BOOK REVIEW

G. S. Shubin

PHYSICAL PRINCIPLES AND CALCULATION OF TIMBER DRYING PROCESSES*

Reviewed by P. S. Kuts and L. S. Slobodkin

In this book the author makes use of the results of many years of experimental and theoretical investigations and presents them in a form which introduces the reader successively to the basic subdivisions of the theory of drying as applied to timber – the statics, kinetics, and dynamics of the processes and the calculation methods derived from them.

The first chapter is devoted to aspects of the statics of the drying process and in it the author examines forms of binding between water and timber, the dependence of the binding energy on the moisture content, sorption isotherms at different pressures, methods of computing the relative moisture of a material (obviously taking into account the various different approaches employed to this question in previously published works), and a psychrometric diagram of air up to 300°C based on the method adopted by the author.

In the second chapter the drying process is analyzed initially from the most general viewpoints of the thermodynamics of irreversible processes and, using this as a basis, the derivation of a set of equations for heat and moisture transfer is examined. Calculations are given for the thermodynamic characteristics of timber (chemical potential of moisture transfer, specific isothermic moisture capacity, temperature coefficient of chemical potential, temperature gradient coefficient), new data on the coefficients of moisture conductivity of timber and its thermal properties are presented, and special features of the mechanism governing the movement of moisture in timber during drying are examined.

The third chapter considers external heat and mass exchange during the drying process. After stating the general positions and formulating boundary-layer equations, the author quotes results from his extensive experiments which have been processed by similarity theory methods and are presented in the form of similar nomograms. The influence of various different factors on the heat and mass exchange during drying is analyzed and the data are compared with figures produced by other authors.

In the fourth chapter the mechanism for and special features of the convective drying of timber are examined. Some original investigation procedures are proposed including methods for the high-speed determination of the moisture field and excess vapor pressure field inside the material.

The special features of the low- and high-temperature timber drying processes, related to the nature of the moisture-transfer moving forces in each of them, are presented systematically. Experimental data are compared with an analytical description of the process.

In the fifth and longest chapter approximate analytical methods for calculating drying times are presented. These methods are based on two theoretical approaches to the solution of equations for drying kinetics: a) on the basis of using moisture-transfer equations and b) on the basis of using heat-transfer equations. In addition, equations for calculating the high-temperature convective drying of a flitch under type III boundary conditions, in hydrophobic fluids (type I conditions), and for the drying of materials with low Bi values are examined here as special cases.

Particular attention should be paid to the methods for taking into account the simultaneous transfer of moisture (heat) in a body in various different directions. The author has produced corrections by considering together the solutions to differential equations for transfer in one- and multidimensional bodies and these can be used to take into account the anisotropy of the material as well.

*Moscow, Lesnaya Promyshlennost' (1973).

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Methods for calculating converted timber drying processes are presented in the sixth and final chapter which deals with universal methods suitable for any temperature–moisture conditions, and extremely simple methods are recommended for a number of special cases of drying.

Several errors are to be found in Shubin's book, which is full of new material. For example, in deriving a formula for calculating the C_T corrections the author fails to specify the magnitudes of moisture content (or to be more accurate, the beginning of the regular condition stage in a two-dimensional flitch) from which they (the corrections) are strictly true. (This comment does not apply to corrections presented in the form of graphs.) In Fig. 5.5.7 some scales are distorted. There are printed errors in the book which are not listed as errata. For example, on page 15 (16th line from the top) P_P should read P_N and on page 126 (15th line from the top) $Bi \rightarrow \infty$ should read $Bi -/\rightarrow \infty$.

These errors do not, however, detract from the merits of this book which is a completely successful attempt to apply the general theory of heat and mass exchange to a study of the processes of drying a specific material. This is all the more important, since the subject of the study – timber – is an exceptionally widely distributed and typical colloidal capillary-porous material. At the same time the book is of no less interest in the study of heat- and mass-transfer processes in other materials as well.