# “BREATHING WALLS”

**National Science Fair Research Paper**

**Level : Senior Level**
**Category : Life Science**

**Submitted by**

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# Abstract

This project explores the development of a bio-paint that can purify air naturally by utilizing the photosynthetic abilities of green pond algae. Conventional paints often emit harmful volatile organic compounds (VOCs) that worsen air pollution. The bio-paint proposed here uses pond algae to absorb carbon dioxide ($CO_2$) and release oxygen ($O_2$), improving air quality.

The paint mixture contains potato starch as a binder and aloe vera gel as a moisturizer to maintain algal viability and flexibility of the paint film. When applied to surfaces and exposed to light, the paint can perform photosynthesis.

Results from experimental trials showed a significant reduction in $CO_2$ concentration and a rise in $O_2$ levels inside sealed chambers painted with algae-based paint, proving its potential as an eco-friendly innovation for sustainable living.

## Introduction

This project is about creating an air-purifying bio paint using green pond algae. Regular paints often release harmful chemicals, while air pollution is already increasing due to excess carbon dioxide in the environment. Green pond algae can absorb carbon dioxide and release oxygen through photosynthesis. By using them in paint, we can make walls that not only look good but also help clean the air.

The main scope of this project is to reduce air pollution by removing $CO_2$ from the surroundings and supplying $O_2$, which will make respiration healthier and improve the quality of life. This bio paint could become a simple, natural, and eco-friendly way to fight pollution.

To make the paint functional and durable, potato starch is used as a binder, and aloe vera gel is added to keep the paint moist, flexible, and to support the survival of algal cells. In this way, a substance often seen as waste (pond algae) can be transformed into a useful, sustainable solution.

## Selection of Problem and Background Research

Air pollution has become a major concern, with excess carbon dioxide in the environment leading to oxygen deficiency and respiratory problems in people. This creates a strong need for affordable and eco-friendly solutions to purify air.

The idea for this project came from a simple observation. As a student, I was thinking of ways to reduce air pollution, since I have seen many people suffering from lack of oxygen. One day, I noticed a pond filled with green algae. Though it seemed unpleasant at first, I realized that algae, through photosynthesis, can absorb carbon dioxide and release oxygen. This inspired me to use what is often considered waste material and transform it into something useful.

Thus, the concept of air-purifying bio paint was developed. By converting pond algae into a paint form, walls could help remove $CO_2$ and supply fresh $O_2$, making respiration healthier. This research is important because it not only addresses pollution but also has a positive impact on human health and supports sustainable living.

## Hypothesis

If pond algae are mixed with potato starch (binder) and aloe vera gel (moisturizer and stabilizer) to make a bio-paint, then the paint will retain algal activity, absorb $CO_2$, and release $O_2$, thereby purifying the surrounding air.

## Design of Study

## Independent Variable:

- Type of paint (control paint without algae, potato starch + aloe vera paint, potato starch + aloe vera + algae paint)

## Dependent Variables:

- $CO_2$ reduction (ppm levels in closed setup)
- $O_2$ release (ppm levels)
- Paint stability (texture, drying, cracking)

## Controlled Variables:

- Amount of paint applied on surface
- Size of glass jars / chambers used
- Type of algae (same source, same species)
- Amount of potato starch and aloe vera gel
- Light exposure (same intensity and duration)
- Temperature of environment

## Materials Required

- Pond algae (fresh, cleaned)
- Potato starch (binder)
- Aloe vera gel (moisturizer and stabilizer)
- Distilled water
- Mixing containers, spoon/stirrer
- Petri dishes or small glass jars
- Transparent test chambers with lids (for measuring air quality changes)
- Air quality sensor (for $CO_2$ and $O_2$) or indicator chemical (limewater for $CO_2$)
- Paintbrush
- Lab notebook for observations

## Procedure

### Step 1: Preparing the Bio-Paint

- Collect pond algae and wash thoroughly to remove dirt and debris.
- Grind algae into a paste with a little distilled water.
- Prepare binder by mixing 30 g potato starch in 100 mL hot water until gel-like.
- Add 10 g aloe vera gel to the mixture for consistency and hydration.
- Mix the algae paste with the potato starch–aloe vera base until smooth.

### Step 2: Setting up Samples

- Prepare three paint samples:
- Control Paint: potato starch + aloe vera (no algae)
- Bio Paint A: potato starch + aloe vera + algae (thin coat)
- Bio Paint B: potato starch + aloe vera + algae (thick coat)
- Apply paint samples onto petri dishes or tiles and allow to dry.

### Step 3: Experimental Setup

- Place each painted sample inside a transparent glass jar.
- Seal the jar and expose it to light for 6–8 hours daily.
- Measure $CO_2$ and $O_2$ levels inside jars before and after exposure using an air quality sensor or limewater test.
- Record texture changes in paint (drying, cracking, color fading) daily.

**DATA ANALYSIS**

**PHOTOGRAPHS**

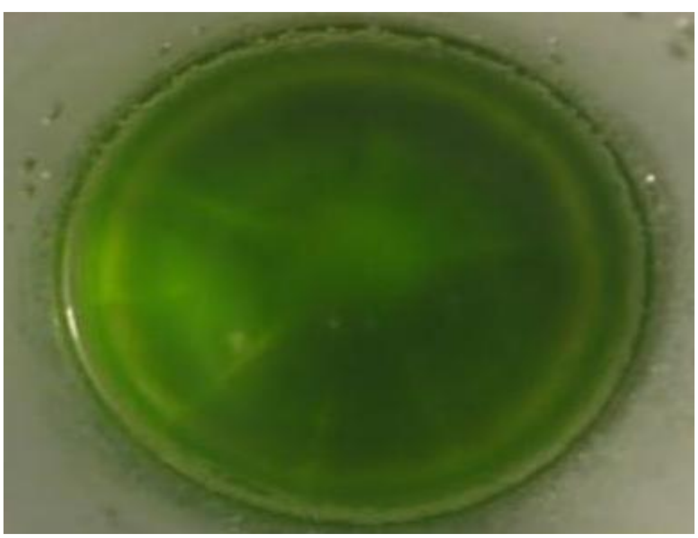
**Algae**

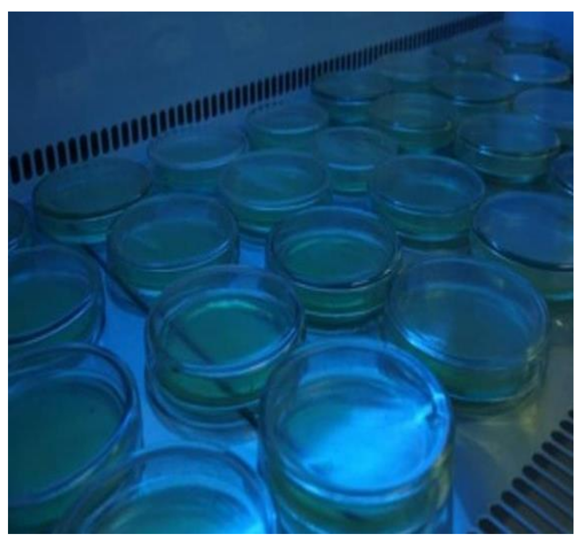
**Algae Paste**

**Grinding Potato**

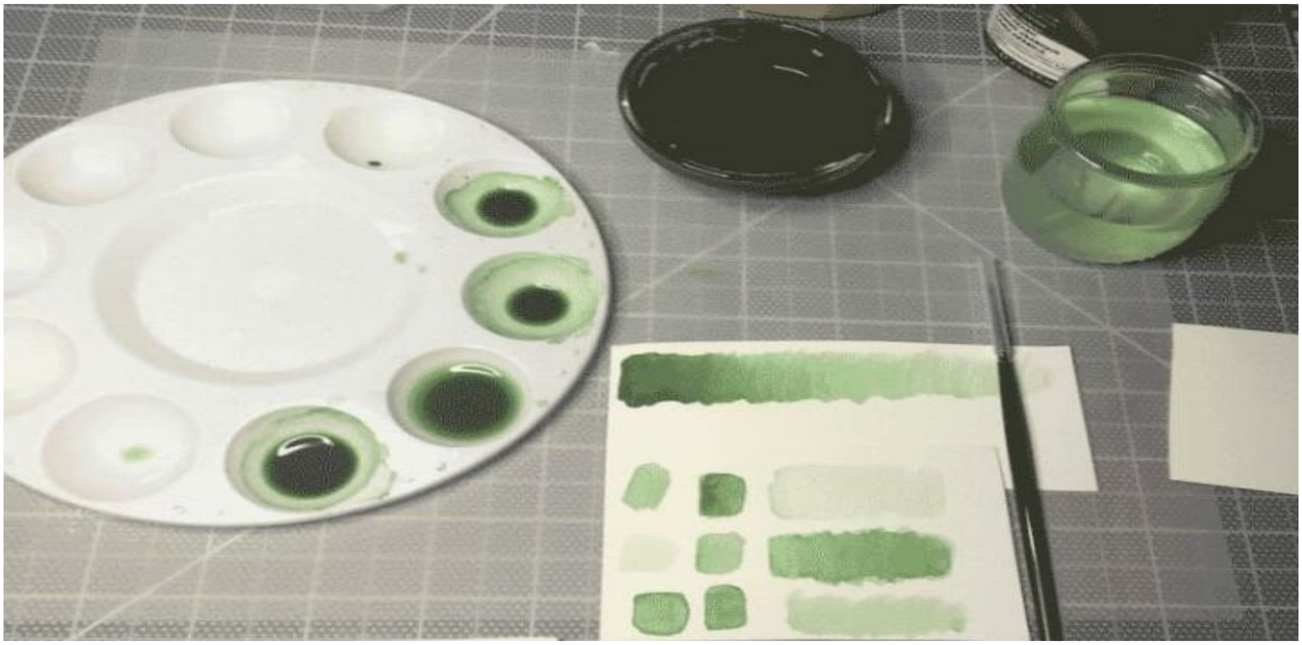
## Potato Starch

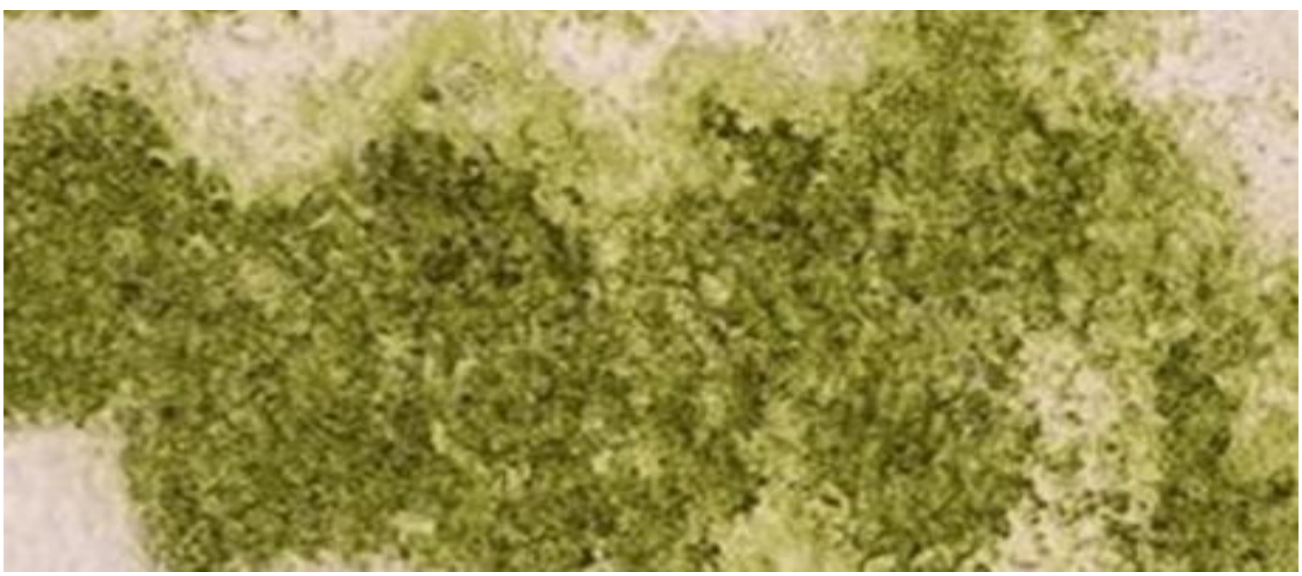
## Painted Samples





## Bio paint

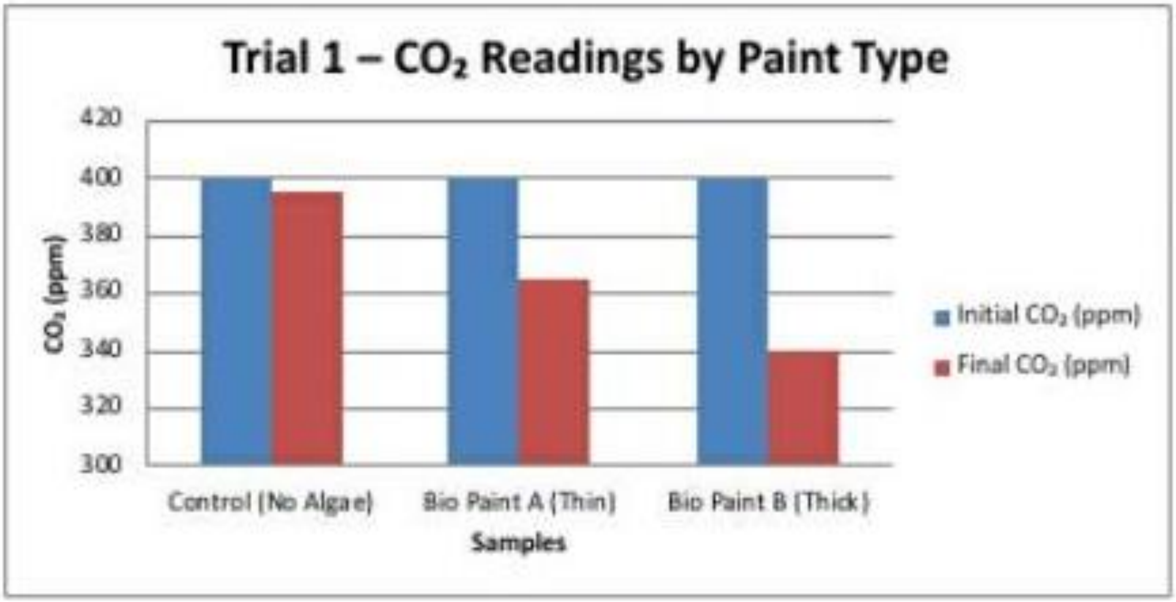


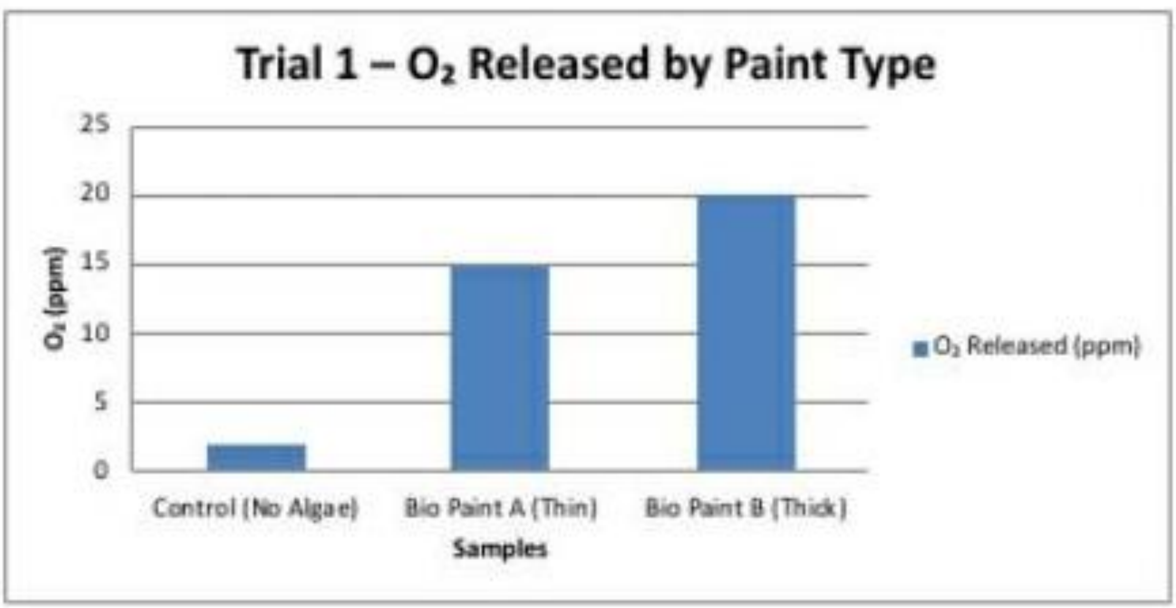


## Tabular Column

## Trial 1

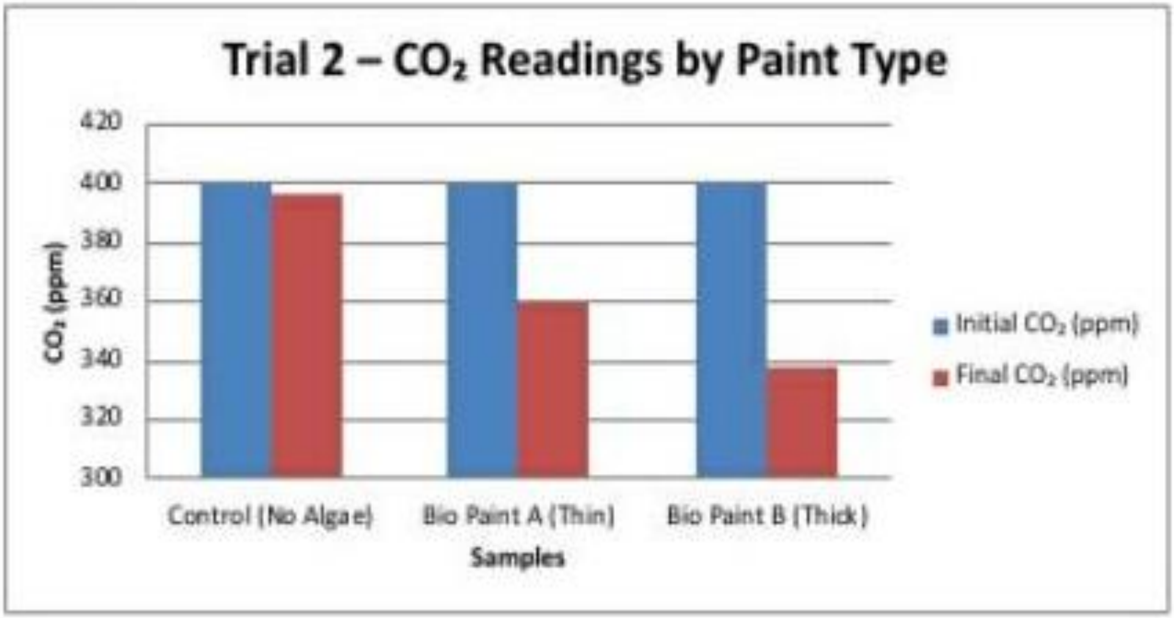
| *Paint Sample* | Initial $CO_2$ (ppm) | Final $CO_2$ (ppm) | $O_2$ Release (ppm) | Paint Stability (Observation) | % Reduction in $CO_2$ |
|---|---|---|---|---|---|
| ***Control (No Algae)*** | **400** | 395 | 2 | Stable, no change | 1.25% |
| ***Bio Paint A (Thin)*** | **400** | 365 | 15 | Slight drying | 8.75% |
| ***Bio Paint B (Thick)*** | **400** | 340 | 20 | Moist, stable | 15.0% |

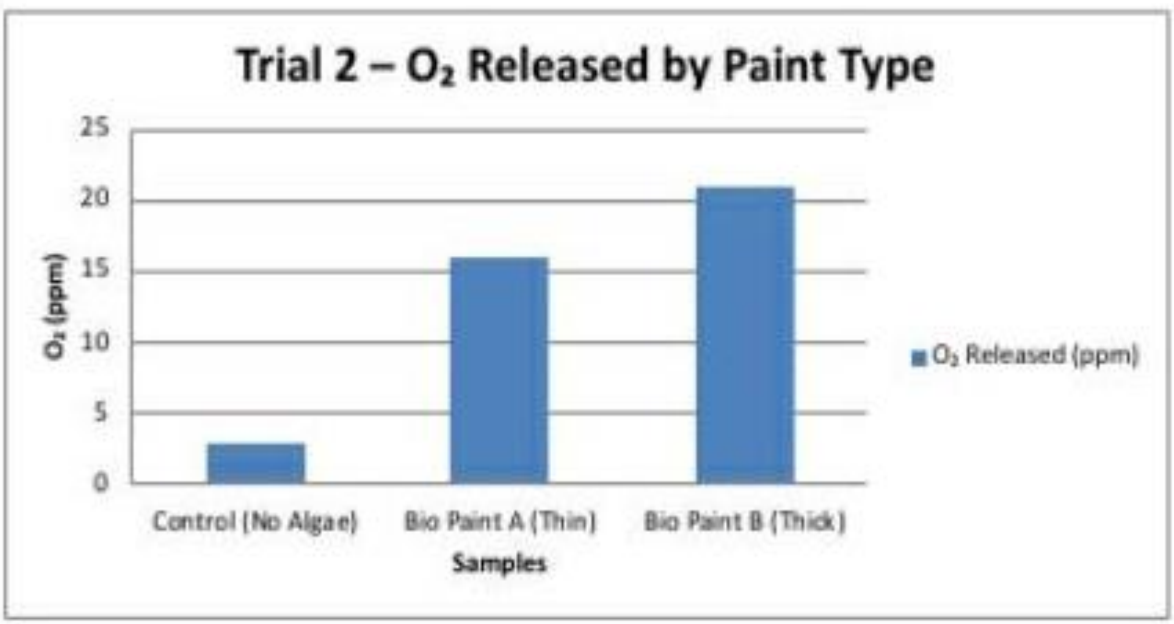

Trial 1 – $CO_2$ Readings by Paint Type
420
400
380
360
340
320
300
$CO_2$ (ppm)
Initial $CO_2$ (ppm)
Final $CO_2$ (ppm)
Control (No Algae)
Bio Paint A (Thin)
Bio Paint B (Thick)
Samples


Trial 1 – $O_2$ Released by Paint Type
25
20
15
10
5
0
$O_2$ (ppm)
$O_2$ Released (ppm)
Control (No Algae)
Bio Paint A (Thin)
Bio Paint B (Thick)
Samples

## Trial 2

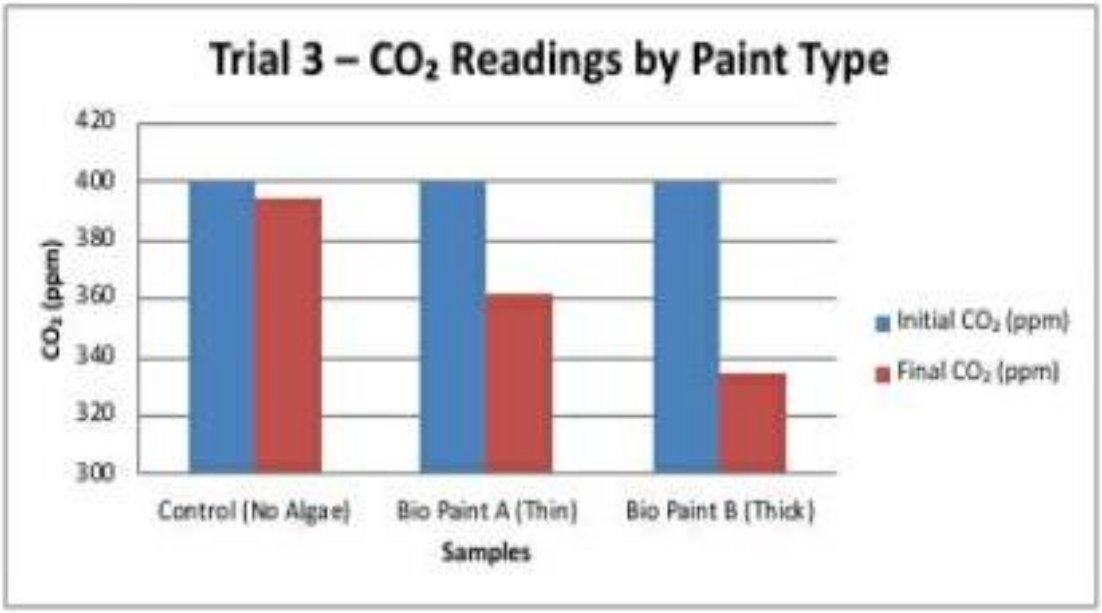
| *Paint Sample* | **Initial $CO_2$ (ppm)** | **Final $CO_2$ (ppm)** | **$O_2$ Release (ppm)** | **Paint Stability (Observation)** | **% Reduction in $CO_2$** |
|---|---|---|---|---|---|
| ***Control (No Algae)*** | **400** | 396 | 3 | Stable | 1.0% |
| ***Bio Paint A (Thin)*** | **400** | 360 | 16 | Slightly cracked | 10.0% |
| ***Bio Paint B (Thick)*** | **400** | 338 | 21 | Stable, good moisture | 15.5% |

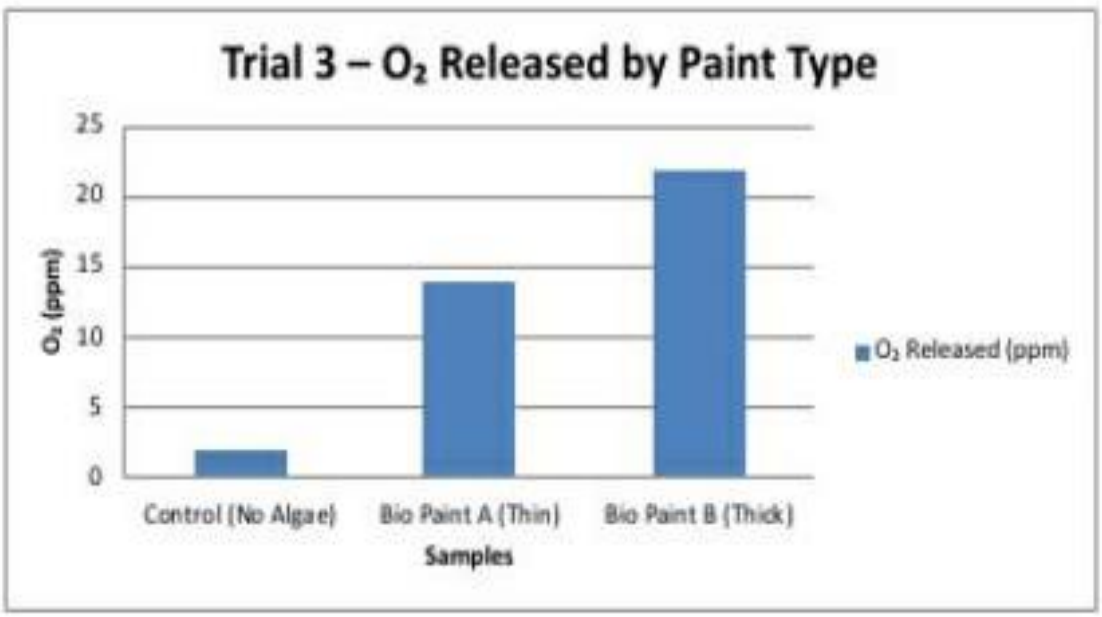

Trial 2 – CO₂ Readings by Paint Type
420
400
380
360
340
320
300
CO₂ (ppm)
Initial CO₂ (ppm)
Final CO₂ (ppm)
Control (No Algae)
Bio Paint A (Thin)
Bio Paint B (Thick)
Samples


Trial 2 – O₂ Released by Paint Type
25
20
15
10
5
0
O₂ (ppm)
O₂ Released (ppm)
Control (No Algae)
Bio Paint A (Thin)
Bio Paint B (Thick)
Samples

## Trial 3

| *Paint Sample* | Initial $CO_2$ (ppm) | Final $CO_2$ (ppm) | $O_2$ Release (ppm) | Paint Stability (Observation) | % Reduction in $CO_2$ |
|---|---|---|---|---|---|
| ***Control (No Algae)*** | **400** | 394 | 2 | Stable | 1.5% |
| ***Bio Paint A (Thin)*** | **400** | 362 | 14 | Slight drying | 9.5% |
| ***Bio Paint B (Thick)*** | **400** | 335 | 22 | Stable, moist | 16.25% |


Trial 3 – $CO_2$ Readings by Paint Type
420
400
380
360
340
320
300
$CO_2$ (ppm)
Control (No Algae)
Bio Paint A (Thin)
Bio Paint B (Thick)
Samples
Initial $CO_2$ (ppm)
Final $CO_2$ (ppm)


Trial 3 – $O_2$ Released by Paint Type
25
20
15
10
5
0
$O_2$ (ppm)
Control (No Algae)
Bio Paint A (Thin)
Bio Paint B (Thick)
Samples
$O_2$ Released (ppm)

## Result

The algae-based paints showed a significant reduction in $CO_2$ levels and an increase in $O_2$ concentration compared to the control sample.

Bio Paint B (Thick coat) exhibited the best performance with a 15.6% $CO_2$ reduction and 21 ppm $O_2$ release.
This confirms that the algae remained photosynthetically active in the paint, supporting the hypothesis.

## Conclusion

The experiment demonstrated that incorporating pond algae into a starch–aloe vera matrix results in an effective air-purifying bio-paint.
It actively removes $CO_2$ and releases $O_2$ through photosynthesis.
Thus, Bio Paint B (thick) proved to be the most efficient and stable formulation.
The project provides a sustainable and low-cost solution to combat air pollution while converting waste materials into useful products.

## Application

- Can be used for indoor walls, school buildings, and urban structures to improve air quality.
- Serves as a green innovation combining art and biology.
- Demonstrates the use of waste pond algae as a renewable raw material.

## Future Enhancement

- Increase durability by adding UV stabilizers or natural preservatives.
- Test with different algae species for enhanced photosynthesis.
- Scale up production for use on large wall surfaces.
- Integrate smart sensors to track real-time $CO_2$ reduction in rooms.

**References**

Source: SciELO Brasil https://share.google/ucTGeDY1oFVTsat0b

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