Mitigation of Excess CO_2 content in the Atmosphere from the Sri Lankan Transportation System

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1 INTRODUCTION

The excessive emission of adverse gases like CO_2 into the atmosphere from the transportation sector has become a serious topic of discussion amongst many researchers and environmental enthusiasts around the globe. Sri Lanka is a country well known for its tourist nature but ironically with an underdeveloped transportation system, which puts the environment in harm's way. Transportation is now considered a major contribution to increasing the amount of CO_2 content in the atmosphere by many climate change forums. Due to the increasing population, the exponential growth in the needs of people directly affects the transportation system as it has become embedded as a building unit of any economy around the world.

Sri Lanka is still a developing nation. The transportation system that prevails in Sri Lanka has to improve as it could be crucial for the country to set a better example on an international level. There are methods and suggestions available globally to deduct the excessively existing CO_2 content. Here, we are focusing more on the emission from the transportation system, intending to reduce the CO_2 content from the Sri Lankan Road transportation system. We aim to suggest a few ideas to mitigate the excessive CO_2 present in the atmosphere with the help of different clay materials and vegetation with which we conducted controlled tests in our lab. Our plan for CO_2 reduction includes the preparation of a module in the shape of an "A" to place CO_2-absorbing clay pots and plant species and using suggested clay material for road paving works. Before doing this, these specimens were subjected to different tests to satisfy the criteria needed to achieve the desired results.

2 MATERIALS AND METHODS

2.1 Methodology

Our main scope is to find a solution to mitigate the excessive emission of CO_2 from the road transportation system in Sri Lanka. The following are the steps and tests carried out to summon a solution to impact a positive development in atmospheric air quality.

With the knowledge gathered from several research papers and literature reviews about CO_2-absorbing materials and vegetation, our first step was to find suitable clay pots for our research. Then we had to find the soil type used to prepare it. As the next step, we had to find a piece of equipment for measuring the CO_2 content in the atmosphere. We made a CO_2 detector for that purpose, which was calibrated afterward.

Two sample boxes were used in control experiments. A smoke sample was continuously inserted into the boxes, one with the clay pots, clay tiles, clay bricks, and plants and the other with the CO_2 detector. The experiment was carried out until an acceptable result was obtained. The procedure was repeated for different plants and quantities of clay materials for different combinations. After getting an acceptable result our final step was to prepare a CO_2 reduction model.

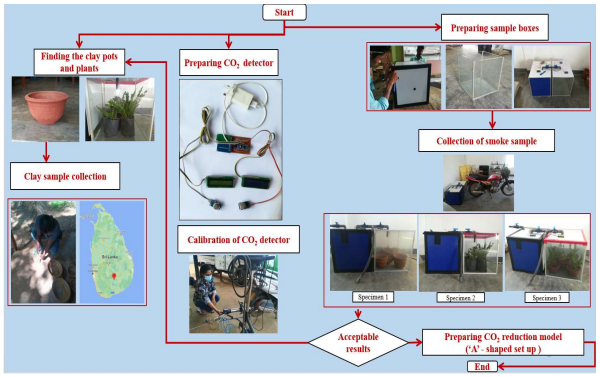

Figure 1: Methodology Flow Chart

2.2 Preparation of CO_2 detector

The CO_2 detector is controlled by an MQ135 gas sensor and also it is coordinated by Arduino IDE software. It can measure the CO_2 content in the atmosphere up to 2000- 2500 ppm. It takes at least 20 minutes to give the correct ppm value without any fluctuations.

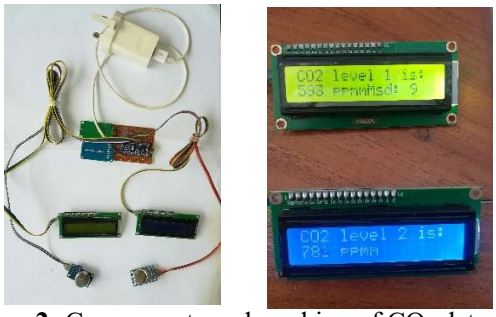

Figure 2: Components and working of CO_2 detector

2.3 CO_2 absorption tests

Figure 3: Testing setup

Two sample boxes are used for the testing. One box is for the sample and the other box is for the saturated emission from the vehicle. A Bajaj caliber 110 cc bike was used for collecting the emission sample. For this testing, some Boston fern plants and a number of Clay pots were used as the samples as shown in Figure 3.

3 RESULTS AND DISCUSSION

3.1 CO_2 absorption outcomes of the samples used

As the first step, we inserted the emission sample for about 3 minutes into the testing setup. Then, they were monitored for about 30-35 minutes for obtaining the saturated results.

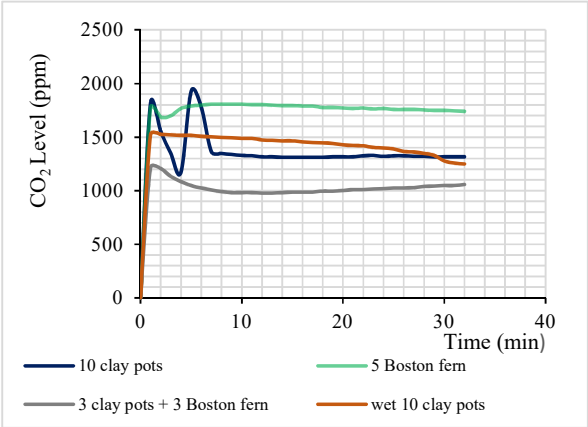

Figure 4: CO_2 absorption for the different tests

From these results, it can be summarized that dry clay pots show high CO_2 absorption compare to the wet clay pots and the Boston plants. Also, the absorption of the dry clay pots was 17% while the absorption of the wet clay pots was 12% and Boston plants was 10%. In order to increase the absorption of CO_2, the surface area of the clay materials should be increased and it can be applied in the transportation sector for sidewalk construction as shown in Figure 5.

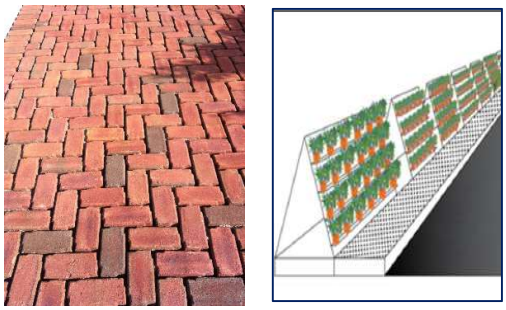

Figure 5: Sidewalk using clay materials and plants

Also, from the sieve analysis and Atterberg limit test of the soil which is used for the clay pot preparation, it can be concluded that the Clayey sand and Sandy clay mixture is the best option based on the USCS classification to prepare the clay products for the transportation sector with consideration of high CO_2 absorption.

3.2 Authorship

The corresponding author is responsible for ensuring that all authors have seen, approved, and are fully conversant with the contents of the paper. All authors are responsible for the accuracy of the manuscript.

4 CONCLUSIONS

Based on the studies and suitable processes, it can be concluded that some plant species and clay products can reduce CO_2 content to a certain level in the atmosphere. According to that plants absorb around 10% and clay products around 17% of CO_2 from the atmosphere. All the results obtained have been depicted using a table and a graph. Finally, we would like to propose that using vegetation and these clay material in whichever manner is suitable would mitigate the CO_2 content emitted from the transportation system in Sri Lanka to a certain extent. And using such clay material for pavements would help in reducing the CO_2 content directly by absorption and indirectly by the reduction in cement usage.

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