CONDUCTIVE DRYING, BY V. V. KRASNIKOV

Reviewed by P. S. Kuts

Conductive drying is one of the most widely used drying methods in various industrial applications. It is used in the paper-cellulose, chemical, food, meat-and-dairy, textile, light, power, wood-processing pharmaceutical, and other branches of industry.

In many applications conductive drying is more economical and faster than convective drying, since extremely high heat flux densities are reached in the case of conductive drying. There is an extensive body of literature on conductive and combined drying methods for various materials.

This material had not previously been generalized and had not always been approached from the standpoint of the theory of heat and mass transfer. The book Conductive Drying is the result of a generalization of the experimental and analytic studies of the author and his students. It also generalizes the research results of several other Soviet and non-Soviet scientists.

The book, which is 285 pages long with 80 figures, describes in detail new research methods, the drying stands, and the other equipment used.

Modern theory on heat and mass transfer and knowledge about the types of bonds between the water and the material are used for a multifaceted study and explanation of the mechanisms for the drying processes; the basic aspects of the heat and mass transport in moist materials in conductive and combined drying methods are explained.

Significantly, all the theoretical results derived are supported by experimental data.

The book devotes an entire chapter to analysis of heat and mass transfer during conductive drying, and it gives several conjugate boundary-value problems which are solved by the author. These problems furnish a basis for calculating the temperature field and moisture content in the material being dried during the first and second stages of the process.

The author treats conductive drying of moist materials as a Stefan problem. A comparison of the calculated and experimental fields not only verifies and refines the drying mechanism proposed by the author but also reveals certain features which cannot be found experimentally. This work furnishes a basis for finding the qualitative features of conductive drying.

Since the drying process is very complicated, consisting of many intimately related events, approximate methods are usually used to calculate the drying kinetics. The author devotes an entire chapter to these questions. After analyzing the kinetics of the drying process, the author introduces a generalized time N_T, which is the basis of a method for generalizing the drying curves and the drying-rate curves and of methods for calculating the duration of the process. For calculations of the rate of heat transfer and the average temperatures in the medium on the basis of the data on drying kinetics during the second stage, several aspects of the behavior of the Rebinder numbers and the temperature coefficient during conductive drying which were obtained by the author are given.

With the approximate methods for calculating the drying kinetics and the methods for analyzing the experimental data which are outlined in this book, it is possible to use the known dependence of the drying rate on the conditions during the first stage to determine, from a single experiment (a very important consideration), the length and rate of the drying, and it is possible to construct drying and rate curves, which are extremely important and useful in industrial practice.

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Since combined drying methods are influenced by more than 30 factors, the material in the seventh chapter is extremely valuable and permits a scientifically grounded choice of the optimum conditions for conductive and combined conductive – convective drying.

Study of the kinetics and dynamics of conductive drying (Chaps. 3-8) has revealed possible ways to accelerate conductive and combined drying methods. Analyzing the possibilities, the author points out several important, scientifically based measures. One promising method for accelerating the drying is proposed by the author; this is the method of nozzle blowing of the open surface of the material, held on a heating surface. This method makes it possible to reduce the time required for drying by a factor of 2-5.

The methods outlined in this book for intensifying the combined drying process have of course been used widely in the Soviet economy for some time now.

An extremely valuable part of this book is the method and examples of calculating drying apparatus; the method is an engineering kinetic method, worked out by the author.

The book also sets forth the supplemental theory of conductive and combined drying and describes engineering solutions for intensifying processes.

We can confidently assert that this book will be widely used by engineers and scientists concerned with drying and the design of drying equipment as well as by students in many colleges.

THERMODYNAMICS OF LIQUID-METAL MHD GENERATORS, BY D. D. KALAFATI AND V. B. KOZLOV

Reviewed by A. A. Kanaev and I. Z. Kopp

This book by Professor D. D. Kalafati and Candidate of Technical Sciences V. B. Kozlov was published by the Atomizdat publishing house in 1972. Work on the use of liquid metals as the working media in the MHD method of converting thermal energy into electrical energy began back in about 1962. Over this relatively short interval, work in this field has expanded considerably and has advanced qualitatively, becoming an independent research field. However, there had been no generalizing monograph in either the Soviet or non-Soviet literature touching on the problem of liquid-metal MHD generators. The book reviewed here deals only with questions involving thermodynamic cycles, thermal schemes, and optimization of the parameters of the corresponding generators.

The methodological plan of the book is successful. The first chapter deals with the thermophysical fundamentals of MHD conversion in connection with the use of liquid metals as working media. Much effort is devoted to an analysis of available work on thermodynamic cycles and thermal schemes for liquid-metal MHD generators. The second chapter of the book generalizes the fundamental results found in this field in the Soviet Union and elsewhere.

The thermodynamic analysis of the conversion cycles dealt with in this book differs significantly from the analysis of the cycles in traditional energy installations. The basic features of this difference analysis are set forth and described in detail in the third chapter. In particular, this chapter introduces the concept of a reversible-expansion cycle, in which all the constituent processes are assumed reversible, except for those which are irreversible by their very nature (condensation by mixing, separation), so that the preliminary analysis can be carried out within the framework of reversible thermodynamics. There is a useful introduction of the concept of the overall energetic efficiency of the actual cycle, which permits an evaluation of the efficiency of a particular scheme in comparison with a thermodynamically reversible scheme and permits comparison of the losses in various cycles.

The fourth chapter is devoted to a thermodynamic analysis of thermal schemes using an injector – condensator as an accelerating device. The effects of the temperature characteristics of the condensation cycle, of the initial vapor content, and of the thermodynamic properties of the working medium on the efficiency are discussed. The optimum condensation temperatures in an isobaric mixing chamber, the initial vapor content, and the ratio of the vapor and liquid flow velocities at the entrance to the mixing chamber are determined for a condensation cycle with reversible expansion in a scheme with a single MHD generator. There is an interesting section devoted to the determination of the optimum temperature for cooling the liquid metal in the reversible-expansion condensation cycle, corresponding to the minimum surface area of the radiator with heat removed by radiation.

The fifth chapter deals with a thermodynamic analysis of liquid-model MHD conversion schemes incorporating a liquefication of the vapor phase of the separated substances formed during the acceleration of the working medium. This chapter also deals with optimizing the parameters of the cycles. In this section, and in the entire book, the general solutions are illustrated by worked-out examples. On the basis of an analysis of the most important types of losses which occur in separation cycles, the authors propose two new schemes – involving a mixture of the vapor phase after the MHD generator and the use of the kinetic energy of a separated vapor in a converter of the turbine type.

Certain thermodynamic features of binary cycles in which one of the various possible liquid-metal MHD conversion cycles is used as a "superstructure" on a steam turbine apparatus are dealt with in the

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sixth chapter. Despite the uncertain outlook for the use of converters of this type in fixed power plants, this chapter is of general theoretical interest. In this book, as in any lengthy book, we can find several shortcomings; in particular, we could cite the content of certain sections, the order of exposition, and certain stylistic points. Nevertheless, this is a good book, important and timely.