BUILDING-INTEGRATED

ACTIVE MODULAR PHYTOREMEDIATION SYSTEM

By

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ABSTRACT

Contemporary construction materials and building types are complicit in the degradation of indoor air quality (IAQ) and have become principal contributors to public health concerns in developed countries. These challenges are further exacerbated by the increasing cost of energy that is required to maintain healthy levels of IAQ in these buildings. Addressing these issues will require not only innovative technologies and approaches, but also deep collaborations across several disciplines.

This doctoral research creates an the interdisciplinary framework for the development of a building-integrated phytoremediation system using bio-mechanical techniques to 'scrub' toxins from the air by integrating modules containing hydroponic-supported plant materials into heating, ventilating and air conditioning (HVAC) systems. This research is multi-dimensional and interdisciplinary in scope, with the precise goal of integrating lab-based testing protocols to reiterative architectural systems design parameters. The design framework outlined in this dissertation links feedback loops from phytoremediation aerosols testing at the lab scale to the design of building scale air flow and environmental control systems for the first time.

There are three scopes within this dissertation: 1. The testing and optimization of a small lab-scale module (prototype); 2. The cross linking of acquired data from the lab-scale module to the design parameters of a room-scale panel, and; 3. Analysis and co-design of an integrated system at building-scale. A series of experiments were undertaken to determine the performance parameters for architectural integration, including: the toxin removal capacity of various growing media and plant species; the impact of module morphology on contaminant concentration levels and air flow rates; and the rates of remediation by constituent components within plant leaves and the root rhizosphere. The conclusions from these experiments show that the building-integrated active modular phytoremediation system (BI-AMPS) could have a significant impact in contributing to remediation strategies addressing poor IAQ in buildings and energy reduction through improved HVAC performance.