Mechanical Engineering Thesis Defense

Prototypes and Experiments on an Enhanced Desiccant-Based Atmospheric Water Harvester

School for Engineering of Matter, Transport and Energy

Shubham Shrivastava
Advisor: Patrick Phelan

Abstract

Atmospheric water harvesting (AWH), in which water vapor contained in the air is condensed into potable water, is being pursued as a viable source of freshwater. Under the low relative humidity conditions of arid climates like that of Arizona, desiccant-based approaches to AWH have been shown to be more energy efficient than refrigerant-based approaches. Desiccant-based approaches, however, are still limited by the energy required to heat up the desiccant to desorb and recover the adsorbed water, as well as the cooling needed for adsorption and condensation. Here, a thermoelectric heat pump (TEC) is applied to provide simultaneous heating and cooling to enable continuous water production from a compact desiccant-based AWH system. Since heat pumps are more efficient than simple electric resistive heaters to generate heat, this approach is inherently more efficient than existing desiccant-based AWH systems. Furthermore, the simultaneous heating and cooling means that while heating is applied to the desiccant to desorb water vapor for subsequent condensation, cooling is provided to a portion of the desiccant to continue adsorbing water vapor from incoming air.

November 6, 2025; 12:00pm; GWC 535

Arizona State University

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