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Controlled evaporative cooling on a superhydrophilic surface: building a green wall SUIN SHIM, SANGWOO SHIN, FORREST MEGGERS, ELIE BOU-ZEID, HOWARD A. STONE, Princeton University — We propose a way to design of an evaporative cooling device using continuous water flow on a superhydrophilic surface. Continuous flow helps prevent contaminant fouling on the surface of the cooler, which is a major challenge for conventional evaporative (swamp) coolers. A superhydrophilic surface leads to a reduced coolant flow rate, allowing for a maximum ratio of evaporative heat transfer to coolant thermal mass. Also, a staggered structure increases the surface area of the thin film flow of water which results in higher cooling efficiency. We performed both experimental and theoretical studies on the temperature change in the thin film flow of water. By keeping the water film thickness below 100 μm, $\sim$5 K of temperature drop in the device was achieved. The cooling device can be manufactured using conventional cost-effective processes, offering practical applications in energy-efficient buildings.

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