What is claimed is:

1. A process for producing acetic acid comprising:

separating a reaction medium formed in a reactor in a flash vessel to form a liquid recycle and a vapor product stream;

distilling the vapor product stream in a first column to obtain a side stream and a first low-boiling overhead vapor stream, wherein the side stream comprises water in an amount from 1 to 3 wt.%;

condensing the first low-boiling overhead vapor stream and biphasically separating the condensed stream to form a heavy liquid phase and a light liquid phase;

distilling the side stream in a second column to obtain a purified acetic acid product and a second low-boiling overhead vapor stream;

condensing the second low-boiling overhead vapor stream to obtain an aqueous recycle stream, comprising water in an amount of less than or equal to 90 wt.%; and

recycling the second low-boiling overhead vapor stream to the reactor,

wherein the recycle ratio of the mass flow of the light liquid phase recycled to the reactor to the mass flow of the aqueous recycle stream recycled to the reactor is from 0.15 to 2.

2. The process of claim 1, wherein the aqueous recycle stream further comprises water in an amount from 50 to 90 wt.%.

3. The process of claim 1, wherein the aqueous recycle stream further comprises methyl iodide in an amount of less than or equal to 20 wt.%, methyl acetate in an amount of less than or equal to 10 wt.%, acetic acid in an amount of less than or equal to 20 wt.%.

4. The process of claim 1, wherein the second low-boiling overhead vapor stream comprises greater than or equal to 90% of the water in the side stream.

5. The process of claim 1, further comprising condensing the second low-boiling overhead vapor stream and biphasically separating the condensed stream to form an organic phase and an aqueous phase, wherein the aqueous recycle stream comprises a

portion of the aqueous phase.

6. The process of claim 1, wherein the recycle ratio of the mass flow of the light liquid phase recycled to the reactor to the mass flow of the aqueous recycle stream is from 0.2 to 1.5.

7. The process of claim 1, wherein the recycle ratio of the mass flow of the light liquid phase recycled to the reactor to the mass flow of the aqueous recycle stream to the reactor is from 0.15 to 1.

8. The process of claim 1, wherein hydrogen iodide concentration in the side stream of less than or equal to 50 wppm.

9. The process of claim 1, wherein a portion of the heavy liquid phase is recycled to the reactor.

10. The process of claim 1, wherein the reaction medium comprises methyl acetate in an amount from 0.5 to 30 wt.%, a metal catalyst in an amount from 200 to 3000 wppm, iodide salt in an amount from 1 to 25 wt.%, and methyl iodide in an amount from 1 to 25 wt.%.

11. The process of claim 1, wherein a portion of the heavy liquid phase is treated to remove at least one permanganate reducing compound selected from the group consisting of acetaldehyde, acetone, methyl ethyl ketone, butylaldehyde, crotonaldehyde, 2-ethyl crotonaldehyde, 2-ethyl butyraldehyde, and the aldol condensation products thereof.

12. The process of claim 8, wherein the hydrogen iodide concentration is maintained in the side stream from 0.1 to 50 wppm.

13. The process of claim 1, wherein the side stream further comprises one or more C_1-C_{14} alkyl iodides in an amount from 0.1 to 6 wt.% and the side stream further

comprises methyl acetate in an amount from 0.1 to 6 wt.%.

14. The process of claim 1, wherein the light liquid phase comprises water in an amount from 40 to 80 wt.%.

15. The process of claim 1, wherein the light liquid phase further comprises acetic acid in an amount from 1 to 40 wt.%, methyl acetate in an amount from 1 to 50 wt.%, and methyl iodide in an amount of less than or equal to 10 wt.%.

16. A process for producing acetic acid comprising:

separating a reaction medium formed in a reactor in a flash vessel to form a liquid recycle and a vapor product stream;

distilling the vapor product stream in a first column to obtain a side stream and a first low-boiling overhead vapor stream, wherein the side stream comprises water in an amount from 1 to 3 wt.%;

condensing the first low-boiling overhead vapor stream and biphasically separating the condensed stream to form a heavy liquid phase and a light liquid phase;

distilling the side stream in a second column to obtain a purified acetic acid product and a second low-boiling overhead vapor stream;

condensing the second low-boiling overhead vapor stream to obtain an aqueous recycle stream, the second low-boiling overhead vapor stream comprises greater than or equal to 90% of the water in the side stream; and

recycling the second low-boiling overhead vapor stream to the reactor,

wherein the recycle ratio of the mass flow of the light liquid phase recycled to the reactor to the mass flow of the aqueous recycle stream recycled to the reactor is from 0.15 to 2.

17. The process of claim 16, wherein aqueous recycle stream further comprises methyl iodide in an amount of less than or equal to 25 wt.%, methyl acetate in an amount of less than or equal to 25 wt.%, acetic acid in an amount of less than or equal to 1 wt.%.

18. The process of claim 16, further comprising condensing the second low-boiling overhead vapor stream and biphasically separating the condensed stream to form a second heavy liquid phase and a second light liquid phase, wherein the aqueous recycle stream comprises a portion of the second light liquid phase.

19. The process of claim 16, wherein the recycle ratio of the mass flow of the light liquid phase recycled to the reactor to the mass flow of the aqueous recycle stream is from 0.2 to 1.5.

20. The process of claim 16, wherein the recycle ratio of the mass flow of the light liquid phase recycled to the reactor to the mass flow of the aqueous recycle stream to the reactor is from 0.15 to 1.

21. The process of claim 1, further comprising treating a portion of the heavy liquid phase to remove at least one permanganate reducing compound selected from the group consisting of acetaldehyde, acetone, methyl ethyl ketone, butylaldehyde, crotonaldehyde, 2-ethyl crotonaldehyde, 2-ethyl butyraldehyde, and the aldo condensation products thereof.

22. The process of claim 16, further comprising treating a portion of the heavy liquid phase to remove at least one permanganate reducing compound selected from the group consisting of acetaldehyde, acetone, methyl ethyl ketone, butylaldehyde, crotonaldehyde, 2-ethyl crotonaldehyde, 2-ethyl butyraldehyde, and the aldol condensation products thereof.