SUMMARY OF THE INVENTION

[0006] In order to maximize the performance of multi-bed catalytic reactors, chimneys that allow good mixing of gas and liquids and evenly distribute the gas/liquid mixture to an underlying catalyst bed are important.

[0006a] According to a first aspect, there is provided a flow distribution device for distributing a poly-phase fluid to a granular solid, comprising:

a. at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid conduit that is provided for introducing a liquid phase into the mixing cavity; and

b. a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.

~~In an embodiment, the invention provides for a flow distribution device for distributing a poly-phase fluid to a granular solid, comprising at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid conduit that is provided for introducing a liquid phase into the mixing cavity; and a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.~~

[0007] ~~In another embodiment, the invention provides for a distributor tray having at least one chimney for distributing a downwardly flowing poly-phase mixture including at least one gas phase and at least one liquid phase, above at least one catalyst bed of granular solid catalytic material, the chimney including one flow distribution device that has been retrofit into the chimney, the flow distribution device comprising at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid that is provided for introducing a liquid phase into the mixing cavity; and a poly-phase nozzle for accelerating and dispersing the~~According to a second aspect, there is provided a distributor tray having at least one chimney for distributing a downwardly flowing poly-phase mixture including at least one gas phase and at least one liquid phase, above at least one catalyst bed of granular solid catalytic material, the chimney including one flow distribution device that has been retrofit into the chimney, the flow distribution device comprising:

a. at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening that is centrally located in a top capping portion, through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid that is provided for introducing a liquid phase into the mixing cavity; and

b. a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.

~~liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.~~

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 is a schematic, cut-away side view of an embodiment of the flow distribution device of the invention.

[0009] Figure 2 is a simplified schematic, perspective, side cut-away view of the flow distribution device of the invention in the context of a reactor vessel.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The invention in one embodiment is a fluid distribution device for distributing a downwardly flowing poly-phase mixture including at least one gas phase and at least one liquid phase, above at least one catalyst bed of granular solid catalytic material. The fluid distribution device for receiving the liquid and gas phases has one or more openings in the top and/or upper portion of its height through which a gas phase can enter and has a gas conduit that opens to a mixing cavity within the device. The fluid distribution device further comprises one or more lateral openings for liquid ingress. The lateral opening or openings allow the liquid to enter a liquid conduit that opens to the internal mixing cavity. The mixing cavity allows intimate contact between the liquid and gas phases. The gas inlet tube is narrower than the mixing cavity, causing a venturi type effect, and creating a lower pressure in the interior of the fluid distribution device. The pressure differential helps "pull" the liquid phase through the liquid conduit to the mixing cavity. Thus, rather than static liquid height on the tray, liquid flow rate through the lateral openings is at least in part determined by the venturi effect of the relatively narrow gas conduit. Therefore the flow distribution device of the invention allows greater tolerance for tray out of levelness than chimneys of the prior art.

We claim:

1. A flow distribution device for distributing a poly-phase fluid to a granular solid, comprising:
    a. at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid conduit that is provided for introducing a liquid phase into the mixing cavity; and
    b. a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.

2. The flow distribution device of Claim 1, wherein the gas conduit is cylindrical.

3. The flow distribution device of Claim 1, wherein the gas conduit is in a vertical orientation.

4. The flow distribution device of Claim 1, wherein the gas conduit opening is on a horizontal plane between the lower extent and the upper extent of the liquid conduit.

5. The flow distribution of Claim 1, wherein the gas conduit opening is on a horizontal plane no lower than the upper extent of the liquid conduit.

6. The flow distribution device of Claim 1, wherein the poly-phase nozzle further comprises a bottom outlet.

7. The flow distribution device of Claim 1, further comprising a top capping portion in fluid tight connection with cylindrical outer wall and comprising at least one gas inlet.

8. The flow distribution device of Claim 1, wherein the poly-phase nozzle comprises a nozzle inlet in fluid communication with the mixing cavity.

9. The flow distribution device of Claim 6, wherein the diameter of the bottom opening is greater than the diameter of the poly-phase nozzle.

10. The flow distribution device of Claim 8, wherein the bevel of the poly-phase nozzle is between 30 degrees and 60 degrees, as measured from a plane bisecting the poly-phase nozzle opening.

11. The flow distribution device of Claim 1, wherein the poly-phase nozzle further comprises a beveled inner wall.

12. The flow distribution device of Claim 11, wherein the bevel of the inner wall is between 30 degrees and 60 degrees, as measured from a plane bisecting the poly-phase nozzle opening.

13. The flow distribution device of Claim 1, further comprising a chimney.

14. A distributor tray having at least one chimney for distributing a downwardly flowing poly-phase mixture including at least one gas phase and at least one liquid phase, above at least one catalyst bed of granular solid catalytic material, the chimney including one flow distribution device that has been retrofit into the chimney, the flow distribution device comprising:

    a. at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid that is provided for introducing a liquid phase into the mixing cavity; and

    b. a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.

15. The distributor tray of Claim 14, wherein the chimney has a lateral opening for liquid flow that is co-axial with the liquid conduit.

CLAIMS

1. A flow distribution device for distributing a poly-phase fluid to a granular solid, comprising:

   a. at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening that is centrally located in a top capping portion, through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid conduit that is provided for introducing a liquid phase into the mixing cavity; and

   b. a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.

2. The flow distribution device of claim 1, wherein the gas conduit is cylindrical.

3. The flow distribution device of claim 1, wherein the gas conduit is in a vertical orientation.

4. The flow distribution device of claim 1, wherein the gas conduit opening is on a horizontal plane between the lower extent and the upper extent of the liquid conduit.

5. The flow distribution of claim 1, wherein the gas conduit opening is on a horizontal plane no lower than the upper extent of the liquid conduit.

6. The flow distribution device of claim 1, wherein the poly-phase nozzle further comprises a bottom outlet.

7. The flow distribution device of claim 1, wherein the top capping portion is in fluid tight connection with a cylindrical outer wall and comprises a gas inlet that is centrally located in the top capping portion.

8. The flow distribution device of claim 1, wherein the poly-phase nozzle comprises a nozzle inlet in fluid communication with the mixing cavity.

9. The flow distribution device of claim 1, wherein the diameter of the one or more gas inlets is between about 0.1 inch and 1 inch.

10. The flow distribution device of claim 1, wherein the diameter of the one or more gas inlets is between 0.3 inches and 0.7 inches.

11. The flow distribution device of claim 1, wherein the diameter of the one or more Lateral liquid inlets is between 0.20 inches to about 0.75 inches.

12. The flow distribution device of claim 7, wherein the diameter of the outer wall is between about 1 inches and about 4 inches.

13. The flow distribution device of claim 6, wherein the diameter of the bottom opening is greater than the diameter of the poly-phase nozzle.

14. The flow distribution device of claim 8, wherein the bevel of the poly-phase nozzle is between 30 degrees and 60 degrees, as measured from a plane bisecting the poly-phase nozzle opening.

15. The flow distribution device of claim 1, wherein the poly-phase nozzle further comprises a beveled inner wall.

16. The flow distribution device of claim 15, wherein the bevel of the inner wall is between 30 degrees and 60 degrees, as measured from a plane bisecting the poly-phase nozzle opening.

17. The flow distribution device of claim 1, further comprising a chimney.

18. A distributor tray having at least one chimney for distributing a downwardly flowing poly-phase mixture including at least one gas phase and at least one liquid phase, above at least one catalyst bed of granular solid catalytic material, the chimney including one flow distribution device that has been retrofit into the chimney, the flow distribution device comprising:

a. at least one gas conduit for introducing a gas phase into a mixing cavity having a radial diameter which is greater than a radial diameter of the gas conduit, the gas conduit extending from a gas inlet opening that is centrally located in a top capping portion, through a lower gas conduit opening into the mixing cavity, the gas conduit opening being positioned no lower than the lower extent of a liquid that is provided for introducing a liquid phase into the mixing cavity; and

b. a poly-phase nozzle for accelerating and dispersing the liquid and gas phases passing out of the flow distribution device, the nozzle having an nozzle inlet that is fixidly coupled to and co-axially aligned with the mixing cavity.

19. The distributor tray of claim 18, wherein the chimney has a lateral opening for liquid flow that is co-axial with the liquid conduit.