Botanical Biofiltration

Experimental Protocol and Method

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Botanical Biofiltration: Experimental Protocol and Method

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SUMMARY
Vegetation systems in combination with biofiltration processes are emerging processes that are expected to have beneficial effects on the improvement of indoor air quality (IAQ). Common indoor plants may provide a valuable strategy to avoid rising levels of indoor air pollution. In an active vegetation system air cleaning rates may be significantly higher than in passive vegetation systems using active fan-assisted hydroponics technology, which draws the air through the root rhizomes of the plants. However, to evaluate the real effect of active green systems on IAQ it is important to create a reliable experimental setup and protocol regarding not only components of the prototype but also the methods for analysis and evaluation.

KEYWORDS
Phytoremediation; Indoor Air Quality; Vegetation Systems; Plants; Experimental Setup

1 INTRODUCTION

Botanical biofiltration is the process of drawing air in through organic material (such as moss, soil and plants), resulting in the removal of volatile organic compounds (VOCs) and contaminants. However, there is still a lack of solid and relevant data on the true pollutant-removal mechanisms and factors of these systems (plant species, microorganism types, gas composition, light source, number of plants, growth medium) (Soreanu et al., 2013; Torpy, et al., 2017; Armijos Moya, et al., 2018). The aim of this research is to create a natural adsorption/absorption system based on the development of an active vegetation prototype (integrating a mechanical ventilation system) where botanical biofiltration is going to be analyzed as the main process for VOCs removal (Armijos Moya, et al., 2018). One of the main challenges in plant foliar VOC research is precise testing, the reactivity of some VOCs that makes them hard to detect, and their low concentrations. Currently, plant VOC research relies on analytical techniques for trace gas analysis, usually based on gas chromatography and soft chemical ionization mass spectrometry (Materic et al., 2015).

2 METHODS

A specific protocol and method is being developed and tested, to analyze properly each one of the elements of the model. The positive performance of this process depends on the interactions between pollutants, selected plants, micro-organisms and substrate (Macek, Mackova, & Kas, 2000; Soreanu et al., 2013). First, a blank experiment, using an empty chamber is performed to evaluate the sink effect on the chamber walls. For the adsorption and/or absorption phase, the chamber is supplied with humidified air containing the targeted VOCs using a gas cylinder connected to a dilution system where several tests are going to be performed to determine the adsorption/ absorption coefficients of each element of the system (Rizk et al., 2016). This experimental setup is focused primarily on two different experimental studies: (a). VOCs removal capacity of three inorganic growing media (expanded clay, growstone, activated carbon) and four common indoor plant species (*hedera helix*, *chlorophytum comosum, dieffenbachia, Epipremnum aureum); and* (b) Uptake of VOCs in Continuous Flow

Experiments under Different Airflow Rates and Concentration Levels. The equipment selected to monitor VOCs in the experimental setup is ppbRAE3000 that is a photoionization detector (PID) with a 11.7 eV gas-discharge lamp.

3 RESULTS AND DISCUSSION

The experimental setup, comprising of a dynamic chamber, a gaseous generation system, and a porous polymer resin to trap the VOCs from the air, will be discussed, based on the results of the first tests with the system. The purpose of developing this experimental protocol and setup was to explore, evaluate and validate the efficacy of active vegetation system in terms of IAQ. The choice of equipment and instrument in plant VOC research depends mainly on three factors: the research question, instrument availability, and budget. Apart from instrument availability, the main factors to be considered in choosing the sampling method are: (1) the concentration of the foliar VOCs in the system, (2) the time resolution required, and the level of VOC separation required (Materic et al., 2015).

4 CONCLUSIONS

The aim of this experimental setup and protocol is to undertake experiments to provide key proof-of-concept performance values towards the development of a prototype as an alternative way to efficiently remediate indoor air problems, increase the comfort of the occupants, decrease energy consumption, and decrease costs as well as health effects in the indoor environment. The final outcomes of the setup and experiments will be presented in a scientific journal.

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