably not less than 30%, and not more than 50%.

5. The process according to claim 1, wherein the heavy feedstock oil is selected from the group consisting of vacuum residues, hydrogenated heavy oils, or any mixtures thereof.

6. The process according to claim 1, wherein the solvent is selected from the group consisting of propane, butane, pentane or any mixtures thereof.

7. The process according to claim 1, wherein the conditions for extraction separation of step (1) include: a temperature of 10-200 ºC, preferably 20-180 ºC; an operating pressure of 1.0-15.0MPa, preferably 2.0-10.0 MPa; a mass ratio of the solvent to the feedstock oil of 1-20, preferably 3-10.

8. The process according to claim 1, wherein the light feedstock oil used in step (2) is selected from the group consisting of petroleum hydrocarbons, other mineral oils, or mixtures thereof, wherein the petroleum hydrocarbon is selected from the group consisting of vacuum gas oils, atmospheric gas oils, coker gas oils, high-quality residues, high-quality hydrogenated heavy oils or any mixtures thereof, and said other mineral oil is selected from the group consisting of coal liquefied oils, tar sand oils, shale oils or any mixtures thereof; wherein,

the high-quality residues refer to residues having a hydrogen content of 11.2% or more,

the high-quality hydrogenated heavy oils refer to hydrogenated heavy oils having a hydrogen content of 11.2% or more.

9. The process according to claim 1, wherein the catalytic conversion reactor used in step (2) is a fluidized bed reactor, including a single fluidized bed reactor or a composite reactor comprising a plurality of fluidized bed reactors connected in series or in parallel, preferably an equal-diameter riser reactor or various types of varied-diameter fluidized bed reactors.

10. The process according to claim 1, wherein said catalytic cracking distillate oil of step (3) has an initial boiling point of no less than 250 ºC, a final boiling point of no greater than 520 ºC, preferably no greater than 500 ºC, and a hydrogen content of no greater than 11.0 wt%.

11. The process according to claim 1, wherein a catalyst comprising a Group VIB metal and/or a Group VIII metal supported on an alumina and/or amorphous silica-alumina carrier is used in the hydrodesulfurization step (4).

12. The process according to claim 11, wherein the catalyst used in the

hydrodesulfurization step (4) comprises 0-10 wt% of an additive, 1-40 wt% of at least one Group VIII metal (calculated as metal oxide), and 1-50 wt% of at least one Group VIB metal (calculated as metal oxide), with the balance being a carrier selected from alumina and amorphous silica-alumina, wherein the additive comprises an element selected from the group consisting of fluorine, phosphorus, titanium, platinum or a combination thereof.

13. The process according to claim 1, wherein the conditions of the hydrodesulfurization step (4) include: a reaction pressure of 2.0-24.0MPa, a reaction temperature of 200-500 ºC, a hydrogen-to-oil volume ratio of 50-5000 N^3/m^3, and a liquid hourly space velocity of 0.1-30.0 h^{-1},

preferably, the conditions of the hydrodesulfurization step (4) include: a reaction pressure of 3.0-15.0MPa, a reaction temperature of 300-400 ºC, a hydrogen-to-oil volume ratio of 200-2000 N^3/m^3, and a liquid hourly space velocity of 0.2-10.0 h^{-1}.

14. The process according to claim 1, wherein the low-sulfur hydrogenated distillate oil obtained in step (4) has a sulfur content of no more than 0.05%.

15. The process according to claim 2, wherein step (2) is carried out to such an extent that the resulting reaction product has a propylene/propane mass ratio of no less than 4, preferably no less than 6, most preferably no less than 8; and/or an isobutene/isobutane mass ratio of no less than 1, preferably no less than 1.5, most preferably no less than 1.8.

16. The process according to claim 2, wherein step (2) is carried out to such an extent that the yield of the catalytic cracking distillate oil in the resulting reaction product is not less than 15%, preferably not less than 20%, more preferably not less than 30%, and not more than 50%.

17. The process according to claim 15, wherein step (2) is carried out to such an extent that the yield of the catalytic cracking distillate oil in the resulting reaction product is not less than 15%, preferably not less than 20%, more preferably not less than 30%, and not more than 50%.