CLAIMS

WHAT IS CLAIMED IS:

1. A fluidized bed regenerator for activating a catalyst to prepare low-carbon olefins from an oxygen-containing compound, wherein the fluidized bed regenerator comprises a second activation zone, a first activation zone, and a gas-solid separation zone from bottom to top;

the second activation zone axially communicates with the gas-solid separation zone;

the first activation zone is arranged on a periphery of a junction between the second activation zone and the gas-solid separation zone;

the first activation zone is an annular cavity;

n baffles are radially arranged in the first activation zone, and the n baffles divide the first activation zone into n first activation zone subzones; and

a catalyst circulation hole is formed in each of n-1 of the baffles, such that a catalyst entering the first activation zone flows in an annular direction.

2. The fluidized bed regenerator according to claim 1, wherein in the first activation zone, the n baffles comprise a 1st baffle, and a 2nd baffle to an nth baffle;

no catalyst circulation hole is formed in the 1st baffle;

a catalyst circulation hole is formed in each of the 2nd baffle to the nth baffle;

a spent catalyst inlet is formed in a 1st first activation zone subzone formed through division by the 1st baffle and the 2nd baffle;

a first activation zone catalyst delivery pipe is arranged in an nth first activation zone subzone formed through division by the 1st baffle and the nth baffle;

a first activation zone distributor is arranged beneath the first activation zone subzones; and

a first activation zone gas delivery pipe is arranged at tops of the first activation zone subzones~~.~~;

preferably, n has a value range of $2 \leqslant n \leqslant 10$;

preferably, a cross section of each of the first activation zone subzones is sector-annular.

3. The fluidized bed regenerator according to claim 1, wherein a first gas-solid separation unit of the regenerator is arranged in an upper part of the first activation zone; and

the first gas-solid separation unit of the regenerator communicates with the first activation zone through the spent catalyst inlet.

~~4. The fluidized bed regenerator according to claim 1, wherein n has a value range of $2 \leq n \leq 10$~~.

~~5. The fluidized bed regenerator according to claim 1, wherein a cross section of each of the first activation zone subzones is sector-annular.~~

~~6~~4. The fluidized bed regenerator according to claim 1, wherein m perforated plates are horizontally arranged in the second activation zone,

wherein $1 \leq m \leq 10$~~.~~:

preferably, the perforated plates have a porosity of 5% to 50%;

preferably, a second activation zone distributor is arranged at a bottom of the second activation zone.

~~7. The fluidized bed regenerator according to claim 6, wherein the perforated plates have a porosity of 5% to 50%.~~

~~8. The fluidized bed regenerator according to claim 1, wherein a second activation zone distributor is arranged at a bottom of the second activation zone.~~

~~9~~5. The fluidized bed regenerator according to claim 1, wherein the fluidized bed regenerator comprises a regenerator gas collection chamber and a fluidized bed regenerator cooler;

the regenerator gas collection chamber is located at a top of the fluidized bed regenerator;

a top of the regenerator gas collection chamber is provided with a regenerator product gas delivery pipe;

the gas-solid separation zone is provided with a second gas-solid separation unit;

the regenerator gas collection chamber is connected to an outlet of the second gas-solid separation unit; and

the fluidized bed regenerator cooler is located in a lower part of the second activation zone.

~~10~~6. A device for preparing low-carbon olefins from an oxygen-containing compound, comprising a fluidized bed reactor and a fluidized bed regenerator,

wherein the fluidized bed regenerator comprises the fluidized bed regenerator according to ~~any one of claims 1 to 9~~ claim 1.

~~11~~7. The device according to claim ~~10~~6, wherein the device comprises a spent catalyst inclined pipe, a fluidized bed reactor stripper, a spent catalyst delivery pipe, a regenerated catalyst inclined

pipe, and a regenerated catalyst delivery pipe;

a spent catalyst zone, the spent catalyst inclined pipe, the fluidized bed reactor stripper, the spent catalyst delivery pipe, and the first gas-solid separation unit of the regenerator communicate with each other in sequence; and

the second activation zone, the regenerated catalyst inclined pipe, the regenerated catalyst

delivery pipe, and a reaction zone of the fluidized bed reactor communicate with each other in sequence.

~~12~~8. The device according to claim ~~10~~6, wherein the fluidized bed reactor comprises a lower shell, a delivery pipe, and an upper shell;

the lower shell encloses a reaction zone;

the delivery pipe is located above the reaction zone and communicates with the reaction zone;

the upper shell is arranged on a periphery of the delivery pipe;

the upper shell and the delivery pipe enclose a cavity; and

the cavity is divided into a spent catalyst zone and a gas-solid separation zone from bottom to top~~.~~;

preferably, the reaction zone is a fast fluidised zone;

preferably, the spent catalyst zone is a bubbling fluidised zone;

preferably, the gas-solid separation zone is provided with a first gas-solid separation unit of the fluidised bed reactor; and

an upper part of the delivery pipe is connected to an inlet of the first gas-solid separation unit of the fluidised bed reactor;

preferably, the fluidised bed reactor comprises a fluidised bed reactor distributor, a fluidised bed reactor cooler, a spent catalyst zone gas distributor, a fluidised bed reactor gas collection chamber, and a second gas-solid separation unit of the fluidised bed reactor;

the fluidised bed reactor distributor is located at a bottom of the reaction zone;

the fluidised bed reactor cooler is located in a lower part of the spent catalyst zone;

the spent catalyst zone gas distributor is located in the lower part of the spent catalyst zone;

gas outlets of the second gas-solid separation unit of the fluidised bed reactor and the first gas-solid separation unit of the fluidised bed reactor are connected to the fluidised bed reactor gas collection chamber;

the fluidised bed reactor gas collection chamber is provided with a product gas delivery pipe; and

catalyst outlets of the first gas-solid separation unit of the fluidised bed reactor and the second gas-solid separation unit of the fluidised bed reactor are connected to the spent catalyst zone;

preferably, the reaction zone and the spent catalyst zone communicate with each other through a spent catalyst circulation pipe.

~~13.The device according to claim 12, wherein the reaction zone is a fast fluidized zone.~~

~~13. The device according to claim 12, wherein the spent catalyst zone is a bubbling fluidized zone.~~

~~15. The device according to claim 12, wherein~~

~~the gas-solid separation zone is provided with a first gas-solid separation unit of the fluidized bed reactor; and~~

~~an upper part of the delivery pipe is connected to an inlet of the first gas-solid separation unit of the fluidized bed reactor.~~

~~16. The device according to claim 12, wherein the fluidized bed reactor comprises a fluidized bed reactor distributor, a fluidized bed reactor cooler, a spent catalyst zone gas distributor, a fluidized bed reactor gas collection chamber, and a second gas-solid separation unit of the fluidized bed reactor;~~

~~the fluidized bed reactor distributor is located at a bottom of the reaction zone;~~

~~the fluidized bed reactor cooler is located in a lower part of the spent catalyst zone;~~

~~the spent catalyst zone gas distributor is located in the lower part of the spent catalyst zone;~~

~~gas outlets of the second gas-solid separation unit of the fluidized bed reactor and the first gas-solid separation unit of the fluidized bed reactor are connected to the fluidized bed reactor gas collection chamber;~~

~~the fluidized bed reactor gas collection chamber is provided with a product gas delivery pipe; and~~

~~catalyst outlets of the first gas-solid separation unit of the fluidized bed reactor and the second gas-solid separation unit of the fluidized bed reactor are connected to the spent catalyst zone.~~

~~17. The device according to claim 12, wherein the reaction zone and the spent catalyst zone communicate with each other through a spent catalyst circulation pipe.~~

~~18. A method for activating a catalyst to prepare low-carbon olefins from an oxygen-containing compound, using the fluidized bed regenerator according to any one of claims 1 to 9.~~

~~19. The method according to claim 18, wherein the method comprises:~~

~~feeding a first activation zone raw material and a spent catalyst into the first activation zone, wherein the spent catalyst chemically reacts with the first activation zone raw material while flowing in an annular direction along the first activation zone subzones to generate a partially-activated catalyst; and~~

~~feeding the partially-activated catalyst and a second activation zone raw material into the second activation zone, and allowing a chemical reaction to generate a regenerated catalyst;~~

~~wherein a coke composition in the partially-activated catalyst comprises oxygen-containing hydrocarbon species and oxygen-free hydrocarbon species.~~

~~20. The method according to claim 19, wherein the first activation zone raw material comprises oxygen, air, and water vapor;~~

~~a mass fraction of the oxygen is 0 wt% to 10 wt%;~~

~~a mass fraction of the air is 0 wt% to 20 wt%; and~~

~~a mass fraction of the water vapor is 80 wt% to 100 wt%.~~

~~21. The method according to claim 19, wherein the second activation zone raw material is water vapor.~~

~~22. The method according to claim 19, wherein a coke content in the spent catalyst is 9 wt% to 13 wt%.~~

~~23. The method according to claim 19, wherein a coke content in the spent catalyst is 10 wt% to 12 wt%.~~

~~24. The method according to claim 19, wherein a coke content in the regenerated catalyst is 5~~

~~wt% to 11 wt; and~~

~~a quartile deviation of a coke content distribution in the regenerated catalyst is less than 1.0 wt%.~~

~~25. The method according to claim 19, wherein in the regenerated catalyst, coke species comprise polymethylbenzene and polymethylnaphthalene;~~

~~a total mass of the polymethylbenzene and the polymethylnaphthalene accounts for greater than or equal to 60 wt% of a total mass of coke;~~

~~a mass of coke species with a molecular weight greater than 184 accounts for less than or equal to 30 wt% of the total mass of coke; and~~

~~the total mass of coke refers to a total mass of coke species.~~

~~26. The method according to claim 19, wherein the spent catalyst comprises an SAPO-34 molecular sieve.~~

~~27. The method according to claim 19, wherein process operating conditions of the first activation zone of the fluidized bed regenerator are as follows: apparent gas linear velocity: 0.1 m/s to 0.5 m/s; temperature: 650°C to 750°C; pressure: 100 kPa to 500 kPa; and bed density: 400 kg/m^3 to 700 kg/m^3.~~

~~28. The method according to claim 19, wherein process operating conditions of the second activation zone of the fluidized bed regenerator are as follows: apparent gas linear velocity: 0.1 m/s to 0.5 m/s; temperature: 550°C to 700°C; pressure: 100 kPa to 500 kPa; and bed density: 400 kg/m^3 to 700 kg/m^3.~~

~~29.~~ 9. A method for preparing low-carbon olefins from an oxygen-containing compound using the device according to claim 7 ~~any one of claims 10 to 17.~~;

wherein the method for preparing the low carbon olefins from the oxygen-containing compound comprises a method for activating a catalyst to prepare the low carbon olefins from the oxygen-containing compound, and the method for activating the catalyst to prepare the low carbon olefins from the oxygen-containing compound uses the fluidised bed regenerator according to claim 1;

wherein the method for activating the catalyst to prepare the low carbon olefins from the oxygen-containing compound comprises:

feeding a first activation zone raw material and a spent catalyst into the first activation zone, wherein the spent catalyst chemically reacts with the first activation zone raw material while flowing in an annular direction along the first activation zone subzones to generate a partially-activated catalyst; and

feeding the partially-activated catalyst and a second activation zone raw material into the second activation zone, and allowing a chemical reaction to generate a regenerated catalyst;

wherein a coke composition in the partially-activated catalyst comprises oxygen-containing hydrocarbon species and oxygen-free hydrocarbon species;

~~30. The method according to claim 29,~~ wherein the method for preparing the low carbon olefins from the oxygen-containing compound further comprises:

feeding a raw material with the oxygen-containing compound and a regenerated catalyst into the reaction zone, and allowing a reaction to obtain a stream A with low-carbon olefins and a spent catalyst;

subjecting the stream A to gas-solid separation, and conveying the spent catalyst to the spent catalyst zone; and

returning a part of the spent catalyst in the spent catalyst zone to a fluidized bed reaction zone,

and allowing the remaining part of the spent catalyst to enter the fluidized bed regenerator.

10. The method according to claim 9, wherein the first activation zone raw material comprises oxygen, air, and water vapor;

a mass fraction of the oxygen is 0 wt% to 10 wt%;

a mass fraction of the air is 0 wt% to 20 wt%; and

a mass fraction of the water vapor is 80 wt% to 100 wt%.

11. The method according to claim 9, wherein the second activation zone raw material is water vapor.

12. The method according to claim 9, wherein a coke content in the spent catalyst is 9 wt% to 13 wt%;

preferably, a coke content in the spent catalyst is 10 wt% to 12 wt%;

preferably, the spent catalyst comprises an SAPO-34 molecular sieve.

13. The method according to claim 9, wherein a coke content in the regenerated catalyst is 5 wt% to 11 wt; and

a quartile deviation of a coke content distribution in the regenerated catalyst is less than 1.0 wt%;

preferably, in the regenerated catalyst, coke species comprise polymethylbenzene and polymethylnaphthalene;

a total mass of the polymethylbenzene and the polymethylnaphthalene accounts for greater than or equal to 60 wt% of a total mass of coke;

a mass of coke species with a molecular weight greater than 184 accounts for less than or equal to 30 wt% of the total mass of coke; and

the total mass of coke refers to a total mass of coke species.

14. The method according to claim 9, wherein process operating conditions of the first activation zone of the fluidised bed regenerator are as follows: apparent gas linear velocity: 0.1 m/s to 0.5 m/s; temperature: 650°C to 750°C; pressure: 100 kPa to 500 kPa; and bed density: 400 kg/m3 to 700 kg/m3.

15. The method according to claim 9, wherein process operating conditions of the second activation zone of the fluidised bed regenerator are as follows: apparent gas linear velocity: 0.1

m/s to 0.5 m/s; temperature: 550°C to 700°C; pressure: 100 kPa to 500 kPa; and bed density: 400 kg/m3 to 700 kg/m3.

~~31.~~ 16. The method according to claim 30, a fluidizing gas of the spent catalyst zone is at least one from the group consisting of nitrogen and water vapor.

~~32.~~ 17. The method according to claim 30, wherein the raw material with the oxygen-containing compound is at least one from the group consisting of methanol and dimethyl ether (DME).

~~33~~. 18. The method according to claim 30, wherein a ratio of a mass flow rate of the regenerated catalyst to a feed amount of the oxygen-containing compound is 0.3 to 1.0 ton of catalyst/ton of methanol.

preferably, a ratio of a mass flow rate of the regenerated catalyst to a feed amount of the oxygen-containing compound is 0.5 to 1.0 ton of catalyst/ton of methanol.

~~31. The method according to claim 30, wherein a ratio of a mass flow rate of the regenerated catalyst to a feed amount of the oxygen-containing compound is 0.5 to 1.0 ton of catalyst/ton of methanol.~~

~~35~~19. The method according to claim ~~30~~9, wherein process operating conditions of the reaction zone of the fluidized bed reactor are as follows: apparent gas linear velocity: 0.5 m/s to 7.0 m/s; reaction temperature: 350°C to 550°C; reaction pressure: 100 kPa to 500 kPa; and bed density: 100 kg/m^3 to 500 kg/m^3.

~~36~~20. The method according to claim ~~30~~9, wherein process operating conditions of the spent catalyst zone of the fluidized bed reactor are as follows: apparent gas linear velocity: 0.1 m/s to 1.0 m/s; reaction temperature: 350°C to 550°C; reaction pressure: 100 kPa to 500 kPa; and bed density: 200 kg/m^3 to 800 kg/m^3.