Using Calcium Chloride to Source Drinking Water in Arid Climates: H2O Absorption and CaCl2 Regeneration Rates in Relation to Desiccant Surface Area

Helmer, Ryan (School: Jefferson Montessori Academy)

Over 2 billion people lack access to clean drinking water, and 844 million lack basic water services. The United Nations estimates 80% of countries can't financially meet future water needs, and the UN's 2030 Agenda goal SDG6 — ensuring available and sustainable management of drinking water — isn't on track. Additionally, climate changes are increasing arid and semi-arid regions, causing greater water sourcing problems. Hygroscopic compounds, like CaCl2, may be the key to a readily available and economically affordable solution to the crisis. In this experiment, it was hypothesized that increasing the surface area of 1000 grams of CaCl2 would increase water vapor absorption and exothermic temperatures, causing greater amounts of H2O condensation in a closed container collection device and increase water collection measurements. Over a 21-day test, three CaCl2 surface areas — 489.44, 978.88, and 1468.32 sq. cm. — were exposed nightly to air to absorb H2O vapor then sealed during the day, allowing solar heat to force H2O condensation for collection. Data recorded included daily measurable H2O collection totals, daily H2O released from CaCl2 trays during the condensation period, daily internal container temperatures, nightly H2O increases per container, nightly humidity, and daily temperature highs. Results showed the greatest surface area containers produced 6.26 times more measurable water collected and higher internal temperatures (+20 to 25˚F) than the smallest surface area containers. Recorded H2O released (uncollected) from containers showed even greater gaps between surface areas sets. These measurable water losses were observed, recorded, and attributed to engineering flaws in seals and overall design.