CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Jonghyun Hong; Jad Soucar

Project Number

38423

Project Title

An Alternative Approach to Synthesizing Concrete,Using the Salt Water Carbonate Buffer System, and the Cocolithophore

Abstract

Objectives/Goals

The concrete industry creates over 86.7 million metric tons of concrete every year, and unfortunately emits over 3 billion tons of carbon dioxide as well. In order to minimize the carbon dioxide emission from the concrete production industry, our project sought to find an environmentally sustainable method that would allow for the formation of a zero emission calcium carbonate based concrete. The main target was to achieve a form of calcium carbonate crystallization around a series of aggregates, to not only create a firm concrete like structure, but also eliminate the mining and burning of limestone.

Methods/Materials

Numerous combinations of CaCl2, Ca(OH)2, and Mg(OH)2 were dissolved in solutions and placed in a modified vacuum/gas chamber with different aggregates (such as sand and gravel). The chamber was then vacuumed out, and saturated with CO2 to promote the formation of carbonate. After multiple trials, we experimentally determined the correct ratio of calcium chloride, magnesium hydroxide, water, carbon dioxide, And aggregate ,to maximize the amount of calcium carbonate created. The calcium carbonate then fused together the aggregate, to create a concrete like structure.

Results

The experimentally determined ratio for the ingredients CaCl2, Mg(OH)2, Ca(OH)2,CO2 and water in moles is, 6.25 / .6 / 2.5 / 192.5 / 1. With this ratio, we gained the ability to synthesize a calcium carbonate-based concrete that could withstand a substantial amount of pressure. When testing the "hardness" of the newly synthesized concrete according to the Moh's test of hardness, our concrete received an average of 7-8.

Conclusions/Discussion

We predict that the addition of carbonic anhydrase and cocolithophore will catalyze the saltwater carbonate buffer system and the formation of calcium carbonate, to create more a more durable concrete structure. Additionally the E.Huxleyi strand of cocolithophore will provide the calcium carbonate within the concrete, a unique microscopic spherical shape, which would increase the strength of the concrete. Conclusively our novel process to create concrete will be applied instead of concretes such as Type l (cinder blocks, benches), and V1 concrete (decorative) and Insulator-based concrete.

Summary Statement

We created inudstrial grade concrete out of carbon dioxide and various other ingrediants, to effectivly remove carbon from our atmosphre and toxic metals from our enviorment.

Help Received

We designed and developed our prodceudre and the machine necasary to complete it, with the feedback of Prof. Jamil Momand in the department of Chemistry & Biochemistry at Cal State LA.