We claim:

1. A process for producing acetic acid, comprising:

(a) a reaction step of allowing methanol to continuously react with carbon monoxide in a reactor in the presence of a reactive system comprising a metal catalyst, an ionic metal iodide, and methyl iodide, acetic acid, methyl acetate, and water;

(b) an evaporation step of separating a reaction mixture obtained in the reaction step with or without heating into a vapor stream and a liquid residuum stream;

(c) a first distillation step of distilling at least a portion of the vapor stream in a first distillation column to form a first overhead stream and a side stream, wherein the first overhead stream comprises water, methyl iodide, and/or acetaldehyde, and the side stream comprises acetic acid;

(d) a phase separation step of condensing the first overhead stream in one or more condensers, collecting the condensates in a receiver, and separating the condensates into an upper phase and a lower phase;

(e) a second distillation step of distilling at least a portion of the lower phase in a second distillation column to form a second mixture comprising acetaldehyde;

(f) an acetaldehyde separation step of separating the second mixture into an acetaldehyde stream and a first return stream;

and at least one step selected from the group consisting of (g) to (k):

(g) a purifying step of purifying the side stream to obtain an acetic acid product stream;

(h) an off-gas treatment step of absorbing one or more off-gas streams from the process with an absorption solvent and forming a carbon monoxide stream and a second return stream;

(i) a high-boiler removal step of removing a higher boiling component from the acetic acid product stream;

(j) an iodine removal step of contacting the acetic acid product stream with an ion-exchange resin and separating an iodine compound from the acetic acid product stream; and

(k) an extraction step of extracting acetaldehyde from the acetaldehyde stream to form an extract and a raffinate, wherein the extract comprises acetaldehyde and the raffinate comprises methyl iodide;

wherein the mass composition of 1,1-dimethoxyethane in a liquid stream of the process is controlled to be not more than 0.2 wt.% by maintaining the amount of unreacted methanol in the reaction mixture to less than 1 wt. % based on the total weight of the reaction mixture; and

wherein the residence time in the first distillation column or the second distillation column is not less than 1 minute.

2. The process of claim 1, wherein the liquid stream contains at least one member selected from the group consisting of methyl iodide, methyl acetate, and water.

3. The process of claim 1, wherein the liquid stream has a mass ratio of methyl iodide to water that is greater than 1.

4. The process of claim 1, wherein no stream comprising air or oxygen is contacted with the liquid stream.

5. The process of claim 1, wherein the mass composition of 1,1-dimethoxyethane in the liquid stream is controlled to be not more than 0.2 wt.% by controlling a methanol mass composition in the first overhead stream.

6. The process of claim 1, wherein the mass composition of the 1,1-dimethoxyethane in the liquid stream is controlled to be from 0.01 to 0.2 wt.%.

7. The process of claim 1, wherein the mass composition of the 1,1-dimethoxyethane in the liquid stream is controlled to be not more than 0.1 wt.%.

8. The process of claim 1, wherein the liquid stream is selected from the side stream, the bottom streams, the condensates, the upper phase, the lower phase, the second mixture, and/or the acetic acid product stream.

9. The process of claim 1, wherein the weight ratio of methyl iodide to water in the lower phase is greater than 1.

10. The process of claim 1, wherein the second mixture is an overhead stream and/or a side cut stream of the second distillation column.

11. The process of claim 1, wherein the upper phase is refluxed to the first distillation column at a reflux ratio from 0.5 to 20, wherein the reflux ratio is the amount of the upper phase refluxed/the amount of upper phase distilled.

12. The process of claim 1, wherein an overhead of the second distillation column is refluxed to the second distillation column at a reflux ratio from 0.2 to 15, wherein the reflux ratio is the amount of the overhead refluxed/the amount of overhead distilled.

13. The process of claim 1, wherein the second mixture comprises less than or equal to 2 wt.% methanol.

14. The process of claim 1, wherein the purifying step comprises at least one step selected from the group consisting of steps (l)-(n):

(l) feeding the side stream to a dehydrating column to yield an overhead stream and a bottom stream comprising the acetic acid product;

(m) feeding the side stream to a dehydrating column to yield an overhead stream and a lower side cut stream comprising the acetic acid product;

(n) feeding the side stream to a dehydrating column to yield an overhead stream comprising water in an amount of 25 wt.% or more, and a lower stream comprising water in an amount of less than or equal to 0.2 wt.%.

15. The process of claim 14, wherein the overhead stream is refluxed to the dehydrating column at a reflux ratio from 0.2 to 15, wherein the reflux ratio is the amount of the overhead stream reflux/the amount of the overhead stream distilled.

16. The process according to claim 1, wherein the off-gas treatment step comprises at least one step selected from the group consisting of steps (o)-(q):

(o) absorbing the off-gas streams with a first absorption solvent selected from the group consisting of acetic acid, methanol, methyl acetate and combinations thereof, at a first pressure;

(p) absorbing the off-gas streams with a second absorption solvent selected from the group consisting of acetic acid, methanol, methyl acetate and combinations thereof, at a second pressure, wherein the second pressure is lower than the first pressure; and

(q) diffusing a gaseous component absorbed in the steps (o) and/or (p).

17. The process of claim 1, wherein the higher boiling component comprises propionic acid, butyl acetate, 2-ethyl crotonaldehyde, or mixtures thereof.

18. The process of claim 1, further comprising maintaining a hydrogen partial pressure of from 0.3 to 2 atm in the reactor by introducing a hydrogen-containing stream into the reactor.

19. The process of claim 1, wherein the acetaldehyde separation step comprises separating the second mixture in one or more extractors and/or one or more additional distillation columns.