

A SYSTEM AND METHOD TO PROVIDE FRESH WATER

Field of the Invention

5 The present invention relates to the field of water production.

Background

Water covers about 70% of the Earth. However, only a low percentage of the water
10 on the Earth is able to sustain human life without further processing of the water.

Unfortunately, many activities carried out by humans also adversely affect the volume
of water that can sustain human life. This situation is exacerbated by climate change,
whereby changes in seasons and extreme weather patterns has further diminished
15 the water that can sustain human life.

Such circumstances has led to a situation where a country's security and stability is
substantially dependent on the availability of drinking water. The importance of access
to an economical method and system to provide fresh water has become extremely
20 critical in this day and age.

The two main desalination processes currently deployed for large scale use are
thermal desalination and membrane desalination. Thermal distillation process uses

heat to distil seawater to provide fresh water. It is a slow process with limited output quantity.

Membrane desalination is more commonly deployed compared to thermal distillation.

- 5 However, membrane desalination requires high pressure to feed seawater through a membrane to separate salt from seawater, and this process incurs a substantial energy load. Furthermore, the membrane which is used has a low usage life span and is costly to replace, and the membrane is highly susceptible to damage from dirt and seaborne debris.

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Summary

In a first aspect, there is provided a method for providing fresh water, the method comprising:

- 15 generating at least one sound wave at a predetermined frequency;
 introducing the at least one sound wave to a saltwater body;
 creating a change of state of the saltwater body;
 collecting a gaseous state of the saltwater body; and
 humidifying the gaseous state of the saltwater body.

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In a second aspect, there is provided a system for providing fresh water, the system being configured to carry out the steps comprising:

 generating, with a sound generator, at least one sound wave at a

predetermined frequency;

introducing, from the sound generator, the at least one sound wave to a saltwater body;

creating a change of state of the saltwater body;

5 collecting, with an enclosure, a gaseous state of the saltwater body; and

humidifying, in the enclosure, the gaseous state of the saltwater body.

In a third aspect, there is provided a system for providing fresh water comprising:

10 a mist generator for generating mist, the mist generator including an ultrasonic vibrator;

an evaporator coupled with the mist generator, the evaporator being configured to vaporize the mist from the mist generator; and

a condenser coupled to the evaporator, the condenser being configured to condense humid air from the evaporator.

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It will be appreciated that the broad forms of the invention and their respective features can be used in conjunction, interchangeably and/or independently, and reference to separate broad forms is not intended to be limiting.

20 **Brief description of drawings**

A non-limiting example of the present invention will now be described, by way of non-limiting example only, with reference to the accompanying drawings in which:

FIG. 1 illustrates an example of a process flow of a method the present invention;
FIG 2 illustrates a schematic diagram of an example system of the present invention;
FIG 3 illustrates an example of the system of FIG 2;
FIG 4 illustrates an example system of the present invention as deployed.

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Detailed description

The present invention provides a system and method to provide fresh water, which can be carried out in a low cost, low maintenance manner using a sustainable energy
10 source. The system and method can be used at coastal areas or at open seas.

For the purpose of illustration, it is assumed that embodiments of the system and method as described are possible non-limiting embodiments, and other embodiments are possible. It should be noted that all advantages should be consistent for all
15 embodiments.

Referring to FIG 1, there is shown a method 100 for providing fresh water. The method 100 carries out a process of breaking surface tension of seawater for the harvesting of fresh water without a water pump and reverse osmosis (RO) membrane like a
20 desalination plant. The method 100 can be deployed at coastal areas or at open seas, and the respective steps of the method 100 can be powered by solar cells. This means that a power supply need not be provided for the carrying out of the method 100.

At step 105, at least one sound wave is generated by a sound generating device like an ultrasonic vibrator at a predetermined frequency. The predetermined frequency can be between 2MHz to 4MHz.

- 5 At step 110, the at least one sound wave is introduced to a water body, typically a saltwater body. For example, this can mean that the sound generating device is positioned in the water body through a calibrated neutral buoyancy against the dynamic wave movements and tidal fluctuations to achieve meaningful mist quantities from a system of harvesting fresh water from seawater.

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- At step 115, the at least one sound wave passing through the water body causes a change of state of the water body, from a liquid state to a gaseous state (for example, micronic mist). Water in liquid state has a surface tension that can be as hard as a concrete slab. This is because water molecules are bound together by the tension of
- 15 its surface boundary layer. This surface boundary layer restricts water molecules from escaping into the atmosphere through evaporation. The at least one sound wave is able to break the surface tension of liquid water and to agitate the surface tension of seawater to cause mist (gaseous state) to rise.

- 20 At step 120, the gaseous state of the water body is then collected in an enclosure.

At step 125, the collected gaseous water (mist) undergoes humidification at the enclosure at more than 80% relative humidity and consequently, this produces fresh

water by condensation. The evaporation humidification process disintegrates salt from mist droplets during the transition to gaseous water. Seawater in liquid state has less than 4% of salt content. A micron size mist with 4% of salt content is virtually zero. A micron size mist vaporized very quickly in an open atmosphere. This vaporization
5 process can be expedited through a low thermodynamic process. The brine disintegrated from the mist can be left at sea or harvested as table salt. The vaporized mist from the thermodynamic process is condensed back into its liquid water without any salt content.

10 It should be appreciated that the method 100 is easily replicable and is a self sustaining solution for producing fresh water.

It should be appreciated that the method 100 can also be employed in a system for producing fresh water, the system being configured to carry out the various steps of
15 the method 100. Thus, the benefits of the method 100 will also be replicated with the deployment of the system. For illustration purposes, the system employing the method 100 with a surface area of 1 sq/ft at sea requires no more than 100W of electrical power. 1 sq/ft of surface area at sea can produce more than one cubic meter of mist in an hour. Separating the brine from the mist through a low thermodynamic process
20 to condense the vaporized mist back into potable liquid water requires less than 2 KW electrical power to produce more than 50 liters of fresh water per day. A domestic 110VAC/220VAC power supply can also keep the system running all year round.

Referring to FIG 2, there is shown a schematic diagram for a system 200 for providing fresh water. The system 200 comprises three stages that operate in a sequential manner in order to provide a desired output of fresh water.

- 5 The first stage is a mist generator 210. Typically, the mist generator 210 includes an ultrasonic vibrator that is configured to be partially submerged in seawater. The ultrasonic vibrator is configured to agitate a seawater surface to produce mist at a lower energy cost compared to a pump to delivering seawater in its liquid state for typical desalination processes. The ultrasonic vibrator is a bespoke device configured
- 10 for submersion in seawater. The mist generator 210 also includes an internal structure to enable the ultrasonic vibrator to remain under neutral buoyancy below seawater level to agitate the water surface molecule to break down its surface tension into mist. Subsequently, fog will form above the seawater surface. A delivery channel will be configured to cause egress of the fog from the mist generator 210 to a second stage.
- 15 The ultrasonic vibrator is configured to operate at a specifically calibrated ultrasonic frequency range between 2MHz to 4MHz to generate appropriate droplets in the mist in order to separate salt from the mist. If the ultrasonic vibrator is not calibrated in a desired frequency range, droplets in the mist can quickly bind together back into a saturated liquid state due to an inherent constant dielectric polarity of the water
- 20 molecule. The ultrasonic vibrator generates a specific frequency range to disintegrate 4% salt content in the mist to prevent saturation in the second stage. Typically, the higher the ultrasonic frequency range, the greater a yield of freshwater obtainable from the seawater.

The second stage is an evaporator 220. The evaporator 220 includes a fan at one end of an evaporation chamber, the fan being configured to blow the mist from the mist generator 210 to flow through the evaporating chamber. The evaporator 220 can be a heating chamber which includes at least one heating element that can be powered by solar energy or mains power. The evaporator 220 is configured to disintegrate salt by vaporizing the fog. Generally, an algorithmic process is applied in the evaporator 220 that is based on dynamic fluctuations of mist volume, temperature and pressure in the evaporating chamber. An airflow generated by the fan would channel humid air from the evaporator 220 to a third stage in a low-pressure pipe. The evaporator 220 is configured for self-regulating air humidity relative to the temperature and pressure-controlled environment in the evaporation chamber using solar energy to disintegrate the salt from its mist state to prevent saturation.

The third stage is a condenser 230. The humid air from the evaporator 220 is channelled into the condenser 230. The condenser 230 is configured to condense the humid air into droplets on at least one cooling surface in the condenser 230. For example, the at least one cooling surface can be fins attached to a series of pipes containing an appropriate refrigerant/coolant. Water condensate which forms on the at least one cooling surface then drops onto at least one collection plate in the condenser 230 for consolidation and subsequent distribution to any intended use.

It should be noted that the evaporator 220 and the condenser 230 can be located either at sea or on land.

It should be noted that there are cost benefits and efficiency advantages resultant from
5 the weight differential between the generated mist compared to seawater in a liquid
state (as used for typical desalination processes). In particular, a cubic meter of water
weighs one ton while a cubic meter of mist is substantially less in weight such that the
mist can be moved within an air channel. As such, the infrastructure costs for the mist
delivery system and liquid water delivery system can be economically built over vast
10 distances. In addition, the system 200 does not require a separation tank for
waterborne debris like for typical distillation processes as the seaborne debris cannot
be carried within an air channel together with the mist. Moreover, none of the mist is
returned back into the sea. Furthermore, heat generated at the third stage is not
wasted but recycled back into the evaporator 220 as dried air flows into the
15 evaporating chamber to vaporize the mist and disintegrate its salt content under a
controlled evaporation process. Hot dry air generated from the condensing coil of the
condenser 230 is not wasted. It is recycled back by air-duct into the evaporator 220 to
regulate the humidity level relative to the temperature and pressure in the evaporating
chamber required for the disintegration of the 4% salt content in the mist. The system
20 200 can be powered by solar energy, whereby the solar panels can be located either
at sea or onshore.

Referring to FIG 3, there is shown a perspective view of an experimental apparatus 300 that was conceived to test the system 200. The apparatus 300 is designed to operate like the system 200. The apparatus 300 includes a mist generator 310, an evaporator 320 and a condenser 330. The mist generator 310, the evaporator 320 and
5 the condenser 330 are connected to one another with pipes 340 that allow passage of air. The apparatus 300 was conceived to test various aspects of the system 200 in a lab.

Referring to FIG 4, there is shown an example embodiment of the system 200 during
10 an actual deployment. FIG 4 shows a 2m x 2m sized example of the system 200. It should be noted that the system 200 generates the mist while floating at sea. Solar panels are also shown in FIG 4. As illustrated, the larger the surface area, the larger would be the production capability of the system 200 as power capacity for the system 200 increases with the use of more solar panels.

15 Throughout this specification and statements which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers or steps but not the exclusion of any other integer or group of integers.

20 Persons skilled in the art will appreciate that numerous variations and modifications will become apparent. All such variations and modifications which become apparent

to persons skilled in the art, should be considered to fall within the spirit and scope that the invention broadly appearing before described.

CLAIMS

1. A method for providing fresh water, the method comprising:
generating at least one sound wave at a predetermined frequency;
5 introducing the at least one sound wave to a saltwater body;
creating a change of state of the saltwater body;
collecting a gaseous state of the saltwater body; and
humidifying the gaseous state of the saltwater body.
- 10 2. The method of claim 1, wherein the predetermined frequency is between 2MHz to 4MHz to prevent a plurality of water droplets in the gaseous state from binding together.
3. The method of claim 1, wherein the gaseous state includes a plurality of water
15 droplets.
4. The method of claim 3, wherein the humidification disintegrates salt from the plurality of water droplets.
- 20 5. A system for providing fresh water, the system being configured to carry out the steps comprising:
generating, with a sound generator, at least one sound wave at a
predetermined frequency;

introducing, from the sound generator, the at least one sound wave to a saltwater body;

creating a change of state of the saltwater body;

collecting, with an enclosure, a gaseous state of the saltwater body; and

5 humidifying, in the enclosure, the gaseous state of the saltwater body.

6. The system of claim 5, wherein the predetermined frequency is between 2MHz to 4MHz to prevent a plurality of water droplets in the gaseous state from binding together.

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7. The system of claim 5, wherein the gaseous state includes a plurality of water droplets.

8. The system of claim 7, wherein the humidification disintegrates salt from the plurality of water droplets.

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9. A system for providing fresh water comprising:

a mist generator for generating mist, the mist generator including an ultrasonic vibrator;

20 an evaporator coupled with the mist generator, the evaporator being configured to vaporize the mist from the mist generator; and

a condenser coupled to the evaporator, the condenser being configured to condense humid air from the evaporator.

25 10. The system of claim 9, wherein the ultrasonic vibrator is configured to operate at a frequency range of between 2MHz to 4MHz to prevent a plurality of water droplets in the mist from binding together.

11. The system of either of claims 9 or 10, wherein the vaporisation of the mist is dependent on dynamic fluctuations of mist volume, temperature and pressure.

12. The system of any of claims 9 to 11, wherein the evaporator is configured for
5 self-regulating air humidity relative to the temperature and pressure-controlled environment in an evaporation chamber using energy to disintegrate the salt from the mist to prevent saturation.

13. The system of any of claims 9 to 12, wherein the condenser is configured to
10 condense humid air into droplets on at least one cooling surface in the condenser.