CLAIMS

1. A process comprising:
    a. providing a feed stream having a first density comprising water, acetic acid, methyl acetate, at least one PRC, and greater than about 30 wt% methyl iodide to a second distillation column comprising a distillation zone and a bottom sump zone; and
    b. distilling the feed stream at a pressure and a temperature sufficient to a produce a second column overhead stream having a second density and comprising greater than about 40 wt% methyl iodide and at least one PRC; wherein a percent decrease between the first density and the second density is from 20% to 35%;
    wherein the feed stream is derived from an overhead of a first distillation column in which a reaction product is distilled to produce acetic acid as a sidestream, wherein a residuum stream flowing from the bottom sump zone has a third density which is less than the first density, and comprises greater than about 0.1 wt% water, and greater than or equal to about 0.11 wt% HI.
2. The process of claim 1, wherein the specific gravity of the second density relative to water is from 1.15 to 1.6, when determined at 10°C.
3. The process of claim 1, wherein a percent decrease between the first density and the second density is from 5% to 10%.
4. The process of claim 1, wherein distillation of the feed stream produces a first liquid phase comprising greater than about 50 weight percent water and a second liquid phase comprising greater than about 50 weight percent methyl iodide within the distillation zone, and wherein the distillation zone comprises a plurality of internal components, each having a component liquid retention volume, and wherein an average residence time of the first liquid phase and an average residence time of the second liquid phase in each of the component liquid retention volumes is less than about 30 minutes.
5. The process of claim 4, wherein the average residence time of the second liquid phase is greater than or equal to the average residence time of the first liquid phase in at least one component liquid retention volume.
6. The process of claim 1, further comprising directing a top flush stream comprising water into the distillation zone at a mass flow rate which is greater than or equal to about 0.1 percent of the mass flow rate of the feed stream.

7. The process of claim 6, wherein the top flush stream comprises a portion of the bottom residuum stream.

8. The process of claim 1, further comprising directing a bottom flush stream comprising acetic acid, water, or both into the bottom sump zone at a mass flow rate which is greater than or equal to about 0.1 percent of the mass flow rate of the feed stream.

9. The process of claim 1, wherein the overhead stream comprises dimethyl ether.

10. A process comprising:

    a. carbonylating a reaction medium comprising a reactant feed stream comprising methanol, methyl acetate, dimethyl ether, or mixtures thereof, water, a rhodium catalyst, an iodide salt and methyl iodide in a reactor to form acetic acid;

    b. distilling a stream derived from the reaction medium in a first column to yield an acetic acid side stream which is further purified to produce a product acetic acid stream, and a first overhead stream comprising methyl iodide, water, acetic acid, methyl acetate, and at least one PRC;

    c. biphasically separating the first overhead stream into a light phase comprising methyl iodide, acetic acid, methyl acetate, at least one PRC, and greater than about 30 wt% water, and a heavy phase comprising water, acetic acid, methyl acetate, at least one PRC, and greater than about 30 wt% methyl iodide;

    d. directing a second column feed stream comprising or derived from the heavy phase into a second distillation column comprising a distillation zone and a bottom sump zone;

    e. distilling the second column feed stream at a pressure and a temperature sufficient to produce a second overhead stream having a second density and which comprises greater than about 40 wt% methyl iodide and at least one PRC, and a residuum stream flowing from the bottom sump zone having a third density which is less than the first density, and which comprises greater than about 0.1 wt% water and greater than or equal to about 0.11 wt% HI, wherein a percent decrease between the first density and the second density is from 20% to 35%;

    f. extracting at least a portion of the second column overhead stream comprising methyl iodide and at least one PRC with water to produce an aqueous stream comprising the

at least one PRC, and a raffinate stream having a fourth density which is greater than the first density, and which comprises greater than about 90 wt% methyl iodide; and

g. directing at least a first portion of the raffinate stream back into the distillation zone of the second distillation column.

11. The process of claim 10, wherein the specific gravity of the second density relative to water is from 1.15 to 1.6 when determined at 10°C.

12. The process of claim 10, wherein a percent increase between the first density and the fourth density is from 10% to 20%.

13. The process of claim 10, further comprising directing a top flush stream comprising water into the distillation zone of the second distillation column at a mass flow rate of greater than or equal to about 0.1 percent of the mass flow rate of the second column feed stream, wherein the top flush stream comprises a portion of the bottom residuum stream, at least a portion of the first portion of the raffinate stream, a portion of the light phase separated from the first overhead stream, or a combination thereof.

14. The process of claim 10, further comprising directing a bottom flush stream comprising acetic acid, water, or both into the bottom sump zone of the second distillation column at a mass flow rate of greater than or equal to about 0.1 percent of the mass flow rate of the second column feed stream.

15. The process of claim 10, wherein the second column overhead stream comprises dimethyl ether and further comprising directing a second portion of the raffinate stream comprising methyl iodide and dimethyl ether back into the reaction medium.

16. The process of claim 15, wherein a mass flow rate of the first portion of the raffinate stream is greater than or equal to a mass flow rate of the second portion of the raffinate stream.

17. The process of claim 10, wherein:

a bottom temperature of the second distillation column is about 70°C to about 100°C,

a top temperature of the second distillation column is about 40°C to about 60°C,

a pressure of the second distillation column is from atmospheric pressure to about 700kPa above atmospheric pressure,

an HI concentration in the reaction medium is from 0.1 to 1.3 wt%,

the rhodium catalyst concentration in the reaction medium is from 300 to 3000 wppm,

the water concentration in the reaction medium is from 0.1 to 4.1 wt%,

the methyl acetate concentration in the reaction medium is from 0.6 to 4.1 wt%,

a hydrogen partial pressure in the reactor is from 0.3 to 2 atm,

or any combination thereof.

18. The process of claim 10, further comprising:

i. introducing a lithium compound selected from the group consisting of lithium acetate, lithium carboxylates, lithium carbonates, lithium hydroxide, and mixtures thereof into the reaction medium to maintain a concentration of lithium acetate between 0.3 and 0.7 wt% in the reaction medium,

ii. controlling a butyl acetate concentration in the product acetic acid stream at 10 wppm or less without directly removing butyl acetate from the product acetic acid stream,

iii. controlling an ethyl iodide concentration in the reaction medium at less than or equal to 750 wppm,

or any combination thereof.