Heat Transfer in Food Processing

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International Series on Developments in Heat Transfer

Objectives

The Developments in Heat Transfer book Series publishes state-of-the-art books and provides valuable contributions to the literature in the field of heat transfer. The overall aim of the Series is to bring to the attention of the international community recent advances in heat transfer by authors in academic research and the engineering industry.

Research and development in heat transfer is of significant importance to many branches of technology, not least in energy technology. Developments include new, efficient heat exchangers, novel heat transfer equipment as well as the introduction of systems of heat exchangers in industrial processes. Application areas include heat recovery in the chemical and process industries, and buildings and dwelling houses where heat transfer plays a major role. Heat exchange combined with heat storage is also a methodology for improving the energy efficiency in industry, while cooling in gas turbine systems and combustion engines is another important area of heat transfer research.

To progress developments within the field both basic and applied research is needed. Advances in numerical solution methods of partial differential equations, high-speed, efficient and cheap computers, advanced experimental methods using LDV (laser-doppler-velocimetry), PIV (particle-image-velocimetry) and image processing of thermal pictures of liquid crystals, have all led to dramatic advances during recent years in the solution and investigation of complex problems within the field.

The aims of the Series are achieved by contributions to the volumes from invited authors only. This is backed by an internationally recognised Editorial Board for the Series who represent much of the active research worldwide. Volumes planned for the series include the following topics: Compact Heat Exchangers, Engineering Heat Transfer Phenomena, Fins and Fin Systems, Condensation, Materials Processing, Gas Turbine Cooling, Electronics Cooling, Combustion-Related Heat Transfer, Heat Transfer in Gas-Solid Flows, Thermal Radiation, the Boundary Element Method in Heat Transfer, Phase Change Problems, Heat Transfer in Micro-Devices, Plate-and-Frame Heat Exchangers, Turbulent Convective Heat Transfer in Ducts, Enhancement of Heat Transfer and other selected topics.

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Belgium

S. Yanniotis
Agricultural University of Athens
Greece

Heat Transfer in Food Processing

Recent Developments and Applications

EDITORS

S.Yanniotis
Agricultural University of Athens, Greece

B. Sundén
Lund Institute of Technology, Sweden

WIT PRESS Southampton, Boston

Editors:

S. Yanniotis
Agricultural University of Athens, Greece

B. Sundén
Lund Institute of Technology, Sweden

Published by

WIT Press
Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK
Tel: 44 (0) 238 029 3223; Fax: 44 (0) 238 029 2853
E-Mail: witpress@witpress.com
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E-Mail: infousa@witpress.com
http://www.witpress.com

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Preface

Heat transfer is one of the most important and most common engineering disciplines in food processing. There are many unit operations in the food industry where steady or unsteady state heat transfer is taking place e.g. sterilization, dehydration, freezing etc. Heat transfer in these operations is of primary importance and affects the design of equipment as well as safety, nutritional and sensory aspects of the product.

In applying heat transfer knowledge to food processing, one must take into account that the food industry usually deals with difficult raw materials with irregular shapes, in many cases of non-uniform and variable consistency, with physical properties that may change during processing. Due to these complexities, the unsteady state heat transfer differential equations can only be solved analytically with several simplifying assumptions, while numerical solutions of these equations can handle such complexities.

The chapters in this book deal mainly with heat transfer applications or methods that have considerable physical property variations with temperature, e.g. freezing, or methods that are not yet widely spread in the food industry, e.g. ohmic heating, infrared radiation, or are less developed in the food engineering literature, e.g. deep-fat frying or baking. The application of numerical methods has received special attention with a separate chapter as well as emphasis in almost every chapter because a substantial number of papers in food processing operations have been published in recent years dealing with numerical solutions of heat transfer problems. It is expected that because of the increased computational capabilities that are possible today with high speed and low price computers, numerical solutions will be used in an increasing range of food processing applications in the near future. A chapter on artificial neural networks (ANN) has been included since ANN is a promising alternative tool to conventional methods for modelling, optimization etc in cases where a clear relationship between the variables is not known or the system is too complex to be modelled with conventional mathematical methods.

We would like to thank the authors for their contributions. Without their effort and expertise this book would not have been possible.

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