Hong Kong Student Science Project Competition 2023

Extended Abstract (Investigation)

(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: JBBC127

Project Title: 金屬海洋 Pollutions in Ocean caused by Heavy Metal Pollutants and Its Impacts

Project Type: Investigation

***To our best knowledge, there ~~are~~ / are no * similar works in the field*; (if there are,) related research links are as below:**

Not applicable

The enhancement our project made / the difference with related research are:

Not applicable

Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.

I. Background

- Provide background information of project and/or state the problem to tackle
- Provide highlights of the **literature review** with the support of pertinent and reliable references
- Provide an overview of work and mention the **research gap that the project is trying to fill**

Nowadays, people are concerned about the environmental pollution caused by their lifestyles and the rapid developments of industrialisation and urbanisation, especially the emission of heavy metal ions towards the marine system. Heavy metals have been a serious issue in Hong Kong and China. The total amount of wastewater experienced a sharp rise from 2001 to 2012, in which the amount of industrial wastewater had declined gradually whereas the amount of domestic wastewater had increased remarkably. Therefore, we have carried out a field investigation to reveal the distribution of heavy metal pollutants in Hong Kong seas and its neighbouring rivers, whilst applying the knowledge of inhibition of catalase in yeasts by the heavy metal ions.

II. Objectives

- State the **aim(s)** of project

Our objective is to find out the quantity of heavy metals distributed in Hong Kong's freshwater and saline water through a simple and efficient test. With the results of which rivers or seas contain a higher amount of heavy metals, we could remind citizens not to use water directly without any treatment because of the harmfulness and negative impacts of the heavy metals and other pollutants. The water samples that we collected cover entire Hong Kong. We could also compare the quantity of pollutants between different areas to find out the differences between them. By doing this experiment, we aim to have a better understanding of Hong Kong's water treatment system and how much will the factories affect the water quality.

III. Hypothesis

- Propose an explanation for a phenomenon and stating how the **hypothesis** can be tested by experiments

Rapid industrial development has produced a staggering amount of chemical waste and sewage, which may contain heavy metal pollutants and cause serious water pollution when discharged into the environment. Therefore, we assume that Hong Kong's water is polluted by the sewage discharge from the factory.

IV. Methodology

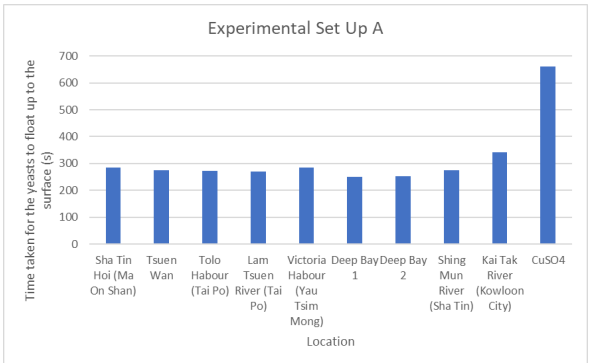
- List out the materials used
- Describe the **experimental protocol** including the set-up of **control experiment** (if any), **repeated experiment** (if any), and its scientific theory
- Indicate with the support of reasons, the **analysis** used in the investigation

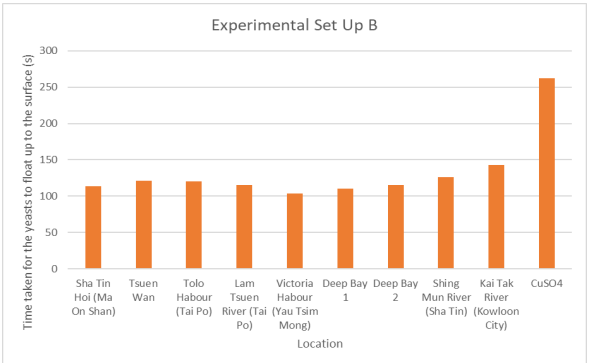
In the experiment, we first add an equal volume of a 10 % yeast solution to a 2% sodium alginate solution and we drop the mixture into a beaker filled ⅓ full with 0.15 M CaCl2 solution with a dropper which gives even pressure so spheres (Figure 3) are of uniform size. We remain the spheres in the solution for about 5 minutes to harden. Making use of the knowledge of the inhibition of the metal ions towards the catalase. We will soap the sphere into 10 water samples, Kai Tak Promenade, Lam Tsuen River, Tolo Harbour, Deep Bay, Tsuen Wan, Ma On Shan, Victoria Harbour, Shing Mun River and CuSO4(aq) for 10 minutes. Next, we put the spheres into a dilute commercial H2O2 solution. We start timing as the sphere touches the surface of the H2O2 solution and keep timing until the sphere reaches the surface again. To make the test as fair as possible, we did the test at the same time in the same room which contained the same temperature. To improve the accuracy, We have experimented two times with different concentrations of 0.05% (Set up A) and 0.075% (Set up B).

V. Results

- Present the **data** with figures, tables or photos
- **Data analysis** (if any, with emphasis on data reliability and the reproducibility based on statistics)
- Interpret the results and its implication
- Discuss **limitation** and compare with existing related works (if any)
- Discuss the importance or impact of the research and how it is applicable to real problems

In general, the water with the least heavy metal ions is Deep Bay (near the beach), followed by Deep Bay (near the factories), Lam Tsuen River, Tsim Sha Tsui, Tolo Harbour, Tsuen Wan West, Sha Tin Hoi and Shing Mun River and the water sample with the most metal ions is Kai Tak. Although we have been trying to carry out a fair test, there are still some variables that cannot be controlled. First, the depth of the river or sea. As different rivers and seas have their depth, we cannot control how deep the water sample is collected from. Second, we cannot control the size of the yeast beads. This might affect the result, as larger yeast beads will take longer to float up.





VI. If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. ***(Word limit: 300 words)***

Our project is related to the 14th sustainable development goal – Life Below Water, as we notice that marine lives in Hong Kong and China are being threatened by rapid economic growth. According to the *Epidemiology of HIV/AIDS in China: recent trends Global Health Journal Volume 1* and *A Study of Heavy Metal Pollution in China: Current Status, Pollution-Control Policies and Countermeasures*, industrial sewage is discharged into the Pearl River Estuary (PRE) from the coastal cities. It is estimated that the annual amount of industrial sewage has reached approximately 200 million tons. Among different types of pollutants in the sewage, heavy metals are of special concern since alarming levels of Cd, Pb and Zn were annually discharged into the Pearl River Delta, potentially causing far-reaching ramifications on human health and the ecosystem. Perceiving that these heavy metals are mostly the inhibitors of enzymes, we innovate to apply the immobilised yeast system in the detection of heavy metals, which is a simple, inexpensive, biological and environmental-friendly test without the need for advanced laboratory facilities, encouraging the practicality of water detection in daily life and brings up the attention towards lives in water.

VII. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. ***(Word limit: 300 words)***

Not applicable

VIII. Conclusion

- Make a **data-driven** conclusion of the project and the way forward of the research
- Justify if the proposed project meets the objective(s)

In conclusion, in this investigation, we have found that water around Hong Kong does contain a high amount of heavy metals which will affect people's health and biological system. Citizens should be reminded not to use water directly without any treatment because of the harmfulness and negative impacts of heavy metals and other pollutants. By using the yeast to investigate, we discover an easier and more convenient way to determine whether the water contains heavy metal or not.

□ Our project is developed based on previous project and the enhancement is below:

Not applicable