CLAIMS

1. A conversion process for an organic material, characterized by comprising the following steps:

preparing a first slurry that comprises a catalyst and an organic material, wherein the catalyst is at least one selected from the group consisting of an iron oxide compound, a desulfurization waste agent resulting from use of an iron oxide compound as desulfurizer, and a regeneration product of the desulfurization waste agent, and wherein the first slurry comprises water; and wherein the catalyst is present in an amount of 0.1 to 10% by weight in the first slurry; and the catalyst has an average particle diameter of from 0.1 μm to 5 mm,

carrying out a first conversion reaction at a reaction pressure of 5-22 MPa and a reaction temperature of 100-470 °C for a reaction time of no less than 15 min by mixing the first slurry with a CO containing gas having a CO volume content of no less than 15% and keeping a molar ratio of iron element to sulfur element of 1: (0.5-5) in a reaction system, thereby obtaining a first conversion product.

2. The conversion process according to claim 1, characterized in that a sulfur-containing substance is added to the catalyst to control the reaction system to have a molar ratio of iron element to sulfur element of 1: (0.5-5), preferably 1: (0.5-2), and more preferably 1: (1-2).

3. The conversion process according to claim 2, characterized in that the sulfur-containing substance is at least one selected from the group consisting of sulfur, hydrogen sulfide, and carbon disulfide.

4. The conversion process according to any one of claims 1 to 3, characterized in that the water comprised in the first slurry comes from water inherently contained in

the organic material, and based on a total weight of the organic material, water accounts for 500 ppm to 20%, preferably 2% to 10%; or,

the water comprised in the first slurry comes from adding of outside water.

5. The conversion process according to any one of claims 1 to 4, characterized in that the CO containing gas has a CO volume content of no less than 50%, and most preferably no less than 90%.

6. The conversion process according to claim 5, characterized in that the CO containing gas is a gas mixture of CO and H_2 or a synthesis gas.

7. The conversion process according to any one of claims 1-6, characterized in that the desulfurization waste agent is at least one selected from the group consisting of a waste agent of a desulfurizer comprising iron oxide as an active component, a waste agent of a desulfurizer comprising $Fe_{21.333}O_{32}$ as an active component, and a waste agent of a desulfurizer comprising FeOOH as an active component; or

the regeneration product is at least one selected from the group consisting of a regeneration product of a desulfurization waste agent of a desulfurizer comprising iron oxide as an active component, a regeneration product of a desulfurization waste agent of a desulfurizer comprising $Fe_{21.333}O_{32}$ as an active component, and a regeneration product of a desulfurization waste agent of a desulfurizer comprising FeOOH as an active component.

8. The conversion process according to claim 7, characterized in that the iron oxide is Fe_2O_3 and/or Fe_3O_4.

9. The conversion process according to claim 8, characterized in that the Fe_2O_3 is at least one selected from the group consisting of α-Fe_2O_3, α-$Fe_2O_3 \cdot H_2O$, γ-Fe_2O_3, γ-

$Fe_2O_3 \cdot H_2O$, amorphous Fe_2O_3, and amorphous $Fe_2O_3 \cdot H_2O$;

the Fe_3O_4 is of cubic crystal system;

the FeOOH is at least one selected from the group consisting of α-FeOOH, β-FeOOH, γ-FeOOH, δ-FeOOH, θ-FeOOH, and amorphous FeOOH.

10. The conversion process according to any one of claims 1-9, characterized in that the regeneration product is obtained with a slurry method by subjecting the desulfurization waste agent to oxidation, vulcanization and oxidation.

11. The conversion process according to claim 10, characterized in that the slurry method comprises the following steps:

preparing a second slurry by mixing the desulfurization waste agent with water or an alkali solution;

carrying out a first oxidation reaction by adding an oxidizing agent to the second slurry to obtain an oxidized slurry;

carrying out a vulcanization reaction by adding a vulcanizing agent to the oxidized slurry to obtain a vulcanized slurry;

carrying out a second oxidation reaction by adding an oxidizing agent to the vulcanized slurry;

repeating the vulcanization reaction and the second oxidation reaction to obtain a final slurry; and

subjecting the final slurry to solid-liquid separation to obtain the regeneration product.

12. The conversion process according to any one of claims 1 to 11, characterized in that the first conversion reaction has a reaction time of 15-120 min.

13. The conversion process according to any one of claims 1-12, characterized in that the catalyst has an average particle diameter of from 5 μm to 100 μm, and most preferably from 5μm to 50 μm.

14. The conversion process according to any one of claims 1-13, characterized in that said carrying out a first conversion reaction by mixing the first slurry with a CO containing gas comprises the following steps:

pressurizing and heating a CO containing gas to a pressure of 5-22 MPa and a temperature of 150-600 °C, then mixing with the first slurry in a reaction system to carry out a first conversion reaction.

15. The conversion process according to any one of claims 1-13, characterized in that said carrying out the first conversion reaction by mixing the first slurry with a CO containing gas comprises the following steps:

pressurizing and heating a partial of the CO containing gas to a pressure of 5-22 MPa and a temperature of 150-600 °C, then mixing with the first slurry in a reaction system to carry out a first conversion reaction, and

pressurizing and heating the remaining CO containing gas to a pressure of 5-22 MPa and a temperature of 300-600 °C, then mixing with the first slurry in a reaction system to carry out a first conversion reaction.

16. The conversion process according to any one of claims 1-15, characterized in that a volume ratio of the CO containing gas to the first slurry is (50-10000): 1, preferably (100-5000): 1.

17. The conversion process according to any one of claims 1-16, characterized in that the reaction system is carried out in a reactor, which is selected from the group consisting of a suspended bed reactor, a slurry bed reactor, a bubbling column reactor,

a fluidized bed reactor, a one-batch reactor; or

the reactor is any one or more of a suspended bed reactor, a slurry bed reactor, a bubbling bed reactor, a fluidized bed reactor, and a one-batch reactor connected in series or in parallel.

18. The conversion process according to any one of claims 1-17, characterized in that the conversion process further comprises pressurizing and heating the first slurry at a pressure of 5Mpa-22Mpa, and a temperature of 50-430 °C prior to the first conversion reaction.

19. The conversion process according to any one of claims 1-18, characterized in that the CO-containing gas is obtained by gasifying a hydrocarbon.

20. The conversion process according to claim 19, characterized in that the gasifying is carried out at a temperature of 350-1600 °C and a pressure of 1-20 MPa, and

the hydrocarbon is at least one selected from the group consisting of coal, mineral oil, coke, biomass, a regenerated bio oil, natural gas, methane, biogas, methanol, and ethanol.

21. The conversion process according to any one of claims 1-20, characterized in that the conversion process further comprises carrying out a second conversion reaction by mixing the first conversion product with a CO containing gas and keeping a molar ratio of iron element to sulfur element of 1: (0.5-5) in a reaction system, thereby obtaining a second oil product.

22. The conversion process according to claim 21, characterized in that the second conversion reaction has a reaction pressure of 5-22 MPa and a reaction temperature of

100-470 °C.

23. The conversion process according to claim 21 or 22, characterized in that the first conversion reaction has a reaction temperature of 100-350 °C, the second conversion reaction has a reaction temperature of 300-470 °C, and the reaction temperature of the first conversion reaction is lower than the reaction temperature of the second conversion reaction.

24. The conversion process according to any one of claims 21-23, characterized in that the first conversion reaction has a reaction time of no less than 15 min, preferably 15-120 min, and most preferably 15-60 min; and

the second conversion reaction has a reaction time of no less than 15 min, preferably 15-120 min, and most preferably 15-60 min.

25. The conversion process according to any one of claims 21-24, characterized in that after carrying out the first conversion reaction and before carrying out the second conversion reaction, the first conversion product is subjected to separation to obtain a light oil and a heavy oil; and a further amount of the catalyst and/or a hydrogenation catalyst is added to the first conversion product;

preferably, the hydrogenation catalyst is composed of a carrier and an active component loaded thereon, and the active component is loaded in an amount of 0.5-15% based on the total weight of the hydrogenation catalyst; and

the active component is selected from the group consisting of Mo oxide, Mn oxide, W oxide, Fe oxide, Co oxide, Ni oxide, Pd oxide, and any combination thereof; and the carrier is selected from the group consisting of silica, alumina, zeolite, molecular sieve, and any combination thereof.

26. The conversion process according to any one of claims 1-25, characterized in

that when the organic material is biomass, said preparing the first slurry comprises the following steps:

pretreatment of raw materials: collecting and pulverizing a biomass to a particle size of 0.2 μm to 5 cm;

compression: compressing and molding the pulverized biomass;

second pulverization: pulverizing the compressed biomass again to a particle size of 0.1μm to 500 μm, thereby obtaining a biomass powder;

slurry preparation: mixing the biomass powder with a flowing medium to obtain a mixed slurry, wherein the biomass powder is present in an amount of 10 to 60% by weight in the mixed slurry; and

adding the catalyst in any of the above steps.

27. The conversion process according to claim 26, characterized in that the compressed biomass has a true density of between 0.75 and 1.5 kg/m^3.

28. The conversion process according to claim 26 or 27, characterized in that the compression step has a compression pressure of 0.5-5 MPa and a compression temperature of 30-60 °C.

29. The conversion process according to any one of claims 26-28, characterized in that the catalyst is present in an amount of 0.1 to 10% by weight in the first slurry.

30. The conversion process according to any one of claims 26-29, characterized in that the first slurry is prepared by grinding pulping, which is stirring pulping, dispersing pulping, emulsifying pulping, shearing pulping, homogeneous pulping and colloid grinder pulping.

31. The conversion process according to any one of claims 26-30, characterized in that the biomass is selected from the group consisting of a crop straw, a wood chip, an oil residue, a leaf, an algae, and any combination thereof; and

the flowing medium is an oil or water, wherein the oil is selected from the group consisting of hogwash oil, rancid oil, waste lubricating oil, waste engine oil, heavy oil, residual oil, washing oil, anthracene oil, and any combination thereof.

32. The conversion process according to any one of claims 21-25, characterized by comprising subjecting the second oil product to a first separation operation to produce a light component and a heavy component;

carrying out vacuum distillation on the heavy component to obtain a light fraction;

mixing the light component with the light fraction to form a mixture, carrying out a hydrogenation reaction on the mixture to obtain a hydrogenation product; and

subjecting the hydrogenation product to fractionation operation to obtain a light oil.

33. The conversion process according to claim 32, characterized in that the vacuum distillation is carried out at a temperature of 320-400 °C under a pressure of 5-20kPa.

34. The conversion process according to claim 32 or 33, characterized in that the hydrogenation reaction is carried out under following conditions:

a reaction temperature of 300-440 °C;

a reaction pressure of 6-25MPa;

a hydrogen/oil volume ratio of 1000-3000; and

a space velocity of 0.3-2h^{-1}.

35. The conversion process according to any one of claims 32-34, characterized in

that the fractionation operation is carried out at a temperature of 340-390 °C.

36. The conversion process according to any one of claims 32-35, characterized by further comprising a step of collecting a partial distillate oil obtained by the vacuum distillation and a heavy fraction obtained by the fractionation operation, and using the partial distillate oil and the heavy fraction as a pore filling oil and /or a solvent oil.

37. The conversion process according to any one of claims 32-36, characterized in that, before subjecting the hydrogenation product to fractionation operation, the hydrogenation product is subjected to a second separation operation to obtain hydrogen gas, a gas-phase light hydrocarbon and a liquid phase, wherein the hydrogen gas is circulated and used in the hydrogenation reaction.

38. The conversion process according to any one of claims 32-37, characterized in that the hydrogenation catalyst comprises at least one selected from the group consisting of:

1) amorphous iron oxide and/or amorphous iron oxide hydroxide; and

2) amorphous aluminum oxide loading an active component, wherein the active component comprises at least one selected from the group consisting of oxides of metals of group VIB, group VIIB and group VIII, and the active component has a content of 10wt% to 25wt%.

39. The conversion process according to any one of claims 1-20, characterized in that the conversion process further comprises carrying out a second conversion reaction by mixing the first conversion product with hydrogen and keeping a molar ratio of iron element to sulfur element of 1: (0.5-5) in a reaction system, thereby obtaining a second oil product.

40. The conversion process according to claim 39, characterized in that both the first conversion reaction and the second conversion reaction have a reaction pressure of 5-22 MPa and a reaction temperature of 100-470 °C.

41. The conversion process according to claim 39 or 40, characterized in that the first conversion reaction has a reaction temperature of 100-400 °C, and the second conversion reaction has a reaction temperature of 300-470 °C.

42. The conversion process according to any one of claims 39-41, characterized in that the first conversion reaction has a reaction time of no less than 15 min, preferably 15-120 min, and most preferably 15-60 min; and

the second conversion reaction has a reaction time of no less than 15 min, preferably 15-120 min, and most preferably 15-60 min.

43. The conversion process according to any one of claims 39-42, characterized in that a further amount of the catalyst and/or a hydrogenation catalyst is added to the first conversion product.

44. The conversion process according to claim 43, characterized in that the hydrogenation catalyst is composed of a carrier and an active component loaded thereon, and the active component is loaded in an amount of 0.5-15% based on the total weight of the hydrogenation catalyst.

45. The conversion process according to claim 43 or 44, characterized in that the active component is selected from the group consisting of oxides of Mo, Mn, W, Fe, Co, Ni, Pd, and any combination thereof; and

the carrier is at least one selected from the group consisting of silica, alumina, zeolite, and molecular sieve.

46. The conversion process according to any one of claims 43-45, characterized in that, after the first conversion reaction and before the second conversion reaction, the first conversion product is subjected to a separation operation to produce a light oil and a heavy oil.

47. The conversion process according to any one of claims 43-46, characterized by comprising subjecting the second oil product to a first separation operation to produce a light component and a heavy component;

carrying out vacuum distillation on the heavy component to obtain a light fraction;

mixing the light component with the light fraction to form a mixture, carrying out a hydrogenation reaction on the mixture to obtain a hydrogenation product; and

subjecting the hydrogenation product to fractionation operation to obtain a light oil.

48. The conversion process according to claim 47, characterized in that the hydrogenation reaction is carried out under the following conditions:

a reaction temperature of 300-450 °C;

a reaction pressure of 5-26 MPa;

a hydrogen/oil volume ratio of 1000-3000; and

a space velocity of 0.3-2h^{-1}.

49. The conversion process according to claim 47 or 48, characterized in that the fractionation operation is carried out at a temperature of 300-400 °C.

50. The conversion process according to any one of claims 47-49, characterized by further comprising a step of collecting a partial distillate oil obtained by the vacuum distillation and a heavy fraction obtained by the fractionation operation, and adding the

partial distillate oil and the heavy fraction to a first hydrogenation reaction.

51. The conversion process according to any one of claims 47-50, characterized in that, before the hydrogenation product is subjected to fractionation operation, the hydrogenation product is subjected to a second separation operation to obtain hydrogen gas, a gas-phase light hydrocarbon and a liquid phase, wherein the hydrogen gas is circulated and used in the second conversion reaction and the hydrogenation reaction.

52. The conversion process according to any one of claims 1-17, characterized in that when the organic material is biomass or coal, the conversion process further comprises preparing an aqueous slurry comprising a catalyst, coal and biomass according to the following steps:

pretreatment of biomass: collecting and pulverizing a biomass to a particle size of 0.2 μm to 5 cm;

compression of biomass: compressing and molding the pulverized biomass;

second pulverization of biomass: pulverizing the compressed biomass again to a particle size of 0.1-500 μm, thereby obtaining a biomass powder;

pulverizing the coal to a particle size of 0.1-500 μm, thereby obtaining a coal powder;

mixing the biomass powder and the coal powder with a solvent oil to obtain the aqueous slurry;

wherein, the catalyst is added in any of the above steps.

53. The conversion process according to claim 52, characterized in that the first conversion reaction is carried out at a reaction pressure of 5-22 MPa and a reaction temperature of 200-500 °C.

54. The conversion process according to claim 53, characterized in that the first

conversion reaction has a reaction time of no less than 15 min, preferably 15-120 min.

55. The conversion process according to any one of claims 52-54, characterized in that the compressed biomass has a true density of between 0.75 and 2.0 kg/m^3;

the compression step has a compression pressure of 0.5-10 MPa and a compression temperature of 30-70 °C;

the biomass powder has an amount of 5-99% by weight based on the total mass of the biomass powder and the coal power; and/or

the catalyst is present in an amount of 0.1-8% by weight in the aqueous slurry; and/or

the biomass powder and the coal power are present in an amount of 10-60% by weight and the water is present in an amount of 1-18% in the aqueous slurry.

56. The conversion process according to any one of claims 52-55, characterized in that the aqueous slurry is prepared by grinding pulping, which is stirring pulping, dispersing pulping, emulsifying pulping, shearing pulping, homogeneous pulping and colloid grinder pulping;

the grinding pulping lasts for 8-60min;

the biomass is selected from the group consisting of a crop straw, a wood chip, an oil residue, a leaf, kitchen waste, feces, animal carcasses, an algae, and any combination thereof; and

the solvent oil is a distillate oil from an animal oil, vegetable oil or petroleum, or is a coal tar or an oil produced by self-processing.