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PANDIT DEENDAYAL PETROLEUM UNIVERSITY

Raisan, Gandhinagar – 382 426, Gujarat - INDIA. Website : www.pdpu.ac.in

NAAC Accredited 'A++' Grade (CGPA 3.52 out of 4.00)

15 November 2024

Letter No : PDEU/SOET/Nov/AirX01

Dr Anshu Kumar,
Chief Technology Officer,
AirX Innovations Pvt. Ltd,
Office No : 202,
Swagat Rainforest 1, Kudasan, Gandhinagar

Subject: Submission of Analytical Report on AirX-O2 Mini Microalgae-Based Air Purifier

Reference :

1. Our meeting dated October 15, 2024 with subject for AirX Device Analytical Testing
2. Testing Report Carried out between October 21, 2024 to November 9, 2024 at our Lab facility

Dear Dr Anshu,

I am pleased to present the enclosed Analytical Report on the AirX-O2 Mini, an innovative microalgae-based air purifier designed to address critical environmental challenges. This pioneering solution not only captures PM2.5/PM10 and carbon dioxide but also generates oxygen, significantly contributing to improved air quality.

The report provides a comprehensive analysis of the AirX-O2 Mini's microalgae-based air purification technology, its market performance, environmental impact, and strategic recommendations for future enhancements.

Key Highlights of the Report for Performance Evaluation of AirX O2 Mini:

1. **CO₂ Absorption Efficiency:** The AirX-O2 Mini demonstrated exceptional performance in reducing CO₂ levels. Initial concentrations of 1046 ppm were reduced to safe levels (≤ 500 ppm) within 3 hours of operation, achieving a reduction rate of 59% to 65%.
2. **PM2.5/PM10 Removal Efficiency:** The purifier effectively reduced PM2.5 concentrations from an initial level of 999.9 $\mu\text{g}/\text{m}^3$ to below the permissible limit of 40 $\mu\text{g}/\text{m}^3$ within 8 hours of continuous operation. During the first 4 hours, a consistent reduction of PM2.5 levels by 78% to 80% was observed. This performance highlights the device's ability to significantly enhance indoor air quality under optimized experimental conditions.

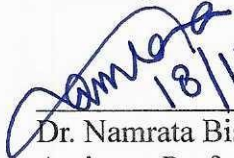


These findings underscore the AirX-O2 Mini's capability to deliver rapid and effective mitigation of both particulate matter and carbon dioxide, establishing it as a groundbreaking solution in the indoor air purification domain.

Please find the full Analytical Report attached for your review. I am confident that the insights presented in the report will demonstrate the exceptional value proposition of AirX-O2 Mini while informing future strategies to maximize its impact.

I look forward to discussing this further and addressing any queries you may have.

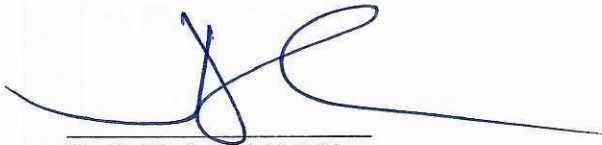
With Regards,


18/11/2024

Dr. Namrata Bist

Assistant Professor - Department of Petroleum Engineering
School of Energy Technology





Prof. (Dr.) Anirbid Sircar
Director - SoET

Enclosure: Analytical Report on AirX-O2 Mini

A brief Report: Micro-algal Air Purification Technology by AirX Innovations Pvt Ltd

Introduction:

The rapid pace of globalization and industrialization has significantly disrupted natural ecosystems, leading to a steep rise in air pollution. According to the World Health Organization (WHO), air pollution is defined as "the presence of materials in the air in such concentrations that are harmful to human health and the environment." Globally, air pollution is a major health hazard, responsible for approximately 7 million premature deaths annually, with around 99% of the world's population living in areas where air quality exceeds WHO guideline limits. This includes both outdoor and indoor air pollution, which contribute to various respiratory and cardiovascular diseases.

In India, air pollution presents a particularly critical challenge. As one of the most rapidly urbanizing countries, India faces high levels of pollution both outdoors and indoors. In 2023, India was home to 22 of the world's 30 most polluted cities, with major cities like Delhi, Kanpur, and Varanasi consistently recording dangerous levels of particulate matter (PM_{2.5}). It is estimated that air pollution contributed to over 1.67 million deaths in India in 2019, making it one of the largest environmental health risks in the country. Additionally, India faces economic losses of \$95 billion annually due to premature mortality and reduced labor productivity linked to poor air quality.

Indoor air pollution is another growing concern, particularly in developing nations like India. Indoor pollutants such as household dust, mold, tobacco smoke, and emissions from cooking stoves—especially in rural areas—pose significant health risks. The burning of biomass fuels for cooking and heating is one of the leading causes of indoor pollution in India, disproportionately affecting women and children. Globally, indoor air pollution causes approximately 3.8 million premature deaths each year.

As the severity of air pollution intensifies, solutions are becoming increasingly vital. For indoor air quality, air purifiers have emerged as a popular solution to mitigate the health risks associated with pollutants like particulate matter, allergens, bacteria, and volatile organic compounds (VOCs). These devices are highly effective in filtering indoor air and have become a recommended part of environmental control measures, particularly for individuals with respiratory conditions such as asthma or allergies.

For outdoor air pollution, combating this global issue requires a multi-faceted approach. Efforts include transitioning to cleaner energy sources, adopting electric vehicles, enforcing stricter emission controls, and expanding urban green spaces to absorb pollutants. In India, government initiatives like the National Clean Air Programme (NCAP) aim to reduce particulate pollution by 20-30% by 2024 in more than 100 cities, offering a pathway toward improving urban air quality.

Addressing air pollution demands a comprehensive approach that incorporates both individual solutions for indoor environments and broader, collective actions to improve outdoor air quality. We have tested AirX air purifiers, developed by AirX Innovation Pvt. Ltd., as part of our efforts to improve indoor air quality. The **AirX purifier** functions like a natural air purifier, similar to a tree, by using microalgae to capture carbon dioxide (CO₂) and release oxygen, creating a cleaner and healthier environment. It offers a sustainable, eco-friendly alternative to conventional air purifiers, with long-term benefits in reducing carbon footprints and enhancing indoor air quality. Though it may have a higher upfront cost, its low maintenance and energy-efficient design make it a cost-effective solution in the long run, contributing to both environmental and financial gains.



Methodology and experimental Setup:

Experiments were carried out in a test chamber (purchased from the Seaveda Biotech Pvt. Ltd., Ahmedabad) with 1 m length $\times$ 1 m width $\times$ 1 m height. The 1500-mL AirX-O₂ mini (Sample contain AirX-O₂ mini + Culture + nutrition, Provided by AirX Innovations Pvt Ltd) were used to hold 1000-mL cultures of microalgae with initial cell density of 1.0×10^5 cells/mL in the test chamber, respectively. In addition, considering that the AirX-O₂ mini used for cultivation of microalgae under the indoor conditions where the light intensity 200- 500 lux aerated at a flow rate of 1.8 L/min.

Step 1: The six-in-one module and oxygen measuring module were placed in the side upper position of the test chamber. Before started experiment, burn one incense stick for 10 minutes to achieve a consistent particle distribution and inject CO₂ mixed Air inside closed test chamber called optimized condition.

Step 2: Run the Experiment under optimized condition with AirX-O₂ mini, six-in-one module and oxygen measuring module were placed in the side upper position of the test chamber.

Step 3: Compile and analyse the data without and with AirX-O₂ mini to find efficacy of PM2.5/PM10, CO₂ reduction and O₂ generation.

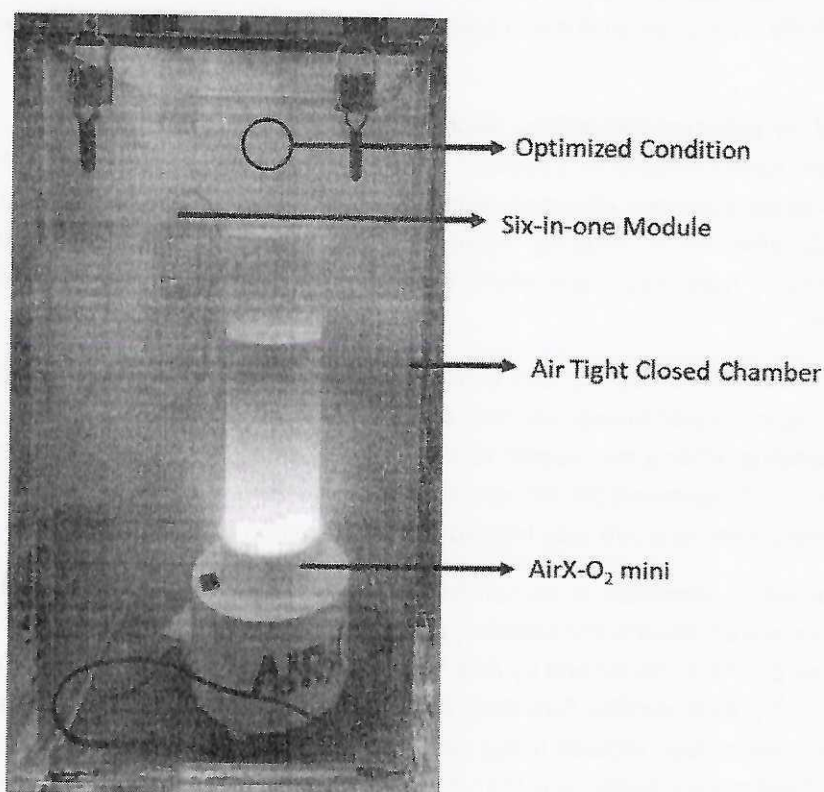


Figure1. Setup of experiment in a closed environment

Brief outcomes of experiment:



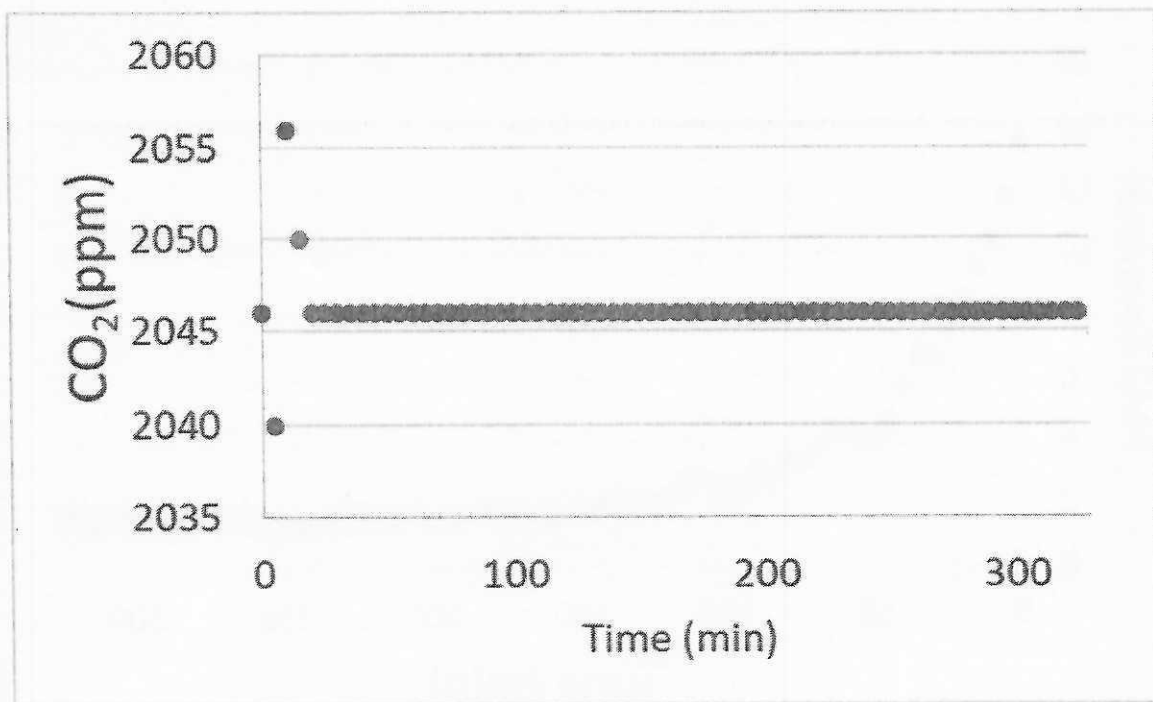


Figure 2. CO₂ Reduction Results (without AirX-O2 mini) from the experiment

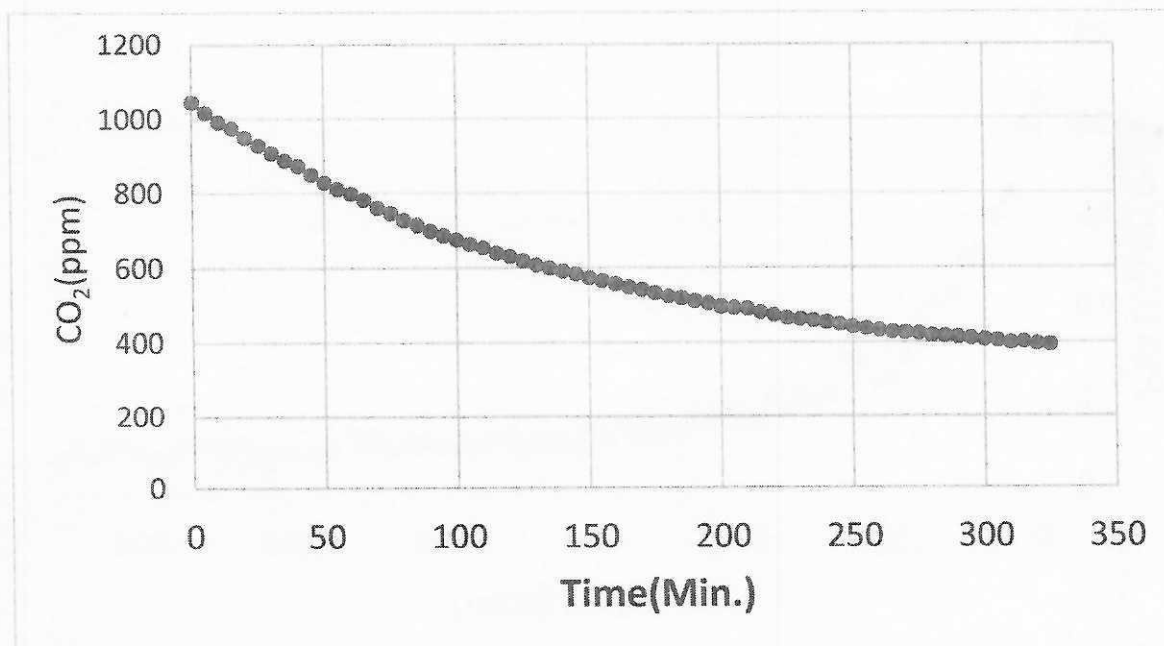


Figure 3. CO₂ Reduction Results (without Incense stick fumes) from the experiment



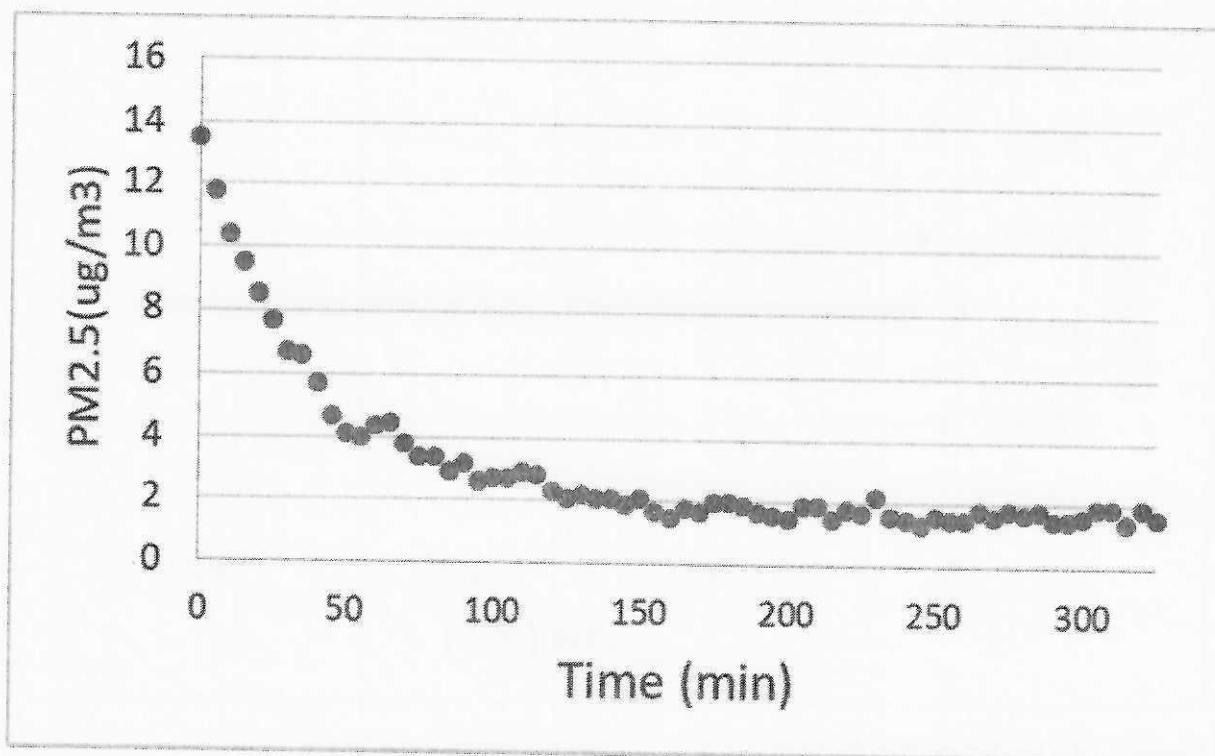


Figure 4. Without Incense stick fumes, PM2.5 removal results from the experiment

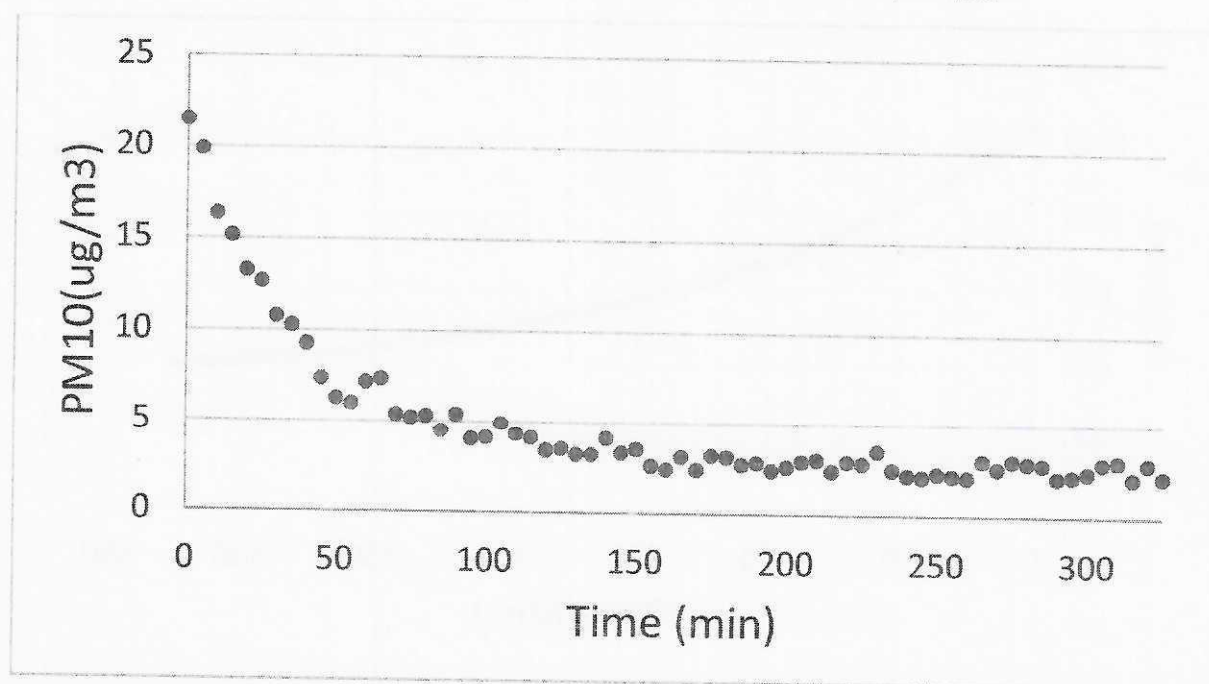
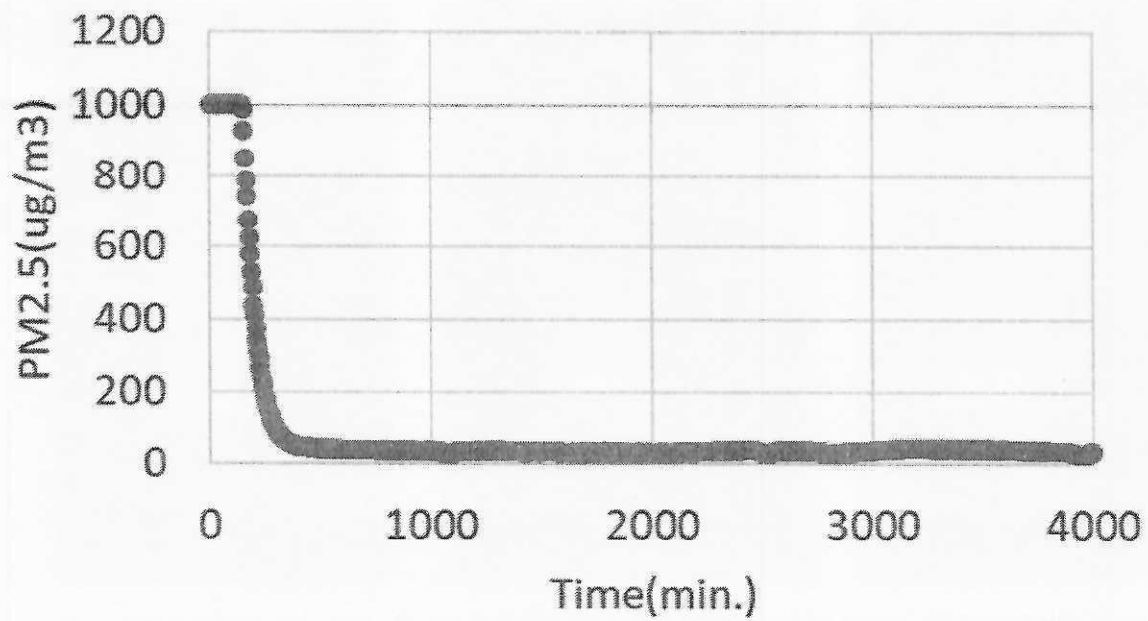


Figure 5. Without Incense stick fumes, PM2.5 removal results from the experiment



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Figure 6. With Incense stick fumes and PM2.5 removal results from the experiment

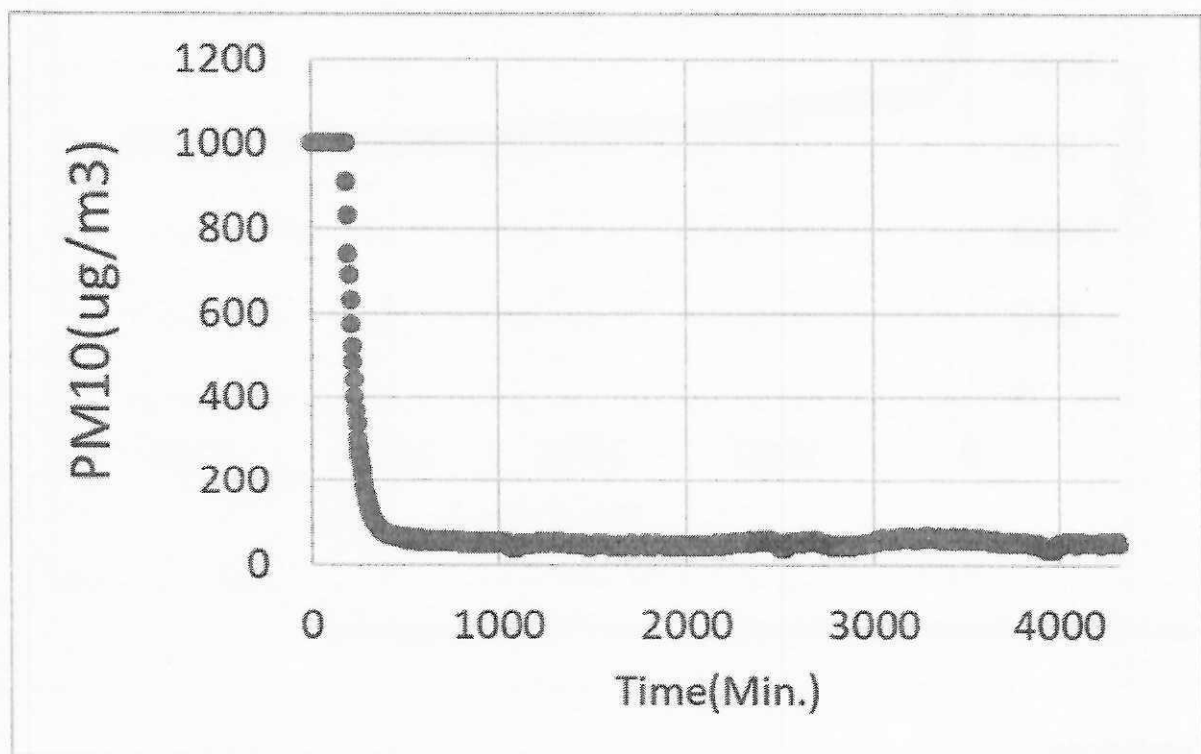


Figure 7. With Incense stick fumes and PM10 removal results from the experiment



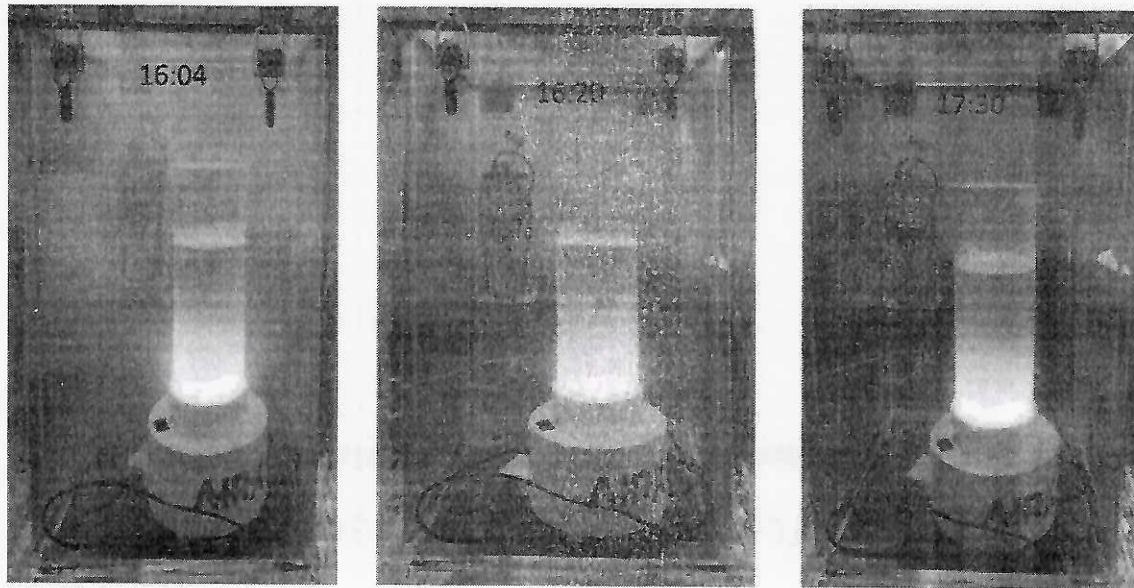


Figure 8. Photographic Image of Incense stick fumes removal results from the experiment

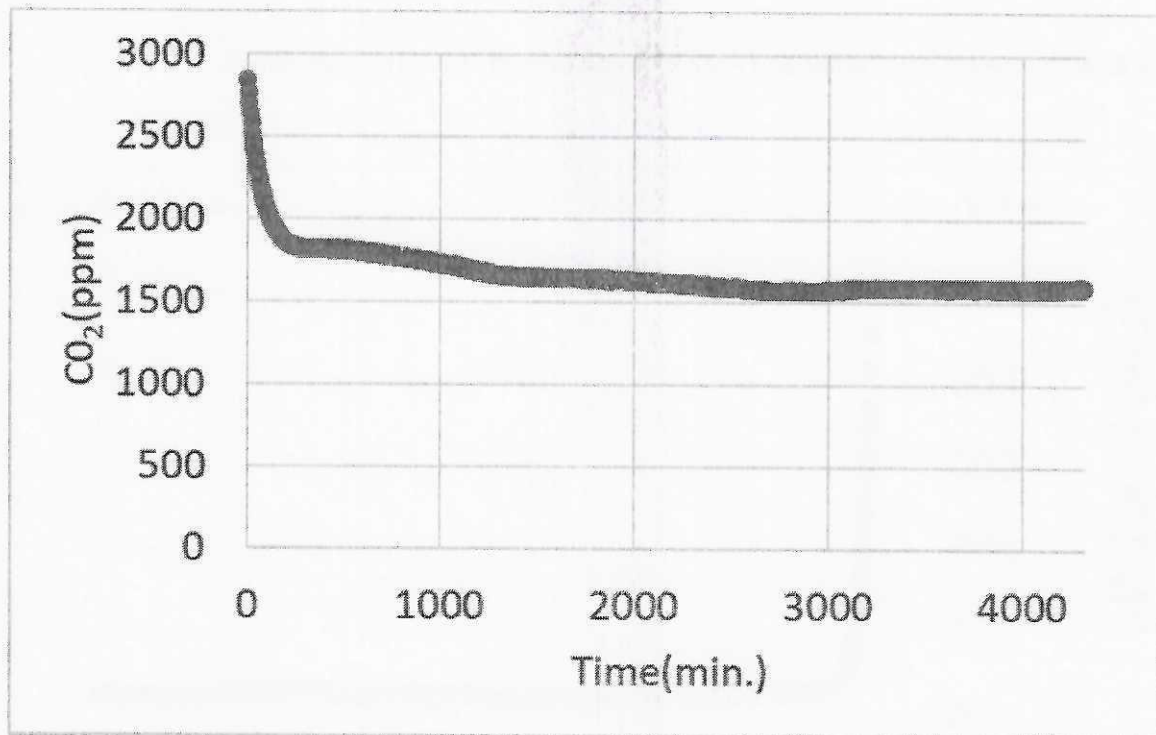


Figure 9. CO₂ Reduction Results (Incense stick fumes) from the experiment

Conclusions:

The performance evaluation of the AirX-O2 Mini Air Purifier revealed remarkable results. Under optimized experimental conditions, the device effectively reduced PM2.5 and PM10 concentrations, demonstrating its ability to significantly improve indoor air quality. After 8 hours of continuous operation, PM2.5 levels (initially 999.9 $\mu\text{g}/\text{m}^3$) were brought below India's permissible limit of 40 $\mu\text{g}/\text{m}^3$. Within the first 4 hours, the purifier consistently reduced PM2.5 levels by 78% to 80%. Similarly, CO₂ levels (initially 1046 ppm) were lowered to the safe

range (≤ 500 ppm) within 3 hours of operation, achieving a reduction of 59% to 65%. These findings highlight the AirX-O₂ Mini's efficiency in rapidly mitigating both particulate matter and CO₂, making it a highly effective solution for enhancing indoor air quality.

