

REVERSE OSMOSIS TREATMENT METHOD

Field of Invention

[0001]

The present invention relates to a reverse osmosis treatment method and more particularly to a method that includes adding an iron-based inorganic flocculant to water to be treated, performing solid-liquid separation of the water, and performing reverse osmosis treatment on the water.

Background of Invention

[0002]

A method including adding iron (III) chloride to water to be treated, performing separation of the water by pressure flotation, performing sand filtration of the water, and performing a membrane separation treatment on the water with a reverse osmosis membrane unit (hereinafter also referred to as a RO unit) is well known as described in Patent Literatures 1 and 2. A scale dispersant may be added to water to be supplied to RO in RO treatment (Patent Literatures 3 and 4).

[0003]

It is mentioned in paragraph 0003 in Patent Literature 5 that an iron chloride flocculant contains manganese (Mn), and a 38% iron (III) chloride solution contains 400 to 1000 mg/L of manganese.

List of Literatures

Patent Literature

[0004]

Patent Literature 1: Japanese Patent Publication 2009-240974 A

Patent Literature 2: Japanese Patent Publication 2008-246386 A

Patent Literature 3: Japanese Patent Publication 5-269463 A

Patent Literature 4: Japanese Patent Publication 10-202066 A

Patent Literature 5: Japanese Patent Publication 2006-342007 A

Object and Summary of Invention

[0005]

In the method including adding an iron-based inorganic flocculant to water to be treated, performing solid-liquid separation of the water, and performing RO treatment on the water, heavy metals, such as Mn, in the iron-based inorganic flocculant may be deposited on a RO membrane surface, act as an oxidation catalyst, and thereby degrade the RO membrane.

[0006]

It is an object of the present invention to provide a reverse osmosis treatment method that can prevent degradation of a RO membrane caused by heavy metals in an

iron-based inorganic flocculant.

[0007]

A reverse osmosis treatment method according to the present invention includes adding an iron-based inorganic flocculant to water to be treated, performing solid-liquid separation of the water, and treating the water with a reverse osmosis unit, wherein a chelate-based scale inhibitor and a scale dispersant are added to the water to be supplied to the reverse osmosis unit.

[0008]

The present invention is preferably applied in the case where the Mn, Zn, and Ni content of the iron-based inorganic flocculant is 0.05% by weight or more in total.

Advantageous Effects of Invention

[0009]

Water to be supplied to RO in the present invention is prepared by adding an iron-based inorganic flocculant to water to be treated and performing solid-liquid separation of the water. A chelate-based scale inhibitor as well as a scale dispersant are added to the water to be supplied to RO. This can prevent degradation of a RO membrane caused by the oxidative catalysis of heavy metals.

Brief Description of Drawings

[0010]

Fig. 1 is an explanatory view of a reverse osmosis

treatment method according to an embodiment.

Fig. 2 is a graph of the results in Example 1 and Comparative Example 1.

Description of Embodiments

[0011]

The present invention will be described in detail below.

[0012]

[Water to be Treated]

Examples of the water to be treated include biologically treated organic wastewater and wastewater from various manufacturing processes and cleaning processes as well as industrial water, river water, lake water, and well water.

[0013]

[Iron-Based Inorganic Flocculant]

The iron-based inorganic flocculant may be iron (III) chloride or polyiron sulfate, particularly iron (III) chloride, which has a high heavy metal content. The present invention is effectively applied in the case where the Mn, Ni, and Zn content of the iron-based inorganic flocculant is 0.05% by weight or more and 5% by weight or less, for example, 0.1% by weight or more and 2% by weight or less, in total. The amount of iron-based inorganic flocculant to be added to water to be treated is preferably determined in an experiment, such as a jar test. The amount of iron-based

inorganic flocculant to be added to water to be treated depends on the quality of water to be treated and generally ranges from approximately 10 to 400 mg/L.

[0014]

In the case where an iron-based inorganic flocculant is added to water to be treated, a pH-adjusting agent is preferably added to the water, if necessary, to adjust the pH to be in the range of approximately 4 to 8, particularly approximately 5 to 8, before flocculation treatment. The pH-adjusting agent may be, but is not limited to, an acid, such as hydrochloric acid or sulfuric acid, or an alkali, such as sodium hydroxide. After the iron-based inorganic flocculant is added, a polymer flocculant, such as an anionic polymer flocculant, may be added.

[0015]

[Solid-Liquid Separation]

It is desirable that the solid-liquid separation after the flocculation treatment be a combination of floatation or sedimentation and filtration through a filter medium layer. The filter medium may be sand or anthracite.

[0016]

[Chelate-Based Scale Inhibitor]

The chelate-based scale inhibitor is preferably ethylenediaminetetraacetic acid (EDTA) or nitrilotriacetic acid (NTA). These chelate-based scale inhibitors may be

used alone, or two or more chelate-based scale inhibitors may be used in combination.

[0017]

The amount of chelate-based scale inhibitor, such as EDTA or NTA, to be added is preferably 20 times, particularly 30 to 40 times, the total equivalent of Mn, Zn, and Ni heavy metals in water to be supplied to RO. The added chelate-based scale inhibitor forms chelate compounds with heavy metals in water to be supplied to RO and thereby solubilizes the heavy metals. Thus, the heavy metals flow out together with concentrated water from a RO unit and are prevented from being deposited on the RO membrane. This prevents degradation of the RO membrane due to the catalytic action of the heavy metals.

[0018]

[Scale Dispersant]

Examples of the scale dispersant include low-molecular-weight polymers, such as (meth)acrylic acid polymers and salts thereof and maleic acid polymers and salts thereof; phosphonic acids and phosphonates, such as ethylenediaminetetra(methylenephosphonic acid) and salts thereof, hydroxyethylidenediphosphonic acid and salts thereof, nitrilotrimethylenephosphonic acid and salts thereof, and phosphonobutanetricarboxylic acid and salts thereof; and inorganic polymeric phosphoric acids and

inorganic polymeric phosphates, such as hexametaphosphoric acid and salts thereof and tripolyphosphoric acid and salts thereof. These scale dispersants may be used alone, or two or more scale dispersants may be used in combination.

The amount of scale dispersant preferably ranges from approximately 1 to 100 mg per liter of water subjected to solid-liquid separation, which is water to be supplied to a RO unit.

EXAMPLES

[0019]

[EXAMPLE 1]

Wastewater (Ca: 100 mg/L, F: 13 mg/L, pH 3) used to simulate treated HF wastewater was prepared and was introduced into a reaction vessel 1, as illustrated in Fig. 1. The pH of the wastewater was adjusted to be in the range of 6 to 7 by the addition of sodium hydroxide. Iron (III) chloride was added to the wastewater such that the concentration of iron (III) chloride in the reaction vessel 1 was 150 mg/L. The Mn, Ni, and Zn contents of the iron (III) chloride were 1%, 0.05%, and 0.05% by weight, respectively. The effluent water from the reaction vessel 1 was allowed to react in a flocculation vessel 2 and was subjected to pressure flotation treatment in a pressure flotation vessel 3. The treated water was filtered through a dual media filter 4 (filter media: sand and anthracite).

10 mg/L of a chelate-based scale inhibitor Welclean A801 (manufactured by Kurita Water Industries Ltd.) and 10 mg/L of a scale dispersant Kurifloat N900 (manufactured by Kurita Water Industries Ltd.) were added to filtered water of the filter 4. The filtered water was then subjected to RO membrane treatment in a RO unit 5. The RO membrane was ES-20 manufactured by Nitto Denko Corp. The recovery rate was 85%. Fig. 2 shows the temporal changes in salt rejection rate and differential pressure in the RO unit 5.

[0020]

[COMPARATIVE EXAMPLE 1]

Treatment was performed in the same manner as in Example 1 except that no chelate-based scale inhibitor was added. Fig. 2 shows the temporal changes in salt rejection rate and differential pressure in the RO unit 5.

[0021]

Fig. 2 shows that the present invention prevents degradation of the RO membrane and maintains high salt rejection rates for a long time.

[0022]

Although the present invention has been described in detail with reference to particular embodiments, it is apparent to a person skilled in the art that various modifications can be made therein without departing from the spirit and scope of the present invention.

The present application is based on Japanese Patent Application (Japanese Patent Application No. 2012-003287) filed on January 11, 2012, which is incorporated herein by reference in its entirety.

CLAIMS

1 A reverse osmosis treatment method, comprising: adding an iron-based inorganic flocculant to water to be treated; performing solid-liquid separation of the water; and treating the water with a reverse osmosis unit,

wherein a chelate-based scale inhibitor and a scale dispersant are added to the water to be supplied to the reverse osmosis unit.

2 The reverse osmosis treatment method according to Claim 1, wherein the chelate-based scale inhibitor is ethylenediaminetetraacetic acid and/or nitrilotriacetic acid.

3 The reverse osmosis treatment method according to Claim 1 or 2, wherein the scale dispersant is at least one selected from the group consisting of (meth)acrylic acid polymers and salts thereof and maleic acid polymers and salts thereof.

4 The reverse osmosis treatment method according to any one of Claims 1 to 3, wherein the Mn, Zn, and Ni content of the iron-based inorganic flocculant is 0.05% by weight or more in total.

5 The reverse osmosis treatment method according to any one of Claims 1 to 4, wherein 10 to 400 mg/L of the iron-based inorganic flocculant is added to the water to be treated.

6 The reverse osmosis treatment method according to any one of Claims 1 to 5, wherein the amount of chelate-based scale inhibitor added is at least 20 times the total equivalent of Mn, Zn, and Ni heavy metals in the supplied water.

7 The reverse osmosis treatment method according to any one of Claims 1 to 6, wherein 1 to 200 mg/L of the scale dispersant is added to the supplied water.

8 The reverse osmosis treatment method according to any one of Claims 1 to 7, wherein the iron-based inorganic flocculant is added to the water to be treated, and the water is subjected to flocculation treatment at pH 4 to 8 and then solid-liquid separation.