CLAIMS

[Claim 1]

A method for producing acetic acid by reacting methanol with carbon monoxide in the presence of a catalyst system comprising a metal catalyst and methyl iodide, acetic acid, methyl acetate, and water, comprising:

a separation step of separating a process stream containing at least water, acetic acid, methyl iodide, and acetaldehyde into an aqueous phase and an organic phase; and

an acetaldehyde separation and removal step for separating and removing the acetaldehyde derived from the process stream, wherein

the separation step satisfies the following condition (i), the following condition (iii), and the following conditions (iv), or satisfies the following condition (i), the following condition (iii), and the following conditions (v), and at least a portion of the organic phase is treated in the acetaldehyde separation and removal step:

(i) an acetaldehyde concentration in the aqueous phase is not less than 0.045% by mass, and/or an acetaldehyde concentration in the organic phase is not less than 0.013% by mass;

(ii) a temperature at the time of the separation is not less than -5°C;

(iii) a methyl acetate concentration in the organic phase is not less than 5.8% by mass and not more than 60% by mass;

(iv) an acetaldehyde distribution coefficient [{acetaldehyde concentration (% by mass) of the aqueous phase} / {acetaldehyde concentration (% by mass) of the organic phase}] is not more than 4.1; and

(v) a methyl acetate distribution coefficient [{methyl acetate concentration (% by mass) of the aqueous phase} / {methyl acetate concentration (% by mass) of the organic phase}] is not more than 0.53.

[Claim 2]

The method for producing acetic acid according to claim 1, wherein the catalyst system further comprises an ionic iodide.

[Claim 3]

The method for producing acetic acid according to claim 1 or 2, wherein the separation step satisfies all of the conditions (i), (ii), (iii), (iv), and (v).

[Claim 4]

A method for producing acetic acid, comprising:

a carbonylation reaction step of reacting methanol with carbon monoxide in the presence of a catalyst system comprising a metal catalyst and methyl iodide, acetic

acid, methyl acetate, and water in a reaction vessel to produce acetic acid;

an evaporation step of separating the reaction mixture obtained in the carbonylation reaction step into a vapor stream and a residual liquid stream in an evaporator;

a lower boiling point component removal step of separating the vapor stream by distillation into an overhead stream rich in at least one lower boiling point component selected from methyl iodide and acetaldehyde and an acetic acid stream rich in acetic acid;

a separation step of separating a process stream containing at least water, acetic acid, methyl iodide, and acetaldehyde into an aqueous phase and an organic phase; and

an acetaldehyde separation and removal step for separating and removing the acetaldehyde derived from the process stream, wherein

the separation step satisfies the following condition (vi), the following condition (viii), and the following conditions (ix), or satisfies the following condition (vi), the following condition (viii), and the following conditions (x), and at least a portion of the organic phase is treated in the acetaldehyde separation and removal step:

(vi) an acetaldehyde concentration in the aqueous phase is not more than 28.1% by mass, and/or an

acetaldehyde concentration in the organic phase is not more than 24.8% by mass;

(vii) a temperature at the time of the separation is not more than 70°C;

(viii) a methyl acetate concentration in the aqueous phase is not less than 5.0% by mass and not more than 12.0% by mass, and/or a methyl acetate concentration in the organic phase is not less than 8.0% by mass and not more than 47.6% by mass, and/or the sum of the methyl acetate concentration in the aqueous phase and the methyl acetate concentration in the organic phase is not less than 14% by mass and not more than 59.6% by mass;

(ix) an acetaldehyde distribution coefficient [{acetaldehyde concentration (% by mass) of the aqueous phase} / {acetaldehyde concentration (% by mass) of the organic phase}] is not less than 1.1 and not more than 4.5; and

(x) a methyl acetate distribution coefficient [{methyl acetate concentration (% by mass) of the aqueous phase} / {methyl acetate concentration (% by mass) of the organic phase}] is not less than 0.25 and not more than 0.53.

[Claim 5]

The method for producing acetic acid according to claim 4, wherein the catalyst system further comprises an ionic iodide.

[Claim 6]

The method for producing acetic acid according to claim 4 or 5, wherein the separation step satisfies all of the conditions (vi), (vii), (viii), (ix), and (x).

[Claim 7]

A method for producing acetic acid by reacting methanol with carbon monoxide in the presence of a catalyst system comprising a metal catalyst and methyl iodide, acetic acid, methyl acetate, and water, comprising

a separation step of separating a process stream containing at least water, acetic acid, methyl iodide, and acetaldehyde into an aqueous phase and an organic phase; and

an acetaldehyde separation and removal step for separating and removing the acetaldehyde derived from the process stream, wherein

the separation step satisfies the following condition (vi), the following condition (viii), and the following conditions (ix), or satisfies the following condition (vi), the following condition (viii), and the following conditions (x), and at least a portion of the organic phase is treated in the acetaldehyde separation and removal step:

(vi) an acetaldehyde concentration in the aqueous phase is not more than 28.1% by mass, and/or an

acetaldehyde concentration in the organic phase is not more than 24.8% by mass;

(vii) a temperature at the time of the separation is not more than 70°C;

(viii) a methyl acetate concentration in the aqueous phase is not less than 5.0% by mass and not more than 12.0% by mass, and/or a methyl acetate concentration in the organic phase is not less than 8.0% by mass and not more than 47.6% by mass, and/or the sum of the methyl acetate concentration in the aqueous phase and the methyl acetate concentration in the organic phase is not less than 14% by mass and not more than 59.6% by mass;

(ix) an acetaldehyde distribution coefficient [{acetaldehyde concentration (% by mass) of the aqueous phase} / {acetaldehyde concentration (% by mass) of the organic phase}] is not less than 1.1 and not more than 4.5; and

(x) a methyl acetate distribution coefficient [{methyl acetate concentration (% by mass) of the aqueous phase} / {methyl acetate concentration (% by mass) of the organic phase}] is not less than 0.25 and not more than 0.53.

[Claim 8]

The method for producing acetic acid according to claim 7, wherein the catalyst system further comprises an ionic iodide.

[Claim 9]

The method for producing acetic acid according to claim 7 or 8, wherein the separation step satisfies all of the conditions (vi), (vii), (viii), (ix), and (x).

[Claim 10]

The method for producing acetic acid according to any one of claims 1 to 12, further comprising a scrubber step of separating offgas from the process into a stream rich in carbon monoxide and a stream rich in acetic acid by absorption treatment with an absorption solvent containing at least acetic acid.