CLAIMS

Claim 1 A process for separating or removing permanganate reducing compounds (PRC's) from a first mixture, the process comprising:
carbonylating methanol in the presence of a catalyst system comprising a metal catalyst, a metal halide, and methyl iodide to form a reaction mixture;
flash-evaporating the reaction mixture to separate the reaction mixture into a volatile phase and a less-volatile phase,
the volatile phase containing at least one of PRCs; methyl iodide; water; methyl acetate; and acetic acid; and the less-volatile phase containing the metal catalyst and the metal halide;
first-distilling the volatile phase in a first distillation column to separate the volatile phase into a first overhead and an acetic acid stream, the first overhead containing at least one of PRCs; methyliodide; and water; and the acetic acid stream containing produced acetic acid;
second-distilling at least a portion of the first overhead, as the first mixture, fed to a feed port of a second distillation column to separate the first mixture into an upper stream and a lower stream, the upper stream being at least one stream selected from the group consisting of a second overhead stream and a side-cut stream,
wherein the distillation of the first mixture allows at least a portion of water in the first mixture to rise to an upper position than the feed port to form a second mixture containing the portion of water, and the process further comprises:
withdrawing the second mixture as the upper stream, and withdrawing the lower stream from a lower position than the feed port, a concentration of water in the lower stream and a weight ratio of water relative to methyl iodide in the lower stream being lower than those in the first mixture.

Claim 2 A process according to claim 1, wherein the distillation of the first mixture allows at least a portion of water in the first mixture to rise to an upper position than the feed port to form an azeotropic second mixture containing the portion of water, and the process comprises: withdrawing the second mixture as the upper stream, and withdrawing the lower stream from a lower position than the feed port, a water content of the lower stream being lower than that of the first mixture.

Claim 3 A process according to claim 1 or 2, wherein not less than 1% by weight of water in the first mixture is transferred or distributed to the upper stream, and not more than 99% by weight of water in the first mixture is transferred or distributed to the lower stream.

Claim 4 A process according to any one of claims 1 to 3, wherein not less than 5% by weight of water in the first mixture is transferred or distributed to the upper stream, and not more than 95% by weight of water in the first mixture is transferred or distributed to the lower stream.

Claim 5 A process according to anyone of claims 1 to 4, wherein a weight ratio of water relative to methyl iodide in the first mixture or first overhead is 0.0001 to 10000, and a weight ratio of water relative to methyl iodide in the lower stream is

0.00005 to 5000.

Claim 6 A process according to any one of claims 1 to 5, wherein the first mixture is separated into the upper stream and the lower stream without supply of additional water to the second distillation column.

Claim 7 A process according to any one of claims 1 to 6, wherein the distillation of the first mixture forms a concentration zone of the PRC's and methyl iodide at an upper position than the feed port of the distillation column and allows at least a portion of water in the first mixture to rise to the concentration zone; and a stream or fluid in the concentration zone is withdrawn as the upper stream.

Claim 8 A process according to claim 7, wherein a mixture falling from the concentration zone is withdrawn as the side-cut stream.

Claim 9 A process according to any one of claims 1 to 8, wherein the first mixture contains 10 ppm to 30% by weight acetaldehyde, 0.1 to 90% by weight methyl iodide, and 0.1 to 90% by weight water, provided that the total amount of the first mixture, including an impurity or impurities, is 100% by weight.

Claim 10 A process according to any one of claims 1 to 9, wherein the first mixture comprises at least a portion of an organic phase, at least a portion of an aqueous phase, or a mixture containing the organic phase and the aqueous phase, and the first mixture has a biphasically separable composition.

Claim 11 A process according to any one of claims 1 to 10, wherein the first mixture comprises acetaldehyde, methyl iodide, and water and further comprises at least one of (a)or (b):

(a) methyl acetate,

(b) at least one member selected from the group

consisting of acetic acid, methanol, dimethyl ether, and an acetaldehyde derivative.

Claim 12 A process according to any one of claims 1 to 11, wherein the withdrawn upper stream is biphasically separated into an aqueous phase containing at least acetaldehyde and an organic phase containing at least methyl iodide, and the process further comprises recycling the organic phase to the second distillation by the following method (a), (b),or (c):

(a) separating the aqueous phase, and recycling the organic phase to the second distillation column;

(b) recycling a portion of the aqueous phase and the organic phase to the second distillation column;

(c) subjecting at least a portion of the aqueous phase to at least one selected from the group consisting of distillation in a succeeding distillation and water extractive distillation in a succeeding distillation, and directly or indirectly recycling the organic phase to the distillation column.

Claim 13 A process according to any one of claims 1 to 12, wherein the withdrawn upper stream is biphasically separated into an aqueous phase and an organic phase, and the process further comprises:

directly or indirectly recycling the organic phase to the second distillation,

distilling at least a portion of the aqueous phase in a succeeding distillation, and directly or indirectly feeding a miscible solvent to the second distillation column, wherein the miscible solvent is miscible with the organic phase and is at least one member selected from the group consisting of water, acetic acid, methyl iodide, and methanol.

Claim 14 A process according to any one of claims 1 to 13, the process further comprising: condensing a gaseous phase to form two phases, the gaseous phase being produced from at least one selected from the group consisting of the carbonylation reaction, the flash evaporation, and the first distillation and containing at least acetaldehyde and methyl iodide.

Claim 15 A process for producing acetic acid, comprising: continuously carbonylating methanol in the presence of a catalyst system comprising a metal catalyst, a metal halide, and methyl iodide to form a reaction mixture;
continuously flash-evaporating the reaction mixture to separate the reaction mixture into a volatile phase and a less-volatile phase, the volatile phase containing at least one of permanganate reducing compounds (PRCs); methyl iodide; water; methyl acetate; and acetic acid; and the less-volatile phase containing the metal catalyst and the metal halide;
first-distilling the volatile phase in a first distillation column to continuously separate the volatile phase into a first overhead and an acetic acid stream,
the first overhead containing at least one of PRCs; methyl iodide; and water; and the acetic acid stream containing produced acetic acid;
second-distilling at least a portion of the first overhead, as the first mixture, in a second distillation column;
withdrawing an upper stream, the upper stream being at least one selected from the group consisting of a second overhead stream and a side-cut stream from the second distillation column;
biphasically separating the withdrawn upper stream into an aqueous phase and an organic phase;
withdrawing the aqueous phase; and
withdrawing a lower stream from a lower position than the feed port, wherein a concentration of water in the lower stream and a weight ratio of water relative to methyl iodide in the lower stream are lower than those of the first overhead.