Dehumidification Through Responsive Desiccant Systems:

The Building Integration of Desiccant Assembly for the Performance Optimization in the Parametric Synthesis of Climatic Inputs, Geometry, Materials, Heating and Cooling Systems

By

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ABSTRACT

While the world's cities are growing at faster rates adapting universal building typologies and traditional cooling/ heating systems, higher energy and water demands are draining our limited available resources globally. By introducing a new dehumidification system with intelligent desiccant materials like SAP and FRH hydrogels, the building integrated assembly will acclimatize to various environments; reincorporating passive strategies into the building envelope and capitalizing off the strengths and weaknesses of current cooling/heating technologies while redistributing energy flows through multiscalar mediums. Building integration will function both theoretically in principle and physically through the connection of building systems and components: solar ETC tubes, photovoltaic films, small absorption chillers, and super absorbent hydrogels. Growing, densely populated urban centers - Mumbai, New York, Miami, DC - serve as test beds to investigate the flexibility to climates and efficiency of the system through existing climate pressures: humidity, solar, and wind. While hot and humid climates will profit most from the proposed desiccant system, the adaptability of the system to other climates with seasonal humid periods will prove to be advantageous for parts of the year. Using the most innovative adsorbent technology and cooling methods, implementation of the desiccant dehumidification system will provide means for water generation and building recuperation, heat dissipation, thermal comfort, and energy generation while simultaneously providing lower energy consumption and driving cost savings. Investigations in the design of the desiccant chamber through hydrogel water storing and expelling capacity, techniques improving the efficiency of adsorption through cooling coils, electric stimulation, and design of the chamber and space, improve the overall efficiency of the system itself. The design of the system and indoor space, are directly responsive to the roof articulation, which will also be subjected to exterior environmental conditions. The proposed building integrated desiccant system will improve on the efficiency of water adsorption and collection through the building integration of the system components such as solar heating, cooling coils, highly adsorptive desiccants, design of ceiling and interstitial space, air distribution, displacement ventilation and articulation of the roof envelope.