Book Review of
G.W. Roberts
"**Chemical Reactions & Chemical Reactors**"
John Wiley & Sons, Inc, 2009

Back in the eighties, instructors of chemical reaction engineering (CRE) courses had rather limited choices as far as undergraduate textbooks were concerned. Among the limited options were the two classics by O. Levenspiel and J.M. Smith, in addition to the book by C.G. Hill. However, all of these three textbooks were increasingly becoming out-of-date at the dawn of the internet age in the nineties. The textbook by H.S. Fogler, first published in 1987, has replaced Levenspiel worldwide as the leading textbook for the CRE course, according to a 1996 study published in *Chemical Engineering Education*. I believe this is still the case, as its fourth edition was published in 2006.

In recent years, a growing number of texts on CRE have appeared. The book by G.W. Roberts (published earlier this year by Wiley) is the latest addition. This book covers the fundamental aspects of CRE and few of the more "advanced" topics. The fundamentals are covered in eight chapters and the advanced topics are covered in the last two chapters. Each chapter begins with a concise list of learning objectives, and ends with a summary of important concepts. The total number of pages is 439.

The first chapter lays down the scope of applications of chemical reactions in modern-day technology, and the importance of chemical kinetics in the analysis and design of reactors. The proper "definition" of the reaction rate in single- and multi-phase systems is also introduced here. In the second chapter, the author presents what he calls "generalizations" concerning the reaction rate. These mainly revolve around the form of the rate expression. The next two chapters deal, for the most part, with the three ideal reactors: BR, CSTR, and PFR. The discussion is restricted to the sizing of isothermal systems; the systems embrace single as well as series and parallel reactors.

The fourth chapter includes a brief qualitative discussion of transport effects in solid-catalyzed reactions; which might seem out-of-place to some readers. In the fifth chapter, a more fundamental look is taken at chemical kinetics, where elementary reaction mechanisms are presented, as opposed to the empirical generalizations given earlier. The author argues that this is necessary in order to broaden the training of "modern" chemical engineers. This idea however may not be shared by some CRE instructors, since the fundamentals of kinetics are typically covered in physical chemistry courses. Correlation of kinetic data is analyzed in detail in the sixth chapter. Both the differential and integral methods of data analysis are presented. This chapter ends with a brief discussion and an illustration of statistical methods in the analysis of reaction rates.

Chapter seven includes the important topic of yield and selectivity in complex reactions. Design options are given for series, parallel, and series-parallel reactions. As the performance equations of BRs and PFRs, hosting multiple reactions, become nonlinear, the author includes an appendix explaining the details of how ODEs can be handled numerically. More specifically, details of the fourth-order Runge-Kutta method are presented and illustrated via a spreadsheet solution.

Chapter eight is where the plot thickens in the typical CRE course, as the more realistic non-isothermal operation of reactors is analyzed. Energy balances are derived for the three ideal reactors. The issue of steady-state multiplicity in CSTRs and in PFRs with a feed/product heat exchanger configuration is discussed also in this chapter. The following two chapters cover advanced topics, namely, heterogeneous catalysis, and non-ideal flow in chemical reactors. In chapter nine, the emphasis is decidedly on internal and external diffusion-reaction interactions in porous catalysts, as well as on internal and external thermal gradients. The final chapter is devoted to analysis of non-ideal flow in tank and tubular reactors. This is a long chapter (can it be otherwise, I wonder) covering tracer-response techniques, RTD, the axial-dispersion model, among other topics.

In any textbook, there must be compromises, and Roberts's text is no exception. I choose to mention only three. It would have been prudent to include a more rigorous development of the stoichiometric relationships in the earlier chapters, especially regarding multiple reactions. Moreover, it would have provided added value to incorporate a discussion of whether steady-state multiplicity is possible in non-isothermal PFRs. Likewise, it would also have been preferable to demonstrate, in chapter nine, how transport effects reflect on industrial catalytic reactor performance.

One of the strong points of the book is the inclusion of real reactions in the examples and in the problems at the end of most of the chapters. Another significant advantage is the style of writing, which lends itself to comfortable reading, especially for non-native English speakers.

Overall, Roberts's text is a welcome addition to the education literature. It is a highly readable undergraduate textbook for reactor analysis and design.