Passive Manipulation of Thermal Radiation: Dual Purpose Condensers to Provide Potable Water

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Water availability and quality are universally important issues. The imbalance between fresh water demand and supply is expected to worsen. To date, water technology has been focused on desalination and purification, but these techniques are limited by economic and ecological concerns. Meanwhile, the earth’s atmosphere is an immense and largely untapped source of fresh water. In this project, novel atmospheric water condenser systems were designed and constructed to extract potable water from the air. Passive radiative cooling techniques were utilized to cool the devices to below dewpoint enabling condensation to occur. Condenser design considerations included the ability to function without electrical or mechanical assistance, induction of convective airflow to maximize exposure to water vapour, optimization of internal surface area for condensation, and adoption of hydrophobic surfaces to facilitate condensate flow. Once the devices were created, enhanced radiative cooling was achieved through custom components. The resulting pilot scale system was capable of continuous condensation for up to 12.5 hours and potable water production at rates of up to 162 ml/hour. The condenser was used in a secondary application as a component of a novel solar still system, designed for increased thermal efficiency relative to conventional stills. This proved successful in producing potable water from contaminated water and introduces the possibility of higher production efficiency than conventional stills. The atmospheric water condenser innovation is the first efficient passive system capable of extracting potable water from air in sufficient volume to address basic human requirements and help alleviate fresh water shortages.

Awards Won:

Second Award of $2,000