Title Energy efficiency of industrial-scale cooling facilities for fruits and vegetables

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Citation Thesis, Master of Science (Biological Systems Engineering), University of California. 138 pages. 2008.

Keywords fruit; cooling

Abstract

Horticultural crops have been in high demand by consumers throughout history, and their availability year-round has become a necessity. The main cause affecting their post-harvest life is temperature as it greatly affects their respiration rate. Refrigerated warehouses must cool down and store these crops right after harvesting using different cooling methods to slow down the deteriorative processes. Each of these methods has different equipment and electricity requirements, and even though energy efficiencies have been calculated in previous studies, current refrigerated warehouses show significant differences in their energy consumption and little information is available on which practices are appropriate to decrease energy costs.

The overall objectives of this project were to gather current data that reflects cooling warehouses operational practices, and identify the specific areas in which greater energy efficiency can be accomplished. Data were collected from 14 refrigerated warehouses in California that used forced-air cooling, hydrocooling, and vacuum cooling for fresh produce. Heat loads coming from equipment, products, lighting, and conducted through walls were calculated and used to estimate the average electricity used. The efficiency of their cooling operations was determined using two different energy coefficients. The first coefficient included only the product heat load (EC_p) while the second coefficient included the total heat load in the cooler (EC_t).

The results indicate that vacuum cooling used less electricity than hydrocooling and forced-air cooling to cool fresh produce. Furthermore, facilities that made better use of their refrigerated space and had high product throughputs consistently had the lowest energy consumption per ton of product cooled.