Claims

[Claim 1] A water treatment method, in which a cycle including: a filtration step of filtering water to be treated through a separation membrane from a primary side to a secondary side of the separation membrane; and a backwashing step of washing the separation membrane from the secondary side to the primary side is repeated,

the water treatment method comprising the steps of:

injecting, into the separation membrane, ozone to be used in the backwashing step; and

when, of the repeated cycles, a previous cycle is defined as a first cycle and a following cycle subsequent to the first cycle is defined as a second cycle, setting an ozone injection amount to be injected in the second cycle to a value less than an ozone injection amount injected in the first cycle,

the separation membrane being hydrophobic,

the water to be treated containing a pollutant having a high affinity for the separation membrane,

the separation membrane being subjected to hydrophilization.

[Claim 2] A water treatment method according to claim 1, wherein an operation time of the filtration step in the second cycle is set to a value equal to an operation time of the filtration step in the first cycle.

[Claim 3] A water treatment method according to claim 1, wherein an operation time of the filtration step in the second cycle is set to a value less than an operation time of the filtration step in the first cycle.

[Claim 4] A water treatment method according to any one of claims 1 to 3, further comprising the steps of:

detecting a value of transmembrane pressure difference across the separation membrane; and

making transition from the filtration step to the backwashing step based on the detected value of transmembrane pressure difference.

[Claim 5] A water treatment method according to any one of claims 1 to 3, further comprising the steps of:

detecting, as a value of transmembrane pressure difference, a difference between a concentration of dissolved organic matter on the primary side and a concentration of dissolved organic matter on the secondary side; and

making transition from the filtration step to the backwashing step based on the detected value of transmembrane pressure difference.

[Claim 6] A water treatment method according to any one of claims 1 to 3, further comprising the steps of:

calculating an indicator of a clogging state of the separation membrane from a membrane property measurement result with an ultrasonic sensor; and

making transition from the filtration step to the backwashing step based on the calculated indicator of a clogging state.

[Claim 7] A water treatment method according to any one of claims 1 to 3, further comprising the steps of:

calculating an indicator of a clogging state of the separation membrane from a membrane property detection result with a detection unit; and

making transition from the filtration step to the backwashing step based on the calculated indicator of a clogging state.

[Claim 8] A water treatment method according to any one of claims 1 to 7, wherein:

a microbial community is present on the primary side and treated water is present on the secondary side in the filtration step; and

the microbial community is present on the primary side and ozone-containing water is present on the secondary side in the backwashing step.

[Claim 9] A water treatment apparatus, in which a cycle including: filtration treatment of filtering water to be treated through a separation membrane; and backwashing treatment of washing the separation membrane is repeated,

the water treatment apparatus comprising:

an ozone injection unit configured to inject, into the separation membrane, ozone to be used in the backwashing treatment; and

a control unit configured to control an ozone injection amount to be injected into the separation membrane by the ozone injection unit,

wherein the control unit is configured to control the ozone injection amount so that, when, of the repeated cycles, a previous cycle is defined as a first cycle and a following cycle subsequent to the first cycle is defined as a second cycle, an ozone injection amount in the second cycle is set to a value less

than an ozone injection amount in the first cycle,

the separation membrane being hydrophobic,

the water to be treated containing a pollutant having a high affinity for the separation membrane,

the separation membrane being subjected to hydrophilization.

[Claim 10] A water treatment apparatus according to claim 9, further comprising a transmembrane pressure difference detector configured to detect a transmembrane pressure difference across the separation membrane,

wherein the control unit is configured to control timing to make transition from the filtration treatment to the backwashing treatment based on the transmembrane pressure difference detected with the transmembrane pressure difference detector.

[Claim 11] A water treatment apparatus according to claim 9, further comprising a detector configured to detect membrane properties of the separation membrane,

wherein the control unit is configured to control timing to make transition from the filtration treatment to the backwashing treatment based on the membrane properties detected with the detector.