Journal of Engineering Materials and Technology

Book Reviews

Particle Size Measurement: Third Edition, Terence Allen, xxi + 678, Chapman and Hall, London, 1981.

REVIEWED BY E. F. C. SOMERSCALES[1]

This book is the third edition of a well-known book and has about 30 percent more pages than the second edition of 1975. It seems unlikely that any other volume is available that gathers together in one place so much information on particle size measurement. The discussion is limited to solid particles. Omitted from consideration are the closely related topics of the size of liquid droplets in gases, liquid droplets in another liquid, and gas bubbles in a liquid. However, many of the ideas and techniques presented in this book are no doubt applicable to these other cases.

The first three chapters deal with sampling from powder in bulk (batches, packets, heaps, streams, or trucks), particles dispersed in gas streams, and particles in the atmosphere. The fourth chapter introduces the physical features used to characterize particle size and the statistical frequency distributions used to present the results. Chapters 5 and 6 are concerned with particle sizing by sieving and microscopy, respectively. The first of these chapters includes a good discussion on sieving errors.

In Chapters 7 through 13 the author discusses the determination of the sizes of particles suspended in liquids. The first of these chapters is concerned with the interaction between particles and fluids, i.e., viscous effects, Brownian motion, particle-particle interaction, and the effect of adjacent surfaces on particle motion. The next chapter involves the important practical problem of dispersing particles in a fluid. Sedimentation (motion in the earth's gravitational field) methods of particle sizing are the topics in Chapters 9 and 10. Chapters 11 and 12 consider the application of other force fields (hydrodynamic drag = elutriation and centrifrugal force fields).

In Chapter 13 the well known Coulter method of particle sizing is discussed. This chapter includes an excellent review of the errors of the method. Chapter 14 is concerned with methods based on the amount and nature of scattered radiation (usually visible light is used but in principle radiation at shorter, invisible wave-lengths could be used). This chapter briefly mentions holographic methods but the discussion is not adequate for a proper understanding of this technique.

Chapters 16 and 17 review methods of obtaining the size of a particle when the surface area is used as the characterizing dimension (this is of importance when finely divided materials are involved in chemical reactions or catalysis).

Chapters 18 and 19 deal with measuring the "complement" of particle size, namely, the pore size in aggregations of particles. Chapter 15 "Permeametry and gas diffusion" is presumably related to chapters 16, 17, 18, and 19 but the author does not make the connection clear.

The concluding chapter, Chapter 20, returns to the topic of the first three chapters by considering on-line particle size measurement where the sampling and sizing are combined operations. Typically the particle size measurement is made in a sampling volume located at some point in a moving stream of fluid.

The scientist and engineer who is attempting to select a method of particle size determination will be assisted by the comparisons made between different techniques. However, these are spread throughout the book and it might have been helpful if these had been collected together in one final, summarizing chapter.

One major omission is the lack of discussion of dynamic methods of particle sizing. Particle dynamic characteristics can be inferred from the response to a known acceleration of a suspending fluid medium, e.g., sinusoidal oscillations of the fluid. A "size" could be determined from such measurements, provided certain assumptions are made about the particle-fluid interaction, but a determination of the dynamic transfer function of the particle is more useful, more accurate and conforms to the rule given by the author (p. 103) that "a particle sizing technique should, wherever possible, duplicate the process one wishes to control."

The final chapter (Chapter 20, "On-line particle size analysis") is not as solidly grounded in the theory of the methods as are the other chapters. In particular, the author has failed to note that on-line sensing of particle size is subject to sampling errors, analogous to those associated with physically extracting a sample from a batch of particles or from a flowing stream (the topics of the first three chapters of this book). In the context of fluid velocity measurement the problem of such sampling errors has been of considerable concern in the last few years to those involved with the application of the laser Doppler velocimeter (in this connection, the "errors of sampling" are called "bias errors").

The book is well produced with clear type and has numerous, well drawn illustrations. The references are up-to-date. A selection of 57 problems is to be found at the end of the book but they are not keyed to the chapters. Two appendices list equipment manufacturers and their addresses. Separate indices of authors' names and of topics are included.

In conclusion, it can only be said that this is an indispensable reference source for those involved in particle sizing. The author is to be congratulated on providing the technical community with a third edition to his, by now, deservedly well known treatise.

[1] Rensselaer Polytechnic Institute, Troy, N.Y. 12181.