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Electrochemical Treatment of Water Polluted With Salmonella

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□ ABSTRACT □

This paper presents a novel safe technique for treating bacterial water. Electrochemical cell is a safe alternative rather than chlorine and hypochlorite on the disinfection of water. Several parameters such as, Current intensity, Anode mature were detected. Results show that under specific condition, Electrochemical could inactivate salmonella. That contamination of drinking water .

Key words: Anodic Oxidation, waters Disinfection, Electrochemical cells, salmonella.

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المعالجة الإلكتروكيميائية للمياه الملوثة بالسالمونيلا

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□ ملخّص □

يقدم هذا البحث تقنية آمنة وجديدة في تطهير المياه من الملوثات البكتيرية وأن الخلية الإلكتروكيميائية أكثر أمناً من استخدام الكلور والهيبوكلوريت في تطهير المياه. واستخدم العديد من البارامترات مثل كثافة التيار وطبيعة الأنود كانت النتيجة وتحت الشروط الخاصة أنه أدى إلى تثبيط السالمونيلا الملوثة لمياه الشرب.

الكلمات المفتاحية: الأكسدة الأنودية، تطهير المياه، الخلايا الإلكتروكيميائية، جراثيم السالمونيلا.

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Introduction:

The nation's water supplies have become chemically and biologically polluted. because of many human activities, and arising pollution, every where we have increasing instances of unsafe and biologically infected waters, causing public health problems and have brought into sharp focus the ever increasing need for clean safe from pathogen free water for human and animal consumption .This need for clean water has led to a number of devices and apparatus for purifying, disinfecting and sterilizing [1].

Water is naturally purified and sterilized by the actions of aeration, percolation and solar illumination is highly desirable, however, natural filtration through soils and sand has become less and less viable as that even rural areas are being forced to deal with dangerous high levels of unwanted contaminates. All matters needed for human consumption must be disinfected ,filtered, coagulated or otherwise pretreated in such way so to remove all unwanted and harmful micro organisms (pathogens) such as *Aeruginosa,Giardia,* the *colifom group* etc[2].

For reasons of economy and technical simplicity ,chlorination is currently is wide spread use form of sterilizing .In many cases the amount of chlorine required to achieve the disinfection is so excessive that the resulting odor and taste created by the chlorine itself is objectionable to consumer . Pathogens are developing immunity to extremely high levels of chlorination and are unaffected by it in low does[3].

When chlorine is added to potable water, it combines with other natural organic compounds (which exist in water) to form Trihalomethanes (chlorination byproducts), or THMs. chlorine byproducts carcinogenic trigger the production of free radicals in the body ,causing cell damage, and are highly [4].

Importance of this subject and its aim:

The electrochemical treatment can be an alternative method for the disinfection of drinking water .It had the advantage that There was no need to add any harmful chemicals to the water. Death of bacteria during electrolytic treatment has been attributed to several factors [5], such as:

- generation of disinfectant compounds like($OH^{'}$) and ozone.
- charge-transfer in the electrode/bacterium interface .
- destruction of the *Bacteria* membrane or simply an increase in its permeability.

Materials and Methods:

A. Bacteria culture and counts:

Applying electrical current between to electrodes for used to disinfect polluted water was tested on pathogen with salmonella [6]. Bacterial sample was isolated from polluted water and inoculated into SS agar. Plates were incubated at 37 °c for 24 h. Then a colony of culture produced in SS agar was added to 1000 ml of sterilized water .Number of *Salmonella* in samples were measured before and after treatment by using Dilution Techniques[7]:

Described in :" ***Serial dilution procedure*** "

B. Experimental set-up and measurements:

In these Experiments ,the electrochemical cell is consisted of a sterile beaker and two electrodes. Which are made of stainless steel(S.S), carbon. Fig (1) illustrates the apparatus[8].

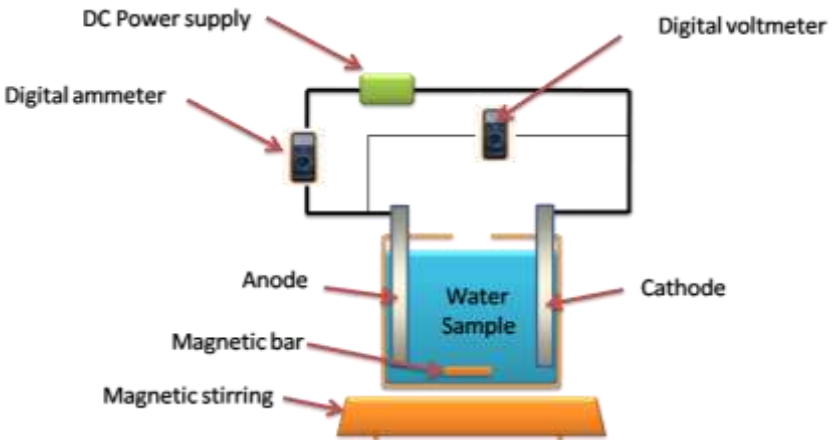

Figure (1). experimental apparatus

C. materials of study:

1- S-S agar .
2- Petri dishes .
3- Electrochemical cell.
4- Electrodes Made up of stainless steel and carbon.
5- Digital ammeter and voltmeter.
6- DC power supply.

Results and discussion:

A. Effect of changing Current intensity:

The efficiency of disinfection was studied and detected at different values of current intensity from 1-5 mA/cm^2 using (S.S) as anode. The results showed that when intensity was 1 ma/cm^2 (V=3,8 volts), The number of bacteria decreased from 110000 #CFUs to 33000 #CFUs within 20 minutes. As it is shown in Fig (2) :

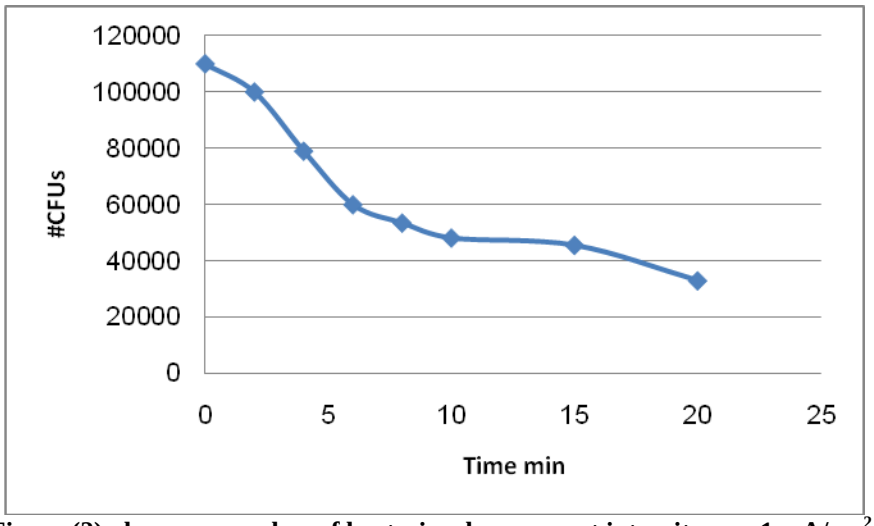

Figure (2). decrease number of bacteria when current intensity was 1 mA/cm^2.

and at 2 mA/cm^2 (V=6.7 volts) the number of bacteria decreased from 110000 # CFUs to 0 #CFUs after 10 minutes, As it is shown in the following line chart Fig (3):

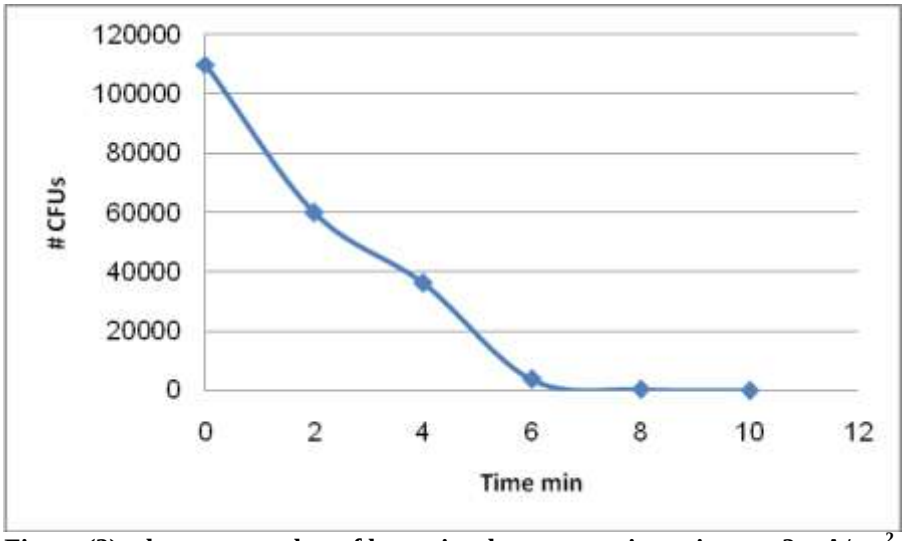

Figure (3) . decrease number of bacteria when current intensity was 2 mA/cm^2.

At 3 mA/cm^2 (V=9.23 volts) the number of bacteria decreased from 110000 #CFUs to 0 #CFUs after 6 minutes ,As it is shown in the following diagram. Fig(4):

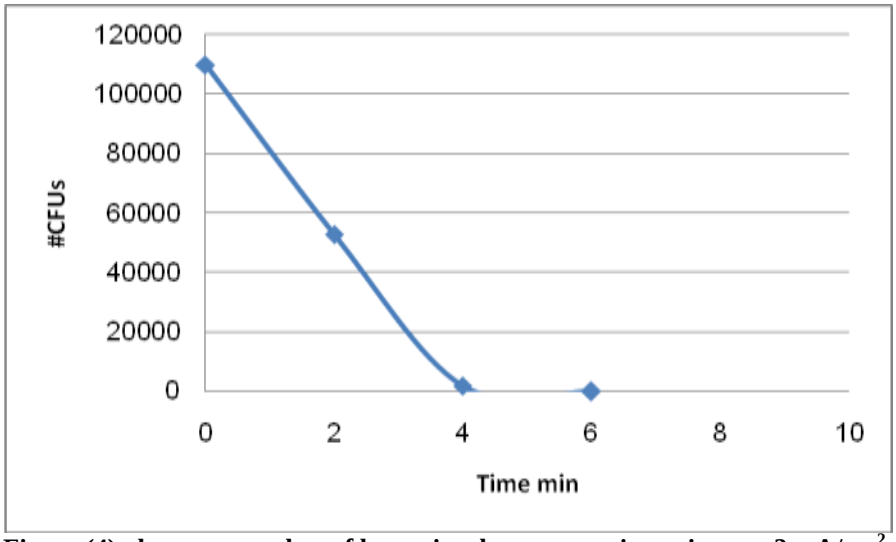

Figure (4). decrease number of bacteria when current intensity was 3 mA/cm^2.

and at 5 ma/cm^2 (V=15.9 volts) the number of bacteria decreased from 110000 to 2400 after 2 minutes .Fig(5).

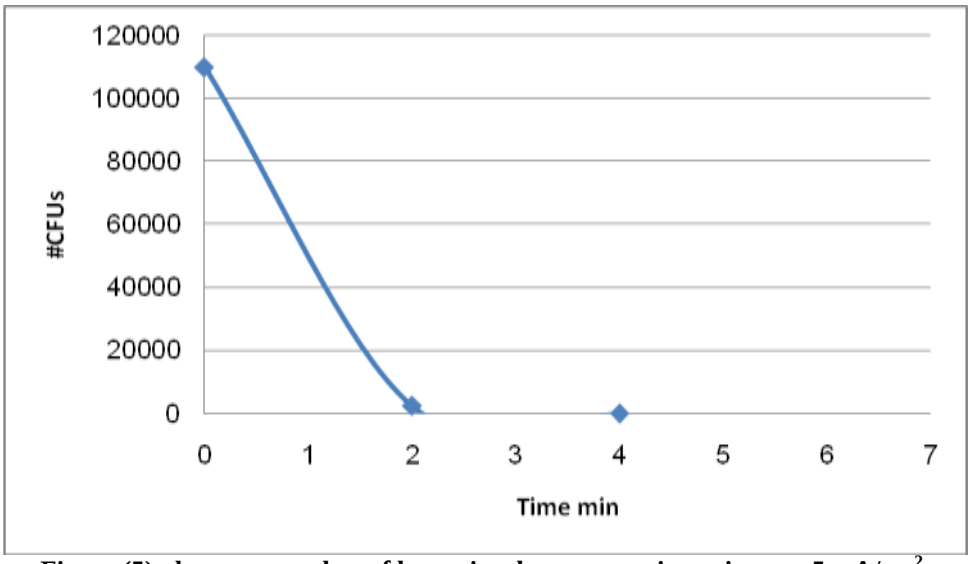

Figure (5). decrease number of bacteria when current intensity was 5 mA/cm^2.

The line chart below Fig (6) shows the results of the last experiments:

The more intensity of the current increases The more efficiency of the disinfection accord of is.

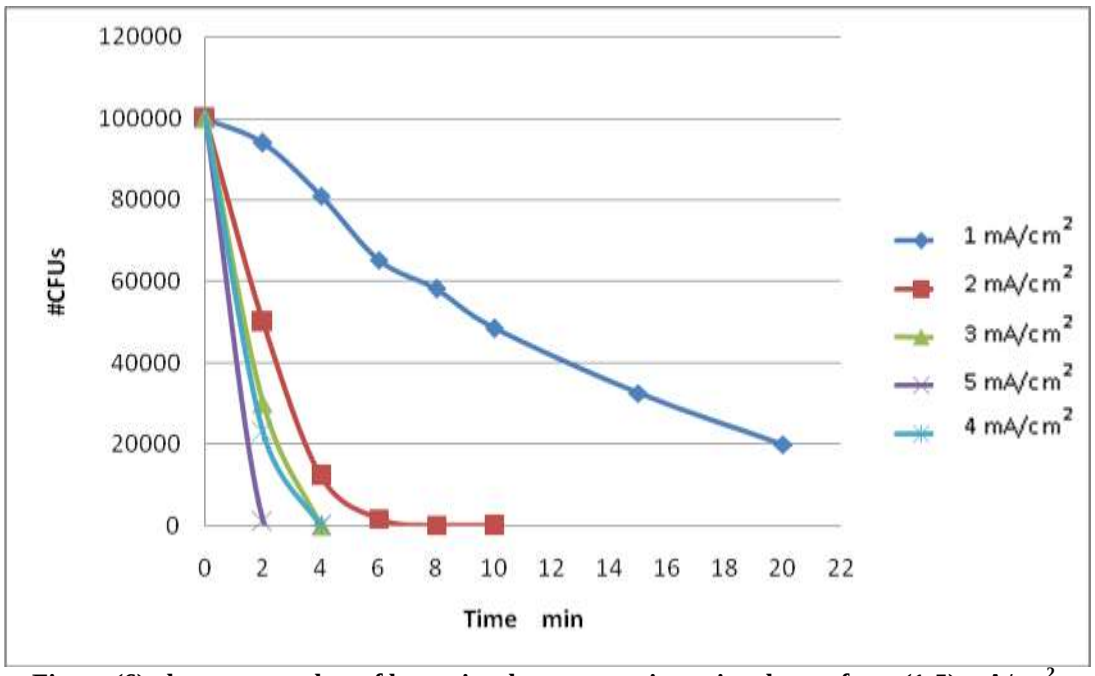

Figure (6). decrease number of bacteria when current intensity change from (1-5) mA/cm^2.

B. Effect of change value of Electrical field:

The distance between two electrodes made from (S.S), was changed in order to change the value of the electrical field : L=1,2,3,4 cm; (where i=2 mA/cm^2).

As it is shown in the following table and the lower line graph The time needed to achieve a perfect treatment also decreased from 15 minutes to 8 minutes .

Table 5. Effect of change value of Electrical field.

#CFUs L=4 cm	#CFUs L=3cm	#CFUs L=2cm	#CFUs L=1 cm	Time
110000	110000	110000	110000	0
105000	95000	60000	37300	2
93500	81000	36200	8400	4
66000	39000	3800	250	6
45800	7000	400	0	8
24000	2000	0		10
0	0			15
				20

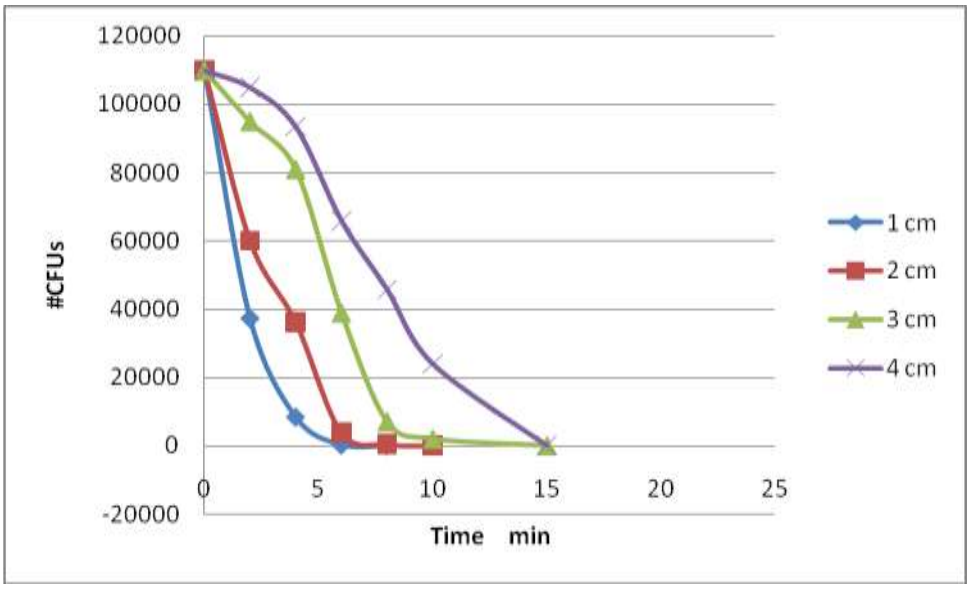

Figure (7). Effect of change values of Electrical field.

C. Effect of Electrode nature :

The nature of electrodes can to large extant affect the efficiency of the electrochemical cells .for example ,test showed that the electrodes made of stainless steal were more efficient than those made of Graphite .

Results and recommendations:

1- The electrochemical cells have good efficiency when they were used to to treat biologically polluted water.

2- Efficiency of electrochemical cells is related with current intensity ,electrical field and electrode nature.

3- It's recommended ,to study the influence of electrochemical treatment on *Sporeing Bacteria* .

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