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Role of expert reviews in guiding future drying R&D

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GUEST EDITORIAL

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With the accelerating growth of technical and scientific literature on drying, it is increasingly difficult for both academic and practicing researchers and innovators to stay abreast of knowledge available in the public domain. *Drying Technology* attempts to provide assistance to our global readership in this matter by providing capsule, yet comprehensive and critical, assessments by experienced expert researchers of recent developments in areas of broad interest. Several such reviews were published after peer review in 2016. Here we attempt to summarize what these reviews contain to facilitate access to information of particular interest to both seasoned and novice researchers in drying and allied fields.

Rattanadecho and Makul[1] present a truly comprehensive, complete, and evaluative review of recent advances in microwave-assisted drying from both analytical and experimental viewpoints. The review covers a wide ground, starting with the kinetic mechanisms, including dielectric aspects of materials being dried; methods for measurement of dielectric properties are concisely discussed. All aspects of microwave systems, their components, and functions, as well as the diverse types of applications, e.g., traveling-wave applicator, near-field applicator, resonant applicators, single-mode resonant applicator, and multimode resonant applicator, are discussed. Both laboratory-scale and industrial-scale microwave systems as applied to drying are considered in detail. Critical discussion of the various modeling approaches along with their advantages and limitations is then given. Overall, this is an excellent overview of the current state-of-the-art of microwave drying, including suggestions for future R&D, so that the advantages of microwave drying can be fully exploited.

Perazzini et al.[2] give a comprehensive review of the most utilized drying methods (including biodrying; thermal drying, e.g., traditional hot air drying and hot-oil fry drying; dewatering, e.g., use of centrifuges, vacuum filters, belt filter presses) for the treatment of solid wastes; energy consumption and drying performance of these methods are also discussed. In addition, essential aspects of solid waste drying and the most relevant recent studies in the literature are outlined. The review summarizes the characteristics of a number of dryer types, which could be suitable for waste drying; these include fixed beds, rotary and moving beds, and spouted beds, as well as pneumatic and fluidized bed dryers. For details on diverse dryers, both conventional and innovative, the reader can consult the *Handbook of Industrial Drying*.[3] Since drying of solid wastes is often a legislative requirement to preserve the environment and the product has a low value, it is very important to design the dryers so as to minimize the overall capital and operating costs.

Duan et al.[4] summarize the latest and most notable advancements in freeze drying, particularly MFD and AFD. The review starts with an overview of the principal aspects of freeze drying, including its characteristics and main parameters that influence the quality and cost of the drying process. It then reviews the application of FD and its effect on such food quality attributes as rehydration properties, color, shrinkage, bioactive components, and aroma. After that, the energy and efficiency of traditional FD are analyzed and emphasized, as they are the main restrictions for industrial FD applications. Current research status of MFD and AFD are then presented. Finally, intensification methods for enhancing the drying process are identified and future perspectives are proposed.

Liapis et al.[5] provide a concise but yet critical summary of the benefits of multiscale modeling procedures based on molecular dynamics (MD) simulation of heat and mass transfer in porous media. The authors consider two distinct types of porous media. Type I is solid, rigid materials that do not change their morphology during the transfer processes (although the initial values of pore size distribution and pore connectivity may change due to physical and chemical processes that they undergo). Type II, porous media, are soft matter and hence may alter more significantly during processing. The authors provide a detailed listing of information needed to model in three dimensions the drying of both Type I and Type II porous media at the molecular level.

The objective of such detailed modeling is to precisely determine the amount of thermal energy that should be locally supplied to evaporate the moisture without causing damage to the product. Application of such modeling requires information on physical characteristics of the porous media, which could obtained via such imaging techniques as SEM, TEM, X-ray microtomography, and MRI. These images are then analyzed by microscopic pore network theory using Monte Carlo modeling.

Deshmukh et al.[6] give a review that provides concise yet in-depth coverage of the basic principles and application of solvent evaporation followed by lyophilization and spray drying to prepare biodegradable and biocompatible controlled release micro- and nanoparticles. Instead of following a purely empirical approach, the authors provide a technological framework to the development of techniques to produce nanoparticles of desired specifications. As pointed out by the authors, solvent evaporation and spray drying are the most commonly used techniques for the preparation of biodegradable microencapsules. The choice of emulsion techniques depends on the hydrophilicity and hydrophobicity of the target drug, e.g., oil-in-water, water-in-oil-in-water, solid-in-oil-in-water, oil-in-oil-in-water, and oil-in-oil. These techniques are summarized along with their characteristics. The authors also provide a summary of a number of R&D results on both solvent extraction and spray drying and their influences on the diverse quality parameters of interest.

Schuck et al.[7] make a compelling case for dried dairy products in view of the very large global market. Considering the continuing growth of the world population coupled with energy and environmental factors and the rising standard of living, the need for dairy products will increase at a significant state. Improved spray drying technologies will make production of dried dairy products more cost-effective and higher quality. It is interesting to note that results of existing studies on spray drying of dairy products deal with classical dairy products and cannot be simply applied to new dairy products. Hence it is necessary to study product–process interaction in spray drying and reevaluate optimal conditions for the stages of drying as well as rehydration of the powders. In this review, the authors consider all key aspects of processing and functionality of instant milk formulae (IMF) in detail.

Defraeye et al.[8] provide a concise yet comprehensive review of interfacial drying and the interactions at product–barrier–environment interfaces, including evaporation from microscopic pores, droplets, or microperforated membranes; drying of soft cellular tissue and gels; and manufacturing of thin biopolymer layers, such as edible films and coatings. Future challenges and research opportunities for interfacial drying are identified and discussed; these include multiscale approaches, which are required for computational engineering, biochemical, and biological processes in biomaterials, and should be incorporated along with the conjugate exchange processes across the interface.

We look forward to feedback from readers on the selection of review articles and suggestions for topics and authors for future issues. Our goal is to make the journal more impactful for both academics and industrial practitioners, as well as to provide guidance to innovators.

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