CLAIMS

1. A filtration membrane treatment device which performs ozone treatment on a filtration membrane, the filtration membrane treatment device comprising:

a first supply portion which supplies an ozone-containing fluid to the filtration membrane;

a measurement portion which measures a measurement value based on a pressure to the filtration membrane, during a supply step of supplying the ozone-containing fluid by the first supply portion; and

a control portion which adjusts, on the basis of a change in the measurement value measured by the measurement portion, a supply amount of the ozone-containing fluid to be supplied by the first supply portion, wherein

the measurement portion measures, as the measurement value, each of a first measurement value H1 after the first supply portion supplies the ozone-containing fluid for a first time period and a second measurement value H2 after the supply is performed for a second time period which is longer than the first time period, and

the control portion

causes the first supply portion to continue the supply of the ozone-containing fluid if a change ratio α in the following expression 1 between the first measurement value H1 and the second measurement value H2 is larger than a

threshold value α1, and

causes the first supply portion to suppress the supply of the ozone-containing fluid if the change ratio α is equal to or smaller than the threshold value α1,

$$|H1-H2|\div|H1|=\alpha \cdots \text{expression 1.}$$

2. A filtration membrane treatment device which performs ozone treatment on a filtration membrane, the filtration membrane treatment device comprising:

a first supply portion which supplies an ozone-containing fluid to the filtration membrane;

a second supply portion which supplies a measurement fluid which is different from the ozone-containing fluid and from a treatment-target liquid to the filtration membrane,

a measurement portion which measures a measurement value based on a pressure to the filtration membrane, during a supply step of supplying the measurement fluid by the second supply portion; and

a control portion which adjusts, on the basis of a change in the measurement value measured by the measurement portion, a supply amount of the ozone-containing fluid to be supplied by the first supply portion, wherein

at a time of measurement by the measurement portion, the control portion causes the first supply portion

to stop, causes the second supply portion to supply the measurement fluid to the filtration membrane, and causes the measurement portion to measure the measurement value,

the measurement portion measures, as the measurement value, each of a first measurement value H1, during the supply of the measurement fluid from the second supply portion, after the first supply portion supplies the ozone-containing fluid for a first time period and a second measurement value H2, during the supply of the measurement fluid from the second supply portion, after the first supply portion supplies the ozone-containing fluid for a second time period which is longer than the first time period, and

the control portion

causes the first supply portion to continue the supply of the ozone-containing fluid if a change ratio α in the following expression 1 between the first measurement value H1 and the second measurement value H2 is larger than a threshold value α1, and

causes the first supply portion to suppress the supply of the ozone-containing fluid if the change ratio α is equal to or smaller than the threshold value α1,

$$|H1-H2|\div|H1|=\alpha \cdots \text{expression 1.}$$

3. The filtration membrane treatment device according to claim 2, wherein

the filtration membrane filters a treatment-target liquid from a primary side to a secondary side, and

the second supply portion is configured to either pour the measurement fluid from the secondary side to the primary side of the filtration membrane, or suction or inject the measurement fluid from the primary side to the secondary side of the filtration membrane.

4. The filtration membrane treatment device according to any one of claims 1 to 3, wherein

the filtration membrane filters a treatment-target liquid from a primary side to a secondary side, and

the first supply portion is configured to either pour the ozone-containing fluid from the secondary side to the primary side of the filtration membrane, or suction or inject the ozone-containing fluid from the primary side to the secondary side of the filtration membrane.

5. The filtration membrane treatment device according to any one of claims 1 to 4, wherein the control portion causes the first supply portion to end the supply of the ozone-containing fluid if the change ratio α between the measurement values is larger than the threshold value α1.

6. The filtration membrane treatment device according to any one of claims 1 to 5, wherein the first supply portion supplies, as the ozone-containing fluid, at least one of ozone gas, ozone water obtained by dissolving ozone, or ozone-mixed water obtained by mixing, with ozone water, a substance that promotes generation of radicals due to decomposition of ozone.

7. The filtration membrane treatment device according to any one of claims 1 to 6, wherein

regarding the measurement value from the measurement portion,

a pressure value in a pipe through which a fluid being supplied to the filtration membrane is flowing is measured as the measurement value,

a trans-membrane pressure value between inside and outside of the filtration membrane at a time of passage of the fluid through the filtration membrane is measured as the measurement value, or

a ratio between the pressure value or the trans-membrane pressure value and a flow rate value of the fluid being supplied to the filtration membrane is measured as the measurement value.

8. The filtration membrane treatment device according to any one of claims 1 to 7, wherein

the filtration membrane is formed of a material that is hydrophilized by ozone, and

the control portion determines a degree of hydrophilization of the filtration membrane on the basis of the change in the measurement value.

9. A membrane filtration device which treats a treatment-target liquid with use of the filtration membrane treatment device according to any one of claims 1 to ~~9~~7, the membrane filtration device comprising:

a storage tank which stores the treatment-target liquid and in which the filtration membrane is immersed; and

a transfer portion which transfers, to outside of the storage tank, the treatment-target liquid having been filtered by the filtration membrane, wherein

the control portion causes the transfer portion to stop and causes the first supply portion to supply the ozone-containing fluid to the filtration membrane immersed inside the storage tank.

10. A filtration membrane treatment method comprising:

a supply step of supplying an ozone-containing fluid to a filtration membrane;

a measurement step of measuring a measurement value based on a pressure to the filtration membrane, during the supply step of supplying the ozone-containing fluid; and

a control step of adjusting a supply amount of the ozone-containing fluid on the basis of a change in the measurement value, wherein

the measurement step includes measuring each of a first measurement value H1 after the ozone-containing fluid is supplied for a first time period and a second measurement value H2 after the supply is performed for a second time period which is longer than the first time period, and

the control step includes:

continuing the supply of the ozone-containing fluid if a change ratio α in the following expression 1 between the first measurement value H1 and the second measurement value H2 is larger than a threshold value α1; and

suppressing the supply of the ozone-containing fluid if the change ratio α is equal to or smaller than the threshold value α1,

$$|H1-H2|\div|H1|=\alpha \cdots \text{expression 1.}$$

11. A filtration membrane treatment method comprising:

a supply step of supplying an ozone-containing fluid to a filtration membrane;

a measurement fluid supply step of supplying a

measurement fluid which is different from the ozone-containing fluid and from a treatment-target liquid to the filtration membrane while the supply step is stopped,

a measurement step of measuring a measurement value based on a pressure to the filtration membrane, during the measurement fluid supply step of supplying the measurement fluid, and

a control step of adjusting a supply amount of the ozone-containing fluid on the basis of a change in the measurement value, wherein

the measurement step includes measuring each of a first measurement value H1, during the supply of the measurement fluid, after the ozone-containing fluid is supplied for a first time period and a second measurement value H2, during the supply of the measurement fluid, after the ozone-containing fluid is supplied for a second time period which is longer than the first time period, and

the control step includes

continuing the supply of the ozone-containing fluid if a change ratio α in the following expression 1 between the first measurement value H1 and the second measurement value H2 is larger than a threshold value α1, and

suppressing the supply of the ozone-containing fluid if the change ratio α is equal to or smaller than the threshold value α1,

$$|H1-H2|\div|H1|=\alpha \cdots \text{expression 1.}$$

12. A filtration membrane treatment device which performs ozone treatment on a filtration membrane, the filtration membrane treatment device comprising:

a first supply portion which continuously supplies a fixed amount of ozone-containing fluid to the filtration membrane, to perform the ozone treatment;

a pipe which connects the first supply portion and the filtration membrane to each other;

a measurement portion which measures a pressure in the pipe as a measurement value; and

a control portion which adjusts the supply of the ozone-containing fluid from the first supply portion on the basis of a change in the measurement value measured by the measurement portion, wherein

the control portion

causes the first supply portion to continue the supply of the ozone-containing fluid if a change ratio between a first measurement value and a second measurement value measured by the measurement portion after the first measurement value is measured is larger than a threshold value, the first measurement value and the second measurement value being measured by the measurement portion, and

causes the first supply portion to end the

supply of the ozone-containing fluid to complete the ozone treatment if the change ratio is equal to or smaller than the threshold value,

the change ratio is a ratio of an absolute value of a difference between the first measurement value and the second measurement value to an absolute value of the first measurement value, and

the first measurement value and the second measurement value are each a pressure at a time of supplying the ozone-containing fluid, tap water, pure water, ultrapure water, an alkaline chemical, or an acidic chemical into the pipe.

13. A filtration membrane treatment method for supplying an ozone-containing fluid from a first supply portion through a pipe to a filtration membrane, to perform ozone treatment on the filtration membrane, the filtration membrane treatment method comprising:

a supply step of supplying a fixed amount of ozone-containing fluid from the first supply portion to the filtration membrane, to perform the ozone treatment;

a measurement step of measuring a pressure in the pipe as a measurement value; and

a control step of adjusting the supply of the ozone-containing fluid from the first supply portion on the

basis of a change in the measurement value, wherein

the control step includes

causing the first supply portion to continue the supply of the ozone-containing fluid if a change ratio between a first measurement value and a second measurement value measured after the first measurement value is measured is larger than a threshold value, the first measurement value and the second measurement value being measured in the measurement step, and

causing the first supply portion to end the supply of the ozone-containing fluid to complete the ozone treatment if the change ratio is equal to or smaller than the threshold value,

the change ratio is a ratio of an absolute value of a difference between the first measurement value and the second measurement value to an absolute value of the first measurement value, and

the first measurement value and the second measurement value are each a pressure at a time of supplying the ozone-containing fluid, tap water, pure water, ultrapure water, an alkaline chemical, or an acidic chemical into the pipe.