Concentrated Solar Power

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Solar power technologies, which offer sustainable, clean energy sources, are developing to improve efficiency of energy conversion and storage. Concentrated solar power (CSP) plants are an emerging technology using mirrors to focus sunlight onto a central receiver, which can generate electricity. One kind, a solar tower system, consists of a tall central receiver in the middle of an array of mirrors, often placed in the open desert. While some use evenly spaced concentric circle mirror arrangements, scientists from MIT and Aachen found in 2012 that spiral arrangements such as those found in a sunflower outperform concentric circles. More recently, there is interest in designing smaller CSP plants in more populated areas. My research aims to determine for a confined space, as would be practical in a population center, how the efficiency of a spiral mirror arrangement in a CSP plant compares with concentric circles. I built two Archimedean spirals to compare with an evenly spaced concentric circle mirror arrangement in a confined space. The mirrors, each 5 cm on a side, were limited to a radius of 15 cm from a black can containing 100 ml of water. For a given number of mirrors the average distance between the can and mirror is closer in the spiral than the concentric circle arrangement, but the distance between turns in the spiral is tighter in the confined space. A light source was placed overhead and the temperature of the water measured. My experiment showed that the spiral outperformed the concentric circle arrangement. The best result was a spiral with fewer mirrors than in the concentric circles, suggesting that CSP plants with spiral configurations limited to smaller spaces can utilize fewer mirrors and focus more light on the receiver.

Awards Won:

Fourth Award of $500