CLAIMS

1. A treatment apparatus for a silica-containing water comprising:

a reaction tank for insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a silica-containing water to be treated, or by utilizing magnesium contained in the water to be treated,

a solid-liquid separation unit for performing a solid-liquid separation of an obtained insoluble material, and

a return unit for adding an acid to at least a portion of a sludge separated by the solid-liquid separation to adjust the pH of the separated sludge to a value within a range from 4 to 6, and returning a resultant material to a stage prior to the solid-liquid separation unit.

2. A treatment apparatus for a silica-containing water comprising:

a reaction tank for insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a silica-containing water to be treated, or by utilizing magnesium contained in the water to be treated,

a first solid-liquid separation unit for performing a solid-liquid separation of an obtained insoluble material,

an acid addition unit for adding an acid to at least a portion of a sludge separated by the first solid-liquid separation unit to adjust the pH of the separated sludge to a value within a range from 4 to 6,

a second solid-liquid separation unit for performing a solid-liquid separation of the sludge containing the added acid, and

a return unit for returning at least a portion of a second solid-liquid separation water separated by the second solid-liquid separation unit to a stage prior to the first solid-liquid separation unit.

3. A treatment apparatus for a silica-containing water comprising:

an insolubilization unit for insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a water to be treated containing organic matter and silica, or by utilizing magnesium contained in the water to be treated,

a membrane filtration unit for performing membrane filtration of an obtained insoluble material,

a backwash unit for backwashing the membrane filtration unit,

an acid addition unit for adding an acid to at least a portion of a discharged backwash wastewater to adjust the pH of the backwash wastewater to a value within a range from 4 to 6, and

a backwash wastewater return unit for returning the backwash wastewater containing the added acid to a stage prior to the membrane filtration unit.

4. A treatment apparatus for a silica-containing water comprising:

an insolubilization unit for insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a water to be treated containing organic matter and silica, or by utilizing magnesium contained in the water to be treated,

a membrane filtration unit for performing membrane filtration of an obtained insoluble material,

a backwash unit for backwashing the membrane filtration unit,

an acid addition unit for adding an acid to at least a portion of a discharged backwash wastewater to adjust the pH of the backwash wastewater to a value within a range from 4 to 6,

a solid-liquid separation unit for performing a solid-liquid separation of the backwash wastewater containing the added acid, and

a solid-liquid separation water return unit for returning at least a portion of a solid-liquid separation water separated by the solid-liquid separation unit to a stage prior to the membrane filtration unit.

5. The treatment apparatus for a silica-containing water as claimed in any one of Claims 1 to 4, wherein

the amount of returning is within a range from 2 to 20% of the flow rate of the water to be treated.

6. The treatment apparatus for a silica-containing water as claimed in Claim 1 or 2, further comprising, at a latter stage after the solid-liquid separation unit, a reverse osmosis membrane treatment device in which a solid-liquid separation water is supplied to a reverse osmosis membrane to obtain a permeate and a concentrate.

7. The treatment apparatus for a silica-containing water as claimed in Claim 3 or 4, further comprising, at a latter stage after the membrane filtration unit, a reverse osmosis membrane treatment device in which a membrane filtrate is supplied to a reverse osmosis membrane to obtain a permeate and a concentrate.

8. A treatment method for a silica-containing water comprising:

an insolubilization step of insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a silica-containing water to be treated, or by utilizing magnesium contained in the water to be treated,

a solid-liquid separation step of performing a solid-liquid separation of an obtained insoluble material, and

a return step of adding an acid to at least a portion of a sludge separated by the solid-liquid separation to adjust the pH of the separated sludge to a value within a range from 4 to 6, and returning a resultant material to a stage prior to the solid-liquid separation step.

9. A treatment method for a silica-containing water comprising:

an insolubilization step of insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a silica-containing water to be treated, or by utilizing magnesium contained in the water to be treated,

a first solid-liquid separation step of performing a solid-liquid separation of an obtained insoluble material,

an acid addition step of adding an acid to at least a portion of a sludge separated in the first solid-liquid separation step to adjust the pH of the separated sludge to a value within a range from 4 to 6,

a second solid-liquid separation step of performing a solid-liquid separation of the sludge containing the added acid, and

a return step of returning at least a portion of a second solid-liquid separation water separated in the second solid-liquid separation step to a stage prior to the first solid-liquid separation step.

10. A treatment method for a silica-containing water comprising:

an insolubilization step of insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a water to be treated containing organic matter and silica, or by utilizing magnesium contained in the water to be treated,

a membrane filtration step of performing membrane filtration of an obtained insoluble material,

a backwashing step of backwashing a membrane used in the membrane filtration step,

an acid addition step of adding an acid to at least a portion of a discharged backwash wastewater to adjust the pH of the backwash wastewater to a value within a range from 4 to 6, and

a backwash wastewater return step of returning the backwash wastewater containing the added acid to a stage prior to the membrane filtration step.

11. A treatment method for a silica-containing water comprising:

an insolubilization step of insolubilizing silica at a pH of 10 or higher, either by adding a magnesium compound to a water to be treated containing organic matter and silica, or by utilizing magnesium contained in the water to be treated,

a membrane filtration step of performing membrane filtration of an obtained insoluble material,

a backwashing step of backwashing a membrane used in the membrane filtration step,

an acid addition step of adding an acid to at least a portion of a discharged backwash wastewater to adjust the pH of the backwash wastewater to a value within a range from 4 to 6,

a solid-liquid separation step of performing a solid-liquid separation of the backwash wastewater containing the added acid, and

a solid-liquid separation water return step of returning at least a portion of a solid-liquid separation water separated in the solid-liquid separation step to a stage prior to the membrane filtration step.

12. The treatment method for a silica-containing water as claimed in any one of Claims 8 to 11, wherein

the amount of returning is within a range from 2 to 20% of the flow rate of the water to be treated.

13. The treatment method for a silica-containing water as claimed in Claim 8 or 9, further comprising, at a latter stage after the solid-liquid separation step, a reverse osmosis membrane treatment step of supplying a solid-liquid separation water to a reverse osmosis membrane to obtain a permeate and a concentrate.

14. The treatment method for a silica-containing water as claimed in Claim 10 or 11, further comprising, at a latter stage after the membrane filtration step, a reverse osmosis membrane treatment step of supplying a membrane filtrate to a reverse osmosis membrane to obtain a permeate and a concentrate.