Claims

1. A separation device for use in a fluidized bed reactor, comprising

a preliminary gas-solid separator communicated with an outlet of the fluidized bed reactor,

a vertically arranged damper, a solid outlet of the preliminary gas-solid separator being communicated with a lower region of the damper, and a gas outlet of the preliminary gas-solid separator being communicated with an upper region of the damper, and

a fine gas-solid separator, an inlet of the fine gas-solid separator being communicated with the upper region of the damper, and a solid outlet of the fine gas-solid separator being communicated with the lower region of the damper, wherein

the separation device is configured so that product having catalysts entrained therein from the fluidized bed reactor is fed into the preliminary gas-solid separator, most solid catalysts being separated and fed into the lower region of the damper; the product entraining the rest catalysts is fed into the upper region of the damper, and into the fine gas-solid separator, the rest catalysts being separated and fed into the lower region of the damper; and final product is obtained from a gas outlet of the fine gas-solid separator,

wherein the upper region of the damper is provided with an inlet port for communicating with the gas outlet of the preliminary gas-solid separator, and the inlet port is configured to be tangent to a side wall of the upper region.

2. The separation device according to claim 1, wherein a diameter of the upper region of the damper is smaller than that of the lower region thereof.

3. The separation device according to claim 2, wherein a ratio of the diameter of the upper region to that of the lower region is in a range of 0.05 to 0.5.

4. The separation device according to claim 1, wherein a position where the gas outlet of the preliminary gas-solid separator is connected with the damper is below a position where the inlet of the fine gas-solid separator is connected with the damper.

5. The separation device according to claim 1, wherein both the preliminary gas-solid separator and the fine gas-solid separator are single cyclone separators.

6. The separation device according to claim 1, wherein the preliminary gas-solid separator is a cyclone separator, and the fine gas-solid separator comprises two- or multi-stage series cyclone separators, wherein

the two- or multi-stage series cyclone separators are configured so that an inlet of a first stage cyclone separator is communicated with the upper region of the damper, the final product being obtained from a gas outlet of a last stage cyclone separator, a gas outlet of an upstream cyclone separator is communicated with a gas inlet of an adjacent downstream cyclone separator, and solid outlets of all the cyclone separators are communicated with the lower region of the damper.

7. The separation device according to claim 1, wherein the lower region of the damper is configured and arranged to perform a steam stripping operation.

8. A reaction regeneration apparatus, comprising the separation device according to claim 1, and further comprising a fluidized bed reactor and a catalyst regeneration device, wherein

the fluidized bed reactor comprises an inlet zone at a lower position, an outlet zone at an upper position, and a reaction zone between the inlet zone and the outlet zone, the outlet zone being communicated with the preliminary gas-solid separator of the separation device, and

the catalyst regeneration device comprises a feed zone at a lower position and a discharge zone at an upper position, the feed zone being arranged lower than the lower region of the damper, and the discharge zone being arranged higher than the inlet zone of the fluidized bed reactor,

wherein, the lower region of the damper is communicated with the feed zone of the catalyst regeneration device through a second pipe, and the discharge zone of the catalyst regeneration device is communicated with the inlet zone of the fluidized bed reactor through a third pipe.

9. The reaction regeneration apparatus according to claim 8, wherein the outlet zone of the fluidized bed reactor is provided with an inlet for accelerating gas.

10. The reaction regeneration apparatus according to claim 9, wherein the inlet for accelerating gas is configured to extend obliquely from a lower position towards an upper

position.

11. The reaction regeneration apparatus according to claim 10, wherein the inlet for accelerating gas forms an angle in a range of 5 to 39 degree relative to a longitudinal axis of the fluidized bed reactor.

12. The reaction regeneration apparatus according to claim 9, wherein a ratio of a diameter of the inlet for accelerating gas to a diameter of the outlet zone of the fluidized bed reactor is in a range of 0.01 to 0.1.

13. The reaction regeneration apparatus according to claim 9, wherein a length of a part of the outlet zone of the fluidized bed reactor that is above the inlet for accelerating gas divided by an overall length of the outlet zone of the fluidized bed reactor is in a range of 0.1 to 0.8.

14. The reaction regeneration apparatus according to claim 8, wherein a guide plate with through holes is disposed between the inlet zone and the reaction zone of the fluidized bed reactor.

15. The reaction regeneration apparatus according to claim 8, wherein the inlet zone of the fluidized bed reactor is disposed lower than the lower region of the damper, and the lower region of the damper is communicated with the inlet zone of the fluidized bed reactor through a first pipe.

16. The reaction regeneration apparatus according to claim 15, wherein the first pipe, the second pipe, and the third pipe each are provided with a valve for controlling material flow.

17. A reaction regeneration apparatus, comprising a separation device, a fluidized bed reactor and a catalyst regeneration device,

wherein the separation device comprises:

a preliminary gas-solid separator communicated with an outlet of the fluidized bed reactor,

a vertically arranged damper, a solid outlet of the preliminary gas-solid separator

being communicated with a lower region of the damper, and a gas outlet of the preliminary gas-solid separator being communicated with an upper region of the damper, and

a fine gas-solid separator, an inlet of the fine gas-solid separator being communicated with the upper region of the damper, and a solid outlet of the fine gas-solid separator being communicated with the lower region of the damper,

wherein the separation device is configured so that product having catalysts entrained therein from the fluidized bed reactor is fed into the preliminary gas-solid separator, most solid catalysts being separated and fed into the lower region of the damper; the product entraining the rest catalysts is fed into the upper region of the damper, and into the fine gas-solid separator, the rest catalysts being separated and fed into the lower region of the damper; and final product is obtained from a gas outlet of the fine gas-solid separator;

wherein

the fluidized bed reactor comprises an inlet zone at a lower position, an outlet zone at an upper position, and a reaction zone between the inlet zone and the outlet zone, the outlet zone being communicated with the preliminary gas-solid separator of the separation device, and

the catalyst regeneration device comprises a feed zone at a lower position and a discharge zone at an upper position, the feed zone being arranged lower than the lower region of the damper, and the discharge zone being arranged higher than the inlet zone of the fluidized bed reactor,

wherein, the lower region of the damper is communicated with the feed zone of the catalyst regeneration device through a second pipe, and the discharge zone of the catalyst regeneration device is communicated with the inlet zone of the fluidized bed reactor through a third pipe; and

wherein the third pipe is provided with a flow blocking member at a top of an inner wall thereof.

18. The reaction regeneration apparatus according to claim 17, wherein the flow blocking member is a baffle tilting towards the fluidized bed reactor.

19. The reaction regeneration apparatus according to claim 18, wherein a ratio of an area of the baffle to an area of a cross section of the third pipe is in a range of 0.1 to 1.

20. The regeneration apparatus according to claim 18, wherein the baffle is sector

shaped or rectangular.

21. The reaction regeneration apparatus according to claim 18, wherein a ratio of a distance between the baffle and the fluidized bed reactor to a length of the third pipe is in a range of 0.01 to 0.5.

22. The reaction regeneration apparatus according to claim 18, wherein an angle formed between the baffle and an axis of the third pipe is in a range of 10 to 75 degree.

23. The reaction regeneration apparatus according to claim 18, wherein a plurality of baffles is provided, which are arranged in parallel with respect to one another.

24. The reaction regeneration apparatus according to claim 17, wherein the flow blocking member is a stop pawl protruding radially inward.

25. The reaction regeneration apparatus according to claim 24, wherein a plurality of stop pawls is provided, which are arranged in a row along the axis of the third pipe.

26. The reaction regeneration apparatus according to claim 25, wherein a ratio of a length of each stop pawl to a diameter of the third pipe is in a range of 0.1 to 0.5.

27. The reaction regeneration apparatus according to claim 24, wherein a cross section of each of the stop pawls is in a shape of a triangle, a rectangle, or a sector.

28. A process for preparing olefins, using the reaction regeneration apparatus according to claim 8, wherein the inlet zone of the fluidized bed reactor is disposed lower than the lower region of the damper, and the lower region of the damper is communicated with the inlet zone of the fluidized bed reactor through a first pipe,

wherein the process comprises:

reacting raw material containing oxygenates with catalysts in the reaction zone of the fluidized bed reactor,

feeding product obtained and entrained catalysts into the separation device through the outlet zone of the fluidized bed reactor,

separating the product and the entrained catalysts through the separation device,

wherein a part of catalysts obtained from the separation is directly fed into the inlet zone of the fluidized bed reactor, and the rest catalysts are regenerated and fed into the inlet zone of the fluidized bed reactor, and

mixing non-regenerated catalysts and regenerated catalysts in the inlet zone of the fluidized bed reactor, and feeding mixed catalysts into the reaction zone of the fluidized bed reactor.

29. The process according to claim 28, wherein a weight ratio of the non-regenerated catalysts to the regenerated catalysts is in a range of 0.3 to 1.5.

30. The process according to claim 28, wherein an operation of the separation device comprises:

preliminarily separating product from the fluidized bed reactor having catalysts entrained therein through the preliminary gas-solid separator,

feeding product obtained from the preliminary separation entraining the rest catalysts into the upper region of the damper,

drawing the product from the damper, and feeding the product into the fine gas-solid separator for fine separation, and

obtaining final product from the gas outlet of the fine gas-solid separator, and gathering catalysts from the preliminary gas-solid separator and the fine gas-solid separator into the lower region of the damper.

31. The process according to claim 30, wherein water vapor is fed into the damper from a lower end thereof, so that product entrained in the catalysts is separated from the catalysts.

32. The process according to claim 28, wherein a pressure in the fluidized bed reactor indicated by gage pressure is in a range of 0-0.4 MPa, an average temperature therein is in a range of 380-550 ^{o}C, and a mean density in the reaction zone is in a range of 40-200 kg/m^{3}, and

the catalyst used therein is SAPO-34, wherein a catalyst regeneration medium is air and a regeneration temperature is in a range of 600-700 ^{o}C.

33. The process according to claim 32, wherein an inlet for accelerating gas is

disposed in the outlet zone of the fluidized bed reactor, and gas flowing into the outlet zone of the fluidized bed reactor through the inlet for accelerating gas is water vapor or nitrogen, a linear speed of the gas being in a range of 1.0-10.0m/s.

34. The process according to claim 28, wherein the oxygenates comprises one or more selected from a group consisting of methanol, ethanol, n-propyl alcohol, isopropyl alcohol, C4-C20 alcohol, ethyl methyl ether, dimethyl ether, diethyl ether, diisopropyl ether, methanal, dimethyl carbonate, acetone, and acetic acid, and a weight of the oxygenates accounts for 10 to 100% of the raw material.

35. A process for preparing aromatic hydrocarbons, using the reaction regeneration apparatus according to claim 8,

wherein the process comprises:

reacting raw material containing oxygenates with catalysts in the reaction zone of the fluidized bed reactor,

feeding product obtained and catalysts entrained therein into the separation device through the outlet zone of the fluidized bed reactor, and

separating the product from the catalysts entrained therein in the separation device, wherein the catalysts obtained from the separation is regenerated, and fed into the inlet zone of the fluidized bed reactor, and into the reaction zone of the fluidized bed reactor.

36. The process according to claim 35, wherein an operation of the separation device comprises:

preliminarily separating product from the fluidized bed reactor having catalysts entrained therein through the preliminary gas-solid separator,

feeding product obtained from the preliminary separation entraining the rest catalysts into the upper region of the damper,

drawing the product from the damper, and feeding the product into the fine gas-solid separator for fine separation, and

obtaining the final product from the gas outlet of the fine gas-solid separator, and gathering catalysts from the preliminary gas-solid separator and the fine gas-solid separator into the lower region of the damper.

37. The process according to claim 36, wherein water vapor is fed into the damper

from a lower end thereof, so that product entrained in the catalysts is separated from the catalysts.

38. The process according to claim 35, wherein a pressure in the fluidized bed reactor indicated by gage pressure is in a range of 0-0.6 MPa, an average temperature therein is in a range of 440-550 ^{o}C, a space velocity in the reaction zone is in a range of 0.3-5 h^{-1}, and a mean density in the reaction zone is in a range of 200-450 kg/m^3, and

the catalyst used therein is ZSM-5, wherein a catalyst regeneration medium is air and a regeneration temperature is in a range of 550-650 ^{o}C.

39. The process according to claim 38, wherein an inlet for accelerating gas is disposed in the outlet zone of the fluidized bed reactor, and gas flowing into the outlet zone of the fluidized bed reactor through the inlet for accelerating gas is water vapor or nitrogen, a linear speed of the gas being in a range of 1.0-10.0m/s.

40. The process according to claim 35, wherein the oxygenates comprises one or more selected from a group consisting of methanol, ethanol, n-propyl alcohol, isopropyl alcohol, C4-C20 alcohol, ethyl methyl ether, dimethyl ether, diethyl ether, diisopropyl ether, methanal, dimethyl carbonate, acetone, and acetic acid, and a weight of the oxygenates accounts for 10 to 100% of the raw material.