Title Designing a model of strawberry package for particle image velocimetry

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Citation Book of Abstracts, 2004 IFT (Institute of Food Technologists) Annual Meeting and Food Expo, 13-16 July 2004, Las Vegas, Nevada, USA. 321 pages.

Keywords strawberry; packaging

Abstract

Particle Image Velocimetry (PIV) is a powerful technique for determining flow fields. However, its application in food engineering has been limited due to difficulties in replicating intricate geometries with transparent materials. One important application is the study of the airflow during the cooling of packaged strawberries to improve cooling rate and uniformity. In this work a transparent model of a one pound strawberry package was developed. Also, a suitable working fluid and the flow rate needed to replicate the flow conditions were determined. The strawberries were modeled as spheres, whose diameter was calculated based on the average volume of strawberries. The basket model dimensions replicate those of the real basket. The material and fluid were selected based on refraction index and oil viscosity. The non distortion of a grid of lines placed behind the system indicates a refraction index match. The viscosity was measured using a Thermo Haake rheometer. To obtain the flow rate, a Reynolds number matching was performed. The void space inside a strawberry basket was characterized by sectioning a resin cast of it and the average open space and wetted parameter were obtained. The experimental model obtained consists of spheres of 1.59 cm and a basket of 9x9x14 cm $\geq$. The material and fluid were plexiglass and a mix of Aniseed and baby oil (1:2 v/v, 6.8 cP), respectively. The open space and wetted perimeter of packaged strawberries were 40 % and 86.2 cm. respectively. The working fluid flow rate that matches the operating conditions of the real system was 440 cm $\geq$ /s. The set of design and experimental conditions obtained in this study allows the use of PIV to elucidate the effect of vent design, upstream velocity and strawberry distribution in air flow field inside the strawberry package.