

## Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation Design Proposal)

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

**Team Number: SBBC256**

**Project Title: A proposal to test the efficacy of biochar to remove pollutants in water and its application**

**Project Type: Investigation Design Proposal**

**To our best knowledge and after thorough literature research, as at 24/06/2022, there are / are no\* similar works. If there are, the reference links are as below:**

/

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

/

\*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

- 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**

Water pollution problem has been observed worldwide, risking the health of human and marine organisms. It also causes food safety problems when fishes or seafood are caught from water in polluted area. To tackle the problem, activated carbon has been the go-to material for filters. Different types of water filtration system are also available. However, most of these methods have the disadvantage of high production or maintenance cost, or not being able to handle high flow rate of polluted water.

During the process of literature review, we have found that biochar, produced from pyrolysis of organic materials, may have an adsorption ability for organic pollutants comparable with that of activated carbon and a higher ability to adsorb inorganic pollutants. We also noticed that household food waste contributes to a large proportion of waste in Hong Kong. Therefore, we are interested in the up-cycling of food waste as raw materials to produce biochar, which is then used in water purification.

### II. Objective(s)

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

In this proposal, we aim to propose methods to test for efficiency of biochar in removing pollutant in water. With a positive attitude towards the use of biochar in removing pollutant in water as supported by literatures, we also suggest incorporating biochar in existing water filtration system and replacing activated carbon in water purification.

### III. Hypothesis

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

After treating samples with biochar, both the concentration of organic pollutants and that of inorganic pollutants can be lowered.

### IV. Methodology

- List out the materials to be 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** to be used in the investigation

Adsorption ability of biochar is provided by porous structures formed during pyrolysis. With high porosity and 'specific surface area', molecules and impurities will be adsorbed to the pores when water is in contact with biochar sample.

Two methods are proposed for testing the efficiency of biochar to remove organic and inorganic pollutants respectively. Methylene blue and copper ion are chosen to represent the two types of pollutants respectively as they are 1) relatively safe to be handled by students; 2) coloured making it possible to observe the adsorption ability by simply measuring the change in colour intensity of sample. For each test, biochar sample is added to the solution representing each type of pollutant. Biochar is separated from the treated sample, which is then transferred to a cuvette to measure absorbance of sample at 660 nm.

The colour intensity of the solution before and after being treated with biochar compared to evaluate the efficiency. The smaller the reading, the lower the concentration of pollutant remaining in the treated sample, the higher the efficiency of biochar.

### V. Expected Results and Impact of research

- Describe the **expected results** with the selected approach
- 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

Both test methods made use of the principle that after adsorption by biochar, colour intensity of treated sample will decrease. By using a spectrometer to quantify the change in colour intensity, we can compare the efficiency of biochar with other existing filter materials.

Limitations of our methods:

- It is difficult to produce biochar in the school laboratory
- The methylene blue may not be widely representative for all organic pollutants as they have different molecular structures.

The research is important because it links water purification by biochar to up-cycling of food waste. It gives insights into the potential of biochar to be added as a new component in existing water filtration system, or even replacing some of the methods by being more sustainable in the long run.

---

## VI. Conclusion

- Make a conclusion of the design project and the way forward of the research

**We propose to test the efficiency of biochar through measuring the adsorption ability for methylene blue solution and copper (II) ions. As for the application of biochar, we can put it into filters at fish rafts, oyster beds or other seafood breeding farms to replace existing water filtration systems as it has the advantage of adsorbing both organic and inorganic pollutants, as long as removing odour.**

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