What is claimed is:

CLAIMS

1. A method of cooling tower water treatment comprising:

obtaining a first and a second portion of blowdown from a cooling tower operating at a high cycle of concentration;

obtaining pure water;

providing said first portion of blowdown and pure water to an electrolysis unit;

obtaining an acidic solution, an alkalic solution, and a salt water solution from said electrolysis unit;

providing said acidic solution to the cooling tower to reduce the alkalinity and pH of the water circulating through the cooling tower;

mixing said alkalic solution and said second portion of blowdown in a precipitation tank to soften said second portion of blowdown, removing resulting precipitate from said precipitation tank; and

providing said softened second portion of blowdown in said precipitation tank to said cooling tower as makeup water.

2. A method of water treatment comprising:

providing an electrolysis device comprising:

an electrolysis vessel;

a pair of electrodes arranged in the electrolysis vessel, the pair of electrodes respectively serving as a positive electrode and a negative electrode; and

a cell unit arranged between the positive and negative electrodes, the cell unit comprising a bipolar membrane element and at least one cation exchangeable membrane, the bipolar membrane element having a cation exchangeable side and an anion exchangeable side, the cation exchangeable side being closer to the negative electrode than the anion exchangeable side, said at least one cation

exchangeable membrane being arranged between the anion exchangeable side of the bipolar membrane element and the positive electrode, so as to define an alkalic chamber between the bipolar membrane element and the cation exchangeable membrane, said cation exchangeable membrane is selective;

an anion exchangeable membrane between the negative electrode and the cation exchangeable side of the bipolar membrane element, an acidic chamber being defined between the anion exchangeable membrane and the bipolar membrane element, said anion exchangeable membrane is selective;

a first salt water chamber defined between said negative electrode and anion exchangeable membrane, a second salt water chamber defined between said positive electrode and said cation exchangeable membrane; and

a first inlet providing a feed stream to said first salt water chamber, a second inlet providing a feed stream to said second salt water chamber, a third inlet providing a feed stream to said acidic chamber, and a fourth inlet providing a feed stream to said alkalic chamber;

providing feed streams to said first salt water chamber, second salt water chamber, acidic chamber, and alkalic chamber, said acidic chamber producing an acidic solution and said alkalic chamber producing an alkalic solution;

directing at least a portion of the contents of said first and second salt water chambers into a precipitation tank; directing at least a portion of the alkalic solution into said precipitation tank, thereby increasing the pH in said precipitation tank to produce precipitate; and

removing said precipitate from said precipitation tank.

3. The method of claim 2, wherein the pH in said precipitation tank is increased to about 7-14.

4. The method of claim 3, wherein the feed stream provided to said acidic and alkalic chambers is H_2O, and the feed stream provided to said first salt water chamber and said second salt water chamber is comprised of at least one of cooling tower make up water, cooling tower blow down water, or low quality water.

5. The method of claim 4, wherein the treated water in said precipitation tank is returned to said cooling tower after said precipitate is removed from said precipitation tank.

6. The method of claim 4, wherein the treated water in said precipitation tank is provided to a water storage tank after said precipitate is removed from said precipitation tank.

7. The method of claim 4, wherein the acidic solution is provided to said cooling tower for pH adjustment or used to adjust the pH of the treated water exiting the precipitation tank after the precipitate is removed.

8. The method of claim 4, wherein the acidic solution is used to clean the membranes of said vessel.

9. The method of claim 4, wherein at least a portion of said acidic solution is returned to said acidic chamber as a feed stream.

10. The method of claim 4, wherein at least a portion of said alkalic solution is returned to said alkalic chamber as a feed stream.

11. The method of claim 3, further comprising providing a selective membrane, said selective membrane receives a feed stream comprised of at least one of cooling tower make up water, cooling tower blow down, or low quality water;

said selective membrane outputs a divalent stream and a univalent stream;

wherein, said divalent stream is provided to said precipitation tank; said univalent stream is provided to said first salt water chamber and said second salt water chamber; and said acidic and alkalic chambers are provided with an H_2O feed stream.

12. The method of claim 11, wherein the treated water in said precipitation tank is returned to said cooling tower after said precipitate is removed from said precipitation tank.

13. The method of claim 11, wherein the treated water in said precipitation tank is provided to a water storage tank after said precipitate is removed from said precipitation tank.

14. The method of claim 11, wherein the acidic solution is provided to said cooling tower for pH adjustment or to adjust the pH of the treated water exiting the precipitation tank after the precipitate is removed.

15. The method of claim 11, wherein the acidic solution is used to clean the membranes of said vessel.

16. The method of claim 11, wherein at least a portion of said acidic solution is returned to said acidic chamber as a feed stream.

17. The method of claim 11, wherein at least a portion of said alkalic solution is returned to said alkalic chamber as a feed stream.

18. The method of claim 11, wherein at least a portion of the output of the first and second salt chambers is combined with the remaining treated water from the precipitation tank and provided as make up water to the cooling tower.

19. An electrolysis device for water treatment comprising:

an electrolysis vessel;

a pair of electrodes arranged in the electrolysis vessel, the pair of electrodes respectively serving as a positive electrode and a negative electrode; and

a cell unit arranged between the positive and negative electrodes, the cell unit comprising a bipolar membrane element and at least one cation exchangeable membrane, the bipolar membrane element having a cation exchangeable side and an anion exchangeable side, the cation exchangeable side being closer to the negative electrode than the anion exchangeable side, said at least one cation exchangeable membrane being arranged between the anion exchangeable side of the bipolar membrane element and the positive electrode, so as to define an alkalic chamber between the bipolar membrane element and the cation exchangeable membrane;

said electrolysis vessel further comprising an anion exchangeable membrane between the negative electrode and the cation exchangeable side of the bipolar membrane element, an acidic chamber being defined between the anion exchangeable membrane and the bipolar membrane element;

wherein said anion and cation exchangeable membranes are selective;

wherein said alkalic chamber produces an alkalic solution and said acidic chamber produces an acidic solution.

CLAIMS

What is claimed is:

1. A method of cooling tower water treatment comprising providing an electrolysis device comprising:

an electrolysis vessel;

a pair of electrodes arranged in the electrolysis vessel, the pair of electrodes respectively serving as a positive electrode and a negative electrode; and

a cell unit arranged between the positive and negative electrodes, the cell unit comprising a bipolar membrane element and at least one cation exchangeable membrane, the bipolar membrane element having a cation exchangeable side and an anion exchangeable side, the cation exchangeable side being closer to the negative electrode than the anion exchangeable side, said at least one cation exchangeable membrane being arranged between the anion exchangeable side of the bipolar membrane element and the positive electrode, so as to define an alkalic chamber between the bipolar membrane element and the cation exchangeable membrane, said cation exchangeable membrane is selective; an anion exchangeable membrane between the negative electrode and the cation exchangeable side of the bipolar membrane element, an acidic chamber being defined between the anion exchangeable membrane and the bipolar membrane element, said anion exchangeable membrane is selective;

a first salt water chamber defined between said negative electrode and anion exchangeable membrane, a second salt water chamber defined between said positive electrode and said cation exchangeable membrane; and

a first inlet providing a feed stream to said first salt water chamber, a second inlet providing a feed stream to said second salt water chamber, a third inlet providing a feed stream to said acidic chamber, and a fourth inlet providing a feed stream to said alkalic chamber;

providing a selective membrane, said selective membrane receives a feed stream comprised of at least one of cooling tower make up water, cooling tower blow down, or low quality water;

said selective membrane outputs a divalent stream and a univalent stream;

wherein, said divalent stream is provided to a precipitation tank; said univalent stream is provided to said first salt water chamber and said second salt water chamber; and said acidic and alkalic chambers are provided with

an H_2O feed stream; said acidic chamber producing an acidic solution and said alkalic chamber producing an alkalic solution;

directing at least a portion of the contents of said first and second salt water chambers into a precipitation tank;

directing at least a portion of the alkalic solution into said precipitation tank, thereby increasing the pH in said precipitation tank to produce precipitate;

removing said precipitate from said precipitation tank; and

removing said treated water from said precipitation tank; wherein at least a portion of said acidic solution is returned to said acidic chamber as a feed stream.

2. The method of claim **1**, wherein at least a portion of said alkalic solution is returned to said alkalic chamber as a feed stream.

3. The method of claim **1**, wherein the water treated in said precipitation tank is returned to said cooling tower after said precipitate is removed from said precipitation tank.

4. The method of claim **1**, wherein a portion of the acidic solution is provided to said cooling tower.