

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: JDPE064

Project Title: Growing Bacillus Bacteria on Concrete to Combat Climate Change

Project Type: Investigation Design Proposal

To our best knowledge and after thorough literature research, as at 30/06/2020 , 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

Growing bacteria on top of the surface of cement is a novel method to increase the carbon dioxide (CO₂) consumption of bacteria. This study aims to investigate the effect of CO₂ consumption of Bacillus bacteria growing on the surface of cement in comparison with the traditional method of mixing cement with bacteria. In addition, this study also provides the foundation for future investigations and applications, in order to provide a more innovative and sustainable way for the construction industry.

II. Objective(s)

This investigation aims to promote sustainable concrete aggregates for the construction industry, in accordance with Goal No. 9, Industry, Innovation, and Infrastructure in the The 17 Goals concluded by the United Nations

III. Hypothesis

We hypothesize that surface bacteria growth rate is equal or better than the growth rate of bacteria mixed with the cement and the carbon dioxide recapture is better with the bacteria growing on the surface of the cement than those where bacteria were mixed with the cement.

IV. Methodology

The following materials are required, general purpose cement GPC, Bacillus subtilis bacteria, growth agar, mixture proportions for the reinforced concrete.

Equipment required including an anaerobic incubation chamber, standard agar plate, a microbiology fume hood, and sterilizing equipment. The limitation is timing with the bacterial growth, once it is started, observations need to be made every 24 hours for the next 144 hours.

First, we need to prepare the concrete proportion, and begin the mixing. At the same time, we need to prepare the bacteria in the flask and ready for plating at the control agar and the cement mix. One group of bacteria is mixed with the cement to form bacterial concrete. One group is plate on top of the cured concrete plate without any agar. Then we observe the growth of bacteria after 48 hours. The separate

batch will be used to observe the carbon dioxide absorption by placing sensors in the incubation chamber to observe the carbon dioxide consumption, temperature, humidity, and oxygen level. The plate which the cement is mixed with the bacteria will be compared with the plate that the bacteria grow on the cement surface.

V. Expected Results and Impact of research

Since the experiment had been conducted in a very restrictive environment with many limits, it is hard to conclude for now for the actual result of the experiment. However, some expected results can be found with surface bacteria having a higher rate of CO₂ consumption.

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We hope this investigation can spark interest in the subject of adding bacteria to concrete. As the research is still in its early stages, more data is required, and later investigations and experiments may be able to reveal more about the effects of Bacillus on concrete, as well as discover ways to maintain the shelf life of Bacillus bacteria. We hope that, once matured, the use of bacteria in concrete production can make the construction industry more sustainable as a whole.

VI. Conclusion

The surface application of bacteria on top of the concrete is for now the most sustainable way and has many advantages for combating climate change, because of its higher rate of CO₂ consumption. We conclude that using Bacillus is an eco-friendly ingredient for any concrete used in any construction projects in order to promote a more sustainable future.

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