NEW EARTH SOLUTIONS

EVALUATION OF THE EFFICIENCY OF A LIVING WALL TO REMOVE INDOOR AIR CONTAMINANTS

PREPARED BY NEW EARTH SOLUTIONS

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ABSTRACT

Biofilter Living Walls (Biofilters) have emerged as a sustainable solution to improve indoor air quality, reduce energy consumption, and mitigate CO2 emissions. This white paper delves into the scientific findings from a study conducted by the National Research Council of Canada, highlighting the efficiency of Biofilters in volatile organic compound (VOC) removal, the underlying mechanisms, and the significance of real-world testing parameters. This specific study used the Respira Pro Biofilter developed by New Earth Solutions to collect the following findings.

INTRODUCTION

Biofilter Living Walls integrate and optimize the biologically active root zone of plants and have shown effectiveness in filtering indoor air pollutants. Beyond aesthetics, they offer tangible health and environmental benefits, including reduced energy consumption and enhanced indoor air quality.

THE SCIENCE BEHIND BIOFILTERS

ROLE OF DIVERSE PLANT SPECIES

Diverse plant species in Biofilters provide varied metabolic pathways, ensuring a broader spectrum of VOCs can be metabolized and removed. Each plant species, with its unique metabolic processes, targets specific VOCs, enhancing the system's overall efficiency.

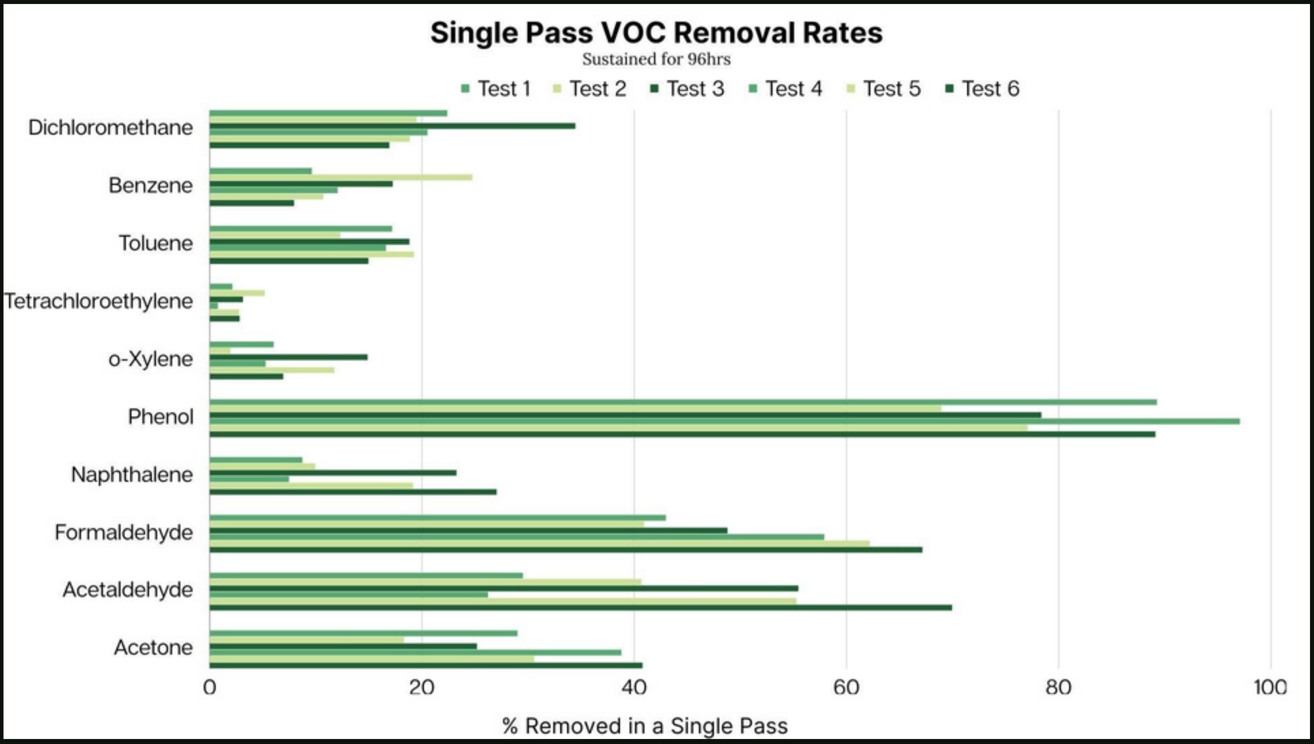
MICROBIAL ADAPTATION AND VOC REMOVAL

Microbes in Biofilters adapt to contaminants over time, leading to improved VOC removal rates. Their ability to acclimatize to VOCs ensures the system's efficiency increases over time.

KEY FINDINGS FROM THE NRCC

The laboratory study conducted at the National Research Council of Canada employed a dynamic chamber test method, simulating real-time environmental conditions. This method provided a realistic evaluation of the Respira Pro Biofilter's performance.

VOC Removal Efficiency: VOCs with low molecular weights and high dipole moments (high polarity) showed superior removal rates. Polar compounds, including formaldehyde, acetaldehyde, and acetone, exhibited higher removal rates (25-87%). while non-polar compounds like tetrachloroethylene and naphthalene had lower rates.



Microbial Adaptation: A significant observation was the evident adaptation of microbes. In tests where the same module was evaluated multiple times, higher VOC removal rates were observed in subsequent tests, highlighting the dynamic nature of the Biofilter Living Wall system.

REAL-WORLD TESTING PARAMETERS

The dynamic chamber test method used in the study was designed to mimic real-world environmental conditions. This approach ensures that the findings are not just theoretically sound but also practically applicable. By simulating real-world conditions where multiple VOCs are present at once, the study offers insights into how Biofilter Living Walls would perform in actual building environments, making the results more relevant for architects, building owners, and engineers.

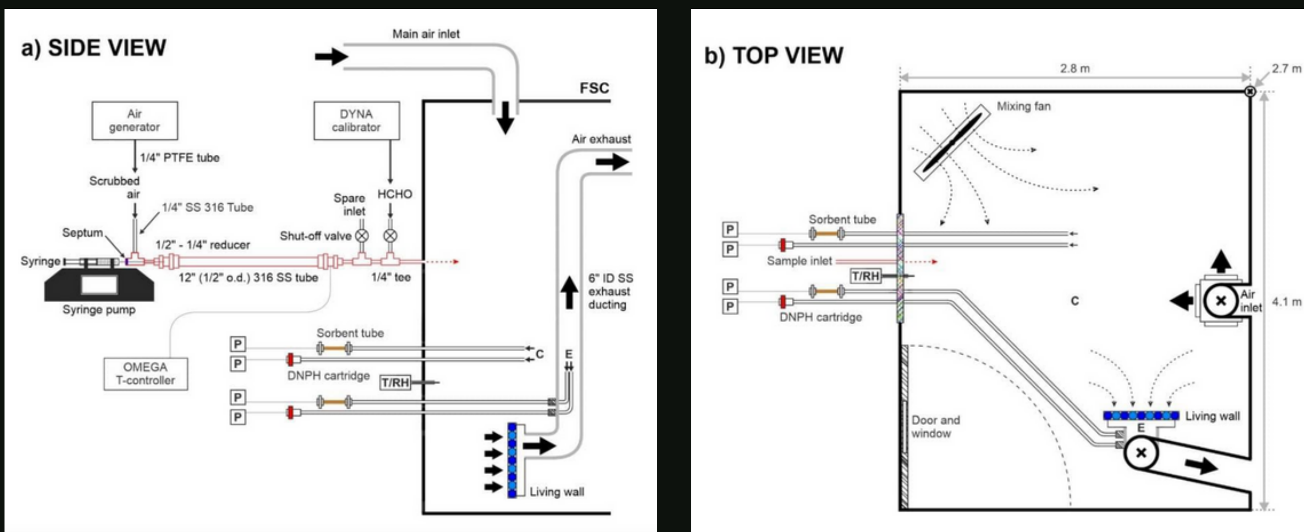


Figure 1. An illustration of the Full Scale Chamber (FSC) (~31 m3) setup used for testing the NES living wall.

(a) Side view of the FSC. The main air inlet delivers clean air at rates up to 40 litres per second. The air was filtered through an activated charcoal to strip off VOCs followed by a high-efficiency particle air (HEPA) filter to remove particles with an efficiency > 99.9% for particles smaller than 0.3 μm in mobility diameter. The air was humidified and the inlet rate varied to simulate various air change rates. Chemical test reagents were introduced into the FSC by means of an automated syringe pump and through a heated inlet whose temperature was kept constant at 100 °C (OMEGA). Formaldehyde (HCHO) was added separately using a permeation device (DYNA calibrator). A constant stream of clean (zero grade) air flushed the heated inlet and swept reagent components toward the FSC interior. Samples were drawn through 4 inlets: 2 inlets sampling from the central (C) region of the FSC and 2 inlets sampling from the exhaust (E) region past the green wall. Each sample region used both DNPH cartridges and sorbent tubes thereby determining the FSC respective region reagent concentrations using two different methods.

(b) Top view of the FSC illustrating the relative location of components used in this experimental setup. P active pump; T/RH temperature and relative humidity probe; C FSC centre; E exhaust, past the living wall. The colour hatched bar denotes the various inlets interface of the FSC.

Effects of Operating Parameters: The removal rates of pollutants in a Biofilter are influenced by physical conditions, in addition to chemical properties. Factors such as the number of plant modules, chamber concentration, and chamber air flow rate played a role in VOC removal efficiency.

CONCLUSION

Biofilter Living Walls offer a comprehensive solution to modern building challenges. Their ability to improve indoor air quality, combined with the scientific principles governing their efficiency and the significance of real-world testing parameters, makes them invaluable for sustainable building designs. The findings from the National Research Council of Canada further underscore the potential of Biofilter Living Walls in the architectural and environmental sectors.