

BOOK REVIEWS

A. A. Mikhelev and N. M. Itskovich

DESIGNING OVENS FOR THE BAKERY AND CONFECTIONARY INDUSTRY*

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The theory, design, and construction of ovens is one of the urgent problems of modern heat-equipment engineering for many industries, including the food industry.

Baking processes are complicated, involving unsteady transfer of heat and moisture; they are accompanied by a complex of colloid-chemicals, physical, microbiological, and other specific changes in the dough.

The book under review employs modern heat- and mass-transport theory, as well as many of the disciplines upon which it is based, to discuss the design and construction of ovens, while considering the physical and technical features and laws involved in the processes developing in both materials themselves and within the ovens.

The acute engineering problems associated with optimal design of furnaces and baking processes are closely bound up with present-day theoretical investigations, which clearly illustrate the importance of theory in the practical design of modern high-output efficient bread and pastry ovens that will ensure high-quality products.

A knowledge of temperature-field developmental kinetics for the ovens and heat absorption in the baked products represents the basic element in thermal computations for baking processes. Thus the book considers temperature-field kinetics for baked products under various boundary conditions, including the A. V. Lykov boundary conditions (fourth-order boundary conditions); the determination of the heat flux absorbed by the dough surface during baking is also covered.

Regions of applicability for analytic solutions are discussed, with attention to the possibility of employing digital computers.

The problems of convective and radiative heat exchange are handled fairly rigorously; the information required for baking processes is covered.

The second chapter briefly characterizes the set of physical, biochemical, colloid-chemical, and other processes occurring in the dough during baking. Much attention is devoted to analyzing the thermal processes during baking on the basis of the modern concepts of heat- and mass-transfer theory and studies of the ways in which moisture is associated with the material. New results of experimental investigations into the processes involved in the baking of various products are employed.

There is a detailed exposition of topics associated with analysis of the baking-process mechanism within the moist environment of the oven; the law of governing moisture sorption processes in the baking of bread are discussed. The analytic calculations for baking duration are of considerable practical value.

The third chapter deals with a wide group of problems associated with laws and computational methods for heat transfer within ovens and the gas ducts of ovens using Perkins tubes, in oven channels in the presence and absence of radiative exchange between the lining and the heat-transmitting surfaces of heating

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surfaces, and in the working chambers of ovens. A sample computation is provided for each individual problem. The chapter concludes by considering possible rational ways of intensifying heat transfer in bread-baking ovens.

Chapter IV, "Fundamentals of Conveyor-Oven Construction and a Brief Survey of Oven Designs," analyzes the requirements for the configuration of the baking chamber with allowance for the individual stages of the baking process (initial, and first and second periods). Individual examples are used to illustrate the relationship between the technical characteristics of oven operation and its construction, so that it is possible to see the reasons for unsatisfactory operation of specific oven types. A brief description is given of various designs, and technical characteristics are given for the fundamental types of modern bread ovens, as established at baking enterprises of the USSR and abroad. Thus the chapter presents the fundamental trends in the development of world-wide baking practice.

The fifth chapter comprehensively examines the selection of firing methods for ovens employing various forms of fuel, and gives valuable practical information about the features and techniques of gaseous, liquid, and solid fuel combustion. The sixth chapter presents well-chosen theoretical information on the mechanics of gas motion insofar as it applies to bread ovens; such data is required for scientifically valid design of new ovens. Some sample calculations of practical importance are given. For example, the characteristics of free stream leaving a cylindrical nozzle in the baking chamber are computed, which is of particular importance for the design of furnaces employing convective heat exchange.

In the sixth chapter, the authors employ the exergetic method for analyzing oven operating efficiency to evaluate the effectiveness of bread-baking installations, in conjunction with the usual energy approach; this method gives very complete data, expressed in terms of universal characteristics associated directly with the technical and economic characteristics required for the design of individual thermal installations.

By using the exergy method to estimate plant efficiency, the authors can quite clearly determine the level of performance and the sources of losses, and thus find ways to improve oven units.

In the seventh and final chapter, the authors synthesize the material of the preceding chapters by actually designing a BN-25 oven.

The book employs fundamental studies by Soviet and foreign authors in this area, and also makes use of the authors' own research, which covers many years. The text written by A. A. Mikhelev and N. M. Itskovich is distinguished by its penetrating approach, both from the engineering and educational viewpoints, so that it is a valuable book both for students of the heat-engineering specialities, and for engineers, technicians, and scientists.

The combination of a comprehensive theoretical analysis of physical processes and specific practical methods for thermal calculations pertaining to furnaces, together with the clear and orderly presentation, ensure that the book will be of great theoretical and practical importance in the further development of furnace design.