Title Towards a semi-continuum approach to the design of hydrocoolers for horticultural produce

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Abstract

A mathematical model of a hydrocooler is proposed. The individual pieces of horticultural produce are treated as discrete items and their averaged properties, along with those of the cooling water and interstitial air, are deemed to vary continuously along the length of the hydrocooler. The work highlights the importance of using the mass weighted average temperature rather than the core temperature of horticultural produce to define the degree of cooling in a hydrocooler. The effects of increasing the flow rate of cooling water on throughput are demonstrated and it is indicated that the rate of cooling is ultimately limited by thermal conduction in the produce. The effects on cooling of the temperature of the cooling water and size of the produce on the rate of cooling are quantified. It is shown that increasing the depth of the bed of produce does not have a profound effect on the overall rate of cooling of produce furthest from the water-inlet, but the load on the water-chilling unit is likely to increase with the increasing depth of the bed.