CLAIMS

What is claimed is:

1. A butanol production system for producing refined mixed butanols from water and mixed butenes, the butanol production system comprising:

an internal baffle single pass reactor that

has an internal fluid conduit defined by an internal wall and an operating length between a proximal end and a distal end,

has a set of internal flow baffles along at least a portion of the operative length of the internal fluid conduit, where the set of internal flow baffles and the internal wall define a set of baffled cells, and

is operable to contain a process fluid comprising water, mixed butenes and mixed butanols, to convey the process fluid through the internal fluid conduit from the proximal end to the distal end along a process fluid flow pathway, and to provide a crude product from the distal end;

a separation system that fluidly couples to the distal end of the internal baffle single pass reactor and is operable to receive the crude product and to separately selectively separate water and mixed butenes from the crude product such that a refined mixed butanols is produced; and

an ~~exterior~~ motion driver that couples to the proximal end of the internal baffle single pass reactor and is operable to induce unsteadiness in the fluid flow of the process fluid through the internal baffle single pass reactor.

2. The butanol production system of claim 1 where the set of flow baffles is located along the entire operative length of the internal fluid conduit.

3. The butanol production system of claim 1 or claim 2 where the ~~exterior~~ motion driver is operable to induces unsteadiness in the process fluid flow by oscillating at a frequency of 3 Hertz.

4. The butanol production system of any one of claims 1 to 3 where the butanol production system is operable to introduce the selectively separated mixed butenes into the interior baffle single pass reactor.

5. The butanol production system of any one of claims 1 to 4 where the butanol production system is operable to introduce the selectively separated water into the interior baffle single pass reactor.

6. The butanol production system of any one of claims 1 to 5 where the separation system is operable to separately selectively separate butene hydration catalyst from the crude product.

7. The butanol production system of any one of claims 1 to 6 where the separation system is operable to produce the refined mixed butanols that have a purity of at least 99 percent by volume mixed butanols.

8. The butanol production system of any one of claims 1 to 7 where each baffled cell contains a heterogeneous butene hydration catalyst, where the heterogeneous butene hydration catalyst is operable to selectively convert the mixed butenes into the mixed butanols in the process fluid at the operating conditions of the internal baffle single pass reactor.

9. The butanol production system of claim 8 where the heterogeneous butene hydration catalyst is located within the baffled cell on the interior wall that defines the baffled cell.

10. The butanol production system of claim 8 or claim 9 where the heterogeneous butene hydration catalyst is located within the baffled cell on a side of the internal flow baffles that are directed inwards towards the baffled cell.

11. The butanol production system of any one of claims 8 to 10 where the heterogeneous butene hydration catalyst is located within the baffled cell such that the process fluid flowing through the flow window of the downstream baffle of the baffled cell contacts the heterogeneous butene hydration catalyst.

12. A method for producing refined mixed butanols from a combination of water and mixed butenes in the presence of a butene hydration catalyst using a butanol production system, the butanol production method comprising the steps of:

introducing mixed butenes, water and a butene hydration catalyst into an internal baffle single pass reactor of the butanol production system such that a process fluid forms;

operating the butanol production system such that the process fluid flows from a proximal end to a distal end of the internal baffle single pass reactor, ~~the~~ external

introducing mixed butenes and water into an internal baffle single pass reactor of the butanol production system such that a process fluid forms;

operating the butanol production system such that the process fluid flows from the proximal end to a distal end of the internal baffle single pass reactor, ~~the~~ external motion driver induces unsteadiness in the process fluid flow, the reaction of mixed butenes and water occurs in the presence of the butene hydration catalyst such that mixed butanols form, and the separation system separately selectively separates water and mixed butenes from a crude product such that the refined mixed butanols forms;

where the heterogeneous butene hydration catalyst is located in each baffled cell and is operable to selectively convert the mixed butenes into the mixed butanols in the process fluid at the operating conditions of the internal baffle single pass reactor.

31. The method of claim 30 where the reaction of mixed butenes and water occurs in each baffled cell on the sides of the flow baffles.

32. The method of claim 30 or claim 31 where the reaction of mixed butenes and water occurs in each baffled cell along the interior wall.

33. The method of any of claims 30 to 32 where the reaction of the mixed butenes and water occurs in each baffled cell proximate to the downstream flow window.

34. The method of any of claims 30 to 33 further comprises introducing a homogeneous butene hydration catalyst into the internal baffle single pass reactor.

CLAIMS

What is claimed is:

1. A butanol production system for producing refined mixed butanols from water and mixed butenes, the butanol production system comprising:

an internal baffle single pass reactor that

has an internal fluid conduit defined by an internal wall and an operating length between a proximal end and a distal end,

has a set of internal flow baffles along at least a portion of the operative length of the internal fluid conduit, where the set of internal flow baffles and the internal wall define a set of baffled cells, and

is operable to contain a process fluid comprising water, mixed butenes and mixed butanols, to convey the process fluid through the internal fluid conduit from the proximal end to the distal end along a process fluid flow pathway, and to provide a crude product from the distal end;

a separation system that fluidly couples to the distal end of the internal baffle single pass reactor and is operable to receive the crude product and to separately selectively separate water and mixed butenes from the crude product such that a refined mixed butanols is produced; and

an external motion driver that couples to the proximal end of the internal baffle single pass reactor and is operable to induce unsteadiness in the fluid flow of the process fluid through the internal baffle single pass reactor.

2. The butanol production system of claim 1 where the set of flow baffles is located along the entire operative length of the internal fluid conduit.

3. The butanol production system of claim 1 or claim 2 where the external motion driver is operable to induces unsteadiness in the process fluid flow by oscillating at a frequency of 3 Hertz.

4. The butanol production system of any one of claims 1 to 3 where the butanol production system is operable to introduce the selectively separated mixed butenes into the interior baffle single pass reactor.

5. The butanol production system of any one of claims 1 to 4 where the butanol production system is operable to introduce the selectively separated water into the interior baffle single pass reactor.

6. The butanol production system of any one of claims 1 to 5 where the separation system is operable to separately selectively separate butene hydration catalyst from the crude product.

7. The butanol production system of any one of claims 1 to 6 where the separation system is operable to produce the refined mixed butanols that have a purity of at least 99 percent by volume mixed butanols.

8. The butanol production system of any one of claims 1 to 7 where each baffled cell contains a heterogeneous butene hydration catalyst, where the heterogeneous butene hydration catalyst is operable to selectively convert the mixed butenes into the mixed butanols in the process fluid at the operating conditions of the internal baffle single pass reactor.

9. The butanol production system of claim 8 where the heterogeneous butene hydration catalyst is located within the baffled cell on the interior wall that defines the baffled cell.

10. The butanol production system of claim 8 or claim 9 where the heterogeneous butene hydration catalyst is located within the baffled cell on a side of the internal flow baffles that are directed inwards towards the baffled cell.

11. The butanol production system of any one of claims 8 to 10 where the heterogeneous butene hydration catalyst is located within the baffled cell such that the process fluid flowing through the flow window of the downstream baffle of the baffled cell contacts the heterogeneous butene hydration catalyst.

12. A method for producing refined mixed butanols from a combination of water and mixed butenes in the presence of a butene hydration catalyst using a butanol production system, the butanol production method comprising the steps of:

introducing mixed butenes, water and a butene hydration catalyst into an internal baffle single pass reactor of the butanol production system such that a process fluid forms;

operating the butanol production system such that the process fluid flows from a proximal end to a distal end of the internal baffle single pass reactor, an external

introducing mixed butenes and water into an internal baffle single pass reactor of the butanol production system such that a process fluid forms;

operating the butanol production system such that the process fluid flows from the proximal end to a distal end of the internal baffle single pass reactor, an external motion driver induces unsteadiness in the process fluid flow, the reaction of mixed butenes and water occurs in the presence of the butene hydration catalyst such that mixed butanols form, and the separation system separately selectively separates water and mixed butenes from a crude product such that the refined mixed butanols forms;

where the heterogeneous butene hydration catalyst is located in each baffled cell and is operable to selectively convert the mixed butenes into the mixed butanols in the process fluid at the operating conditions of the internal baffle single pass reactor.

31. The method of claim 30 where the reaction of mixed butenes and water occurs in each baffled cell on the sides of the flow baffles.

32. The method of claim 30 or claim 31 where the reaction of mixed butenes and water occurs in each baffled cell along the interior wall.

33. The method of any of claims 30 to 32 where the reaction of the mixed butenes and water occurs in each baffled cell proximate to the downstream flow window.

34. The method of any of claims 30 to 33 further comprises introducing a homogeneous butene hydration catalyst into the internal baffle single pass reactor.