

Hong Kong Student Science Project Competition 2022

Extended Abstract (Investigation)

(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: JBBC030

Project Title: To Investigate the Effectiveness for Ultra-low Current to Eliminate Bacteria

Project Type: Investigation (Type B)

To our best knowledge and after thorough literature research, as at 30/6/22 , there are / are no* similar works. If there are, the reference links are as below:

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The enhancement our project has made for the existing related products or research is summarized as below:

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*Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.

I. Background

With the stronger antibiotic resistance of bacteria and the spread of coronavirus disease(COVID-19) in recent years, public health is therefore suffering from increasing risk. By observing the surrounding around us under the pandemic, we found that everyday touching of elevators buttons are necessarily required in our daily life , which potentially facilitating bacterial transmission. The general proprietors choose to stick a plastic plate on the buttons and sterilize them at certain regular time intervals.

In our opinion, we believe that the application of ultra low electric voltage and current can help to keep the film clean more efficiently. Since the 1960s, electric voltage, current and field have been explored as physical means for suppressing the growth, and/or killing, of bacteria. It was then found that low electric voltage and current can also effectively kill bacteria and destroy biofilms. [1-18]. We want to prove the effectiveness for ultra-low current to eliminate bacteria by finding out how many percent of bacteria can be eliminated under ultra-low current in a certain time duration. We will compare the number of tested bacteria on the film before and after electric current passes through.

II. Objectives

To improve the efficiency of the cleaning of the films used to cover the elevators buttons in the society.

III. Hypothesis

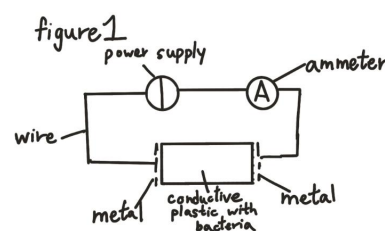
A percentage of bacteria can be killed by ultra-low current.

IV. Methodology

A Brief Methodology

To start with, we need to prepare a piece of conductive plastic film that has two sides, one of which conducts electricity. Sterilize a conductive film with alcohol, wash thoroughly with sterilized distilled water. Nitrifying bacteria, bought from Taobao's fish stall, are prepared and cultured. Two copper strips are fixed on the two sides of the plastic.

With the power supply (3V) turned on, the experiment begins (as shown in figure 1). Pass 0.15 A current through the film for one hour. But the exact current measured is 0.123 A. After the current is applied for an hour, count



the number of bacterial colonies left. Repeat the experiment several times to take the average value. The percentage of bacteria eliminated will be calculated. For the control, the steps will be repeated and extract bacteria on another piece of conductive plastic film with the same size, but without conducting electricity

Repeat the experiment with no bacteria added as a control(as shown in figure2) to ensure the elimination of bacteria is due to electrical current.

V. Results

From the data shown below, it is clear that current is able to eliminate bacteria to a point. The control, under no current, has an average of 11.67 bacteria(cor.to 2 d.p.), while the petri dishes with current(0.123A) have a lower average bacteria of 6.4. Therefore, the petri dishes with current can eliminate bacteria as it has less bacteria in the experiment.

Dish	Control(0A)	0.123A
1	15	10
2	10	32(outlier)
3	17	9
4	14	6
5	4	2
6	10	5
Average	11.66667	6.4

The average of 0.123A has not included the result in dish 2, 32 bacteria, as it is possibly contaminated.

From the calculation $\frac{11.66667-6.4}{11.66667} \times 100\% = 45\%$ (cor. to nearest integer)

$$\frac{11.66667-6.4}{11.66667}$$

This reflects that around 45 percent of bacteria can be eliminated under current.

VI. Conclusion

Around 45 percent of bacteria can be eliminated under ultra-low current in a certain time duration. Through counting the spots formed on the nutrient agar plate with 0.123A current supplied and the control without any current supply, we get the results that around half of the bacteria are successfully killed with 0.123A. However, the overall percentage of the bacteria being eliminated is not as high as our ideal and there are some miscalculation in dish 2 too, indicating that our experiment is not rigorous enough during the processes, there might be some external factors cause the deviation of our results due to our negligence in doing the precaution. It also shows that we need to have some improvement in our experiment. After reviewing the above questions, we might try ultra-low current like 90aA in order to increase the effectiveness in eliminating bacteria with current.

□ **Our project is developed based on our school's previous project and the enhancement is as below:**