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The Role of Wind Velocity in Saline Water Evaporation from Porous Media and Surface Salt Crystallization Dynamics

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Saline water evaporation from porous media with the corresponding surface salt crystallization patterns play a vital role in many environmental and engineering applications. While the impact of factors such as type and concentration of salt, particle size and angularity, and ambient temperature and humidity are relatively well characterized [1]–[3], the influence of wind and aerodynamic conditions on saline water evaporation and salt crystallization is not fully understood. We conducted a series of laboratory experiments in a wind tunnel to systematically investigate the effect of wind flow on saline water evaporation and dynamics of salt crystallization. Cylindrical sand columns (D: 5 cm – H: 20 cm) were placed in the test section of the wind tunnel. Surface of the samples were exposed to uniform mean wind velocities of 0.5 and 5 m/s. To keep samples fully saturated during the evaporation experiments, sand columns were supplied from Mariotte bottles containing 10, 15, and 20% NaCl solutions. Evaporation rates were monitored by measuring mass losses from Mariotte bottles, while salt crystallization patterns were captured using an optical camera positioned above the surface of columns. Preliminary results indicate that variation in aerodynamic conditions and turbulence patterns, driven by changes in wind velocity and surface roughness (due to crystal growth), significantly alter evaporation rates and salt crystallization process. Distinct crystallization patterns were observed with variation of wind velocity with possible influences on the evaporative fluxes. Using the measured data, we will identify the key effects of air flow regimes coupled with the salt concentration on evaporative losses and the evolution of crystallized salts at the surface, which will be important for a wide range of environmental and hydrological applications.

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