Enhancing Environmental Control Systems With Intelligent Desiccant Materials

By
Marcel Perez-Pirio

An Abstract of a Thesis Submitted to the Graduate
Faculty of Rensselaer Polytechnic Institute
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
Major Subject: ARCHITECTURAL SCIENCES

The original of the complete thesis is on file in the
Rensselaer Polytechnic Institute Library

Approved:

_____
Anna Dyson, Thesis Adviser

_____
Jason Vollen, RA, Reviewer

_____
Pravin Bhiwapurkar, PhD, Reviewer

Rensselaer Polytechnic Institute
Troy, New York
January 2009
(For Graduation May, 2009)

Abstract

Like many of the developing countries located within 30 degrees of the equator, Mumbai, India's financial and commercial capital is on a developmental trajectory that will increase the negative and harmful effects on its already strained environmental conditions, particularly, if it continues to adopt current infrastructural and architectural practices of more economically developed areas. In the case of Mumbai much of the commercial building stock is at a critical point, undergoing rapid transformation and importation of wasteful and energy-intensive technologies. Within this hot and humid climate the overriding energy-consumption challenge in effectively maintaining interior thermal comfort is determined by the means to achieve dehumidification. A second area of concern is the regional lack of consistent rainfall critically diminishing potable water resources. If, through the transfer of emerging material from the field of biotechnology is utilized in conjunction with the relocation and distribution of traditional building systems, then an opportunity is created for a novel membrane typology proposal to mitigate these challenges while responding to the specific local bioclimatic and programmatic criteria. Compared to existing dehumidification technologies, the proposed system will reduce energy consumption necessary for dehumidification, prior to the cooling of air, by orders-of-magnitude. As a result of these methods, the removed water can then be harvested for potable and/or greywater building use, offsetting municipal water reliance. As a demonstration, the design and implementation of this responsive system, as it is integrated within the Mumbai International Airport, will be influential in setting new expectations for interior environmental control as it relates to energy demands and water consumption. When operating within a building-integrated system the opportunity that these new bio-responsive materials present has the ability to significantly outperform existing infrastructural energy technologies.