

SPECIFICATION

Title Of The Invention

5 NEUTRAL ELECTROLYTIC WATER, NEUTRAL ELECTROLYTIC WATER
 PRODUCTION METHOD AND DEVICE THEREOF

Field Of The Invention

 This invention relates to neutral electrolytic
10 water generated from an electrolyte tank including a low-
 frequency vibration-stirring apparatus, and to a device for
 continuously producing that neutral electrolytic water.

Background Of The Invention

15 Oxygen and hydrogen are generated at the
 electrodes when electrolyzing water by means of a device with
 diaphragms (separator films). In that case, ion
 electrophoresis occurs in the fluid due to electrical
20 attraction. An acidic substance is consequently generated at
 the positive electrode (anode) enclosing the film and that
 liquid becomes an acidic liquid. The liquid at the negative
 terminal (cathode) on the other hand, becomes an alkaline
 liquid.

25 In the related art, acidic water is produced at
 the anode, and deoxidized water is produced at the cathode by
 electrolysis in a 2-tank type electrolyte tank or 3-tank type
 electrolyte tank using electrolytic films. This electrolytic
 water functions as a pH (potential of hydrogen) adjuster,
30 oxidizer, and reducer and is also utilized in a wide range of
 fields such as medical treatment, the electronic industry,
 agriculture, and the food product industry.

 This type of electrolytic water is strongly
 acidic water or strongly alkaline water. The pH of the
35 strongly acidic water is 2.7 or less. The pH of the strongly

alkaline water is 11 or more. No germs or microorganisms can survive at these pH levels. A neutral electrolytic water whose effect is the same or better than the electrolytic water of the related art is now needed.

5 Technology is disclosed in patent document 1 (Japan Techno Co., Ltd.) for producing a sterilizing or germicidal effect by processing with a vibration-stirring means using anatase titanium oxide blades (vanes). In this disclosed technology, the photocatalytic effect of the blades
10 electrolyzed organic compounds and killed germs within the water, breaking down small quantities of chlorinate compounds (organic halogen compounds such as trihalomethanes and dioxins), and oxidizing nitric acid ions in water lines and sulfuric acid in well (underground) water respectively into
15 nitrous acid ions and sulfurous acid ions. The antiseptic fluid rendered by the technology described in that document was neutral (pH 7.5 to 7.6) and the concentration of the sulfurous ions was approximately 0.08 to 0.5 milligrams per liter. Moreover, this neutral electrolytic water was
20 antiseptic or germ-free after the processing, however this germicidal effect could not be maintained for a long period of time.

 The technology disclosed in patent document 2 (Japan Techno Co., Ltd.) operated via a vibration-stirring means installed in the water tank and utilized a
25 sterilizing (disinfecting) means such as germicidal metal/metallic compounds (photocatalytic), members generating a magnetic force or ultraviolet rays as methods to clean or sterilize food products. This method utilizes the oxidizing power of the photocatalyst to produce sterilized water by
30 using the photocatalytic effect of the vibration-stirring device. However, the disinfecting effect did not last after the vibration-stirring device was stopped, so utilizing the sterilized water away from the equipment was difficult. The sealed sterilized water did not change until its container
35 was unsealed. The disinfected water was therefore used along

with the photocatalytic device so that the sterilizing power did not last for a long time if the equipment was the open type.

5 The technology in the patent document 3
discloses a method for manufacturing sterilized water with a hypochlorous acid content of 0.2 to 2 ppm by utilizing the separator film type electrolyzing tank. However, the sterilized water possessed a pH of 3 or less showing strong acidity. Therefore in addition to the above described
10 problem, this technology had the drawback that the service life of the device was limited.

The technology in the patent document 4 (Miura Denshi Co., Ltd. and others) discloses a method for supplying saltwater to an electrolyte tank containing an anode and a
15 cathode to produce free chlorine water. This free chlorine water is a purified and sterilized water for uses such as in foodstuffs and sanitation purposes, and contains a high content of free chlorine.

This invention is a neutral electrolytic water
20 with no chlorine odor yet possessing a strong germicidal effect, making it effective as a disinfectant for wounds, boils, burns, athlete's foot, atopy, and as a disinfectant for bathrooms. Moreover, this neutral electrolytic water is also effective as a deodorant for people and pets, for
25 improving oral odors, and as a skin (facial) lotion or health beverage, and for purifying foodstuffs or raising plants. Additional benefits are that the effects last for a long time, and that there is yet no other electrolytic water possessing the features of both strong alkalinity and strong
30 acidity.

More specifically, this neutral electrolytic water contains large amount of H_2 and O_2 . Furthermore there has never been an electrolytic water containing activized oxygen of OH, D_2 , HD and HDO.

35 The overall size of the equipment must also be

made more compact and simpler in order to promote the widespread use of neutral electrolytic water.

Patent document 1: JP-A No. 122109/2004 (Japan Techno Co., Ltd.)

5 Patent document 2: JP-A No. 008093/2004 (Japan Techno Co., Ltd.)

Patent document 3: International Publication No. W096/03881 (Toto Ltd.)

10 Patent document 4: JP-A No. 330986/1992 (Miura Denshi Co., Ltd.)

SUMMARY OF THE INVENTION

In view of the above described problems in the related art, the present invention has the object of
15 providing neutral electrolytic water usable in a wide range of fields and stable over long periods of time. The present invention has the further object of providing a method and device for producing that neutral electrolytic water.

The method of the present invention for
20 producing neutral electrolytic water is characterized in including an electrolysis process that applies a voltage of 1 volt to 30 volts, and current density of 5A/dm^2 to 300A/dm^2 from a direct current or pulsed current, to a liquid for processing containing at least one type of salt selected from
25 a group consisting of NaCl, KCl, and CaCl_2 while vibrating that liquid at an amplitude from 0.01 to 15 millimeters at a period between 10 Hertz and 200 Hertz.

The method of the present invention for producing neutral electrolytic water is characterized in that
30 the salt concentration in the water for processing is 0.05 percent or more by weight and 10 percent or less by weight.

The method of the present invention for producing neutral electrolytic water is characterized in that the process for performing electrolysis is performed in 5
35 minutes or more, or 90 minutes or less.

The method of the present invention for producing neutral electrolytic water is characterized in that the water for processing is sea water.

5 The method of the present invention for producing neutral electrolytic water is characterized in that the water is selected from a group including tap water, underground water, well water, distilled water, soft water, ion replacement water and reverse osmosis membrane water.

10 The method of the present invention for producing neutral electrolytic water is characterized in further including a process for photocatalyzing the water for processing prior to the process for performing electrolysis.

15 The method of the present invention for producing neutral electrolytic water is characterized in that the photocatalyzing process is performed by making the water for processing come in contact with photo-activizd anatase titanium oxide (blades or plates).

20 The neutral electrolytic water of this invention is characterized in containing a activized elements selected from a group made up of OH, D₂, HD and HDO.

The neutral electrolytic water of this invention is characterized in containing 1 milligram per liter or more to 7 grams or less per liter of residual chlorine.

25 The neutral electrolytic water of this invention is characterized in that the pH of the hydrogen ion exponent is larger than 6.5 and lower than 8.5. In typical non-separator film electrolysis methods not used along with a vibration-stirring device, an alkaline electrolytic water is obtained whose pH must be adjusted even though needed in the neutral region, however the neutral electrolytic water
30 obtained in this invention is electrolytic water directly within the neutral region.

The neutral electrolytic water of this invention is characterized in that the oxidation-reduction potential
35 (voltage) is higher than 650 millivolts and lower than 800

millivolts.

The neutral electrolytic water of this invention is characterized in being utilized in at least one application selected from a group including sterilization, health beverages, washing of foodstuffs, medical treatment, cosmetics, mist spray, deodorizing, rust prevention, plant growth, disinfecting, pet/animal care, pond/fountain spraying, reservoir water, water for product tasting, and purifying.

10 The device for producing neutral electrolytic water of this invention comprising:

 an electrolyte tank for storing the water for processing, and

 multiple electrode plates installed alternately
15 in proximity to the electrolyte tank, and connected to a direct current power supply by way of a rectifier, and

 a vibration-stirring device to make the water for processing agitate and flow,

 wherein the device is characterized in applying
20 a direct current or a pulsed current to the multiple electrode plates to perform electrolyzing while vibrating the water for processing with the vibration-stirring device.

 The device for producing neutral electrolytic water of this invention comprising:

25 an electrolyte tank for storing the water for processing, and

 a vibration-stirring device including multiple vibrating blades connected via a rectifier to the direct current power supply, for making the water for processing
30 agitate and flow, is characterized in applying a direct current or a pulsed current to the multiple vibrating blades to perform electrolyzing while vibrating the water for processing with the vibration-stirring device.

 The device for producing neutral electrolytic
35 water of this invention comprising:

a photocatalyzing tank for performing
photocatalysis of the water for processing, and

an electrolyte tank for storing the
photocatalyzed water for processing, and

5 multiple electrode plates installed alternately
in proximity to the electrolyte tank, and connected to a
direct current power supply by way of a rectifier, and

a vibration-stirring device to make the water
for processing agitate and flow,

10 wherein the device is characterized in applying
a direct current or a pulsed current to the multiple
electrode plates to perform electrolyzing while vibrating the
water for processing with the vibration-stirring device.

The device for producing neutral electrolytic
15 water of this invention is characterized in that the distance
between the multiple electrodes is 0.3 millimeters to 100
millimeters.

The device for producing electrolytic water of
this invention is characterized in that the distance between
20 the multiple vibrating blades is 0.3 millimeters to 100
millimeters.

The device for producing neutral electrolytic
water of this invention comprising:

a photocatalyzing tank for photocatalyzing the
25 water for processing, and

an electrolyte tank for storing the
photocatalyzed water for processing, and

multiple electrodes installed alternately in
proximity to the electrolyte tank, and connected to a direct
30 current power supply by way of a rectifier, and

a vibration-stirring device to make the water
for processing agitate and flow,

wherein the device is characterized in applying
a direct current or a pulsed current to the multiple
35 electrode plates to perform electrolyzing while vibrating the

water for processing with the vibration-stirring device.

A device for producing neutral electrolytic water of this invention is characterized in that the vibration-stirring unit is an insulated type vibration-
5 stirring device.

A device for producing neutral electrolytic water of this invention is characterized in that the liquid for processing contains at least one type of salt selected from a group consisting of NaCl, KCl, and CaCl₂.

10 The vibration-stirring device in this invention signifies a low-frequency vibration-stirring device. In other words, an agitator device containing an agitating shaft vibrating between 10 Hertz to 200 Hertz by driving a vibration motor from an inverter to make blades attached to
15 multiple levels on the agitating shaft vibrate within a few centimeters to generate a turbulent flow at a low energy.

The insulated type vibration-stirring device refers to a device connecting the agitating shaft of the vibration-stirring device, or utilizing the vibrating blades
20 attached to that shaft as electrodes. Utilizing this insulated type vibration-stirring device in the electrolyte tank eliminates the need for electrode plates that are normally required, since this device incorporates the functions of the electrode plates.

25

THE EFFECT OF THE INVENTION

The neutral electrolytic water of this invention possesses characteristics superior to either of already existing acidic electrolytic water or alkaline electrolytic
30 water, and may be utilized for sterilizing, in health beverages, for washing of foodstuffs, in medical treatment, in cosmetics, in mist spray, for deodorizing, for rust prevention, for plant growth, for disinfecting, for pet/animal care, for pond/fountain spraying, in reservoir
35 water, in water for product tasting, and for purifying.

Moreover, those characteristics remain stable over a long period from six months after storage to one year or longer. Also this neutral electrolytic water has no chlorine smell.

5 This invention provides a neutral electrolytic water stable over long periods of time, and further provides a compact sterilizing water production device or automatic sterilizing water production device.

BRIEF DESCRIPTION OF THE DRAWINGS

10 FIG. 1 is a drawing showing an overview of the vibration-stirring means of the present invention;

FIG. 2 is a drawing showing a frontal view of the water electrolyzing device of the first embodiment;

15 FIG. 3 is a drawing showing a plan (flat) view of the water electrolyzing device of the first embodiment;

FIG. 4 is a drawing showing a side view of the water electrolyzing device of the first embodiment;

FIG. 5 is a parts list table for the water electrolyzing device of the first embodiment;

20 FIG. 6 is a drawing is an example of a frontal view of the water electrolyzing device of the second embodiment;

FIG. 7 is a drawing of another example of a frontal view of the water electrolyzing device of the second
25 embodiment;

FIG. 8 is a drawing showing a frontal view of the tank in the second embodiment;

FIG. 9 is a drawing showing a plan view of the tank in the second embodiment;

30 FIG. 10 is a drawing showing a side view of the tank in the second embodiment;

FIG. 11 is a drawing showing an example of the analysis flow chart for the gas that is generated (raw gas);

35 FIG. 12 is a drawing showing a frontal view of the water electrolyzing device of the third embodiment;

FIG. 13 is drawing showing an example of the vibrating blade placement in the third embodiment;

FIG. 14 is drawing showing an example of the vibrating blade placement in the third embodiment;

5 FIG. 15 is drawing showing an example of the vibrating blade placement in the third embodiment;

FIG. 16 is drawing showing an example of the vibrating blade placement in the third embodiment, and is a side view of FIG. 15;

10 FIG. 17 is a drawing showing a top view of the cylindrical insulation member;

FIG. 18 is a drawing showing a cross-sectional view of the cylindrical insulation member;

15 FIG. 19 is a drawing showing the state where the vibrating rods 7, 7 are fitting into the matching holes 24, 25 in the cylindrical insulation member;

FIG. 20 is a photograph of the buttocks prior to coating with the neutral electrolytic water;

20 FIG. 21 is a photograph of the rear section after coating with the neutral electrolytic water;

FIG. 22 is a frontal view of the auxiliary electrolyte tank in the tenth embodiment;

FIG. 23 is a plan (flat) view of the auxiliary electrolyte tank in the tenth embodiment;

25 FIG. 24 is a side view of the auxiliary electrolyte tank in the tenth embodiment;

FIG. 25 shows the effect of neutral electrolytic water of the present invention in preventing growth of colon bacillus or Escherichia coli;

30 FIG. 26 shows the effect of the neutral electrolytic water of the present invention in preventing growth of colon bacillus or Escherichia coli obtained after performing electrolysis for one minute;

35 FIG. 27 shows the effect of the neutral electrolytic water of the present invention in preventing

growth of colon bacillus or Escherichia coli obtained after performing electrolysis for three minutes;

FIG. 28 shows the effect of the neutral electrolytic water of the present invention in preventing growth of colon bacillus or Escherichia coli obtained after performing electrolysis for five minutes;

FIG. 29 is a drawing showing an overall view of the neutral electrolytic water production device of this invention including a photocatalytic processing unit.

10

EXPLANATION OF REFERENCE NUMERAL

	1	water tank
	2	vibration motor
	3	spring
15	7	vibrating rod
	8	vibrating blade
	8'	electrode
	9	vibrating blade clamping member and/or electrode clamping member
20	10	vibrating blade
	11	connecting section
	14	water for processing
	16	insulation type vibration-stirring device
	16a	base plate
25	16b	coil spring
	16c	joint vibrating member
	16d	vibration motor
	16e	vibrating rod
	16f	vibrating blade
30	16j	nut
	20	electrode plate
	21	electrode plate
	23	vibration motor
	27	wire
35	30	spacer

33 composite resin
34 power supply
35 transistor-inverter
40 installation stand
5 41 vibration cushion material
43 guide member
81 electrode (+)
82 electrode (-)
83 insulation member
10 84 insulation member
136 power supply

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is described according to
15 the following embodiments, however this invention is not
limited by these examples.

The neutral electrolytic water production device
of this invention includes the following structural elements.

1) The electrolyte tank contains a vibration-
20 stirring device, and includes an anode and a cathode. The
electrolyte tank may be a type that electrolyzes by utilizing
the vibrating blades as electrode plates.

2) The material for the anode may include gold,
rhodium, and platinum, etc. These materials may be used
25 singly or these materials may be used as an alloy surface
treated with an electrically conductive material.

3) The material for the cathode may include
stainless steel and titanium, etc. These materials may be
used singly or these materials may be used as an alloy
30 surface treated with an electrically conductive material.

4) The electrolyte tank includes a supply port
for constantly draining the overflow of neutral electrolytic
water and for supplying water.

5) A direct current power supply required for
35 electrolysis.

6) A salt water tank for supplying salt water for electrolysis (Volume capable of continuous supply for a minimum of three days at concentration for 1 to 10 percent, and with a low water level sensor alarm function.)

5 7) A supply pump for continuously supplying a specified amount of electrolytic water.

8) An air blower for supplying liquefied salt solution to within the electrolyte tank.

9) The water for processing contains water and
10 at least one type of salt selected from a group consisting of NaCl, KCl, and CaCl₂. This water includes tap water, underground water, well water, distilled water, soft water, ion replacement water and reverse osmosis membrane water. The water may also include swimming pool water and bath water.

15 The neutral electrolytic water is produced by electrolyzing using a non-separator film electrolyte tank containing a vibration-stirring device and multiple electrode plates or an insulated type vibration-stirring device with vibrating blades serving as electrode plates. The vibration-
20 stirring device is explained here in detail (one type of vibration-stirring means).

FIG. 1 is drawing showing a concept view of the vibration-stirring means. In this example, a base plate 16a is clamped to the installation bed 40 on the upper part of
25 the electrolytic tank 10A by way of the vibration absorbing member 41. A rod-shaped guide member 43 extending perpendicularly upwards is clamped to the installation bed 40. This guide member 43 is installed (positioned) within the coil spring 16b. An inverter 35 for controlling the frequency
30 of the vibration motor 16d is installed between the vibration motor 16d and the rectifier 25 for driving that motor 16d. The voltage of the rectifier 25 is for example 200 volts AC.

The vibration-stirring means of the present invention is not limited to that shown in FIG. 1, and may for
35 example be used in the inventions disclosed in Japanese

patent publication 1941498, Japanese patent publication 2707530, Japanese patent publication 2762388, Japanese patent publication 2852878, Japanese patent publication 3142417, JP-A No. 339270/2003, JP-A No. 282669/2002, JP-A No.

5 210341/2002, JP-A No. 191680/2002, JP-A No. 102323/2002, JP-A No. 271189/2001, JP-A No. 122109/2004, JP-A No. 055747/2002, WO 03/000395 A1 and WO 02/090621 A1, etc.

The vibration-stirring means of this invention is described next in further detail. An inverter oscillates
10 the vibration motor 16d at 10 to 500 Hertz. This vibration is conveyed to the vibrating rod 16e, and the vibrating blade 16f is made to vibrate under conditions of an amplitude of 0.01 to 30.0 millimeters as well as a frequency of 500 to 30,000 revolutions per minute.

15 A Uras Vibrator (Murakami Seisakusho) low frequency vibration motor (50 hertz to 60 hertz) and a Haifre Uras (Murakami Seisakusho) high-frequency vibration motor (60 Hertz to 200 Hertz) are used as the vibrating elements.

The anode (positive electrode) is preferably an
20 anode plate of stainless steel (SUS) plate or titanium plate covered with platinum or vanadium in view of the required characteristics such as (1) no flow of hazardous metallic ions, (2) corrosion resistance, (3) low chlorination over-voltage, (4) large oxygen over-voltage. The anode plate is
25 preferably Pt-Ir alloy covered with platinum, or titanium alloy plate.

The cathode (negative electrode) plate is preferably made from a negative electrode member including rhodium, nickel, nickel alloy (Ni-Mo₂, Ni-Co, Ni-Fe, Ni-Mo-Cd,
30 Ni-S), titanium alloy.

The mutual gap between the electrodes is 60 millimeters or less and is preferably 0.2 to 5 millimeters. Shortening this distance increases the production of neutral electrolytic water and prevents heat emissions. However when
35 this distance is shortened, a stoppage in the electrolytic

water vibration must be stopped in order to prevent burning or scorching the electrodes. Using the vibration-stirring device allows efficient production and neutral electrolytic water with a powerful germicidal effect and no chlorine smell
5 can be obtained.

The electrolyte tank of this invention can be the so-called non-separator film type that does not contain separator film within the tank. The inner surface of the electrolyte tank of the related art was covered with a non-
10 corrosive resin to make it able to withstand heat and to prevent corrosion. However there is virtually no need for this resin cover in the present invention. Maintaining the separator film during electrolyzing raises costs and the electrical conductivity becomes poor.

15 The salt liquefied into the water was described as at least one type of salt selected from a group consisting of NaCl, KCl, and CaCl₂. The salt concentration in the water for processing is 0.05 percent or more by weight and 10 percent or less by weight. NaCl is used in this embodiment,
20 but the same effect has been confirmed from KCl and CaCl₂. Also these can be used together. Seawater mostly contains NaCl and KCl, and so is included in this invention as a water for processing.

The method for producing neutral electrolytic
25 water in this invention normally performs the electrolyzing in a period from 5 to 90 minutes. In other words, electrolyzing is performed using the water for processing and applying a direct current or pulsed current, and maintaining the voltage within a range normally from 1 to 30 volts, and
30 further maintaining the current density within a range from 5 to 300 A/dm².

Usually H₂ and O₂ are emitted as a gas during electrolyzing of water. However, in this invention a vibration-stirring device is operated so that the generated
35 gas and the H₂ and O₂ disperse and liquefy within the water,

and little gas exits outside the device.

A pulsed current is more preferable than direct current. The pulsed current preferably has a pulse waveform and a rectangular pulse waveform is particularly preferable.

5 A pulsed waveform prevents crystallization, allows long-term use, and prevents a drop in performance.

This pulsed waveform is generated by technology of the known art. Examples of such technology include: a transistor regulated power supply, a dropper type power
10 supply, a switching power supply, a silicon rectifier, an SCR type rectifier, a high-frequency (RF) rectifier, and an inverter digital-controller rectifier.

The neutral electrolytic water of this invention is produced as described above. Namely the neutral
15 electrolytic water is characterized in containing large quantities of H₂ and O₂ and also activized components made up of activized oxygen OH, D₂, HD and HDO. This neutral electrolytic water contains hypochlorous acid and chlorous acid ions. The residual chlorine content is 1 milligram to 7
20 grams per liter.

In the neutral electrolytic water of this invention the pH of the hydrogen ion exponent is larger than 6.5 and lower than 8.5 ($6.5 < \text{pH} < 8.5$), and preferably is larger than 6.5 and lower than 7.5. Therefore the neutral
25 electrolytic water of this invention is not acidic or alkaline water, but is a neutral electrolytic water.

The acidic electrolytic water of the related art exhibits a strong sterilizing (or germicidal effect. However in spite of the fact that the neutral electrolytic water of
30 this invention is neutral, it retains the germicidal effect (or sterilizing power) over a long period, so that the germicidal effect can be maintained far in excess of that acid electrolytic water of the related art.

The neutral electrolytic water of this invention
35 is generally used with a residual chlorine content within the

following range. The residual chlorine content increases as the electrolyzing continues so the device operating time might have to be adjusted according to the application.

- Skin use 15 to 20 ppm
- 5 Bath use 100 ppm (approx.)
- Deodorizing-sterilizing use 300ppm (approx.)

The method for measuring the above residual chlorine content conforms to JIS (Japanese industrial standards) K0102 for tap water.

- 10 The neutral electrolytic water of this invention possesses anti-bacterial, bacteria-suppressant, and germicidal effects on microorganisms of all types. This neutral electrolytic water is also effective against the following bacteria; colon bacillus (colon bacillus,
- 15 Escherichia coli bacillus sources such as O-157), Salmonella, Enteritis vibrio, campylobacter, Yersinia, Clostridium perfringens, Non-agglutinate vibrius, Enterococcus, Psudomonas aeruginosa, Burkholderiacepacia, Staphylococcus aureus, Staphylococcus epidermis,
- 20 Streptococcus pneumonia, Serratia, proteus, Enterobacter, citrobacter, Enterococcus, Klebsiella, Bacteroides, Legionella, Mycobacterium, pneumocystiscarinii, fungus, and virus-causing germs.

- 25 Using the neutral electrolytic water of this invention may render a germicidal (sterilizing) effect from several dozen minutes to several days.

Applications of the neutral electrolytic water of this invention also include the following.

- 1) Deodorizing and sterilizing of the
- 30 interior of hospital and facilities for the elderly
- 2) Deodorizing and sterilizing of the inside
- of hotels, restaurants, coffee shops and cafeterias
- 3) Deodorizing and sterilizing of the
- meeting places with many people and pachinko halls
- 35 4) Deodorizing and sterilizing of the inside

of bars and restaurants

5) Sterilizing the inside of general practitioner's treatment rooms

6) Oral disinfection for dentist's office and home use

7) Facial spray using neutral electrolytic water (Water from the spray penetrates into pores and skin layers and since negative ions come from this facial spray it is considered good for the health.)

8) Deodorizing of pets/animals, deodorizing excreta

9) Sterilizing and care of plants

10) Preventing decay in fruits and vegetables and maintaining freshness

11) Preventing halitosis and deodorizing

12) Sterilizing instruments used in hospitals

13) Preventing mold from occurring

14) Sterilizing storage tanks, water tanks for aquariums, and spray fountain water

15) Sterilizing ponds at golf courses

The neutral electrolytic water of this invention is further utilized for sterilization, health beverages, washing of foodstuffs, medical treatment, cosmetics, mist spray, deodorizing, plant growth, preventing decay, disinfecting, pet/animal care, pond/fountain spraying, reservoir water, water for aquariums, and purifying.

First Embodiment

FIG. 2, FIG. 3, FIG. 4 and FIG. 5 are frontal drawings, plan (flat) views, side views and parts list tables showing the overall test device.

(1) Hydroelectrolysis device

(a) Utilized an a-Torino water production device Model 1 (30 liters) (made by Japan Techno Co., Ltd.)

Vibration motor: 75 watts 200 volts×3φ

Vibrating blades: stainless plates 4 plates
 SUS304

Vibration shaft: stainless rod 2 rods SUS304

(b) Electrolyte tank

5 Utilizing a 30 liter container covered with
 heat-resistant propylene resin: 500×290×305 (unit:mm).

(c) Electrodes

Anode plates: titanium mesh 3 plates (covered with platinum
 plating)

10 Cathode plates: SUS304 4-plates
 Electrode gap: 20mm

The anode plate and cathode plate are
 alternately installed in mutual proximity. The surface area
 of the electrode plates was 12dm² for the three anode plates;
 15 and 16dm² for the four cathode plates.

(d) Rectifier (transistor type)
 Chujo Seisakusho (Corp.) PEM11-12V-200

(e) Inverter: Fuji Electric (Inc.) Product name
 Fuji Inverter FVR-E9S

20 (2) Electrolytic water

Salt (class 1 chemical product) was liquefied
 into water from the Tokyo metropolitan water supply (tap
 water), and at a salt (NaCl) content of 5 grams per liter.

(3) Vibration flow

25 A direct current of 15 amperes and 12 volts was
 obtained from a rectifier using 3-phase 200 volts AC. The
 vibration frequency of the vibration motor was adjusted to 45
 Hertz by the inverter, and the electrolytic water vibrated
 and made to flow for six minutes. The electrical current
 30 density was 2 amperes per liter.

(4) Bacteria type

Colon bacillus (Kanto Chemical Co., Ltd.: No.
 ATCC8739)

Staphylococcus aureus (Kanto Chemical Co., Ltd.
 35 : No. ATCC25923)

(5) Measurement method

The neutral electrolytic water obtained in this way was filled into bottles, stored in a cool, dark location, and measured after a one week period.

5 Device: Milliflex Vacuum Filtration Systems

Cultivation:

Colon bacillus MXLM Col 20 (fluid culture medium for Colon bacillus)

Staphylococcus aureus MXSM CTT24 (agar medium)

10 Culturing time 48 hours

[Table 1]

Bacteria type	Processing	0-Minutes	2-Minutes	4-Minutes	8-Minutes	10-Minutes	30-Minutes
Colon bacillus	Vibration flow	4.8×10^7	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
E.coli JCM 1349	No stirring	4.5×10^7	6.9×10^6	5.7×10^4	7.8×10^3	6.7×10^2	Not-detected
Staphylococcus	Vibration flow	3.7×10^7	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
aureus JCM 2413	No stirring	3.8×10^7	2.9×10^5	2.9×10^4	5.6×10^3	4.8×10^2	Not-detected
Colon bacillus	Vibration flow	2.8×10^6	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
E.coli. O157	No stirring	2.5×10^6	5.9×10^5	3.8×10^3	3.2×10^2	5.3×10^1	Not-detected

The above described sample fluid was next filled in bottles (transparent 300 milliliters) and stored for a six month period. The germicidal effect was then retested.

15 The electrolytic water showed almost no germicidal effect if the vibration-stirring device was not operated. An approximate 10 percent reduction in effect was observed when the vibration-stirring device was operated (45 to 50 Hertz) but the initial germicidal effect was
20 maintained. The vibration-stirring device was not of practical use when the gap between the vibrating blades was 20 millimeters and the blades could not be made any closer to each other. Immediate use of acetic electrolytic water after adjustment is generally compulsory.

25 In this embodiment the batch method was used rather than an automatic production device.

If electrolyzing was accomplished by operating the vibration-stirring device then the electrolyzing process

was able to proceed without raising the temperature of the electrolytic water. However if the vibration-stirring device was stopped then the temperature of the electrolytic water rose and the electrolyzing efficiency declined.

5 (6) Physical data on the neutral electrolytic water

The hypochlorous acid was measured by using the following method. The same measurement method was utilized in the following examples.

10 Purity test

(1) Liquid strong acidity hypochlorous acid solution pH2.7 or less

Weak acidity hypochlorous acid solution pH5.0 to 6.5

15 (2) Evaporation residual matter 0.25% or less

After twenty grams of this product was weighed and then made to evaporate, it was dried for 2 hours at 110°C, and the mass of the residual matter (minerals) then weighed. The measured value was 0.05%.

20 Quantitative method

(1) The strong acidic hypochlorous acid solution was measured by the following method.

Approximately twenty grams of this product was precisely weighed, and 2 grams of potassium iodide and 10 milliliters of acetic acid (1→4) was added, promptly sealed and stored in a dark location and left standing for a 15 minute period, and the separated iodine dripped by sodium thiosulfate solution at 0.01mol per liter (starch reagent as the indicator chemical). A separate dummy test was made and correction performed.

0.01mol per liter of sodium thiosulfate solution
1 milliliter = 0.35453 milligrams Cl

(2) The weak acidic hypochlorous acid solution was measured by the following method.

35 Approximately two hundred grams of this product

was precisely weighed, and 2 grams of potassium iodide and 10 milliliters of acetic acid (1→ 4) was added, promptly sealed and stored in a dark location and left standing for a 15 minute period, and the separated iodine dripped by sodium
5 thiosulfate solution at 0.005 mol per liter (starch reagent as the indicator chemical). A separate dummy test was made and correction performed.

0.005mol per liter of sodium thiosulfate
solution 1 milliliter = 0.17727 milligrams Cl

10 Hypochlorous acid content: Shown in Table 4
along with results for the second embodiment.

Residual chlorine content: 10ppm

When the neutral electrolytic water produced the same as above using (100 liter: a-Torino water production
15 device Model 2) the device of FIG. 6 and FIG. 7 and those results evaluated, essentially the same results were obtained. Hereafter, the description utilizes the reference numerals of FIG. 6 and FIG. 7 that utilizes the insulated type vibration-stirring device.

20 16 insulated type vibration-stirring device
16f vibrating blade
80, 82 holding means
84 electrode member
127 electrical line

25

Second Embodiment

Germicidal test

(1) Hydroelectrolysis device

This was a larger device than that of the first
30 embodiment. FIG. 2 shows an overview of the (Neutral electrolytic water production device - Model 2 100 liter: a-Torino water production device Model 2) device.

The vibration-stirring device is used in FIG. 2.
A large-size chemical fluid tanks (auxiliary liquefier tank,
35 200 liters) was attached to the device. Drawings of the tanks

are shown in FIG. 8 through FIG. 10.

All other conditions, namely the (2) water for processing, (3) vibration flow, (4) bacteria types, and the (5) measurement methods were the same as the first embodiment.

The germicidal test was performed in compliance with JIS-K 0102-72.2 and the number of general dead bacteria (each type) and the number of colon bacillus germs were measured.

[Table 2]

Germicidal test results for colon bacillus

Time	0-Minutes	1-Minute	3-Minutes	5-Minutes	10-Minutes	20-Minutes
Germ count	3.1×10^7	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected

[Table 3]

Germicidal test results for staphylococcus aureus

Time	0-Minutes	1-Minute	3-Minutes	5-Minutes	10-Minutes	20-Minutes
Germ count	1.9×10^8	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected

The above sample was next stored in a cool, dark location for a three month period. The same germicidal test as above was performed using this sample. The pulse power supply utilized 3-phase 200 volts (Chuo Seisakusho (Corp.) Rectifier Power Master PND-1).

Electrolytic water obtained from the conventional 3-chamber type electrolyte tank was tested as a comparison example. However after storage for three months there was absolutely no germicidal effect.

Neutral electrolytic water was continually produced for one month using the device of the second embodiment. Unlike the case of the first embodiment, the gap between the electrodes was set to 5 millimeters and the

production yield increased 4-fold (four times).

Scorching and burns occurred when the electrode gap was set to 5 millimeters without operating the vibration-stirring device, and continuous operation was not possible.

5 A device to liquefy the salt beforehand was added, and neutral electrolytic water then continually produced. Continuous production was now possible over a long time period. There was no rise in the liquid temperature, and a uniform neutral electrolytic water was produced in large
10 quantities.

Quantizing measurements were made of the hypochlorous acid in the neutral electrolytic water obtained in the first embodiment and the second embodiment. The measurement results are shown in FIG. 4. The hypochlorous
15 acid content in the neutral electrolytic water of both embodiments was found to be lower than that of separator film electrolytic water (strongly acidic electrolytic water).

Hypochlorous acid content in the separator film electrolytic water: 5 ppm
20 [Table 4]

Hypochlorous acid content

	Directly afterwards	After 1 week	After 1 month
First embodiment	2 ppm	2 ppm	1 ppm
Second embodiment	2 ppm	2 ppm	1 ppm

The above results confirm that like alkaline electrolytic water, the neutral electrolytic water of this invention can be used in items such as mouthwash (gargling)
25 and skin lotion.

Tap water was continuously electrolyzed per the first embodiment and the second embodiment and the neutral electrolytic water of this invention was obtained. This neutral electrolytic water was sealed in bottles and stored
30 for about a one week period. The gas emitted from the neutral electrolytic water was then sampled and analyzed. Elements of the emitted gas were H₂, O₂, H₂O, OH, D₂, HD and HDO. The

activized elements among these were OH, D₂, HD and HDO. No significant differences were found between the two types.

An example of the analysis chart of the raw gas that was emitted is shown in FIG. 11.

5 In FIG. 11, the horizontal axis shows the mass number of the observed molecule while the vertical axis shows the intensity. In the GAIN indicated in the figure, (1) indicates a height for the mass 100 times the actual height, while (2) indicates a height for the mass 10 times the actual
10 height, and (3) indicates the actual height for the mass. In other words, the quantity for the applicable gas element is small so the mass for GAIN (1) and GAIN (2) shows it was amplified.

15 Approximate figures for element ratios of the emitted gases are shown next.

H₂: 55 to 70 mol%

H: 0.12 to 0.45 mol%

³H and/or HD 0.3 to 1.2 mol%

OH: 0.3 to 1.2 mol%

20 ¹⁶O: 1.0 to 4.2 mol%

O₂: 5 to 27 mol%

 The mass spectrometer used here for analysis (dual-convergence) [product brand name EMD-O5SK] was made by the Electronic Science Co., Ltd. Analysis conditions were as
25 follows.

Ion acceleration speed: 1200 volts

Ionization method: Voltage accelerated impact
type

Resolution: 500

30 Ion flight distance: 26 cm

Vacuum intensity: 5 × 10⁻⁷ Torr

Full scale: 5 volts

(6) Other physical data for the neutral
electrolytic water

35 Residual chlorine content: 15 ppm

Third Embodiment

(1) Hydroelectrolysis device (small model)

FIG. 12 is a frontal view of this test device.

5 The insulated type vibration-stirring means was utilized. The vibrating blades can be positioned by four methods in this device as shown in FIG. 13 through FIG. 16. The electrode plates and the vibrating blades are integrated together so that the overall device is compact. The number of vibrating
10 blades is shown in the drawings.

The vibration motor supports were sealed in rubber per laid open patent JP-A No. 317295/2000.

The following reference numerals apply to FIG. 12 through FIG. 16.

15 20: first vibrating transmission member

23: cylindrical insulation member

The cylindrical insulation member is further described next. The cylindrical insulation member 23 is equivalent to the first working model of the electrical
20 insulation region. The cylindrical insulation member 23 is shown in detail in FIG. 17 through FIG. 19. FIG. 17 is top view of cylindrical insulation member 23, and FIG. 18 is a cross sectional view. The reference numeral 23 indicates the cylindrical (made of hard rubber) insulation member forming
25 the insulation region. Holes or in other words, mating holes 24, 25 are formed at the top and bottom of the cylinder for mating the vibrating rods 7, or the vibrating rod with the vibration generating means. FIG. 19 shows the state where the vibrating rods 7,7 are fitted in the mating holes 24, 25. The
30 reference numeral 27 denotes the electrical wire that makes the vibrating rods 7 and the vibrating blade 8 function as electrodes. In some cases, the electrode auxiliary blades can be used along with the vibrating blades 8. In this case, the vibrating blade need not always function as the electrode and
35 may serve solely for vibration-stirring. The material for the

vibrating blades at this time may be synthetic resin. The auxiliary blade 8 functions solely as an electrode, and may indicate almost no vibration stirring capability.

5 All other conditions, namely the (2) water for processing, (3) vibration flow, (4) bacteria types, and the (5) measurement methods were the same as the first embodiment.

(6) Physical data on the neutral electrolytic water

10 Hypochlorous acid content: 2 ppm

Residual chlorine content: 15 ppm

(Applications to horticulture)

Unlike the first embodiment and the second embodiment, the vibrating blades are alternately made up of electrode plates.
15 The electrode plates therefore do not have to be installed separately from the vibration-stirring device so the entire device can be made compact. Of the five vibrating blades on the 75 watt vibration-stirring device, three blades are anodes (positive electrodes) and 2 blades are cathodes
20 (negative electrodes), and the tank capacity is approximately 1/2 the tank volume of the first embodiment. The vibration motor supports are sealed with rubber.

Salt of just 0.5 percent by weight was added to tap water the same as the first embodiment. Three anode
25 blades and two cathode blades were installed on one 3-phase, 75 watt vibration motor and that motor then made to vibrate at 40 Hertz.

Three volts was applied for a 10 minute period and the neutral electrolytic water produced. This neutral
30 electrolytic water was filled into coloration bottles and stored in a cool, dark location for a one month period. This neutral electrolytic water was used as water for cropped plants. The plants with this neutral electrolytic water lasted three times longer than those plants using only tap
35 water.

The plants with neutral electrolytic water utilized as water for cropped plants were observed after a one week period. Those results are shown below.

5 After the snapdragon flower grown in neutral electrolytic water had wilted, its seeds sprouted the same as plants grown in soil.

Watercress grown in neutral electrolytic water possessed thick trunks, grew well, produced leaves and had a deep green color. All of them produced roots.

10 The watercress grown only in tap water all had narrow stems that narrowed finely. Watercress grown in the neutral electrolytic water developed the same as plants grown by hydroponic farming.

15 **Fourth Embodiment**

(Applications for cosmetics)

The neutral electrolytic water was produced for a 10 minute period according to the method of the second embodiment.

Physical data on the neutral electrolytic water

20 Hypochlorous acid content: 2 ppm

Residual chlorine content: 15 ppm

Activized element types: OH, D₂, HD and HDO

On comparing the neutral electrolytic water of this invention with the strongly acidic electrolytic water
25 obtained by three-chamber electrolyzing in terms of germicidal (sterilizing) power, when the neutral electrolytic water of this invention was used for hand washing disinfection, the germicidal effect continued for three days. The effect from the strongly acidic electrolytic water
30 however was lost in one day. Moreover, roughened skin was prone to occur when using the strongly acidic electrolytic water. However there was little skin roughening when using the neutral electrolytic water of this invention.

The neutral electrolytic water of this invention
35 was used as an oral disinfectant in dental surgery. Compared

with the normally used water, corrosion of metal sections and waste water section of the equipment used in disinfecting was improved when the neutral electrolytic water of this invention was used. In particular, the finish rinsing
5 required after using the acidic electrolytic water was no longer needed when the neutral electrolytic water of this invention was used. The neutral electrolytic water of this invention renders the same cleaning effects as the conventional alkali electrolytic water and possesses the same
10 washing effects such as maintaining luster such as on hands, skin, and hair. Strongly acidic electrolytic water is known as not suitable for these applications.

This electrolytic water is used for the purposes of treating nasal inflammation, for mouthwash, and for oral
15 hygiene. This electrolytic water has been found to be ideal for hand, skin and hair care.

The specified performance was still maintained for a one month period after breaking the seal. Use of strongly acidic water is required by law immediately after
20 its production as recorded in the handling criteria and it is not sold in bottles.

After sealing and storing in a cool, dark location, the specified performance was still maintained after a one year period. The neutral electrolytic water of
25 this invention was capable of emergency use and this was not achieved with electrolytic water of the related art.

Fifth Embodiment

(Treatment of burns)

30 Fried foods were being prepared for supper. Flying oil splashes caused a burn of approximately 3 by 7 millimeters on the fingertip. The pain felt from the burn promptly disappeared after spraying with the neutral electrolytic water (first embodiment) of this invention.
35 Several minutes later, pain was again felt so this neutral

electrolytic water was again sprayed. The pain once again vanished. When this was repeated another 1 to 2 times, the pain did not reoccur. After 3 or 4 days the skin no longer appeared red.

5 (Treating injuries)

When the neutral electrolytic water (first embodiment) of this invention was sprayed on a knee injured in a fall, the wound healed extremely quickly.

(Cold prevention)

10 After suffering from coughing or a runny nose, and the neutral electrolytic water of this invention (second embodiment) was then gargled or sprayed into the nasal cavity. The coughing ended during the night and the subject slept soundly until the following morning, and a stuff nosed
15 was cured before becoming serious.

(Preventing skin rash)

When the neutral electrolytic water (second embodiment) of this invention was coated on the buttocks of an elderly individual with repeating diaper rash, the skin
20 peeling disappeared after one month. FIG. 20 and FIG. 21 show photographs of the buttocks before and after coating with the neutral electrolytic water of this invention. Though acidic electrolytic water possesses a germicidal effect it is not currently used in (medical) treatment.

25 (Treatment test for burns - 2)

Ordinary acidic electrolytic water containing free chlorine at 20 ppm and the neutral electrolytic water (third embodiment) of this invention was utilized.

30 The ordinary acidic electrolytic water was sprayed on the burn several times a day but the burn was still not healed or soothed after five days had elapsed.

When the neutral electrolytic water of this invention was sprayed on the burn under the same conditions, the pain disappeared at a point 30 minutes after the
35 spraying, and after five days the burn was completely healed.

Sixth Embodiment

(Germicidal test)

The neutral electrolytic water produced
5 according to the third embodiment was filled as an undiluted
solution into a handling spray type applicator. A triple
dilute solution made up of this neutral electrolytic water
diluted by three times, by adding tap water filled into the
same type of applicator.

10 Test method

1. Bacteria: Colon bacillus (Escherichia
coli IFO3972)

2. Adjustment of the test bacteria fluid
The bacteria was transplanted to an ordinary Agar medium, and
15 after culturing for 24 hours at 35°C, one colony was moved to
an ordinary bouillon culture and vibrated for 18 hours for
culturing at 35°C. This bacterial fluid was diluted and
adjusted using ordinary bouillon.

3. Test operation

20 Fifty milliliters of the test product was filled
into a sterilized triangular flask of 100 milliliters
capacity, and 0.1 milliliters of the test bacterial fluid
adjusted above in 2 was also inserted and the flask then
stored at 35°C.

25 4. Measuring the number of bacteria

The number of living bacteria per one milliliter
in the triangular flask was measured at each elapsed time by
the mixed dilute culture method utilizing an SCDLP Agar
medium. An SCDLP bouillon culture was utilized for diluting
30 during the measurement of the number of living bacteria.

Test results

There was no change in the initial germicidal
power even after a six month storage period. The germicidal
power of the strongly acidic electrolytic water was lost from
35 six months and onward.

[Table 5]

Germicidal test results for staphylococcus
aureus

Test water	Immediately after breaking the seal	After 30-seconds	After 1-Minute	After 3-Minutes	After 5-Minutes
Undiluted solution	5.4×10^6	Not-detected	Not-detected	Not-detected	Not-detected
After triple dilution	5.4×10^6	1.7×10^4	5.6×10^3	Not-detected	Not-detected

5

Seventh Embodiment

(Survival of killifish)

Two 10 liter water tank units were prepared.

Ordinary strongly acidic electrolytic water containing 10 ppm
of free chlorine was inserted in one tank where 10 killifish
10 were released. The neutral electrolytic water (second
embodiment) of this invention was filled into the second tank
where 10 killifish were also released. Killifish cannot be
raised in tap water.

All killifish died 10 seconds after being
15 released into the ordinary electrolytic water. On the other
hand, three killifish survived for 5 days and the remaining
seven killifish survived for seven days in the neutral
electrolytic water of this invention.

20

Eighth Embodiment

(Free chlorine and odors in pools and baths)

In pools and baths with free chlorine there was
much damage from chlorine and odors even at free chlorine
levels of 1 ppm. On the other hand, there was absolutely no
25 chlorine damage or chlorine odor in the neutral electrolytic
water (second embodiment) of this invention even at a free
chlorine concentration of 10 ppm, to the contrary, the skin
felt smooth after leaving the water. Ozone sterilizer is used

as a pool disinfectant because chlorine is harmful to the eyes. The neutral electrolytic water of this invention was used however without ozone sterilizer (disinfectant) or UV irradiation. In hot springs (public baths) where strong alkaline electrolytic water is not used, the neutral electrolytic water of this invention retained its germicidal effect even in alkali hot springs (public baths).

Nineth Embodiment

10 (Anti-corrosion test)
(1) Hydroelectrolysis device
Utilized a neutral electrolytic water production device Model 1 (30 liters): a-Torino water production device Model 1 (made by Japan Techno Co., Ltd.)
15 (a) Vibration-stirring device
Vibration motor: 75 watts 200 volts × 3-phase :
1 unit
Vibrating blades: SUS304 4 plates
Vibration shaft: SUS304 2 rods
20 (b) Electrolyte tank
A container covered with heat-resistant propylene resin: 500×290×305 (unit:mm) was utilized.
(c) Electrodes
Anode plates: titanium plates covered with
25 platinum 3 plates
Cathode plates: titanium plates 4-plates
Electrode gap: 30mm
The anode plates and cathode plates are alternately installed.
30 The surface area of the electrode plates was 4.8dm² for the four cathode plates; and 6dm² for the three anode plates.
(d) Rectifier
Chuo Seisakusho (Corp.) PEM11-12V-200
35 (e) Inverter

Made by Fuji Electric (Inc.) Fuji Inverter FVR-
C9S

(2) Water: soft water = 1:19 (well water, and
good for drinking water)

5 Salt (reagent class) was added, to adjust the
electrolytic water to at 0.3 percent (3 grams per liter) by
weight.

Three volts of direct current was applied and
electrolyzing performed. The frequency of the vibrating
10 blades was set to 40 Hertz and the electrolyzing time was set
to 60 minutes. The residual chlorine content reached 300 ppm.
The pH was 6.8. Power was applied and no rise in temperature
in the electrolytic water was observed.

Hypochlorous acid content: 20 ppm

15 Activized element types: OH, D₂, HD and HDO

The above described electrolytic water was next
filled into transparent bottles (one liter) and stored in a
cool, dark location for a one month period. It was then
diluted 10 times and used for the test.

20 Chinese cabbage was immersed in this neutral
electrolytic water and then the Chinese cabbage was promptly
removed and left standing for two weeks. The Chinese cabbage
maintained its original state with no withering. On the other
hand, when unprocessed water was used, then withering
25 occurred and the cabbage lost its freshness.

When justpicked fruit (apples, pears, etc.)
were immersed in the neutral electrolytic water of this
invention, that fruit maintained its freshness compared to
unwashed fruit, and no internal discoloration was observed.

30

Tenth Embodiment

The auxiliary electrolyte tank shown in FIG. 22
though FIG. 24 (capacity: 100 liters) was installed onto the
device of the ninth embodiment.

35 Reference numerals for the auxiliary electrolyte

tank

- 1 frame
- 2 tank
- 3 pump dispensing outlet
- 5 4 stirring blower

This auxiliary tank was joined to the electrolyte tank by a pipe. Neutral electrolytic water was continuously produced according to the ninth embodiment using tap water. Approximately 4.5 liters per minute were produced. Processing was able to continue for a long time. This test was performed continuously over a one year period but no drop in performance was found.

- Hypochlorous acid content: 2 ppm
- Residual chlorine content: 20 ppm
- 15 Activized element types: OH, D₂, HD and HDO

Eleventh Embodiment

(Neutral electrolytic water applications)

The neutral electrolytic water produced in the method of the ninth embodiment was used as cosmetic material or external skin solution. There were almost no inferior points in terms of usage sensation or maintaining luster compared to commercially sold astringent lotion.

The above neutral electrolytic water was apportioned into external use pharmaceutical products such as soft ointments, dispersers, cream solutions and cosmetic material such as milky lotion, skin lotion (or facial lotion), packs, shampoos, and rinses; and the viscosity was adjusted with soluble macromolecular compounds such as stiffeners, emulsifiers, skin membrane formers. Ordinary strongly acidic electrolytic water cannot be used for these applications.

Twelfth Embodiment

The interrelation between the elapsed time after

starting device operation and the residual chlorine content was investigated.

(1) Hydroelectrolysis device

Neutral electrolytic water was produced by
5 utilizing the same device as in the second embodiment.

Storage tank capacity: 100 liters

(2) Electrolytic water

Salt was liquefied in tap water and the
concentration adjusted to 0.4 percent (4 grams per liter) by
10 weight.

(3) Vibration flow

The vibrating frequency of the vibration motor
was adjusted to 43.8 Hertz.

[Table 6]

15 Residual chlorine content

Elapsed time (min.)	Electrical current (A)	Voltage (V)	Residual chlorine content (ppm)
0	80	11.1	2
5	80	11.1	10
10	80	11.1	35
15	80	11.1	60
20	80	11.1	80
25	80	11.1	90
50	80	11.1	180

Thirteenth Embodiment

The interrelation between the elapsed time after
starting device operation and the residual chlorine content
20 was investigated.

(1) Hydroelectrolysis device

Neutral electrolytic water was produced by
utilizing the same device as in the second embodiment.

Storage tank capacity: 100 liters

25 (2) Electrolytic water

Salt was liquefied in tap water and the concentration

adjusted to 0.3 percent (3 grams per liter) by weight.

(3) Vibration flow

The vibrating frequency of the vibration motor was adjusted to 43.8 Hertz.

5 [Table 7]

Residual chlorine content

Elapsed time (min.)	Electrical current (A)	Voltage (V)	Residual chlorine content (ppm)
0	70	12.9	Not-detected
5	70	13.0	10
10	70	12.9	20
15	70	12.8	30
20	70	12.7	40
30	70	12.6	50
60	70	12.7	100
60	350	12.6	500

Fourteenth Embodiment

10 The neutral electrolytic water produced according to the method of the first embodiment was next filled in bottles and stored for a three month period and its germicidal effect was then tested. Ordinary strongly acidic electrolytic water maintained its initial germicidal effect. However after 3 months that germicidal effect was mostly
15 lost.

1. Bacteria types

Colon bacillus (clinical drug resistant bacteria cultures)

Staphylococcus aureus (MRSA culture)

20 Salmonella bacillus (SE culture)

Pseudomonas aeruginosa (clinical drug resistant bacteria cultures)

Legionella (culture detected in baths)

2. Two milliliters of neutral electrolytic water
25 was added to 200 microliters of fluid for each of the above

six types of bacteria. After mixing, the mixture was let to sit. 100 microliters of bacterial fluid was then incubated after 30 seconds, 60 seconds, 90 seconds, 120 seconds, 3 minutes, 5 minutes, 10 minutes, and 20 minutes.

5 3. Bacteria concentration (content)

All were pure cultivated so the bacteria fluids were 105 through 106.

4. Test results

Results were rated as follows:

10 + : if growth was found

- : if growth was not found

Results are shown in Table 8 and Table 9.

[Table 8]

15 Bacterial fluid 200 microliters + 2 milliliters
of neutral electrolytic water (immediately after production)

Bacteria type	30 seconds	60 seconds	90 seconds	120 seconds	3 minutes	5 minutes	10 minutes	20 minutes
Colon bacillus	-	-	-	-	-	-	-	-
Staphylococcus aureus	+	+	-	-	-	-	-	-
Salmonella	+	+	+	-	-	-	-	-
Pseudomonas aeruginosa	-	-	-	-	-	-	-	-
Legionella	+	-	-	-	-	-	-	-

[Table 9]

Bacterial fluid 200 microliters + 2 milliliters
of neutral electrolytic water (3 months after production)

Bacteria type	30 seconds	60 seconds	90 seconds	120 seconds	3 minutes	5 minutes	10 minutes	20 minutes
Colon bacillus	-	-	-	-	-	-	-	-
Staphylococcus aureus	+	+	-	-	-	-	-	-
Salmonella	+	+	+	-	-	-	-	-
Pseudomonas aeruginosa	-	-	-	-	-	-	-	-

Legionella	+	-	-	-	-	-	-	-
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Fifteenth Embodiment

The same vibration-stirring device as in the third embodiment was utilized.

5 The electrode plates within the tank were the same as those in FIG. 6 and FIG. 7.

Electrolyte tank: heat-resistant propylene resin: capacity 200 liters

10 Vibration-stirring device: Vibratory Agitator type 2

Vibration motor 150 watts X 200 volts X 3-phase dual shaft type

Vibrating blades 5 blades titanium

Vibration shaft 2 shafts titanium

15 Electrode plates in electrolyte tank

Anode platinum 3 plates

Cathode titanium 4 plates

Electrode gap 5 millimeters

Electrolytic water

20 (1) KCl 0.5% reagent 2-class product

(2) CaCl₂ 0.5% reagent 2-class product

25 The above electrolytic water was placed in the tank, the vibration-stirrer operated at room temperature, and it was completely liquefied in about five minutes.

Inverter Fujitsu FVR-E9S

Use 0.1 to 3.7 kilowatts with a 200 volt 3-phase input.

30 The vibration motor was rotated for 45 minute, and 5 volts of direct current applied to the electrolytic water for 15 minutes. The same task was performed in the case of NaCl.

The germicidal test was performed using O-157

bacteria.

Culturing was performed for 24 hours while complying with the JIS general bacterial method.

5 The strongly acidic electrolytic water from the 3-chamber device possessed only a slight germicidal effect the same as the above embodiments and so was not practical to use.

[Table 10]

Germicidal test

Salt	Residual chlorine	0- Minutes	2- Minutes	5- Minutes	10- Minutes	Chlorine odor	Hypochlorous acid
KCl	20 ppm	5.1×10^7	Not-detected	Not-detected	Not-detected	None	2 ppm
CaCl ₂	22 ppm	4.8×10^7	Not-detected	Not-detected	Not-detected	None	2 ppm

10 Note: Here, "Not detected" signifies less than 40 particles per nL.

There was no chlorine odor and the germicidal effect was the same as NaCl.

15 The neutral electrolytic water eliminated odors from pet dog excrement.

The neutral electrolytic water was found to be usable for cleaning laboratory floors. However it was not usable in the case of stubborn stains or dirt. The neutral electrolytic water was usable if used in combination with
20 alkaline cleanser.

The effect was confirmed when the germicidal test was performed after placing in a bottle and storing for a three month period.

25 Sixteenth Embodiment

The neutral electrolytic water of the fifteenth embodiment was stored in a polyvinyl tank (16 liters) for a three month period and water quality tests of the undiluted fluid performed. The residual chlorine contents were at the

water quality standard of 250 ppm or lower.

The effect was confirmed when this liquid was placed in a small, plastic spray container and used for oral disinfection and dental oral washing. In the case of acidic electrolytic water, rinsing with tap water is required after oral disinfection, however this finish-rinsing was not required when using the neutral electrolytic water of this invention. This neutral electrolytic water can also be used as mouthwash water (for gargling) or drinking water.

A dedicated humidity adjustor was used to adjust the humidity within a building. This humidity adjustment however was performed by installing a large spray device (for the neutral electrolytic water) in the customer reception room within the building and the results were well rated. This device currently is still continuously being used. Germs were increasing within the air conditioning water within a building and the effect on the cooling equipment and water flying outwards were a problem. These problems were resolved by using the neutral electrolytic water of this invention. Strongly acidic water is difficult to use for circulation and is not economical in terms of the water quantity.

The following items were confirmed in terms of actual performance of the neutral electrolytic water of this invention.

1) The neutral electrolytic water deodorized and cleaned the indoor air.

2) When fresh food products such as fruits or vegetables were sprayed with this neutral electrolytic water and then placed in a refrigerator, they were effectively disinfected, and could be stored for longer periods.

3) Spraying the neutral electrolytic water on the hands disinfected and sterilized them.

4) The neutral electrolytic water prevented mold from occurring.

5) The neutral electrolytic water
disinfected and sterilized kitchen knives and cutting boards.

6) The neutral electrolytic water deodorized
pets such as dogs, cats and birds.

5

Seventeenth Embodiment

Seawater was processed utilizing the neutral
electrolytic water production device of this invention.

(1) Test device: a-Torino water production
10 device Model 1

(a) Vibratory Agitator type 2 Vibration motor
dual shaft type

75 watts X 200 volts 3-phase vibrating -lades
vibration-shaft stainless steel (SUS304)

15 Cathode electrode plate SUS304 4-plates anode
electrode plate platinum film covering (3 plates)

(b) Electrolyte tank: heat-resistant
propylene: capacity 30 liters (500 x 250 x 305 mm)

(c) Regulator Chuo Seisakusho PME11-12V-200

20 (d) Inverter Fuji Denki (Inc.) FVR-C11S model

(2) Test method

The vibration cycle of the vibration-stirring
device was adjusted to 45 Hertz with the inverter.

Electrolyzing of the sea water was performed by applying a
25 fixed electrical current at a voltage of 10 to 11 volts, and
electrical current of 20 amperes at a processing time of 5
minutes.

(3) Test results

Neutral electrolytic water with a pH of 7.6 and
30 a residual chlorine content of 700 ppm was obtained
(hereafter called neutral electrolytic water (originally
seawater). A germicidal test was performed by using the
neutral electrolytic water as the sterilizing water. This
neutral electrolytic water was placed in a fishing water
35 tanks, a portion of it was frozen. When a test was then

performed using the neutral electrolytic water for preserving fish (young yellowtail, sardines) caught from the open sea, the fish showed no damage at least from transporting from the fishing grounds to land, and were maintained in a
5 satisfactory fresh state.

Eighteenth Embodiment

A germicidal test was performed under the following conditions.

10 <Test method>

(Test preprocessing) The processing device was washed and sterilized with alcohol.

(Electrolyzing) Electrolyzing was performed at 3.57 volts and 5 amperes (fixed current) and sampling of the
15 test piece performed at each of the following times.

(1) Prior to performing electrolyzing(seawater)

(2) Sampling after 1 minute of electrolyzing (1 minute processing of neutral electrolytic water)

20 (3) Sampling after 3 minutes of electrolyzing (3 minute processing of neutral electrolytic water)

(4) Sampling after 5 minutes of electrolyzing (5 minute processing of neutral electrolytic water)

(Incubation processing) Colon bacillus was incubated for 48
25 hours (culture: ordinary sterilizing SCD agar medium) using 4 test pieces in an incubator (Yamato incubator: IC340S).

(Test results)

Results are shown in FIG. 25 through FIG. 28. A colon bacillus colony was observed in sea water processing
30 but the colony quantity decreased over a time from 1 to 5 minutes, and almost no colonies were observed in the 3 and 5 minute processed neutral electrolytic water.

These results show a satisfactory example for a method for preventing fish from rotting and maintaining
35 freshness by using the neutral electrolytic water and the

neutral electrolytic water production device of this invention.

A) To produce the neutral electrolytic water, the content of the water for processing is usually changed by adding 0.05 to 8 percent salt to the water such as tap water or ion exchange water to obtain salt water and then electrolyzing it. In this case, the electrolyzing is preferably performed at an electrical current density of 0.05A/L-5A-L. The time for the electrolyzing is preferably 10 to 90 minutes.

In fields utilizing a means for preventing decay by freezing ordinary water, the neutral electrolytic water of this invention can also be utilized as a "germicidal ice" and demonstrated a powerful decay prevention effect. The preservation of the raw foods was improved, and its safety was enhanced.

(B) Seawater may also be utilized instead of the above described salt water. In that case, the seawater is filled into the electrolyte tank of the neutral electrolytic water production device of this invention preferably under electrolyzing conditions where the free chlorine content becomes 50 ppm to 2000 ppm. Neutral electrolytic water made under these conditions will penetrate into the internal organs of the caught fish. The caught fish are then covered with ice made of this electrolytic water. This method can completely sterilize and prevent partial decay, and the fish can be transported as is, in a fresh state to land.

The neutral electrolytic water production device of this invention can also be utilized while installed for example on a fishing boat. In this case, a "germicidal ice" possessing powerful germicidal characteristics and a decay prevention effect can be produced by the neutral electrolytic water production device of this invention using seawater, and used to maintain the freshness of the fish.

Moreover, the neutral electrolytic water of this invention possesses a strong decay prevention effect that is also highly safe since it does not generate hazardous substances such as sodium hypochlorite.

5

Nineteenth Embodiment

The neutral electrolytic water obtained by electrolyzing at a fixed electrical current in conformance with the method for producing neutral electrolytic water of this invention by utilizing a device described in FIG. 29 including a photocatalytic unit containing a vibration-stirring device surface-treated utilizing anatase titanium oxide activized by ultraviolet rays, was evaluated as follows. Those results are shown in Table 11.

15

<Measurement conditions>

Water for processing: 17.5 g NaCl/14.4L water

Rectifier: DC12V-20A

Electrode gap: 20 millimeters (2 electrodes are platinum anodes, and 3 are titanium cathode electrodes)

20

Vibrating conditions: frequency 44 Hertz

[Table 11]

Neutral electrolytic water of this invention produced by photocatalytic processing of water

Elapsed time (min.)	Electrical current (A)	Voltage (V)	Residual chlorine content (mg/L)	pH
0	7.1	12.11	Not detected	—
60	7.1	11.68	18	—
120	7.2	11.43	32	—
180	7.3	11.1	50	—
210	7.3	11.05	50	7.86

25

INDUSTRIAL APPLICABILITY

The effect as described above that is rendered

by the neutral electrolytic water of this invention lasts for a long period of time, and this neutral electrolytic water is likely to be utilized in a wide range of fields. Along with these uses, this neutral electrolytic water is also likely to
5 be produced in ever greater amounts.

WHAT IS CLAIMED IS:

5

1. A method for producing neutral electrolytic water including a process for electrolyzing a liquid for processing comprised of water and at least one type of salt selected from a group consisting of NaCl, KCl, and CaCl₂ by
10 applying a direct current or pulsed current at a current density of 5A/dm² to 300A/dm² and a voltage from one to thirty volts, while vibrating that liquid at an amplitude from 0.01 to 15 millimeters at a period between 10 Hertz and 200 Hertz.

15

2. A method for producing neutral electrolytic water according to claim 1, wherein the salt content of the
20 liquid for processing is from 0.05 percent by weight to 10 percent by weight.

25

3. A method for producing neutral electrolytic water according to claim 1 or claim 2, wherein the electrolyzing process is performed from 5 to 90 minutes.

30

4. A method for producing neutral electrolytic water according to one or any one of claim 1 through claim 3,
35 wherein the liquid for processing is seawater.

5 5. A method for producing neutral electrolytic
water according to one or any one of claim 1 through claim 4,
wherein the water includes tap water, underground water, well
water, distilled water, soft water, ion replacement water and
reverse osmosis membrane water.

10

 6. A method for producing neutral electrolytic
15 water according to one or any one of claim 1 through claim 5,
further including a photocatalysis process performed on the
liquid for processing prior to the electrolyzing process.

20

 7. A method for producing neutral electrolytic
water according to claim 6, wherein the photocatalysis is
performed by making the liquid for processing come in contact
25 with the photoactivizied anatase titanium oxide.

30 8. A neutral electrolytic water wherein the
activizied element is selected from a group containing OH, D₂,
HD and HDO.

35

9. A neutral electrolytic water according to claim 8, wherein the residual chlorine is one milligram per liter to seven grams per liter.

5

10. A neutral electrolytic water according to claim 8 or claim 9, wherein the pH of the hydrogen ion exponent is larger than 6.5 and lower than 8.5.

15

11. A neutral electrolytic water according to one or any one of claim 8 through claim 10, wherein the oxidation-reduction potential is 650 millivolts or more and 800 millivolts or less.

20

12. A neutral electrolytic water according to one or any one of claim 8 through claim 11, wherein the neutral electrolytic water is utilized in at least one application selected from among a group including sterilization, health beverages, washing of foodstuffs, medical treatment, cosmetics, mist spray, deodorizing, rust prevention, plant growth, disinfecting, pet/animal care, pond spraying, reservoir water, water for aquariums, and purifying.

35

13. A device for producing neutral electrolytic water comprising:

an electrolyte tank for storing the liquid for
5 processing, and
multiple electrode plates installed alternately
in proximity to the electrolyte tank, and connected to a
direct current power supply by way of a rectifier, and
a vibration-stirring device to make the liquid
10 for processing agitate and flow,
wherein electrolyzing is performed with the
vibration-stirring device vibrating the liquid for processing
while a direct current or a pulsed current is applied to the
multiple electrode plates.

15

14. A device for producing neutral electrolytic
20 water according to claim 13, wherein the distance between the
multiple electrodes is 0.3 millimeters to 100 millimeters.

25

15. A device for producing neutral electrolytic water comprising:

an electrolyte tank for storing the liquid for
processing, and
30 a vibration-stirring device including multiple
vibrating blades connected via a rectifier to the direct
current power supply, for making the liquid for processing
agitate and flow,
wherein electrolyzing is performed with the
35 vibration-stirring device vibrating the liquid for processing

while a direct current or a pulsed current is applied to the multiple vibrating blades.

5

16. A device for producing neutral electrolytic water according to claim 15, wherein the distance between the multiple vibrating blades is 0.3 millimeters to 100
10 millimeters.

15 17. A device for producing neutral electrolytic water comprising:

a photocatalyzing tank for performing photocatalysis of the liquid for processing, and

20 an electrolyte tank for storing the photocatalyzed liquid for processing, and

multiple electrode plates installed alternately in proximity to the electrolyte tank, and connected to a direct current power supply by way of a rectifier, and

25 a vibration-stirring device to make the liquid for processing agitate and flow,

wherein electrolyzing is performed with the vibration-stirring device vibrating the liquid for processing while a direct current or a pulsed current is applied to the multiple electrode plates.

30

18. A device for producing neutral electrolytic
35 water comprising:

a photocatalyzing tank for performing photocatalysis of the liquid for processing, and

an electrolyte tank for storing the photocatalyzed liquid for processing, and

5 a vibration-stirring device including multiple vibrating blades connected via a rectifier to a direct current power supply, to make the liquid for processing agitate and flow,

10 wherein electrolyzing is performed with the vibration-stirring device vibrating the liquid for processing while a direct current or a pulsed current is applied to the multiple vibrating blades.

15

19. A device for producing neutral electrolytic water according to any or any one of claim 13 through claim 18, further comprising an agitating tank for storing the
20 liquid for processing and for agitating the liquid for processing, wherein the liquid for processing is supplied from the agitating tank to the electrolyte tank so that electrolyzing can be continuously performed.

25

20. A device for producing neutral electrolytic water according to any or any one of claim 13 through claim
30 19, wherein the vibration-stirring device is an insulated type vibration-stirring device.

35

21. A device for producing neutral electrolytic water according to any or any one of claim 13 through claim 20, wherein the liquid for processing is comprised of water and at least one type of salt selected from a group
5 consisting of NaCl, KCl, and CaCl₂.