

Book Review

Fossil Fuel Combustion: A Source Book

William Bartok and Adel F. Sarofim (eds.), Wiley, New York, 1991, 866 pp., \$99.95.

This book is a useful compendium of combustion technology for the student, researcher, or practicing engineer beginning to study the field. The book is divided into three parts and an appendix. Section I, Combustion Chemistry, discusses chemical aspects of combustion. Section II, Flame Phenomena, Diffusional Processes and Turbulent Reactive Flow, considers premixed and non-premixed gas-phase flame propagation in laminar and turbulent environments. Section III, Heterogenous Combustion, addresses the combustion of liquid and solid fuels. The Appendix contains data on fuel and combustion properties.

Section I begins with an historical perspective by J. P. Longwell. He presents information on past and future uses of fossil fuels and discusses the important characteristics of the major fuel groups. This is followed by a discussion of the basic ideas of chemical thermodynamics and reaction rate theory for combustion modeling by D. Golden. Thermodynamics is treated from the chemist's perspective, with a focus on estimating properties. Basic reaction rate theory is presented in terms of transition state theory. F. L. Dryer gives an extensive tutorial on detailed kinetic modeling of combustion chemistry; included are a catalog of types of reaction mechanisms, a discussion of organic molecular reactions over a range of temperatures, a presentation of Dryer's ideas on detailed kinetic modeling, and a final discussion of global kinetics modeling. C. T. Bowman next deals with the chemistry of the major combustion pollutants: carbon monoxide, oxides of nitrogen, and oxides of sulfur. This section ends with a discussion of soot formation by B. S. Haynes.

Section II begins with a discussion of premixed flames and detonations by the late R. A. Strehlow. He presents the Rayleigh and Hugoniot solutions to the one-dimensional conservation equations, demonstrating the difference between deflagration and detonation. He then discusses laminar flame propagation under deflagration conditions, followed by flame propagation under detonation conditions. Strehlow finishes with a presentation on combustion safety and explosion dynamics. Nonpre-

mixed (diffusion) flame propagation is described by M. Gerstein, who begins with laminar flame theory, moves on to turbulent flame propagation, and closes with flame stability. F. A. Williams follows with a discussion of turbulent combustion. Of particular interest for the beginner is Williams' first section, in which he presents the important parameters encountered in turbulent combustion problems as well as a codification of tractable and intractable problems. His next section presents information on three major modeling approaches: the moment method, the probability density method, and perturbation methods. In his final section, Williams describes the role of coherent structures in turbulent combustion (however, he does not include a discussion of recent advances in direct numerical simulation).

Section III begins with a presentation on spray combustion by A. H. Lefebvre. He discusses atomization, droplet evaporation, and spray combustion, respectively. L. D. Smoot then discusses coal and char combustion starting with an overview, following with information on fuel properties, particle ignition and devolatilization, and char reactions, and closing with a discussion on practical coal flames and modeling of coal processes.

The Appendix, by P. C. Wu and H. C. Hottel, presents a variety of charts and tables of properties of fuels and combustion systems. Although much of the information in the Appendix is available in computer data bases from various sources, such a compendium is useful for a first look at a variety of problems. The student would be well advised to study this section.

Overall, the book gives a fairly balanced presentation of fossil fuel combustion. The authors are well known for their numerous contributions to the field. The presentations are, in some cases, several years out of date; however, as the book is meant to provide an introduction to the field, the reader is expected to turn to the current literature for more recent information.

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