New advances in electrolyzed water technology

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Introduction

- Safety and quality control are very important aspects in food and agricultural products.
- One of the most important processes is sterilization

Electrolyzed water is one of advance technology

We called DENKAI SUI in Japan!
Introduction 2

- Dr. Hotta is most famous leading researcher of DENKAI SUI in Japan
- Dr. Ishobe is leading researcher of DENKAI SUI in food & Agri. Production
- Dr. Yoshida is a leading researcher of DENKAI SUI in food industries
- Dr. Morita is one of researcher of DENKAI SUI in university
Today’s presentation

I introduce application of EO water for food and agricultural processing including cut flowers and other uses as new advances in EO water technology in Japan

Changed topics

-How can we get safe drinking water?-
To make safe drinking water with New electrolytic technology

- Background
- New electrolytic technology
- Basic properties
- Bactericidal effects on E.coli
- Residual CL2 removal effect
Background

- Drinking water availability is decreasing year by year in the world.
- 300 million people have some trouble to get safe drinking water easily and they can’t control sanitation.

Why can not we get safe water now??
Reasons

Advanced Countries

- We use too many kind of detergents or chemicals
- Some chemicals are not decomposed into its elements in a natural environment

Developing Countries

- Industrial pollution of a river has happened
- Some water is contaminated by microbes
Solution

Electrolytic technology is expected to solve the problems

Two Advantages
1. Using EO water controls bacteria on food without detergents.
2. Reduced water enhances Human’s immunology system
EO water has strongly bactericidal effect (for sanitation)
Reduced water has ORP reducing effect (for health)

New advances in electrolyzed water technology

We propose New drinking water generation system using electrolytic technology
Electrolytic water generation system

Anode side
- Make low pH water
- Higher concentration Cl₂ and O₂

Cathode side
- Neutralize pH level
- Higher H₂ gas concentration

Gas remover
- Remove Cl₂ gas and O₂ gas

Flow chart

Plate: Pt coating

Electrolysis box

Gas remover

Water outlet

membrane

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New drinking water generator

- Controller
- Water tank
- Cell
- Vacuum pump
- Pump
Electrolysis cell
Controller
Vacuum Pump
pH
ORP
A
V
Electrolysis Cell

Anode side

Cathode side
Electrolysis Cell

Cathode side
To Vacuum Pump

Gas remover
Experiment 1

Objective

Compare basic properties between New electrolyzed water and Reduced water

Conditions

Supplied water

Each water is adjusted with de-ionized water & pure salt
Experiment 1

Conditions

Electric conductivity

The concentration of NaCl is arranged by electric conductivity

Range: EC 50, 100, 200, 300, 400 μS/cm

Electrolysis Voltage

Range: Voltage 0, 10, 20, 30, 40, 50 V

Flow rate

Flow rate 1.0 L/min
Basic properties for New water generation

The relationship between current & voltage

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The relationship between pH & voltage

**Graphical Representation:**

- **Title:** 電解電圧とpHの関係 - Fig.2-
- **Y-axis:** pH
- **X-axis:** 電圧/Voltage
- **Legend:**
  - NEW50
  - RW50
  - NEW100
  - RW100
  - NEW200
  - RW200
  - NEW300
  - RW300
  - NEW400
  - RW400

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The relationship between voltage & oxidation reduction potential

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電解電圧とORPの関係 -Fig.3-
The relationship between current & conductivity

- Fig. 4 -

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The relationship between DO-DH and electric current (A)

\[ y = 0.2016x + 0.085 \]
\[ R^2 = 0.8442 \]

\[ y = 0.201x + 0.078 \]
\[ R^2 = 0.8492 \]
Conclusion 1

- RW and NEW similarly changed with A & V
- RW was alkali water but NEW was neutralized water
- NEW kept minus ORP level similar to RW
- EC of NEW kept same level vs A, though EC of RW increased with increasing A
- DO of NEW kept low concentration vs. A, though both DH increased with A
Experiment 2

Objective

In anode cell, HOCL is generated
To confirm bactericidal effect on \textit{E.coli}.

Conditions

Supplied water

Each water is adjusted with de-ionized water & pure salt
Experiment 2

Conditions

Electric conductivity

The concentration of NaCL is arranged by electric conductivity

Range: 

EC 100,300,500 μS/cm

Electrolysis Voltage

Range: 

Voltage 0, 20,30,40,50V

Flow rate

Flow rate 1.0L/min

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Experiment 2

Bactericidal effect

*E. coli* are arranged $10^9$ cfu/mL : (JCM1649)

Added *E. coli* liquid (10mL) to each supplied water (20L)

Electrolysis

Bacteria count after incubation at 37 degree for 48 hour
**Bactricidal effects at E.Coli**

- **EC100**
- **EC300**
- **EC500**

**Graph:**
- **Y-axis:** Number Colony formed unit (log CFU/mL)
- **X-axis:** Voltage

**Legend:**
- Large triangles: EC100
- Blue diamonds: EC300
- Red dots: EC500

**Title:** 新しい電解処理による殺菌効果

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Conclusion 2

- NEW still have bactericidal effects
Experiment 3

Objective

Is HOCL changed as CL2 gas in new electrolyzed water at low pH?

This test attempt to control residual chlorine.
Result

新電解処理を用いた有効塩素濃度と電圧の関係

Relation ship between Voltage & Avaiable chlorine concentration

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Conclusion 3

NEW kept low concentration of available chlorine with gas remover
Conclusion of NEW

- Have bactericidal effects
- Reduced residual chlorine concentration
- Reduced ORP level

New electrolytic technology shows the possibility to generate drinking water!
Thank you for your attention