CLAIMS

1. A process for producing acetic acid, comprising: a carbonylation reaction step for allowing methanol to react with carbon monoxide in the presence of a catalyst system, acetic acid, methyl acetate, and water, wherein the catalyst system comprises a metal catalyst, an ionic metal iodide, and methyl iodide, to obtain a reaction mixture; a flash step for separating the reaction mixture into a volatile phase and a less-volatile phase; a first distillation step for separating the volatile phase into a first overhead and a crude acetic acid stream, wherein the first overhead is rich in at least one lower boiling point component selected from the group consisting of methyl iodide and acetaldehyde, and the crude acetic acid stream is rich in acetic acid; and a separation step for separating at least acetaldehyde from the first overhead, wherein the separation step comprises: a second distillation step for distilling the first overhead to separate the first overhead into a second overhead rich in acetaldehyde and methyl iodide and a bottom or lower stream, the second distillation step comprising at least one distillation column, while controlling an internal pressure of the distillation column in the second distillation step by the following method (1) and/or (2): (1) introducing at least one gas selected from the group consisting of a nitrogen gas, an off-gas, and an inert gas constantly to the feeding line communicating with the column top of the distillation column, with remaining a control valve on the feeding line open at a predetermined degree of opening, (2) discharging or withdrawing a non-condensable gas, and an extraction step for extracting acetaldehyde from the second overhead to form an extract rich in acetaldehyde and a raffinate rich in methyl iodide.

2. The process according to claim 1, wherein the separation step further comprises: a step for condensing the first overhead to form a two-phase first condensate, wherein at least a portion of an upper phase, a lower phase, or both is distilled in the second distillation step while controlling the internal pressure of the distillation column.

3. The process according to claim 2, wherein at least a portion of at least the lower phase is distilled in the second distillation step while controlling the internal pressure of the distillation column.

4. The process according to claim 1, wherein the first overhead is distilled in the second distillation step while controlling the internal pressure of the distillation column to 0.1 to 0.7 MPa.

5. The process according to claim 1, wherein the control of the internal pressure of the distillation column comprises: detecting the internal pressure of the distillation column by a pressure sensor to obtain a detected value, producing a controlling signal based on the detected value and a standard value, and providing or sending the control signal from a pressure control unit disposed at a top of the distillation column to a pressure control valve to regulate or control an opening degree of the pressure control valve for regulating an outflow rate of the first overhead.

6. The process according to claim 1, wherein the second distillation step comprises a plurality of distillation steps, and the first overhead is distilled while controlling an internal pressure of the distillation column in at least a downstream distillation step.

7. The process according to claim 1, which further comprises: a step for condensing the second overhead to form a second condensate and an off-gas, wherein the second condensate is subjected to the extraction step and a step for directly or indirectly recycling a useful component in the off-gas to at least one step selected form the group consisting of the reaction step and the distillation step(s).

8. The process according to claim 7, wherein the off-gas is condensed to form a third condensate, and the third condensate is recycled to at least one step selected form the group consisting of the reaction step and the distillation step(s).

9. The process according to claim 1, wherein an off-gas produced from the process is recycled to at least one step selected form the group consisting of the reaction step and the distillation step(s).

10. The process according to claim 7, wherein the off-gas is adsorbed to an absorption solvent under an applied pressure, and at least one component

selected from the group consisting of methyl iodide, methyl acetate, dimethyl ether, water, and carbon monoxide is diffused from the resulting absorption solvent and is recycled to at least one step selected form the group consisting of the reaction step and the distillation step(s).

11. The process according to claim 1, wherein at least a portion of the raffinate is recycled to at least one step selected form the group consisting of the reaction step and the distillation step(s).

12. The process according to claim 1, wherein the second overhead is subjected to water extraction stepwise or continuously with a plurality of theoretical stages.

13. The process according to claim 1, which further comprises: a fourth distillation step for distilling the extract to form a fourth overhead containing an aldehyde and a bottom or lower aqueous stream, wherein the aqueous stream is used for extraction in the extraction step.

14. The process according to claim 1, wherein an acetaldehyde concentration in a reaction medium in a reactor of the reaction step is maintained at not more than 400 ppm by weight, and the process further comprises a step for distilling the crude acetic acid stream and separating the crude acetic acid stream into a purified acetic acid and at least one component selected from the group consisting of a lower boiling point component and a higher boiling point component, wherein at least one of the following (i) to (iii) is satisfied: (i) a potassium permanganate test value of the purified acetic acid is maintained at not less than 120 minutes, (ii) a propionic acid concentration of the purified acetic acid is maintained at not more than 200 ppm by weight, and (iii) an iodide concentration of the purified acetic acid is maintained at not more than 100 ppb.

15. The process according to claim 1, wherein in the method (1), the internal pressure of the distillation column is controlled by introducing at least one gas selected from the group consisting of a nitrogen gas, an off-gas, and an inert gas with a flow rate of not more than 1% relative to a flow rate of the first overhead being fed to the distillation column in the second distillation step.

16. The process according to claim 1, wherein in the method (2), the internal pressure of the distillation column is controlled by regulating or controlling the temperature and/or the flow rate of a cooling water for a condenser, which cools and condenses an overhead from the distillation column in the second distillation step, to form a condensate and a noncondensable gas, and by regulating or controlling a discharging amount of the noncondensable gas froπm a discharging line.

17. The process according to claim 1, wherein in the method (2), the inner pressure of the distillation column is controlled by detecting a pressure and/or a flow rate at a withdrawing port communicating with a gaseous phase in a hold tank, which is disposed downstream of a condenser for cooling and condensing an overhead from the distillation column in the second distillation step to form a condensate and a noncondensable gas, and regulating or controlling a discharge amount of the noncondensable off-gas.