What is claimed is:

1. A process for processing an aromatics-rich fraction oil, characterized in comprising:

(2) introducing a deoiled asphalt and an aromatics-comprising stream comprising the first heavy component into a hydrogen dissolving unit to be mixed with hydrogen to form a mixed material, and introducing the mixed material into a first reaction unit for a hydrogenation reaction, wherein the first reaction unit comprises a mineral-rich precursor material and/or a hydrogenation catalyst, and wherein the deoiled asphalt and the aromatics-containing stream are used in such an amount ratio that a mixed feedstock formed by the deoiled asphalt and the aromatics-containing stream is in liquid state at a temperature of not higher than 400 ℃;

(3) fractionating a liquid-phase product from the first reaction unit to provide a second light component and a second heavy component, wherein the cutting point for the second light component and the second heavy component is at 240-450℃;

(41) introducing the second light component into a second reaction unit for reaction, to provide at least one product selected from a gasoline component, a diesel component and a BTX feedstock component, wherein the second reaction unit is at least one selected from the group consisting of a hydrocracking unit, a catalytic cracking unit and a diesel hydro-upgrading unit; and

(42) introducing the second heavy component into a delayed coking unit for reaction, to provide at least one product selected from the group consisting of coker gasoline, coker diesel, coker wax oil and low sulfur petroleum coke; or using the second heavy component as a component of low sulfur ship fuel oil.

2. The process according to claim 1, further comprising:

(1) introducing an aromatics-rich fraction oil into a third reaction unit for hydrosaturation, followed by fractionation, to provide a first light component and a first heavy component, wherein the first light component and the first heavy component has a cutting point of 100-250 ℃, and the aromatic content in the first heavy component is more than or equal to 20 wt%; wherein the first heavy component is used as the first heavy component comprised in the aromatic-comprising stream in step (2).

3. The process according to claim 1, wherein in the step (2), the first reaction unit is a liquid-phase hydrogenation reaction unit, the mineral-rich precursor material is a material capable of adsorbing at least one metal selected from V, Ni, Fe, Ca and Mg.

4. The process according to claim 1, wherein in step (2), the deoiled asphalt and the aromatics-containing stream are used in a ratio such that the viscosity at 100℃ of the mixed feedstock formed from the deoiled asphalt and the aromatics-containing stream is not greater than 400 mm^2/s, more preferably not greater than 200 mm2/s, more preferably not greater than 100 mm^2/s.

5. The process according to claim 1, wherein in step (2), the aromatics-containing stream further comprises an aromatic hydrocarbon and/or an aromatic oil, and the aromatic oil is at least one selected from the group consisting of LCO, HCO, FGO, ethylene tar, coal tar, coker diesel, and coker wax oil;

preferably, the aromatic hydrocarbon is at least one selected from the group consisting of benzene, toluene, xylene, naphthalene, naphthalene substituted with at least one C_{1-6} alkyl group, and tricyclic or higher aromatic hydrocarbons.

6. The process according to claim 1, wherein the aromatic hydrocarbon content in the aromatics-rich fraction oil is more than or equal to 20 wt%, preferably more than or equal to 25 wt%, preferably more than or equal to 40 wt%.

7. The process according to claim 1, wherein in step (2), the deoiled asphalt is obtained by subjecting a heavy oil feedstock to a solvent deasphalting process in a solvent deasphalting unit;

preferably, in the solvent deasphalting unit, the yield of the deoiled asphalt is not more than 50% by weight, more preferably not more than 40% by weight, and still more preferably not more than 30% by weight.

8. The process according to claim 1, wherein in the step (2), the aromatics-containing stream is an aromatics-rich fraction oil, and the weight ratio of the

amount of the deoiled asphalt to the amount of the aromatics-containing stream is from 1:10 to 50:10, more preferably 2:10 to 30: 10; more preferably 3:10 to 15: 10.

9. The process according to claim 1, further comprising: recycling the coker diesel and/or coker gas oil obtained in step (42) to the first reaction unit in step (1) for hydrosaturation.

10. The process according to claim 2, wherein in the step (1), the third reaction unit is at least one of a fixed bed reactor, a moving bed reactor and a boiling bed reactor;

preferably, the third reaction unit is operated under conditions of: a reaction temperature of 200-420 ℃, a reaction pressure of 2-18 MPa, a liquid hourly space velocity of 0.3-10 h^{-1}, and a volume ratio of hydrogen to oil of 50-5000;

preferably, the third reaction unit is operated under conditions of: a reaction temperature of 220-400 ℃, a reaction pressure of 2-15 MPa, a liquid hourly space velocity of 0.3-5 h^{-1}, and a volume ratio of hydrogen to oil of 50-40000.

11. The process according to claim 1, wherein in step (2), the first reaction unit is operated under conditions of: a reaction temperature of 260-500 ℃, a reaction pressure of 2.0-20.0 MPa, a volume ratio of the recycling oil to the raw oil at inlet of the first reaction unit of 0.1: 1-15: 1, and a liquid hourly space velocity of 0.1-1.5 h^{-1}.

12. The process according to claim 1, wherein in the step (2), the mineral-rich precursor material has a loss on ignition of not less than 3 wt%, a specific surface area of not less than 80 m^2/g, and a water absorption of not less than 0.9 g/g.

13. The process according to claim 12, wherein in step (2), the mineral-rich precursor material comprises a support and an active component element loaded on the support, wherein the support is at least one selected from the group consisting of aluminum hydroxide, alumina and silica, and the active component element is at least one metal element selected from the group consisting of Group VIB and Group VIII.

14. The process according to claim 13, wherein in step (2), according to the flowing

direction of reactants, the first reaction unit is sequentially loaded with a first mineral-rich precursor material and a second mineral-rich precursor material, and the second mineral-rich precursor material has a loss on ignition equal to or greater than that of the first mineral-rich precursor material;

preferably, the first mineral-rich precursor material has a loss on ignition of 3-15% by weight, and the second mineral-rich precursor material has a loss on ignition of not less than 15% by weight;

preferably, the first mineral-rich precursor material and the second mineral-rich precursor material are loaded at a ratio by volume of from 5:95 to 95: 5.

15. The process according to claim 1, wherein in step (41), the second reaction unit is a hydrocracking unit, operated under conditions of: a reaction temperature of 360-420 ℃, a reaction pressure of 10.0-18.0 MPa, a volume ratio of hydrogen to oil of 600-2000, and a liquid hourly volume space velocity of 1.0-3.0 h^{-1};

preferably, the hydrocracking unit is loaded with at least one hydrotreating catalyst and at least one hydrocracking catalyst.

16. The process according to claim 1, wherein in step (41), the second reaction unit is a catalytic cracking unit, and the catalytic cracking unit is a fluid catalytic cracking unit;

preferably, the fluid catalytic cracking unit is operated under conditions of: a reaction temperature of 500-600 ℃, a catalyst-to-oil ratio of 3-12, and a retention time of 0.6 - 6s.

17. The process according to claim 1, wherein in step (41), the second reaction unit is a diesel hydrogenation upgrading unit, operated under conditions of: a reaction temperature of 330-420 ℃, a reaction pressure of 5.0-18.0 MPa, a volume ratio of hydrogen to oil of 500-2000, and a liquid hourly volume space velocity of 0.3-3.0 h^{-1};

preferably, the diesel hydrogenation upgrading unit is loaded with at least one diesel hydrogenation upgrading catalyst.

18. The process according to claim 1, wherein in step (42), the second heavy

component is introduced into a delayed coking unit for reaction, to provide at least one product selected from coker gasoline, coker diesel, coker wax oil and low sulfur petroleum coke, wherein the delayed coking unit is operated under conditions of: a reaction temperature of 440-520 ℃, and a retention time of 0.1-4 h;

preferably, in step (42), the sulfur content of the second heavy component is not greater than 1.8 wt%, the second heavy component is introduced into a delayed coking unit for reaction, to provide a low-sulfur petroleum coke. More preferably, the sulfur content of the low-sulfur petroleum coke is not greater than 3 wt%.

19. The process according to claim 1, wherein in step (42), the second heavy component is used as a low-sulfur ship fuel oil component, and the conditions are controlled such that the sulfur content of the low-sulfur ship fuel oil component is not more than 0.5 wt%.

20. The process according to claim 2, further comprising:

(11) introducing a heavy raw oil into the solvent deasphalting unit for solvent deasphalting treatment, to provide a deoiled asphalt and a deasphalted oil;

(12) introducing the deasphalted oil into a fourth reaction unit for hydrogenation reaction, and introducing a liquid phase effluent obtained in the fourth reaction unit into a DCC unit for reaction, to provide propylene, LCO, HCO and slurry oil, wherein the fourth reaction unit is a fixed bed reaction unit; and

using the aromatics-rich fraction oil comprising LCO and/or HCO from the DCC unit as the aromatics-rich fraction oil in step (1).

21. The process according to claim 20, further comprising: recycling the coker diesel and/or coker gas oil obtained in step (42) to the third reaction unit for hydrosaturation.

22. The process according to claim 20, wherein in step (12), the fourth reaction unit is operated under conditions of: a reaction temperature of 280-400 ℃, a reaction pressure of 6.0-14.0 MPa, a volume ratio of hydrogen to oil of 600-1200, and a liquid hourly space velocity of 0.3-2.0 h^{-1};

preferably, in step (12), the fourth reaction unit is loaded with at least two hydrogenation catalysts;

preferably, in step (12), the hydrogenation catalyst is a catalyst capable of catalyzing at least one reaction selected from the group consisting of a hydrodemetallization reaction, a hydrodesulfurization reaction, and a hydrodecarbonization reaction; and

preferably, in step (12), the hydrogenation catalyst comprises alumina as the support and a metal element from Group VIB and/or Group VIII as an active component element, and optionally at least one auxiliary element selected from P, Si, F and B.

23. A system for processing an aromatics-rich fraction oil, comprising:

a third reaction unit, for hydrosaturation and fractionation on the aromatics-rich fraction oil to provide a first light component and a first heavy component;

a hydrogen dissolving unit in fluid communication with the third reaction unit, for mixing therein the deoiled asphalt and the aromatics-containing stream comprising the first heavy component from the third reaction unit with hydrogen;

a first reaction unit in fluid communication with the hydrogen dissolving unit, which is a liquid-phase hydrogenation reaction unit, and is used for carrying out hydrogenation reaction therein of the mixed material from the hydrogen dissolving unit;

a separation unit in fluid communication with the first reaction unit, for fractionating the liquid phase product from the first reaction unit therein;

a second reaction unit in fluid communication with the separation unit, for reaction therein of the second light fraction obtained in the separation unit, wherein the second reaction unit being at least one selected from the group consisting of a hydrocracking unit, a catalytic cracking unit, and a diesel hydro-upgrading unit;

a delayed coking unit in fluid communication with the separation unit, for reaction therein of the second heavy component obtained from the separation unit, to provide at least one product selected from the group consisting of coker gasoline, coker diesel, coker wax oil, and low sulfur petroleum coke; and

an outlet in fluid communication with the separation unit, for discharging the second heavy fraction obtained from the separation unit as a low sulfur ship fuel oil fraction from the system.

24. The system according to claim 23, wherein the delayed coking unit is in fluid communication with the hydrogen dissolving unit, for recycling the coker gas oil and/or the coker gas oil obtained in the delayed coking unit back to the first reaction unit.

25. The system according to claim 23, further comprising a solvent deasphalting unit in fluid communication with the hydrogen dissolving unit, which is used for solvent deasphalting the heavy oil feedstock therein and introducing the deasphalted asphalt obtained after the solvent deasphalting into the hydrogen dissolving unit.

26. The system according to claim 23, further comprising:

a solvent deasphalting unit, used for subjecting the heavy raw oil to solvent deasphalting treatment therein, to provide deoiled asphalt and deasphalted oil;

a fourth reaction unit in fluid communication with the solvent deasphalting unit, wherein the fourth reaction unit is a fixed bed reaction unit, for hydrogenation reaction therein of the deasphalted oil from the solvent deasphalting unit;

a DCC unit in fluid communication with the fourth reaction unit, for reaction therein of the liquid phase effluent obtained from the fourth reaction unit, to provide propylene, LCO, HCO and slurry oil;

wherein the DCC unit is in fluid communication with the third reaction unit, for transporting the aromatic-rich fraction oil comprising LCO and/or HCO from the DCC unit to the third reaction unit for use as the aromatic-rich fraction oil.