Title Cooling of apples as a conjugate heat transfer problem
Author Márcio Aredes Martins and Leandro Soares de Oliveira
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Abstract

The convective cooling of apples in tandem arrangement on storage trays was numerically studied as a conjugate heat transfer problem. Two distinct approaches, a generic single-problem and a multi-problem approach, were employed for the solution of the conjugate heat transfer problem. In the single-problem approach, a generic format for the conservation equations is used to describe both the flow and the heat transfer in a computational domain comprised of all phases within the system being considered. In this approach, artifices such as making viscosity to assume an infinite value in the solid phase should be employed. In order to solve the conjugate problem without the need for such artifices, an approach in which the heat transfer problem is divided into as many problems as there are distinct phases in the system was also employed in this study. He individual problems are mathematically coupled by means of continuity conditions at the solid-fluid interfaces. A finite volume method on unstructured triangular meshes was employed to solve the system of couple equations. Results obtained for both approaches are presented and discussed, with the multiproblem approach presenting the best performance. The local Nusselt number was evaluated for each apple as a function of time, position along the apples' surfaces and also as a function of the distance between the apples. The conjugate approach has demonstrated to be a powerful tool for the optimization of the heat transfer coefficient correlations available in the literature and for the design of improved storage units