Claims

1. A device for preparing propylene and C4 hydrocarbons from oxygen-containing compounds, comprising:

a turbulent fluidized-bed reactor, the turbulent fluidized-bed reactor comprises a reactor shell, n reactor feed distributors, a reactor gas-solid separator 1, a reactor gas-solid separator 2, a reactor heat extractor, a product gas outlet and a reactor stripper, wherein the lower part of the turbulent fluidized-bed reactor is a reaction zone, the upper part of the turbulent fluidized-bed reactor is a settling zone, the n reactor feed distributors are disposed in the reaction zone, the reactor heat extractor is disposed in the reaction zone, the reactor gas-solid separator 1 and the reactor gas-solid separator 2 are placed in the settling zone or outside the reactor shell, the inlet of the reactor gas-solid separator 1 is connected to a regenerated catalyst lift pipe, the catalyst outlet of the reactor gas-solid separator 1 is located at the bottom of the reaction zone, the gas outlet of the reactor gas-solid separator 1 is located in the settling zone, the inlet of the reactor gas-solid separator 2 is located in the settling zone, the catalyst outlet of the reactor gas-solid separator 2 is placed in the reaction zone, the gas outlet of the reactor gas-solid separator 2 is connected to the product gas outlet, and the reactor stripper passes through the reactor shell from outside to inside at the bottom of the turbulent fluidized-bed reactor and is opened in the reaction zone of the turbulent fluidized-bed reactor;

a catalytic cracking lift pipe, the bottom of the catalytic cracking lift pipe is connected to the outlet of a catalytic cracking inclined pipe and is provided with an inlet of hydrocarbons with 5 or more carbons , and the outlet of the catalytic cracking lift pipe is connected to the settling zone of the turbulent fluidized-bed reactor;

a fluidized-bed regenerator, the fluidized-bed regenerator comprises a regenerator shell, a regenerator feed distributor, a regenerator gas-solid separator, a regenerator heat extractor, a flue gas outlet and a regenerator stripper, wherein the lower part of the fluidized-bed regenerator is a regeneration zone, the upper part of the fluidized-bed regenerator is a settling zone, the regenerator feed distributor is placed at the bottom of the regeneration zone, the regenerator heat extractor is placed in the regeneration zone, the regenerator gas-solid separator is placed in the settling zone or outside the regenerator shell, the inlet of the regenerator gas-solid separator is disposed in the settling zone, the catalyst outlet of the regenerator gas-solid separator is disposed in the regeneration zone, the gas outlet of the regenerator gas-solid separator is connected to the flue gas outlet, and the regenerator stripper is opened at the bottom of the regenerator shell;

wherein, the bottom of the reactor stripper is provided with a reactor stripping gas inlet, the bottom of the reactor stripper is connected to the inlet of a inclined spent catalyst pipe, a spent catalyst sliding valve is arranged in the inclined spent catalyst pipe, the outlet of the inclined spent catalyst pipe is connected to the inlet of a spent catalyst lift pipe, the bottom of the spent catalyst lift pipe is provided with a spent catalyst lifting gas inlet, and the outlet of the spent catalyst lift pipe is connected to the settling section of the fluidized-bed regenerator;

the bottom of the regenerator stripper is provided with a regenerator stripping gas inlet, the bottom of the regenerator stripper is connected to the inlet of a inclined regenerated catalyst pipe, a regenerated catalyst sliding valve is arranged in the inclined regenerated catalyst pipe, the outlet of the inclined regenerated catalyst pipe is connected to the inlet of the regenerated catalyst lift pipe, the bottom of the regenerated catalyst lift pipe is provided with a regenerated catalyst lifting gas inlet, and the outlet of the regenerated catalyst lift pipe is connected to the inlet of the reactor gas-solid separator 1;

the bottom of the regenerator stripper is further connected to the inlet of the catalytic cracking inclined pipe, and a catalytic cracking sliding valve is arranged in the catalytic cracking inclined pipe.

2. The device according to claim 1, wherein the n reactor feed distributors are disposed in the reaction zone from bottom to top, and $0<n<10$.

3. The device according to claim 1, wherein a horizontal height of opening of the reactor stripper in the reactor shell is higher than 1/10 a height of the reaction zone.

4. The device according to claim 1, wherein the catalytic cracking lift pipe and the turbulent fluidized-bed reactor share the gas-solid separator 2.

5. The device according to claim 1, wherein the fluidized-bed regenerator is a turbulent fluidized-bed regenerator.

6. The device according to claim 1, wherein the reactor gas-solid separator 1, the reactor gas-solid separator 2 and the regenerator gas-solid separator are cyclone separators.

7. A method for preparing propylene and C4 hydrocarbons from oxygen-containing compounds, including:

feeding a raw material containing an oxygen-containing compound from n reactor feed distributors to a reaction zone of a turbulent fluidized-bed reactor, and contacting the raw material with a catalyst, to generate a stream containing propylene and C4 hydrocarbons product and a spent catalyst containing carbon;

regenerating the spent catalyst by a fluidized-bed regenerator to form a regenerated catalyst, wherein a part of the regenerated catalyst is fed to the bottom of the reaction zone of the turbulent fluidized-bed reactor after being gas-solid separated by a reactor gas-solid separator 1, and another part of the regenerated catalyst is fed to a catalytic cracking lift pipe via a catalytic cracking inclined pipe;

sending the stream discharged from the turbulent fluidized-bed reactor containing propylene and C4 hydrocarbons product into a product separation system, obtaining propylene, C4 hydrocarbons, light fractions, propane and hydrocarbons with 5 or more carbons after separation, wherein the light fractions contain more than 90 wt% of ethylene and a small amount of methane, ethane, hydrogen, CO and CO_2, returning 70 wt.% or more of the light fractions to the reaction zone of the turbulent fluidized-bed reactor from the reactor feed distributor at the bottom-most of the turbulent fluidized-bed reactor to react ethylene and the oxygen-containing compounds to perform an alkylation reaction in presence of the catalyst to produce a product containing propylene, and retrieving less than 30 wt.% of the light fractions as a by-product;

feeding 80 wt.% or more of the hydrocarbons with 5 or more carbons coming from the product separation system into the catalytic cracking lift pipe via an inlet of hydrocarbons with 5 or more carbons, to contact cocurrent with the regenerated catalyst coming from the catalytic cracking inclined pipe to perform a cracking reaction to generate a stream containing propylene and C4 hydrocarbons and a carbon-containing catalyst, subsequently, feeding the stream containing propylene and C4 hydrocarbons and the carbon-containing catalyst into a settling zone of the turbulent fluidized-bed reactor via the outlet of the catalytic cracking lift pipe, and retrieving less than 20 wt.% of the hydrocarbons with 5 or more carbons as a by-product.

8. The method according to claim 7, being carried out by using the device according to any one of claims 1 to 6, wherein

the spent catalyst passes through the reactor stripper, the inclined spent catalyst pipe, the spent catalyst

sliding valve and the spent catalyst lift pipe into the settling section of the fluidized-bed regenerator;

a regeneration medium enters the regeneration zone of the fluidized-bed regenerator from the regenerator feed distributor, the regeneration medium reacts with the spent catalyst to perform calcination to produce a flue gas containing CO and CO_2 and the regenerated catalyst, and the flue gas is discharged after dust removal by the regenerator gas-solid separator;

a part of the regenerated catalyst passes through the regenerator stripper, the inclined regenerated catalyst pipe, the regenerated catalyst sliding valve and the regenerated catalyst lift pipe into the inlet of the reactor gas-solid separator 1, and enters the bottom of the reaction zone of the turbulent fluidized-bed reactor after gas-solid separation; another part of the regenerated catalyst passes through the regenerator stripper, the catalytic cracking inclined pipe and the catalytic cracking sliding valve into the catalytic cracking lift pipe;

a reactor stripping gas enters the reactor stripper via the reactor stripping gas inlet and contacts countercurrent with the spent catalyst, and then enters the turbulent fluidized-bed reactor; a spent catalyst lifting gas enters the spent catalyst lift pipe via the spent catalyst lifting gas inlet and contacts cocurrent with the spent catalyst, and then enters the settling section of the fluidized-bed regenerator;

a regenerator stripping gas enters the regenerator stripper via the regenerator stripping gas inlet and contacts countercurrent with the regenerated catalyst, and then enters the fluidized-bed regenerator; a regenerated catalyst lifting gas enters the regenerated catalyst lift pipe via the regenerated catalyst lifting gas inlet and contacts cocurrent with the regenerated catalyst, and then enters the inlet of the reactor gas-solid separator 1.

9. The method according to claim 7, wherein the catalyst contains a SAPO molecular sieve.

10. The method according to claim 7, wherein a circulating amount of the light fractions is 5-40 wt.% of a feeding amount of the oxygen-containing compound.

11. The method according to claim 7, wherein a circulating amount of the hydrocarbons with 5 or more carbons is 2-20 wt.% of a feeding amount of the oxygen-containing compound.

12. The method according to claim 7, wherein the carbon content of the spent catalyst is 5-12 wt.%, and the carbon content of the regenerated catalyst is less than 2 wt.%.

13. The method according to claim 8, wherein the oxygen-containing compound is methanol and/or dimethyl ether; and/or the regeneration medium is any one of air, oxygen-poor air or water vapor or a mixture thereof; and/or the reactor stripping gas, the regenerator stripping gas, the spent catalyst lifting gas and the regenerated catalyst lifting gas are water vapor or nitrogen.

14. The method according to claim 7, wherein the reaction conditions in the reaction zone of the turbulent fluidized-bed reactor are: the apparent linear velocity of gas is in a range from 0.1 m/s to 2 m/s, the reaction temperature is in a range from 300°C to 550°C, the reaction pressure is in a range from 100 kPa to 500 kPa, and the bed density is in a range from 200 kg/m^3 to 1200 kg/m^3; and/or the reaction conditions in the catalytic cracking lift pipe are: the apparent linear velocity of gas is in a range from 2.0 m/s to 10.0 m/s, the reaction temperature is in a range from 400°C to 750°C, the reaction pressure is in a range from 100 kPa to 500 kPa, and the bed density is in a range from 30 kg/m^3 to 300 kg/m^3; and/or the reaction conditions in the

regeneration zone of the fluidized-bed regenerator are: the apparent linear velocity of gas is in a range from 0.1 m/s to 2 m/s, the regeneration temperature is in a range from 500℃ to 750℃, the regeneration pressure is in a range from 100 kPa to 500 kPa, and the bed density is in a range from 200 kg/m^3 to 1200 kg/m^3.