CLAIMS

1. A circulating fluidized bed reaction-regeneration device, characterized in that the device comprises a fluidized bed reactor, a fluidized bed regenerator and a riser reactor;

the fluidized bed reactor is configured to introduce naphtha feedstock and methanol feedstock, wherein the naphtha feedstock contacts with a catalyst from the riser reactor to produce a product gas flow containing benzene, toluene, and xylene (BTX) and a spent catalyst, and the methanol feedstock undergoes methylation reaction with benzene and toluene in the product gas flow containing BTX to generate para-xylene; the product gas flow undergoes gas-solid separation, with the separated product gas being delivered to downstream sections, unconverted naphtha being recycled as feedstock to the fluidized bed reactor, and partial light alkanes being recycled as feedstock to the riser reactor, while the spent catalyst is introduced into the fluidized bed regenerator;

the inlet of the riser reactor is connected to the fluidized bed regenerator, and the outlet of the riser reactor is connected to the fluidized bed reactor.

2. The circulating fluidized bed reaction-regeneration device according to claim 1, characterized in that the fluidized bed reactor comprises a reactor shell, wherein the region enclosed by the reactor shell is divided from top to bottom into a first gas-solid separation zone and a reaction zone, the reaction zone being provided with a reactor distributor comprising n sub-distributors arranged sequentially from bottom to top as the 1^{st} sub-distributor to the n^{th} sub-distributor, where $n \geq 2$ and $n \leq 10$; the 1^{st} sub-distributor is configured to introduce naphtha feedstock; and the 2^{nd} to n^{th} sub-distributors are configured to introduce methanol feedstock.

3. The circulating fluidized bed reaction-regeneration device according to claim 2, characterized in that the first gas-solid separation zone is provided with a gas-solid separation unit I, a gas-solid separation unit II and a reactor gas collection chamber; a gas outlet of the gas-solid separation unit I is connected to the reactor gas collection chamber; the reactor gas collection chamber is connected to a product gas delivery pipe; a inlet of the gas-solid separation unit II is

connected to the riser reactor; a gas outlet of the gas-solid separation unit II is connected to the reactor gas collection chamber; a catalyst outlet of the gas-solid separation unit II is located above the open end of the inlet pipe of the reactor stripper and between the 1st sub-distributor and the 2nd sub-distributor.

4. The circulating fluidized bed reaction-regeneration device according to claim 3, characterized in that the reactor gas collection chamber is located at the inner top of the reactor shell.

5. The circulating fluidized bed reaction-regeneration device according to claim 3, characterized in that the gas-solid separation unit I employs one or more sets of gas-solid cyclone separators, each set comprising a first-stage gas-solid cyclone separator and a second-stage gas-solid cyclone separator.

6. The circulating fluidized bed reaction-regeneration device according to claim 1, characterized in that the fluidized bed regenerator is connected to the fluidized bed reactor and is configured to introduce a regeneration gas to regenerate the spent catalyst from the fluidized bed reactor, thereby obtaining a regenerated catalyst.

7. The circulating fluidized bed reaction-regeneration device according to claim 6, characterized in that the fluidized bed reactor is sequentially connected to the fluidized bed regenerator through a reactor stripper, a spent catalyst slide valve and a spent catalyst delivery pipe; wherein the inlet of the reactor stripper extends into the reactor shell of the fluidized bed reactor, with its open end located below the catalyst outlet of the gas-solid separation unit I and above the 1st sub-distributor.

8. The circulating fluidized bed reaction-regeneration device according to claim 1, characterized in that the fluidized bed regenerator comprises a regenerator shell, wherein the shell enclosed by the regenerator shell is divided from top to bottom into a second gas-solid separation zone and a regeneration zone; the second gas-solid separation zone is provided with a regenerator

gas-solid separation unit and a regenerator gas collection chamber; the regenerator gas collection chamber is located at the inner top of the regenerator shell and is provided with a flue gas delivery pipe; the gas outlet of the regenerator gas-solid separation unit is connected to the regenerator gas collection chamber; the lower section of the regeneration zone is provided with a regenerator distributor for introducing the regeneration gas.

9. The circulating fluidized bed reaction-regeneration device according to claim 8, characterized in that the regenerator gas-solid separation unit employs one or more sets of gas-solid cyclone separators, each set comprising a first-stage gas-solid cyclone separator and a second-stage gas-solid cyclone separator.

10. The circulating fluidized bed reaction-regeneration device according to claim 1, characterized in that the riser reactor is configured to introduce the riser reactor feedstock and the catalyst to react and produce aromatics, and a flow containing unreacted the riser reactor feedstock, aromatics and the catalyst enters the fluidized bed reactor through the outlet of the riser reactor.

11. The circulating fluidized bed reaction-regeneration device according to claim 1, characterized in that the inlet of the riser reactor is connected to the fluidized bed regenerator, and the catalyst introduced into the riser reactor is the regenerated catalyst produced in the fluidized bed regenerator.

12. The circulating fluidized bed reaction-regeneration device according to claim 11, characterized in that the fluidized bed regenerator is sequentially connected to the inlet of the riser reactor through a regenerator stripper, a regenerated catalyst slide valve and a pipeline.

13. The circulating fluidized bed reaction-regeneration device according to claim 12, characterized in that the inlet of the regenerator stripper extends into the regenerator shell of the fluidized bed regenerator and is located above the regenerator distributor.

14. An use method based on the device according to any one of claims 1 to 13, characterized

in that the method comprises: using the circulating fluidized bed reaction-regeneration device and a metal molecular sieve bifunctional catalyst to prepare aromatics;

the metal molecular sieve bifunctional catalyst employs a metal-modified HZSM-5 zeolite molecular sieve;

a metal used for a metal modification is at least one selected from the group consisting of La, Zn, Ga, Fe, Mo, and Cr;

the metal modification comprises: placing an HZSM-5 zeolite molecular sieve in a metal salt solution, and carrying out an impregnation, a drying and a calcination to obtain the metal-modified HZSM-5 zeolite molecular sieve.

15. The use method according to claim 14, characterized in that the method comprises:

introducing naphtha feedstock into the reaction zone of the fluidized bed reactor through the 1^{st} sub-distributor of the reactor distributor, contacting with the catalyst from the riser reactor to generate a product gas flow containing BTX, light olefins, hydrogen, light alkanes, combustible gas, heavy aromatics and unconverted naphtha;

introducing methanol feedstock into the reaction zone of the fluidized bed reactor through the 2^{nd} to n^{th} sub-distributors of the reactor distributor respectively, undergoing methylation reaction with benzene and toluene in the product gas flow to generate para-xylene;

outputting the product gas from the fluidized bed reactor to downstream sections;

before outputting the product gas, the fluidized bed reactor first uses the gas-solid separation unit I for gas-solid separation to remove the spent catalyst entrained in the product gas flow;

after entering the fluidized bed reactor, the catalyst from the riser reactor first undergoes gas-solid separation through the gas-solid separation unit II, and the catalyst with gas removed enters between the 1^{st} sub-distributor and the 2^{nd} sub-distributor through the catalyst outlet of the gas-solid separation unit II;

the naphtha feedstock is at least one selected from the group consisting of coal direct liquefaction naphtha, coal indirect liquefaction naphtha, straight-run naphtha and hydrocracked naphtha;

the naphtha feedstock further comprises unconverted naphtha separated from the product gas flow, with the main components of the unconverted naphtha being linear aliphatic hydrocarbons, branched aliphatic hydrocarbons and naphthenes of C_4-$C_{12;}$

the process conditions for the reaction zone of the fluidized bed reactor are: gas superficial velocity of 0.5-2.0 m/s, reaction temperature of 500-600°C, reaction pressure of 100-500 kPa, bed density of 150-700 kg/m³;

the method further comprises: introducing the spent catalyst generated in the fluidized bed reactor into the fluidized bed regenerator, introducing the regeneration gas into the regeneration zone of the fluidized bed regenerator to contact with the spent catalyst and react to produce the flue gas and the regenerated catalyst;

the flue gas enters the regenerator gas-solid separation unit to remove regenerated catalyst entrained in it, then enters the regenerator gas collection chamber and is delivered to downstream sections through the flue gas delivery pipe;

the method further comprises: the regenerated catalyst sequentially passes through the regenerator stripper and the regenerated catalyst slide valve to enter the riser reactor;

the carbon content in the spent catalyst is in a range from 1.0 wt% to 3.0 wt%;

the carbon content in the regenerated catalyst is ≤0.5 wt%;

the regeneration gas is at least one selected from the group consisting of oxygen, air and oxygen-enriched air;

the process conditions for the regeneration zone of the fluidized bed regenerator are: gas superficial velocity of 0.5-2.0 m/s, regeneration temperature of 600-750°C, regeneration pressure of 100-500 kPa, bed density of 150-700 kg/m³;

the method further comprises: introducing the riser reactor feedstock and the catalyst into the riser reactor to react and produce aromatics;

the flow containing the unreacted riser reactor feedstock, aromatics and the catalyst enters the gas-solid separation unit II of the fluidized bed reactor from the outlet of the riser reactor;

the catalyst is the regenerated catalyst from the fluidized bed regenerator;

the riser reactor feedstock comprises water vapor and light alkanes separated from the product gas flow;

the water vapor content in the riser reactor feedstock is in a range from 0 wt% to 50 wt%;

the process conditions for the riser reactor are: gas superficial velocity of 3.0-10.0 m/s, temperature of 580-700°C, pressure of 100-500 kPa, bed density of 50-150 kg/m³.