

Book Review

FUNDAMENTALS OF FREEZE-DRYING. By J. D. Mellor.

London: Academic Press, 1978. Pp. xxvii + 386.

J. D. Mellor is obviously a leading authority in the field of freeze-drying. He has produced a comprehensive study of the physical processes involved.

The emphasis of the book is strongly towards a detailed mathematical analysis of all the processes described. A full understanding of the mathematics requires a working knowledge of differential and integral calculus, especially in Part 1 which deals mainly with theory. The less technical reader could, however, gain a good understanding of the basic processes in freeze-drying by reading Chapter 1 and Parts 2 and 3, though even in the descriptive sections a mathematical analysis is included wherever possible. For example, in the chapter on biological aspects a theory on the leakage of plasma bottle gaskets is given.

Part 1 deals extensively with the theory of sublimation, heat transfer and vapour transfer. Modifications and refinements have been made to take into account the effects of non-equilibrium and the effects of kinetic and diffusive resistance to the vapour flow. The latest theoretical development described is the author's own. His model for heat and vapour transfer is based on a 'moving boundary between a dry outer layer and a semi-infinite frozen solid'. (The book cover shows a diagram of this set against a Martian sunset.) The dry product is treated as a porous solid filled with gas, and heat transfer theories based on such a model have been evolved.

The ultimate solution required, the drying rate, depends on so many variables that a complete analytical solution is not possible. However, satisfactory solutions have been obtained from consideration of the vapour transfer through the porous layer and heat transfer by conduction through the material.

Part 2, the central theme of the book, is the cyclic-pressure process invented by the author. This method utilizes increased heat transfer in the high pressure phase and rapid (flash) vapour flow in the low pressure phase. It generally cuts drying times by one-third. The author shows a natural bias towards this system. In the section on costing he compares the cyclic-pressure process very favourably with one called the vertical vibration system which is not described anywhere in the book.

Part 3 outlines techniques for measurements and applications of commercial and laboratory equipment including a simple test tube method using dry-ice for freezing and phosphorus pentoxide for vapour removal.

The chapter on foodstuffs is mainly concerned with physical conditions but the additions of some chemical excipients are described. For example, sulphite treatment for peas; the use of ascorbic acid and 2-mercaptobenzothiazole

sodium to prevent "browning" in fruit; the preslaughter injection of adrenalin, insulin and glucoseoxidase in animals. Rehydration of oysters is aided by the addition of the proteolytic enzyme "Pronase". Apart from this there is not a great deal which would directly concern the food analyst.

The subject matter is highly specialized and would prove extremely useful to those actually involved in freeze-drying, whether in production or research or in the laboratory or industry.

The material is presented logically and clearly. Comprehensive appendices give derivations of the important formulae used, and despite its depth the book is very readable. The scope of the author's researches is indicated in the extensive bibliography of over four hundred references.

W. CASSIDY