CLAIMS

1. A crystallization reactor comprising a stirring device having a stirring blade, a crystallization reaction tank having a crystallization reaction unit for adding a calcium preparation to a raw water containing a crystallization target substance and generating crystals of a poorly soluble salt, and a water supply device for supplying the raw water to the crystallization reaction unit, wherein

an inner peripheral wall which faces an outer peripheral wall of the crystallization reaction tank is disposed inside the crystallization reaction tank, a solid-liquid separation unit which forms an upward flow between the inner and outer peripheral walls and performs a solid-liquid separation of the crystals and the treated water is provided inside the crystallization reaction tank,

the water supply device ~~supplies~~is configured to supply the raw water to the crystallization reaction unit intermittently, and is configured such that a duration of supply of the raw water during intermittent water supply by the water supply device is at least 1/2 but not more than 5 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply by the water supply device is at least 1/5 but not more than 1 times the retention time in the solid-liquid separation unit

~~a duration of supply of the raw water and a duration for which supply of the raw water is stopped by the water supply device are set based on a retention time of the raw water in the solid-liquid separation unit (volume of the solid-liquid separation unit/flow rate of raw water into the~~

~~crystallization reaction tank)~~.

~~2. The crystallization reactor according to Claim 1, wherein a duration of supply of the raw water during intermittent water supply by the water supply device is at least 1/2 but not more than 5 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply by the water supply device is at least 1/5 but not more than 1 times the retention time in the solid-liquid separation unit.~~

2~~3~~. The crystallization reactor according to Claim 1, wherein the water supply device is configured such that a duration of supply of the raw water during intermittent water supply by the water supply device is at least 1 times but not more than 4 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply by the water supply device is at least 1/4 but not more than 1/2 of the retention time in the solid-liquid separation unit.

3~~4~~. The crystallization reactor according to ~~any one of~~ Claim~~s~~ 1 ~~to~~or 2~~3~~, wherein a discharge port for discharging the treated water is formed in an outer peripheral wall of the crystallization reaction tank in which the solid-liquid separation unit is provided,

a top edge of the inner peripheral wall is either located

at the same height as the discharge port, or located at a position that is lower than the discharge port but still enables a portion of the treated water to be discharged from the discharge port, and a portion of the treated water inside the solid-liquid separation unit flows over the top of the inner peripheral wall and is recycled back into the crystallization reaction unit.

4. A method of treating raw water containing a crystallization target substance, the method comprising:

a crystallization reaction step in which a calcium preparation is added to a raw water containing a crystallization target substance while stirring with a stirring device having a stirring blade in a crystallization reaction unit in a crystallization reaction tank, to generate crystals of a poorly soluble salt;

a water supply step in which the raw water is supplied to the crystallization reaction unit; and

a solid-liquid separation step in which an upward flow is formed by a solid-liquid separation unit formed between an outer peripheral wall of the crystallization reaction tank and an inner peripheral wall which faces the outer peripheral wall, to perform a solid-liquid separation of the crystals and the treated water, wherein

in the water supply step, the raw water is supplied to the crystallization reaction unit intermittently, a duration of supply of the raw water during intermittent water supply is

at least 1/2 but not more than 5 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply is at least 1/5 but not more than 1 times the retention time in the solid-liquid separation unit.

5. The method of treating raw water containing crystallization target substance according to Claim 4, wherein in the water supply step, a duration of supply of the raw water during intermittent water supply is at least 1 times but not more than 4 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply is at least 1/4 but not more than 1/2 of the retention time in the solid-liquid separation unit.

6. The method of treating raw water containing crystallization target substance according to Claim 4 or 5, wherein a discharge port for discharging the treated water is formed in an outer peripheral wall of the crystallization reaction tank in which the solid-liquid separation unit is provided,

a top edge of the inner peripheral wall is either located at the same height as the discharge port, or located at a position that is lower than the discharge port but still enables a portion of the treated water to be discharged from the discharge port, and a portion of the treated water inside

the solid-liquid separation unit flows over the top of the inner peripheral wall and is recycled back into the crystallization reaction unit.

CLAIMS

1. A crystallization reactor comprising a stirring device having a stirring blade, a crystallization reaction tank having a crystallization reaction unit for adding a calcium preparation to a raw water containing a crystallization target substance and generating crystals of a poorly soluble salt, and a water supply device for supplying the raw water to the crystallization reaction unit, wherein

an inner peripheral wall which faces an outer peripheral wall of the crystallization reaction tank is disposed inside the crystallization reaction tank, a solid-liquid separation unit which forms an upward flow between the inner and outer peripheral walls and performs a solid-liquid separation of the crystals and the treated water is provided inside the crystallization reaction tank,

the water supply device is configured to supply the raw water to the crystallization reaction unit intermittently, and is configured such that a duration of supply of the raw water during intermittent water supply by the water supply device is at least 1/2 but not more than 5 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply by the water supply device is at least 1/5 but not more than 1 times the retention time in the solid-liquid separation unit.

2. The crystallization reactor according to Claim 1, wherein the water supply device is configured such that a duration of supply of the raw water during intermittent water supply by the water supply device is at least 1 times but not more than

4 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply by the water supply device is at least 1/4 but not more than 1/2 of the retention time in the solid-liquid separation unit.

3. The crystallization reactor according to Claim 1 or 2, wherein a discharge port for discharging the treated water is formed in an outer peripheral wall of the crystallization reaction tank in which the solid-liquid separation unit is provided,

a top edge of the inner peripheral wall is either located at the same height as the discharge port, or located at a position that is lower than the discharge port but still enables a portion of the treated water to be discharged from the discharge port, and a portion of the treated water inside the solid-liquid separation unit flows over the top of the inner peripheral wall and is recycled back into the crystallization reaction unit.

4. A method of treating raw water containing a crystallization target substance, the method comprising:

a crystallization reaction step in which a calcium preparation is added to a raw water containing a crystallization target substance while stirring with a

stirring device having a stirring blade in a crystallization reaction unit in a crystallization reaction tank, to generate crystals of a poorly soluble salt;

a water supply step in which the raw water is supplied to the crystallization reaction unit; and

a solid-liquid separation step in which an upward flow is formed by a solid-liquid separation unit formed between an outer peripheral wall of the crystallization reaction tank and an inner peripheral wall which faces the outer peripheral wall, to perform a solid-liquid separation of the crystals and the treated water, wherein

in the water supply step, the raw water is supplied to the crystallization reaction unit intermittently, a duration of supply of the raw water during intermittent water supply is at least 1/2 but not more than 5 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply is at least 1/5 but not more than 1 times the retention time in the solid-liquid separation unit.

5. The method of treating raw water containing crystallization target substance according to Claim 4, wherein in the water supply step, a duration of supply of the raw water during intermittent water supply is at least 1 times but not more than 4 times a retention time in the solid-liquid separation unit, and a duration for which supply of the raw water is stopped during intermittent water supply is at least

1/4 but not more than 1/2 of the retention time in the solid-liquid separation unit.

6. The method of treating raw water containing crystallization target substance according to Claim 4 or 5, wherein a discharge port for discharging the treated water is formed in an outer peripheral wall of the crystallization reaction tank in which the solid-liquid separation unit is provided,

a top edge of the inner peripheral wall is either located at the same height as the discharge port, or located at a position that is lower than the discharge port but still enables a portion of the treated water to be discharged from the discharge port, and a portion of the treated water inside the solid-liquid separation unit flows over the top of the inner peripheral wall and is recycled back into the crystallization reaction unit.