CLAIMS

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 having

an internal fluid conduit defined by an internal wall and an operating length between a proximal end and a distal end, the internal fluid conduit selectively containing and mixing a process fluid comprising water, mixed butenes, mixed butanols, and a catalyst to form a crude product,

internal flow baffles located along at least a portion of the operating length of the internal fluid conduit, the internal flow baffles being ring shaped and secured to the internal wall, the internal flow baffles generating vortices within the process fluid, and

baffled cells located consecutively along the operating length and defined at an outer diameter by the internal wall and at a first end and a second end by the internal flow baffles, wherein one of the internal flow baffles defines both the second end of one of the baffled cells and the first end of an adjacent baffled cell;

a separation system in fluid communication with the internal baffle single pass reactor, oriented for selectively receiving the crude product and separating the water and the mixed butenes from the crude product such that refined mixed butanols is produced; and

an oscillator assembly coupled to the proximal end of the internal baffle single pass reactor, the oscillator assembly having a reciprocating oscillator head selectively movable in a back and forth linear motion, and in communication with the process fluid such that the process fluid undergoes a general sinusoidal movement along the internal baffle single pass reactor; wherein

the oscillator assembly includes

an external motion driver mechanically coupled to, and selectively driving, the oscillator head, and

an oscillator seal section sealingly engaging the internal baffle single pass reactor and a process fluid oscillator member, the process fluid oscillator member mechanically linking the external motion driver to the oscillator head; and

wherein the external motion driver includes a rotary disk connected to the process fluid oscillator member.

2. The butanol production system of claim 1, wherein each of the internal flow baffles are formed of a disk shaped plate with an orifice extending through the plate.

3. The butanol production system of claim 2, wherein an outer diameter of the disk shaped plate is fixed to the internal wall.

4. The butanol production system of claim 2, wherein the orifice is sized and positioned through the plate to generate vortices within the process fluid in the baffled cells.

5. The butanol production system of any one of claims 1-4, wherein an outer diameter of the oscillator head slidingly engages the internal wall.

6. The butanol production system of any one of claims 1-5, wherein the separation system is in fluid communication with the distal end of the internal fluid conduit.

7. The butanol production system of any one of claims 1-6, wherein the separation system is in fluid communication with at least one of the baffled cells.

8. The butanol production system of any one of claims 1-7 where the baffled cells are located along an entire operating length of the internal fluid conduit.

9. The butanol production system of any one of claims 1-8 where the oscillator head has a reciprocating frequency of 2 to 5 Hertz.

10. The butanol production system of any one of claims 1-9 where the oscillator head has a reciprocating amplitude of 20-40 millimeters.

11. A method for producing refined mixed butanols from a combination of water and mixed butenes, the method comprising:

providing an internal baffle single pass reactor having

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

internal flow baffles located along at least a portion of the operating length of the internal fluid conduit, the internal flow baffles being ring shaped and secured to the internal wall, and

baffled cells located consecutively along the operating length and defined at an outer diameter by the internal wall and at a first end and a second end by the internal flow baffles, wherein one of the internal flow baffles defines both the second end of one of the baffled cells and a first end of an adjacent baffled cell;

passing a process fluid comprising, mixed butenes, water, mixed butanols, and a catalyst through the internal baffle single pass reactor;

mixing the process fluid within the internal baffle single pass reactor to form a crude product by inducing a generally sinusoidal movement and generating vortices in the process fluid along the internal baffle single pass reactor with an oscillator assembly that is coupled to the proximal end of the internal baffle single pass reactor, the oscillator assembly having a reciprocating oscillator head selectively movable in a back and forth linear motion;

driving the oscillator head with an external motion driver that is mechanically coupled to the oscillator head, sealingly engaging the internal baffle single pass reactor and a process fluid oscillator member with an oscillator seal section that mechanically links the external motion driver to the oscillator head, where the external motion driver includes a rotary disk connected to the process fluid oscillator member; and

separating the water and the mixed butenes from the crude product in a separation system that is in fluid communication with the internal baffle single pass reactor to produce refined mixed butanols.

12. The method of claim 11, wherein the step of mixing the process fluid within the internal baffle single pass reactor includes inducing vortices in the process fluid in the baffled cells by pushing the process fluid past the internal flow baffles.

13. The method of claim 11 or claim 12, further comprising transferring the process fluid to the separation system at the distal end of the internal fluid conduit.

14. The method of any one of claims 11-13, further comprising transferring the process fluid from within at least one of the baffled cells to the separation system.

15. The method of any one of claims 11-14 further comprising operating the oscillator assembly with a reciprocating frequency of 2 to 5 Hertz.

16. The method of any one of claims 11-15 further comprising operating the oscillator assembly with a reciprocating amplitude of 20-40 millimeters.