

Utilization of Ozone Water Generators for Preventing Infection in Home Care

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Functional water

Among the aqueous solutions that have been given **reproducible** and **useful functions** by human processing, those that have been **scientifically clarified**.

- Japanese Functional Water Foundation 1993 -

Electrolyzed water

Acidic electrolyzed water(**Bactericidal ability**)

Alkaline electrolyzed water(Intestinal regulation, washing detergent)

Ozone water

Bactericidal ability

Our previous study on acidic electrolyzed water with bactericidal ability

1. A simple device producing **electrolyzed water** for home care. IFMBE Proceedings, pp. 1419-1422, 2015
2. Studies on the Use of **Electrolyzed Water** as a Disinfectant at Home Care. GLOBAL HEALTH, pp.5-7, 2014
3. Development of device producing **electrolyzed water** for home care. Journal of Physics, pp.1-5, 2013
4. Apparatus producing a wide variety of **electrolyzed water** for home care. IFMBE Proceedings , pp. 696-699, 2012
5. Measurement of Available Chlorine in **Electrolyzed Water** Using Electrical Conductivity. IFMBE Proceedings, pp. 324-327, 2011
6. Development of automatic controller for providing multi **electrolyzed water**. IFMBE Proceedings, pp. 306-309, 2009
7. Development of a Device to Provide **Electrolyzed Water** for Home Care. Biomed 2008, Proceedings, pp. 738-741, 2008
8. Effect of long-term storage on bactericidal activity of strong acidic **electrolyzed water**. IFMBE Proceedings, pp. 3596-3599, 2006.
9. Characteristics of strong acidic **electrolyzed water**. IFMBE Proceedings, 2005
10. Evaluation of strong acidic **electrolyzed water** for the disinfection. ", IEEE-EMBS, APBME, 2003

Patent

1. Invention title: Apparatus and Method for Producing **Electrolyzed water**

Inventor : Koichi Umimoto, Syunji Nagata

JP patent No. 4580039

2. Invention title: Apparatus and Method for producing **Electrolyzed water**

Inventor: Koichi Umimoto, Syunji Nagata

US patent No.8, 173, 006B2(JP-800597-02-US-REG)

Patent application

1. Invention title: APPARATUSES AND TO METHOD TO PRODUCING **ELECTROLYZED FLUID**

Inventor: Koichi Umimoto, Syunji Nagata, Aki Kamada

JP-925458-01-US-REG(2016)

2. Invention title: DEVICE AND METHOD FOR PRODUCING **ELECTROLYZED LIQUID**

Inventor: Koichi Umimoto, Syunji Nagata

PCT/JP2013/002171

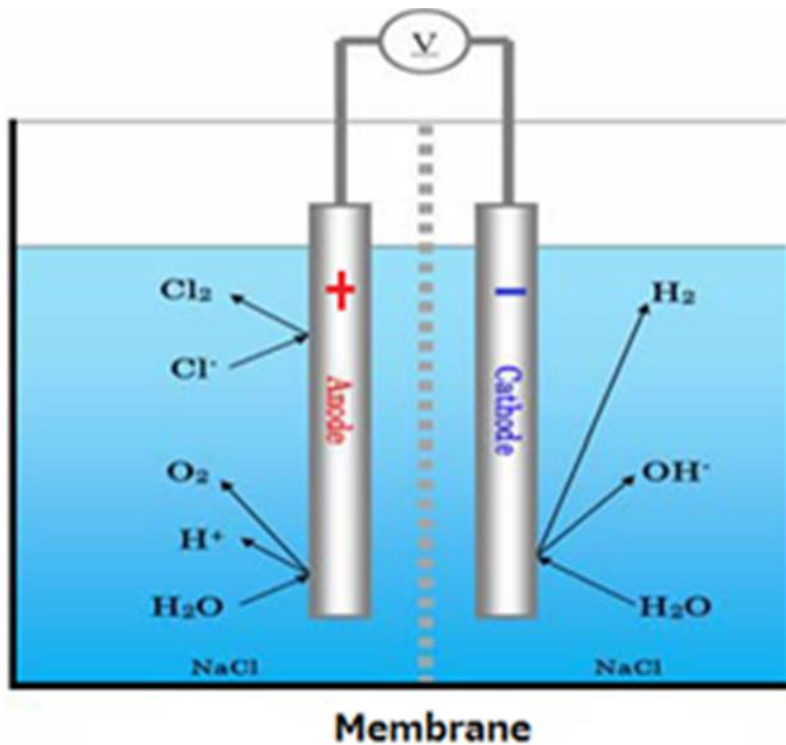
3. Invention title: DEVICE AND METHOD PRODUCING **ELECTROLYZED LIQUID**

Inventor: Koichi Umimoto, Syunji Nagata

PCT/JP2012/008363

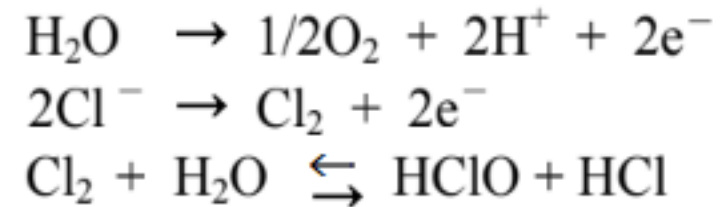
Advantage

Electrolyzed water with bactericidal ability is easily **made of water**.
This reverts to **ordinary water after use**.



Acidic electrolyzed water

Anode side



Disadvantage



Ozone water

Purpose

The Hygiene management for infection is important in home care.

The **ozone water** is an attractive option for hygiene management in home care.

In this study,

We developed **two devices** for producing ozone water for use in home care.

We used the first, **simple device** to investigate the properties and bactericidal activity of ozone water. With the second, **flowing water device**, which produces ozone water for outdoor use, we studied the concentration of ozone water at different distances from the hose nozzle.

Simple device

1. Properties of ozone water

To investigate the sustainability of ozone water,

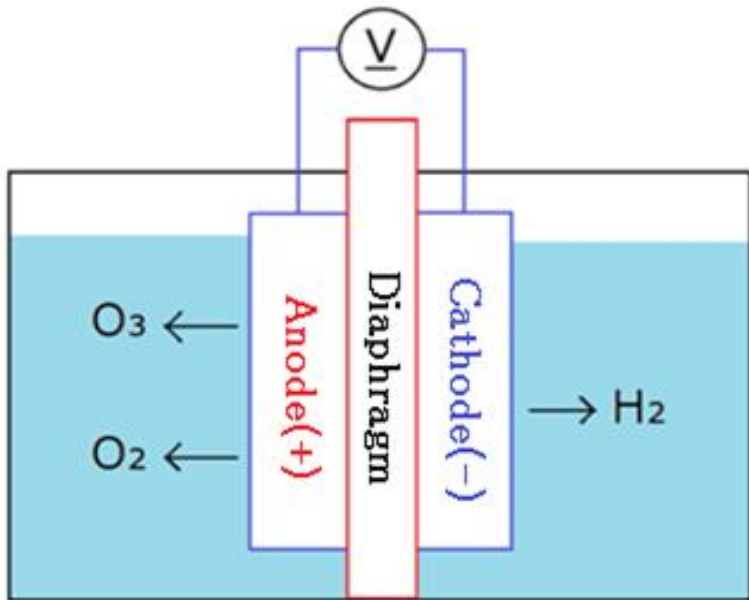
- 1) Fresh ozone water was put into a beaker and measured its ozone concentration over time.
- 2) Hands were soaked into the fresh ozone water and measured its ozone concentration

2. Bactericidal activity

To investigate the bactericidal activity of ozone water,

Escherichia coli (*E. coli*) gram-negative bacterium and *Staphylococcus aureus* (*S. aureus*) gram-positive bacterium were prepared. The bactericidal activity was assessed by counting the number of colonies of bacteria in the petri dish.

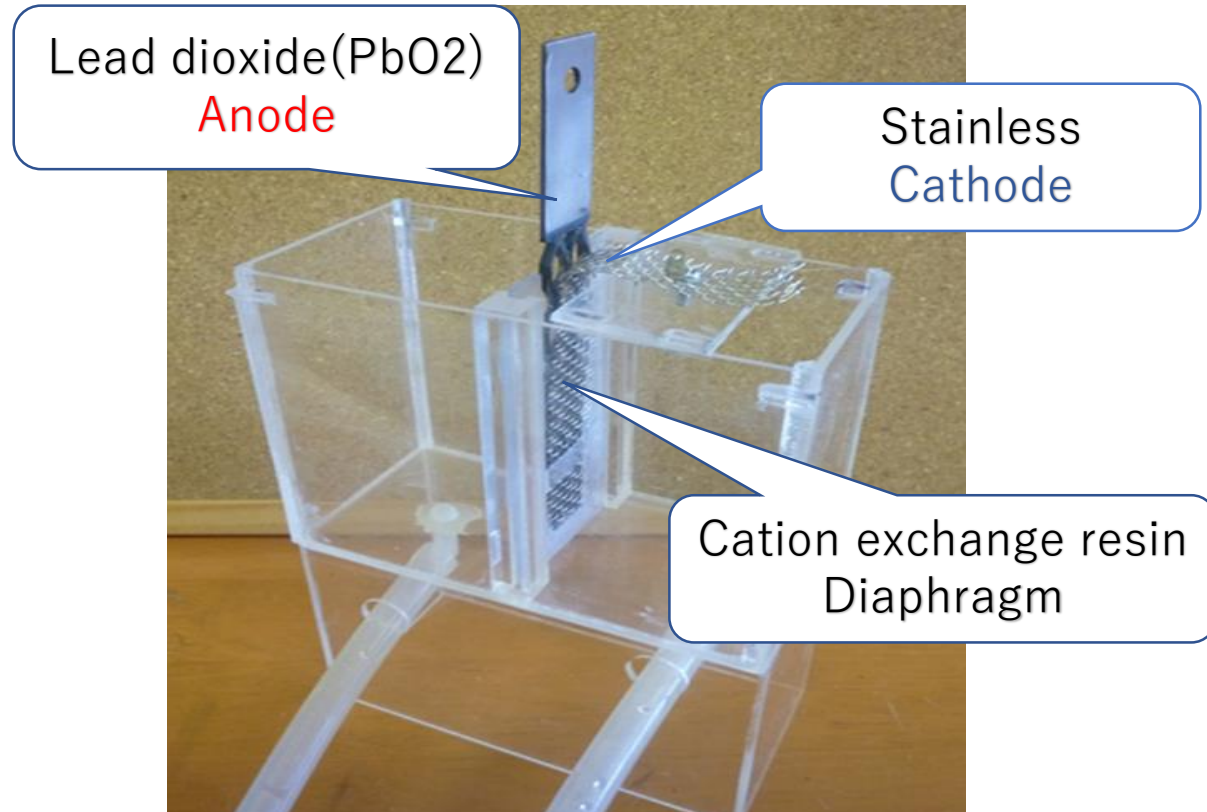
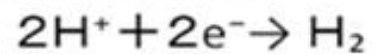
Simple device(Prototype of ozone generator)



Anode side



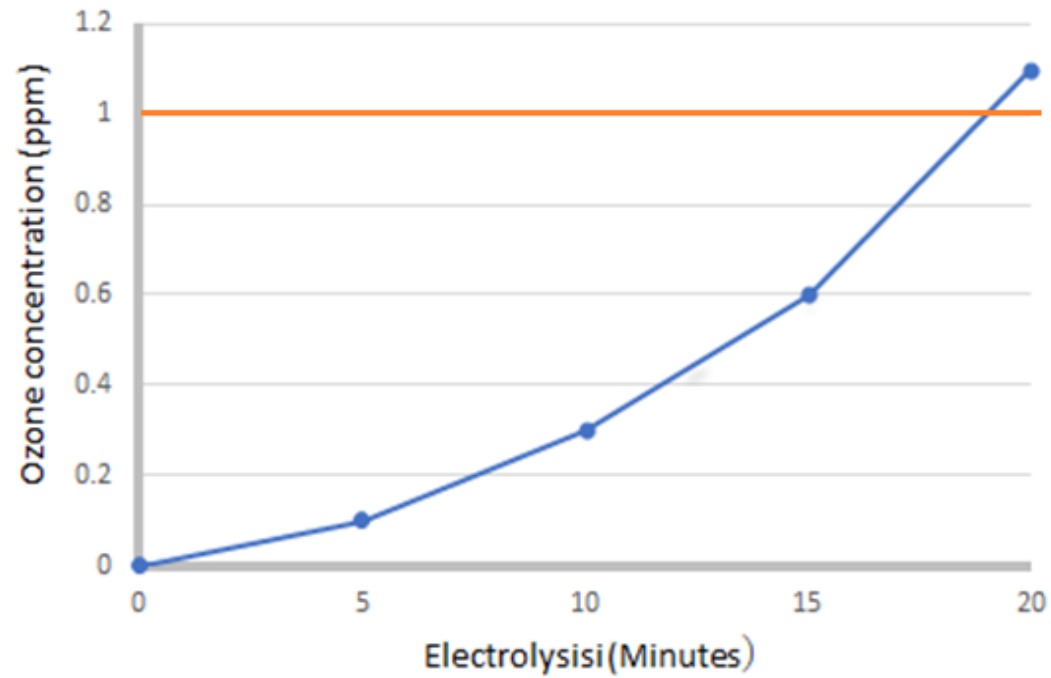
Cathode side



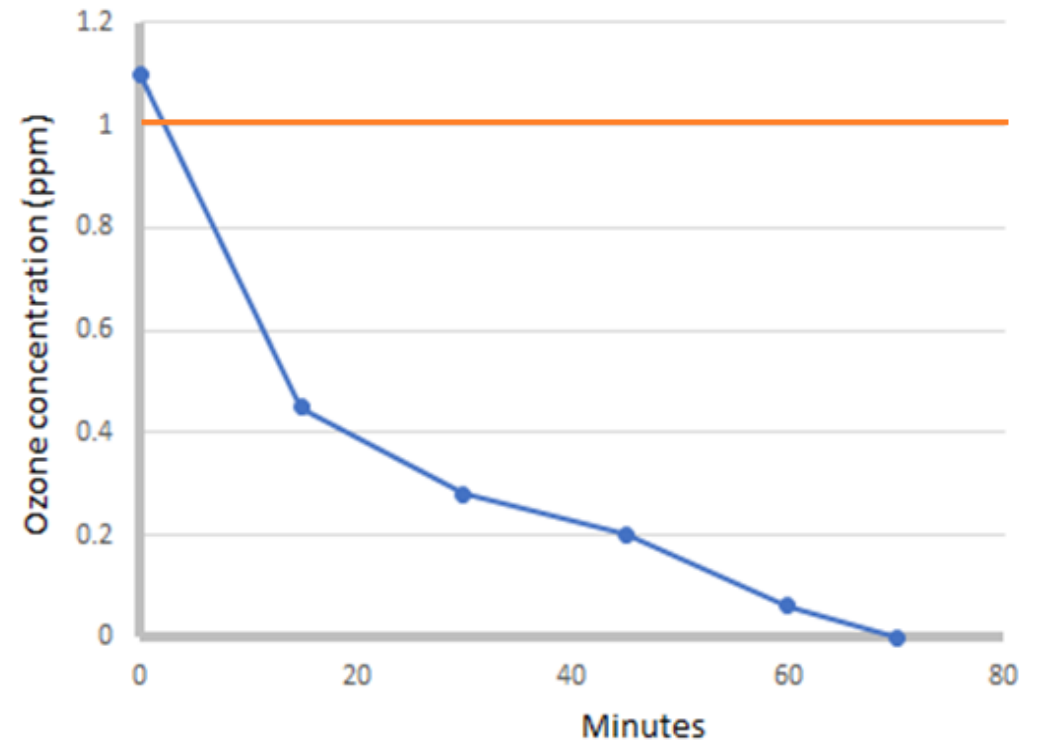
Tap water (1 L) was electrolyzed by DC 20 V

Results

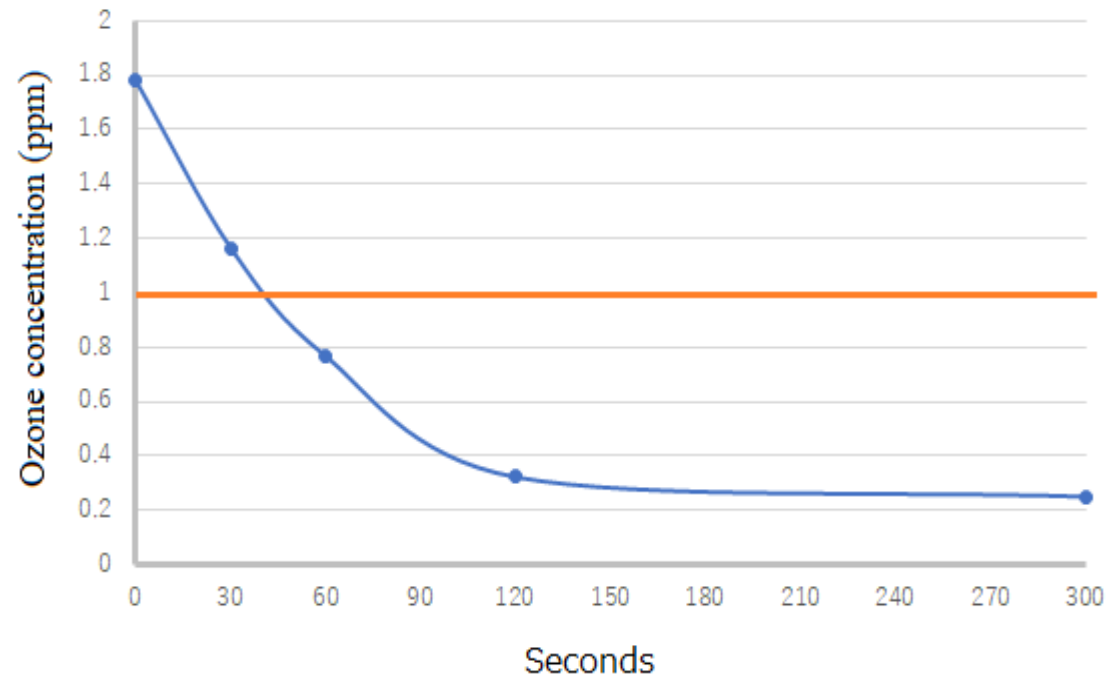
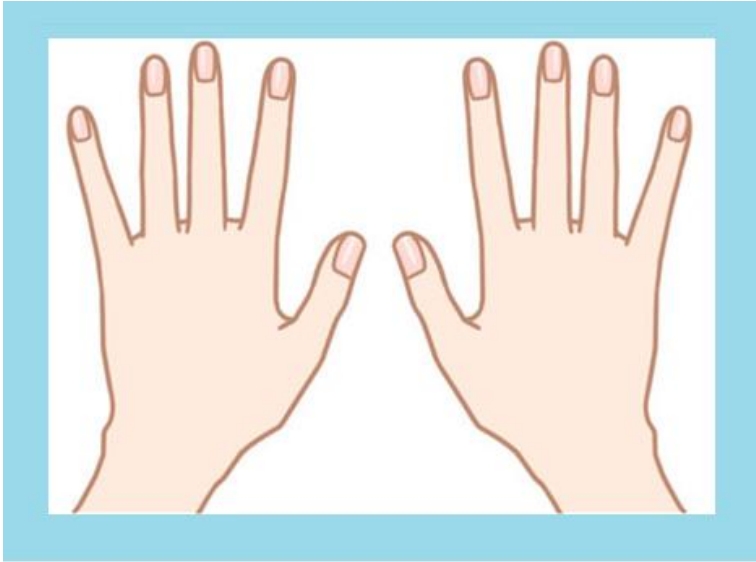
Ozone concentration during electrolysis



Changes in ozone concentration after generation

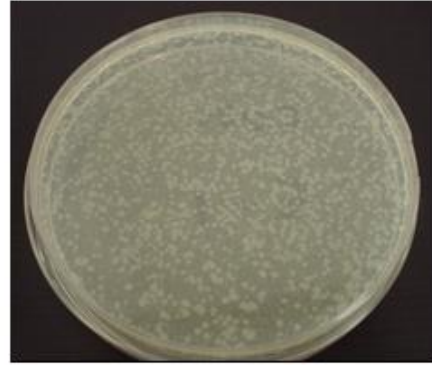


Changes in ozone concentration by soaking hands



Bactericidal activity of ozone water produced by simple device

E.Coli



$\times 10^6$ Dilution

S.aureus

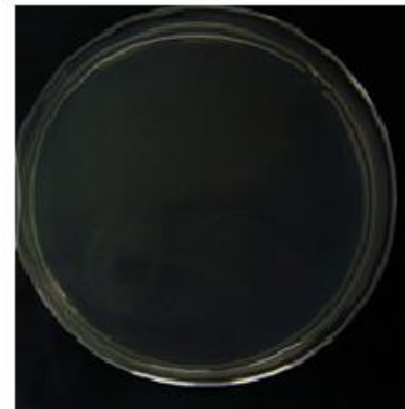


$\times 10^6$ Dilution

↓ Ozone water(1.1ppm) ↓



0 CFU/mL



0 CFU/mL

Flowing water device

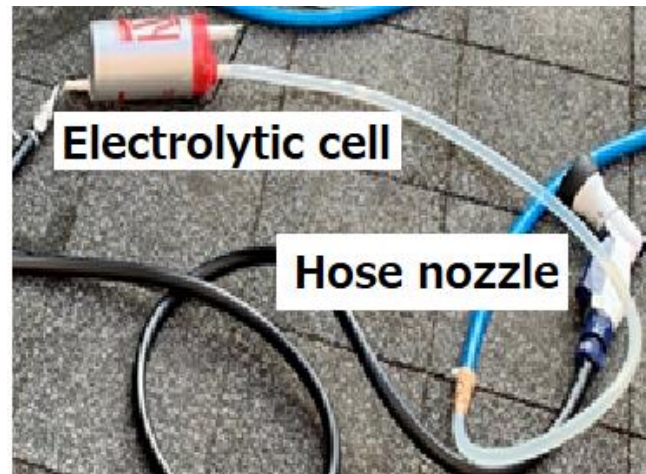
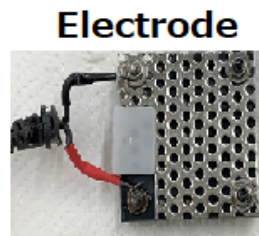
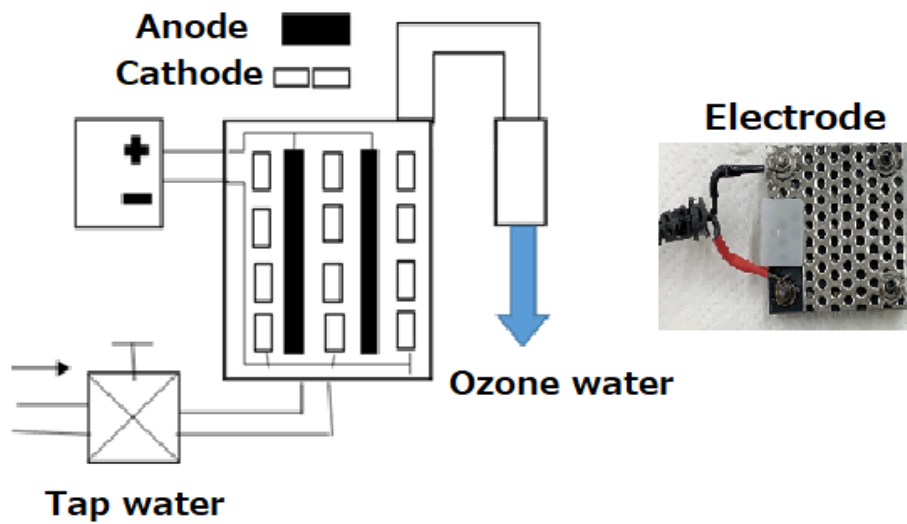
1. **Prototype of a flowing water device**

A diamond-coated titanium plate is used as the anode, and a stainless steel plate as the cathode. The device consisted of an electric cell with built-in electrodes and a hose, which is directly connected to an outdoor water source. The ozone water is released by pressing the hose nozzle.

2. **Water release experiment**

The ozone concentration in the water was measured at 0m, 2m and 4 m from the hose nozzle.

Flowing water device



Water release experiment



Results

Released distance of ozone water (m)	0	2	4
Ozone concentration in released water (ppm)	1.6 ± 0.2	1.4 ± 0.2	0.6 ± 0.3

Conclusion

We developed two devices that can be used at home to produce ozone water for infection prevention.

Our simple device produces 1 ppm of ozone water within 20 minutes of starting electrolysis and the ozone disappears within 70 minutes. And also, the ozone water shows strong bactericidal activity.

The flowing water device maintains a bactericidal ozone concentration up to 2 m from the hose nozzle and is suitable for outdoor use.

The devices are useful for producing ozone water as a disinfectant for use in indoor and outdoor home care and are beneficial from both an economic and an environmental perspective.

Acknowledgement

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