CLAIMS

1. A water treatment method comprising:

a flocculating step of adding an anionic polymer flocculant to water to be treated containing suspended solids to form flocculated flocs;

a granulating step of stirring the water to be treated to granulate the flocculated flocs; and

a solid-liquid separating step of performing solid-liquid separation of generated granulated substances to obtain treated water,

wherein before the anionic polymer flocculant is added, a cationic polymer flocculant having a cationic group rate of 10 to 50 mole% is added to the water to be treated,

wherein an inorganic coagulant is added to the water to be treated together with the cationic polymer flocculant or before the addition of the cationic polymer flocculant, and

wherein the granulating step and the solid-liquid separating step are performed in a granulation type flocculating and settling tank maintaining a sludge blanket therein.

2. The water treatment method according to Claim 1, wherein an addition amount Am of the inorganic coagulant, an addition amount Ac of the cationic polymer flocculant, and

an addition amount Aa of the anionic polymer flocculant satisfy the following equation:

$0.1<(Am/100+Ac)/Aa<2$.

3. The water treatment method according to any one of Claims 1 to 2, wherein the water to be treated contains a heavy metal, the method further comprising, before the addition of the anionic polymer flocculant, a neutralizing step of performing a neutralization treatment on the water to be treated to settle a heavy metal hydroxide.

4. The water treatment method according to any one of Claims 1 to 3, wherein immediately before the granulating step is performed, the anionic polymer flocculant is added.

5. The water treatment method according to any one of Claims 1 to 4, wherein the anionic polymer flocculant is a low ionic anionic polymer flocculant having an anionic group rate of 30 mole% or less.

6. The water treatment method according to any one of Claims 1 to 5, wherein the weight average molecular weight of the cationic polymer flocculant is 12,000,000 to 22,000,000.

7. The water treatment method according to any one of Claims 1 to 6, wherein the weight average molecular weight of the anionic polymer flocculant is 9,000,000 to 18,000,000.

8. The water treatment method according to any one of Claims 1 to 7, wherein the ratio of Ac/Aa of the addition amount Ac of the cationic polymer flocculant to the addition amount Aa of the anionic polymer flocculant is 0.1 to 1.

9. The water treatment method according to any one of Claims 1 to 8, wherein a G value in a stirring tank obtained when the cationic polymer flocculant is added and stirred is set to 2 to 150 s^{-1}.

10. The water treatment method according to any one of Claims 1 to 9, wherein the solid-liquid separation is performed in a granulation type flocculating and settling tank, and an SS concentration of a sludge blanket in the granulation type flocculating and settling tank is set to 2,000 to 100,000 mg/L.

11. The water treatment method according to Claim 10, wherein a water flow LV in the granulation type flocculating and settling tank is set to 5 to 90 m/hr.

12. The water treatment method according to any one of Claims 1 to 11, wherein the SS concentration of treated water is 20 mg-SS/L or less.

13. A water treatment apparatus comprising:

anionic polymer flocculant addition means for adding an anionic polymer flocculant to water to be treated containing suspended solids;

stirring means provided at a downstream side of the anionic polymer flocculant addition means and configured to granulate flocculated flocs by stirring water to be treated; and

solid-liquid separation means for performing solid-liquid separation of water to be treated which is stirred by the stirring means to obtain treated water,

wherein the water treatment apparatus comprises cationic polymer flocculant addition means provided at an upstream side of the anionic polymer flocculant addition means and configured to add a cationic polymer flocculant having a cationic group rate of 10 to 50 mole%,

wherein the water treatment apparatus comprises inorganic coagulant addition means for adding an inorganic coagulant to the water to be treated, the means being configured to add the inorganic coagulant together with the cationic polymer flocculant or being provided at an upstream

side of the cationic polymer flocculant addition means, and

wherein the water treatment apparatus comprises a granulation type flocculating and settling tank as stirring granulation means and the solid-liquid separation means.

14. The water treatment apparatus according to Claim 13, wherein the water to be treated contains a heavy metal, and the water treatment apparatus comprises neutralizing means provided at an upstream side of the cationic polymer flocculant addition means and configured to neutralize water to be treated to settle a heavy metal hydroxide.

CLAIMS

1 A water treatment method for treating suspended solids-containing water comprising:

a flocculating step of adding an anionic polymer flocculant to the water to be treated to form flocculated flocs;

a granulating step of stirring the water to be treated to granulate the flocculated flocs; and

a solid-liquid separating step of performing solid-liquid separation of generated granulated substances to obtain treated water,

wherein before the anionic polymer flocculant is added, a cationic polymer flocculant having a weight average molecular weight of 15,000,000 or more and a cationic group rate of 10 to 50 mole% is added to the water to be treated,

wherein an inorganic coagulant is added to the water to be treated together with the cationic polymer flocculant or before the addition of the cationic polymer flocculant,

wherein the granulating step and the solid-liquid separation step is conducted in a granulation type flocculating and settling tank in which a sludge blanket is formed; the tank has a stirring machine provided with stirring paddles; and, the granulating step and the solid-liquid separation step is conducted by stirring the sludge

blanket at a stirring intensity G of 2 to 150 s^{-1}, and

wherein a charge point of the anionic polymer flocculant is set to a water channel through which the flocculation-treated water by the cationic polymer flocculant is fed to the granulation type flocculating and settling tank, or to a line mixer through which the water added with the cationic polymer flocculant flows.

2 The water treatment method according to Claim 1, wherein an addition amount Am of the inorganic coagulant, an addition amount Ac of the cationic polymer flocculant, and an addition amount Aa of the anionic polymer flocculant satisfy the following equation:

$0.1<(Am/100+Ac)/Aa<2$.

3 The water treatment method according to Claim 1 or 2, wherein the water to be treated contains a heavy metal, the method further comprising, before the addition of the anionic polymer flocculant, a neutralizing step of performing a neutralization treatment on the water to be treated to settle a heavy metal hydroxide.

4 The water treatment method according to any one of Claims 1 to 3, wherein immediately before the granulating step is performed, the anionic polymer flocculant is added.

5 The water treatment method according to any one of Claims 1 to 4, wherein the anionic polymer flocculant is a low ionic anionic polymer flocculant having an anionic group rate of 30 mole% or less.

6 The water treatment method according to any one of Claims 1 to 5, wherein the weight average molecular weight of the cationic polymer flocculant is 15,000,000 to 22,000,000.

7 The water treatment method according to any one of Claims 1 to 6, wherein the weight average molecular weight of the anionic polymer flocculant is 9,000,000 to 18,000,000.

8 The water treatment method according to any one of Claims 1 to 7, wherein the ratio of Ac/Aa of the addition amount Ac of the cationic polymer flocculant to the addition amount Aa of the anionic polymer flocculant is 0.1 to 1.

9 The water treatment method according to any one of Claims 1 to 8, wherein a G value in a stirring tank obtained when the cationic polymer flocculant is added and stirred is set to 100 to 500 s^{-1}.

10 The water treatment method according to any one of Claims 1 to 9, wherein an SS concentration of a sludge blanket in the granulation type flocculating and settling tank is set to 2,000 to 100,000 mg/L.

11 The water treatment method according to Claim 10, wherein a water flow LV in the granulation type flocculating and settling tank is set to 5 to 90 m/hr.

12 The water treatment method according to any one of Claims 1 to 11, wherein the SS concentration of treated water is 20 mg-SS/L or less.

13 A water treatment apparatus for treating suspended solids-containing water, comprising:

anionic polymer flocculant addition means for adding an anionic polymer flocculant to water to be treated;

stirring means provided at a downstream side of the anionic polymer flocculant addition means and configured to granulate flocculated flocs by stirring water to be treated; and

solid-liquid separation means for performing solid-liquid separation of water to be treated which is stirred by the stirring means to obtain treated water,

wherein the water treatment apparatus comprises

cationic polymer flocculant addition means provided at an upstream side of the anionic polymer flocculant addition means and configured to add a cationic polymer flocculant having a weight average molecular weight of 15,000,000 or more and a cationic group rate of 10 to 50 mole%,

wherein the water treatment apparatus comprises inorganic coagulant addition means for adding an inorganic coagulant to the water to be treated, the means being configured to add the inorganic coagulant together with the cationic polymer flocculant or being provided at an upstream side of the cationic polymer flocculant addition means,

wherein the water treatment apparatus comprises a granulation type flocculating and settling tank as stirring granulation means and the solid-liquid separation means; a sludge blancket is formed in the tank; and, the tank has a stirring machine provided with stirring paddles so that the sludge blanket is stirred at a stirring intensity G of 2 to 150 s^{-1}, and

wherein the anionic polymer flocculant addition means is either one of means for adding the anionic polymer flocculant to a water channel through which the flocculation-treated water by the cationic polymer flocculant is fed to the granulation type flocculating and settling tank; and means for adding the anionic polymer flocculant to a line mixer through which the water added

with the cationic polymer flocculant flows.

14 The water treatment apparatus according to Claim 13, wherein the water to be treated contains a heavy metal, and the water treatment apparatus comprises neutralizing means provided at an upstream side of the cationic polymer flocculant addition means and configured to neutralize water to be treated to settle a heavy metal hydroxide.