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BOOK REVIEW

Advances in Drying, volume 3

Ed A. S. Mujumdar

During the past decade drying has become a fashionable subject for academic chemical engineering research. This has been stimulated mainly by the enormous rise in fuel costs and the realisation that drying accounts for a large fraction of the energy used by many industries. It is also a fascinating subject in its own right, being perhaps a unique blend of heat transfer, mass transfer, aerodynamics and particle technology. Professor Mujumdar has been instrumental in creating an international community of drying researchers and this third volume in his series is a welcome addition to the rapidly growing literature in the field.

The format is the same as in the first two volumes. A number of leading drying researchers have been invited to contribute individual chapters, typically of the order of 40 pages each, reviewing critically the present state of knowledge in their own corner and placing their own research in context. The result is a series of authoritative reviews which will be standard references for many years to come and which will be invaluable introductions for newcomers to the field.

One of the highlights is the chapter by King, Kieckbusch and Greenwald on 'Food quality factors in spray drying'. This chapter serves to remind us that dryers do more than remove moisture; they also create products, and in many instances the quality of the product depends critically on the drying conditions and the dryer design. In recent years a scientific basis has been developed for understanding the influence of these design variables on the flavour, aroma and stickiness of spray-dried foods and beverages and this has resulted in considerably enhanced product quality. The authors present a most readable account of this development as well as a very good introduction to the scientific basis of spray drying in general.

The theme of the influence of drying conditions on product quality recurs in the chapter by Sokhansanj on 'Grain drying simulation with respect to energy conservation and grain quality'. Until recently, for drying processes'. Probably as many as half the fluid bed dryers installed in the last few years employ vibration of the distributor to guard against materials handling problems and to enhance drying rates, but fundamental research on this topic has been largely restricted to Eastern Europe. Over two-thirds of the references are from the East European literature, and while this may be frustrating for Western readers who wish to consult the original papers the authors have nevertheless performed a most valuable service in bringing all this work together and evaluating it.

The same fault detracts from an otherwise good review by Kirk of progress in 'Computer simulation of paper drying'. This chapter is unusual in that there are no section headings to act as signposts for the reader. Instead, the author presents a chronological narrative which reads like a gripping detective yarn, ranging from the earliest simulations performed on hand calculators to present day simulations requiring large computers. On the way much progress has been made in sorting out the relative contributions of various mechanisms of heat and mass transfer in these exceedingly large and expensive drying machines. The chapter would have been strengthened by the inclusion of some examples of the practical utility of these simulations.

Pakowski, Mujumdar and Strunillo contribute a chapter entitled 'Theory and application of vibrated beds for drying processes'. Probably as many as half the fluid bed dryers installed in the last few years employ vibration of the distributor to guard against materials handling problems and to enhance drying rates, but fundamental research on this topic has been largely restricted to Eastern Europe. Over two-thirds of the references are from the East European literature, and while this may be frustrating for Western readers who wish to consult the original papers the authors have nevertheless performed a most valuable service in bringing all this work together and evaluating it.

There is an excellent chapter by Basmadjian on

'The adsorption drying of gases and liquids'. This is a novel departure for these volumes in that it does not concern the drying of solids except in the adsorbent regeneration step, which the author points out has received much less attention than the adsorption step. The review is authoritative, readable and comprehensive and is particularly good in its critical evaluation of the relative utility of models of progressively increasing complexity. A worked design example is included.

Liapis and Marchello discuss 'Advances in the modelling and control of freeze dryers' and present some novel concepts in the modelling of mass transport in heteroporous media when Knudsen, molecular diffusion and hydrodynamic flow occur simultaneously. They show how solution of the complete non-steady-state optimal control problem leads to operating policies for the heat input and chamber pressure which minimise batch times and maximise equipment productivity. In particular, they show that there is no advantage in cycling the chamber pressure compared to operating at the optimal constant pressure predicted by their model.

Filkova and Cedik discuss 'Nozzle atomization in spray drying' with particular reference to atomization of non-Newtonian feedstocks. There have been better and more comprehensive reviews of nozzle atomization published elsewhere, but none which focus on the non-Newtonian materials which comprise over 70% of industrial spray dryer feeds and which have received scant research attention. The chapter is weighted heavily towards the authors' own research on pneumatic atomization of spray dryer feeds, much of which has not hitherto been published outside Eastern Europe.

Finally, Richard and Raghavan present a chapter on 'Drying and processing by immersion in a heated particulate medium'. This is a new technique in which the wet solids are intimately mixed with hot dry sand and heat is transferred mainly by conduction through point contacts. The sand is separated by sieving from the product particles, which are typically agricultural grains or seeds, and recycled. Thermal efficiency is claimed to be higher than conventional grain drying without creating serious deterioration in the quality of the grain. So far the process has only been operated on a pilot scale.

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