

## Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Invention)

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

**Team Number: JABC264**

**Project Title: AlgoPure 多功能清新機**

**Project Type: Invention**

**To our best knowledge and after thorough literature research, as at 01/06/2022 , there are / ~~are no~~ \* similar works. If there are, the reference links are as below:**

<https://doi.org/10.1016/j.scitotenv.2020.142168>  
<https://doi.org/10.1016/j.enpol.2008.12.025>  
<https://www.researchgate.net/publication/344389525> Algal biomass harvesting for biofuel production

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

To combine the air and water purifying capabilities of microalgae in a single invention to universalize the efficient utilization of microalgae.

**\*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**

In the 21st century, air pollution and increasing greenhouse gases such as carbon dioxide or nitrous oxide are intensifying global warming, in addition to a lot of water being polluted by industrial activities. At the same time, biofuel production from microalgae is rapidly increasing in potential. Fortunately, scientists have found that not only does algae have a higher photosynthetic efficiency than terrestrial plants, but the capture of carbon dioxide by algae reduces combustion products such as NO<sub>x</sub> and SO<sub>x</sub> at the same time as they are used as nutrients for the algae.

On top of that, wastewater has been found to be an effective microalgae nutrient and algal biomass can even become a material for recovery of heavy metals from industrial wastewater.

However, the largest problem concerning microalgae utilization to date is that it is still not popularized. Therefore, by creating a product utilizing microalgae, we hope to get one step closer to being able to bring this new technology to industrial areas and even everyone's own households, while trying to mitigate the global warming problem caused by greenhouse gases and contributing to the creation of biofuel.

### **II. Objectives**

This project aims to lend a helping hand towards fighting climate change and environmental pollution by utilizing microalgae to reduce greenhouse gas concentration, and pollution, such as nutrients and metals, in water; while producing sustainable biomass

### **III. Methodology**

A lot of tools and equipment have been used in this project, including a drill to drill holes not in the original container, General Purpose Sealant to affix the valve and water input pipe and microscopes to examine experimental results.

We have focused on experimenting aspects not covered by literature. We have tested and confirmed the reliability of the product by filling it with water and repeatedly testing water circulation with a water pump. No leakage has been found. Another experiment is about the effects of different types of filters on concentration of residue or purity of filtrate. To do this, we poured around 5mL of water with microalgae into each filter and examined the results with a microscope.

#### IV. Design of Invention

AlgoPure makes use of a transparent cylindrical container to create a custom photobioreactor. With a cylindrical container, light is magnified by the water and we can ensure a more uniform light level across the whole container. A water pump is used for circulating water every time the life cycle of microalgae ends, pumping new nutrient water into the system while nutrient-free water flows out of the container through a water valve at the bottom.

After the microalgae have absorbed nutrients and undergone photosynthesis until the end of its life cycle, it would be carried along by the water flow out of the container, but stopped by a filter around the exit.

#### V. Application / Market Need

AlgoPure is suitable for use in any place as long as it has a water supply. Recommended areas are areas near industrial areas or roadsides. The energy requirement to power the product is low as it only needs power for water pump usage. The market need is increasing as biofuel from microalgae is a budding technology that has potential to be the replacement for non-sustainable fuel sources. Efficiency of carbon fixation and water purification may be limited to the concentration of nutrients from air and water sources. However, AlgoPure is still in the prototype development stage and so far, no related works have tested the possibility of combining the carbon-fixation efficiencies and nutrient-absorbing rates of microalgae to maximize its efficiency and efficacy of benefiting the environment.

#### VI. Conclusion

This project is to utilize the capabilities of microalgae to purify air and water while producing biomass. Research has shown that the microalgae is able to both absorb air pollutants and nutrient wastes from water, and in our own experiments, we were able to successfully filter out microalgae biomass. Thus, the invention meets our objective. In the future, we will look for the increase in efficiency of purification by increasing aeration and experimenting with more species of microalgae.



**A stage of aeration and water circulation testing of AlgoPure.**