CLAIMS

[Claim 1]

A method for producing a liquid fuel, comprising:

a raw material supply step of supplying an organic raw material containing biomass and/or organic polymer waste, and an artificial carbon particle other than activated charcoal to a fluidized-bed-type decomposition apparatus,

a decomposition step of decomposing the organic raw material into a non-solid decomposition component and a solid residue while fluidizing the artificial carbon particle with introducing an inert gas containing oxygen at a concentration of 3% by volume or less as a carrier gas to the fluidized-bed-type decomposition apparatus, to discharge the non-solid decomposition component with the carrier gas as well as to discharge the solid residue separately from the non-solid decomposition component,

a gas-liquid separation step of separating the non-solid decomposition component discharged from the fluidized-bed-type decomposition apparatus into an off-gas component and a decomposed oil by cooling,

a step of reforming the decomposed oil by conducting at least one type of reforming treatment selected from dehydrogenation, conversion, isomerization, hydrogenation, hydrocracking, and hydrotreating under the presence of a catalyst, to produce reformate, and

a step of distilling the reformate.

[Claim 2]

The method according to claim 1, wherein the decomposition step is conducted at a temperature of from 400 to 600°C.

[Claim 3]

The method according to claim 1 or 2, wherein the organic raw material is decomposed through catalytic decomposition by the artificial carbon particle.

[Claim 4]

The method according to claim 1 or 2, wherein the method comprises a step of recycling by returning at least a part of the solid residue discharged

from the decomposition step to the raw material supply step as the artificial carbon particle before the solid residue is cooled to room temperature.

[Claim 5]

The method according to claim 1 or 2, wherein the method comprises a step of returning at least a part of the solid residue discharged from the decomposition step to the raw material supply step as the artificial carbon particle with or without particle size adjustment.

[Claim 6]

The method according to claim 1 or 2, wherein the artificial carbon particle has a specific surface area of 500 m^2/g or less.

[Claim 7]

The method according to claim 1 or 2, wherein the artificial carbon particle contains a metal atom in an amount of 20% by mass or less.

[Claim 8]

The method according to claim 1 or 2, wherein the artificial carbon particle contains a solid base or a solid acid.

[Claim 9]

The method according to claim 1 or 2, wherein, in the raw material supply step, the organic raw material is subjected to at least one type of pretreatment selected from impurities removal, moisture removal, particle size adjustment, and raw material blending, to be supplied to the fluidized-bed-type decomposition apparatus.

[Claim 10]

The method according to claim 1 or 2, wherein, in the raw material supply step, at least one selected from the organic raw material, the artificial carbon particle, and a mixture of the organic raw material and the artificial carbon particle is continuously supplied to the fluidized-bed-type decomposition apparatus.

[Claim 11]

The method according to claim 1 or 2, wherein the biomass is at least one type selected from lignocellulosic biomass and biomass of fat derived from an oil plant, and the organic polymer waste is at least one type of waste selected from synthetic resin, synthetic rubber, and synthetic fiber.

[Claim 12]

The method according to claim 1 or 2, wherein, in the raw material supply step, the organic raw material and the artificial carbon particle are supplied together with organic acids to the fluidized-bed-type decomposition apparatus.

[Claim 13]

The method according to claim 12, wherein the organic acids are mixed with the organic raw material and the artificial carbon particle, to be supplied to the fluidized-bed-type decomposition apparatus.

[Claim 14]

The method according to claim 12, wherein the organic acids include a fatty acid derived from fat and oil or a salt of the fatty acid.

[Claim 15]

The method according to claim 1 or 2, wherein the inert gas is nitrogen.

[Claim 16]

The method according to claim 1 or 2, wherein the method further comprises a heat recovering step of recovering heat generated by combusting the off-gas component through heating the carrier gas before introduction into the fluidized-bed-type decomposition apparatus.

[Claim 17]

The method comprising the steps of the method according to claim 1 or 2, wherein the method further comprises,

a decomposed oil separation step of separating the decomposed oil generated in the gas-liquid separation step into a light cracked oil and a heavy cracked oil based on a difference in boiling point and/or a difference in

solubility, and

a step of distilling reformed light cracked oil.

[Claim 18]

The method according to claim 1 or 2, wherein the liquid fuel is at least one type selected from naphtha, an aviation fuel, kerosine, and diesel fuel.

[Claim 19]

The method according to claim 18, wherein the naphtha is bio-naphtha, the aviation fuel is SAF, the kerosine is bio-kerosine, and the diesel fuel is bio-diesel fuel.

[Claim 20]

The method according to claim 17, wherein at least one selected from the heavy cracked oil generated in the decomposed oil separation step and the remaining oil which has not been distilled off as the liquid fuel from the distillation column in the production step of the liquid fuel is returned to the decomposition step for reprocessing.

[Claim 21]

A production equipment for a liquid fuel, comprising:

a fluidized-bed-type decomposition apparatus to decompose an organic raw material including biomass and/or organic polymer waste into a non-solid decomposition component and a solid residue with an artificial carbon particle other than activated charcoal fluidized by a carrier gas,

at least one raw material supply port mounted to the fluidized-bed-type decomposition apparatus to supply the organic raw material and the artificial carbon particle other than activated charcoal,

a carrier gas line to supply inert gas as the carrier gas containing oxygen at a concentration of 3% by volume or less to the fluidized-bed-type decomposition apparatus,

a gas discharge line to discharge the non-solid decomposition component together with the carrier gas from the fluidized-bed-type decomposition apparatus,

a gas-liquid separation tank to separate a decomposed oil and an off

gas from the non-solid decomposition component discharged from the fluidized-bed-type decomposition apparatus,

a reforming furnace to reform the decomposed oil, and

a distillation column to distill the reformate.

[Claim 22]

The equipment according to claim 21, wherein the equipment further comprises:

an outlet of the solid residue mounted to the fluidized-bed-type decomposition apparatus and,

a recycling system to return the discharged solid residue to the raw material supply port.

[Claim 23]

The equipment according to claim 21 or 22, wherein the distillation column is a distillation column to separate and collect at least one type of liquid fuel selected from naphtha, an aviation fuel, kerosine, and diesel fuel.

[Claim 24]

The equipment according to claim 21 or 22, wherein the distillation column is a distillation column to distill the light cracked oil and the equipment further comprises:

a separation apparatus to separate the decomposed oil contained in the non-solid decomposition component discharged from the fluidized-bed-type decomposition apparatus into a light cracked oil and a heavy cracked oil based on a difference in boiling point and/or a difference in solubility, and

a re-decomposition system involving returning at least one selected from the heavy cracked oil generated by the separation apparatus and the remaining oil which has not been distilled off as the liquid fuel from the distillation column to the raw material supply port to be decomposed again.

[Claim 25]

The method according to claim 1 or 2, wherein at least a portion of the artificial carbon particles forms the fluidised bed.