BOOK REVIEW

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THERMOPHYSICAL CALCULATIONS IN AGRICULTURAL-PROCESSING BUILDINGS*

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There are several books on the physics of buildings that deal adequately with thermophysical calculations on a variety of buildings, particularly industrial and domestic ones, whereas there has so far been no thorough study of heat and mass transfer in agricultural buildings, particularly no unified analysis or survey of the available evidence. This monograph fills this gap, and its publication at the present time is particularly appropriate.

The first chapter deals with methods used in thermophysical calculations on such a building, which is considered as a whole from the energy viewpoint, with emphasis on the coupling between the various heat and mass fluxes. This principle is realized mathematically in a system of balance equations for the characteristics of the volumes and surfaces. The heat- and mass-transfer processes in the surrounding soil, air, and environment generally are not considered in isolation, and this approach to thermophysical calculation should be of value not only for agricultural buildings, but also for industrial and other structures.

The subsequent sections present general principles and successive steps in improving thermophysical calculations for the major types of agricultural building.

The second chapter deals with a wide range of topics, particularly calculations on the heat- and water-transfer processes in buildings with thin transparent surfaces (greenhouse structures and the like). The complex heat- and mass-transfer processes in such a system can be described by means of very simple mathematical models, which give accuracy completely adequate for engineering purposes.

Some particular interest attaches to determination of the radiation fluxes in a system containing semitransparent shells; equations are derived for calculating the temperatures to be expected in greenhouses with plastic-film cover, and also similar structures in which there is partial infrared transmission. Here we may note the interesting suggestion that glasses with selective radiation transmission might be of value in such respects.

The book presents not only theoretical methods, but also experimental data on heat and mass transfer in agricultural buildings, the latter being extremely valuable in elucidating the physical patterns involved. In particular, data on the temperature distributions in the air have been accumulated for various styles of greenhouse and similar structures.

The third and fourth chapters present methods of calculating the temperatures and thermal resistances of walls of buildings used for processing agricultural products. Some specific features of such buildings are emphasized that make it impossible to use normal heat-engineering methods that have been developed for domestic and industrial buildings. In particular, it is shown that radiative heat transfer plays a large part in producing the microclimate and therefore that it is not justified to use standard heat-transfer coefficients for such types of structure.

The fifth chapter deals with some special aspects of thermophysical calculations on agricultural buildings, particularly heat and mass transfer during the melting of snow on roofs, conditions in buildings used in plant cultivation, calculations on tubular heaters, and drying effects produced by ventilating systems.

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These methods of calculating heat transfer for walls appear to be extremely promising, particularly in application to agricultural and similar buildings with adjustable heat transfer.

The topics are accompanied by abundant illustrative examples, as well as graphs, tables, and worked calculations. This makes the volume of considerable value for a wide range of specialists in the design and operation of agricultural buildings.

Although the book covers a wide range of topics, some major aspects are not represented; in particular, there is inadequate consideration of nonstationary heat conditions in agricultural buildings, although the topic is of considerable importance in system regulation in order to provide a specified microclimate. Further, there is no exposition of thermophysical calculations on widely used structures such as stores for agricultural products. Since the book is of applied character, more attention should have been given to calculation on heating and ventilation systems, in addition to purely thermal topics.

These major aspects should be incorporated in a revised edition of the monograph, although the lack of them in the present edition does not reduce the value and importance of the first edition, which is written at a high scientific level and which represents a considerable contribution to constructional thermophysics for agricultural buildings.