Department of Civil Engineering
&
Engineering Mechanics
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AIR CLEANING FOR GREEN BUILDINGS: IMPROVING INDOOR AIR QUALITY WITHOUT ENERGY CONSEQUENCES

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Abstract

Approximately 40% of all energy used in the United States is associated with buildings and over 85% of Columbia's carbon footprint comes from building energy use. Furthermore, Americans are indoor creatures who spend over 90% of their time inside of buildings where pollutant concentrations are often much higher than in outdoor air. Historically, energy conservation and improved indoor air quality have been considered mutually exclusive goals. Improved perception and productivity can be achieved by increasing ventilation rates, but in many climates this can dramatically increase energy use as well as introduce water vapor and outdoor pollutants to the indoor environment. Continuous use of centralized air cleaning technology has significant fan energy and duct leakage consequences, not to mention the fact that many Americans live in homes without central forced air systems. Effective portable air cleaning devices require high air flow rates, and can be associated with serious energy consequences or ozone emission. The purpose of this presentation is to report on the use passive reactive panels (PRPs) as a means to remove pollutants from indoor air without using energy. Using the example of ozone, field and laboratory experiments coupled with modeling show that augmenting an existing wall in a residential room with a PRP can reduce occupant exposures by as much as 80% with activated carbon panels and 50% with unpainted gypsum drywall panels. Even greater reductions can be achieved by taking advantage of buoyancy driven airflows and other mechanisms of high mass transfer. The issues surrounding the removal of more challenging pollutants, such as particles and water vapor, will also be explored. The goal of this research is to encourage a paradigm shift to low- and zero-energy technologies for air cleaning.