# 行政院國家科學委員會專題研究計畫　成果報告

## 製造條件對電解水品質影響的研究(II)

計畫類別：個別型計畫
計畫編號：NSC91-2214-E-002-023-
執行期間：91 年 08 月 01 日至 92 年 07 月 31 日
執行單位：國立臺灣大學食品科技研究所

計畫主持人：許順堯

計畫參與人員：朱淯維(研究生)、張淑美(研究生)

報告類型：精簡報告

處理方式：本計畫可公開查詢

中　華　民　國 92 年 9 月 17 日

# 行政院國家科學委員會補助專題研究計畫成果報告

## 製造條件對電解水品質影響的研究(二)

Studies on the effects of processing conditions on qualities of electrolyzed water(2)

計畫類別： 個別型計畫 整合型計畫
計畫編號：NSC 91－2214－E－002－023－
執行期間： 91 年 8 月 1 日至 92 年 7 月 31 日

計畫主持人：許順堯 Email: gifsthsu@ntu.edu.tw
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執行單位：國立臺灣大學　食品科技研究所

中　華　民　國　92 年　9　月　17　日

# 行政院國家科學委員會專題研究計畫成果報告

計畫編號：NSC 90-2214-E-002 -036 -

計畫名稱：中文：製造條件對電解水品質影響的研究(二)

英文：Studies on the effects of processing conditions on qualities of electrolyzed water(2)

執行期限：91 年 8 月 1 日至 92 年 7 月 31 日

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**I、Abstract**

The purpose of this study is to investigate the effects of processing conditions on properties of EOW. This study adopted a duplicated three-factor central composite design to study the effects of raw-water flow rate, salt concentration and water temperature on pH, oxidation- reduction potential (ORP), total chlorine, conductivity, dissolved oxygen (DO), chloride ion and sodium ion concentrations of EOW. Furthermore, a study on the efficiency of EOW generator and a study on storage properties of the EOW were also conducted.

Results indicated that increasing water flow rate decreased total chlorine concentration and ORP of the EOW. Increasing salt concentration increased total chlorine concentration and electrical conductivity of the EOW. Results also indicated that electrolysis efficiency of the electrolysis cell varied in the range of 47 % to 66 %. Separation efficiency of the cation ion-exchange membrane varied in the range of 33 % to 59 %. Both efficiency rates were significantly reduced by increases in water flow rate and/or salt concentration in the feed solution. Results also indicated that total residual chlorine and DO decreased 24% and 21%, respectively, in the 21-day closed storage and decreased 81% and 47%, respectively, in the 14-day semi-open storage.

**Keywords**: Electrolyzed oxidizing water, Processing conditions, Efficiency, Storage

**摘要**

本研究目的在探討影響電解氧化水品質的加工製造條件。本計劃依二重複三變數之中心混成設計，探討原料水流速，食鹽濃度和溫度等，對強酸性電解水製品品質的影響；包括：pH 值、氧化還原電位(ORP)、總氯濃度、電導度、溶氧量(DO)、氯離子、鈉離子和殺菌效力等。並進而探討其對電解水產生器效率的影響，以及所生產之電解水在貯藏中的變化情形。

結果顯示，原料水流速降低電解氧化

水之總氯濃度和 ORP；食鹽水濃度增加總氯濃度和導電度。結果亦顯示，電解水產生器的電解效率介於 47-66 %，陽離子隔膜的分離效率介於 33-59 %。且兩者皆會被原料水流速或食鹽水濃度降低。結果亦顯示，經密閉貯藏 21 天後，電解氧化水之總氯濃度和 DO 分別下降 24 %和 21 %。經半開放貯藏 14 天後，電解氧化水之總氯濃度和 DO 分別下降 81 %和 47 %。

**關鍵詞**：電解氧化水, 製造條件, 效率, 貯藏

## II、Introduction

Electrolyzed oxidizing water (EOW) has been reported to have strong bactericidal effects on many pathogenic bacteria. Major advantages of using EOW for inactivation of bacteria are less adverse impact on the environment and no need to transport and store potentially hazardous chemicals. EOW has been widely used in medical applications such as prevention of infection of methicillin resistant *Staphylococcus aureus* (MRSA), for various agricultural purposes such as sterilization of fruits and vegetables, and in food processing industry or household kitchens for disinfection of food materials and food processing utensils.

Generation of EOW, in general, involves reactions in a cell containing inert positively charged (anode) and negatively charged (cathode) electrodes, respectively, separated by a membrane, and through which a dilute salt solution passes. By subjecting the electrodes to direct current voltage, negatively charged ions such as hydroxide and chloride in the salt solution move to the anode to give up electrons and become oxygen gas, chlorine gas, hypochlorite ion, hypochlorous acid and hydrochloric acid, while positively charged ions such as hydrogen and sodium move to the cathode to take up electrons and become hydrogen gas and sodium hydroxide. As a result, two types of water possessing different characteristics are generated. An electrolyzed basic solution (pH > 11 and ORP < –800 mV) is produced from the cathode side, which has strong reducing potential and may be used as a cleaning solution. An electrolyzed acid solution (pH < 2.7 and ORP > 1100 mV and presence of hypochlorous acid) is produced from the anode side, which has strong oxidation potential and bactericidal effect and can be used as a disinfectant.

Although many studies showed good bactericidal effects of EOW, there were few studies on the effects of processing factors on EOW and EOW generator. Therefore, the purposes of this study are to investigate the effects of processing factors on chemical and physical properties of EOW, on efficiency of EOW generator and on effects of storage conditions on pH, ORP, conductivity, total residual chlorine, DO, sodium ion and chloride ion concentrations of the EOW.

## III、Results and discussion

In the first part of the study, we investigated the effects of raw- water flow rate, salt concentration and water temperature on pH, ORP, total chlorine, conductivity, DO, chloride ion and sodium ion concentrations of EOW. Results indicated that pH and DO were not affected by these processing factors. Increasing water flow rate decreased total chlorine concentration and ORP of the EOW. Increasing salt concentration increased total chlorine concentration and electrical conductivity of the EOW. Water temperature had minor effect on total chlorine concentration. The variations can be well described by linear or quadratic polynomial models.

In the second part of the study, we investigated the efficiency of EOW generator. Results indicated that electric potential (7.9 - 15.7 volts) and power consumption (16 – 120 watts) of the electrolysis cell were not affected by water flow rate, water temperature or salt concentration in the feed solution. Electric current of the cells changed in between two levels (7.41±0.1 amperes and 7.68±0.1 amperes) depending on water temperature and water flow rate. Electrolysis efficiency of the electrolysis cell, represented by the reduction ratio of chloride ions, varied in the range of 47 % to 66 %. Separation efficiency of the cation ion-exchange membrane, represented by the

reduction ratio of sodium ions, varied in the range of 33 % to 59 %. Both efficiency rates were significantly reduced by increases in water flow rate and/or salt concentration in the feed solution.

In the third part of the study, we investigated storage properties of the EOW. Results indicated that pH, ORP, conductivity and chloride ion concentration did not change much under the storage conditions. Total residual chlorine and DO decreased 24% and 21%, respectively, in the 21-day closed storage and decreased 81% and 47%, respectively, in the 14-day open storage. That indicated that exposing to the atmosphere reduced more of these compounds than prolongation of the storage time. Sodium ion concentration decreased 10-13% in the storages.

**IV、Self-evaluation**

Most of the project had been completed. .The results are being published.

**V、References**

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