Fluid Dynamics and Scale-Up in Process Engineering

(Theory and Logic in Practice)

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Preface

This book covers the author's and a host of his colleague's industrial design as well as research and development experiences, gained over the years from 1942 to 2012. In the words of Johannes Kepler in his 1609 *Astronomia Nova*: "What matters to me is not merely to impart to the reader what I have to say, but above all to convey to him the reasons, subterfuges, and lucky hazards which led me to my discoveries." The contents are intended to serve process engineers as a source tested correlations tracked to related theory in fluid dynamics, for the design and arrangements of reactors, process vessels and internals, handling gases, liquids, and particulate solids, passing through single and multi-phase, co- and counter-current flow. It is replete with examples encountered in the design and operation of numerous specifically cited industrial processes, as well as accompanying illustrative calculations. Corporate entities are not in all instances identified in order to preserve confidentialities where deemed appropriate.

The subject matter is presented in 22 chapters dealing with recurring questions in design, and the resolution of past un-published failures. Every chapter contains new data and engineering design correlations never before published in book or other form. The breadth of contents can serve as a text for a graduate, or continuing education, course in practical process, design engineering. Several chapters are descriptive of correlating functions, their origin, and numerous analogous observations that obviate the logic in terms understandable to a layman. Fluid dynamics underlies and defines every observed level in scale of size and motion. Process engineering encompasses the relatively limited ranged in scale lying within the capability to physically construct.

Much of the content has resulted from the financial and technical and technical support of domestic and foreign corporations and their past and present principal and responsible personnel in research, development and design, such as John Chiu and Herb Andrus (Alstom Power), John York (Q.O. Chemicals), Peter Slater (Conoco Philips), Mel Pell (duPont), Barry Tarmy and John Matsen (Exxon), G. Papa (Snamprogetti, Milan), P. LaBourt-Ibarre (Rhone-Poulenc, Paris), D. Durand (BP Chemicals, S.N.C., Fr.), H. Singh (E.I.L., New Delhim India), M. Cecchini (Lonza S.P.A., Milan), A. Avidan (Mobil), J. Barberio (Gt. Lakes Chemicals), S. Bunk and R. Samu (Dorr-Oliver Technip), W. Heumann (Fisher Klosterman), J. Wells (Philips Petroleum), P. Mangin (B.P. Chimie, France), F. E. and J.A. Zenz (PemmCorp), K. Weitz (Ducon), J. Ross (Stone & Webster), C.T. Burris (Man. College), and their staffs, as well as the early mentoring and support from Leo Friend, Walter Lobo (M.W. Kellogg), Manson Benedict, A.M. Squires, P.C. Keith (Hydrocarbon Research), and a host of colleagues met and worked with over the years.

To preserve readers' recognition of nomenclature, experimental functions, and variables, as they were first presented by their authors, few have been altered. The reader is therefore cautioned with regard to units such as time, size, and velocity in applying any functions that are not dimensionless. Making each chapter relatively self sufficient results in some repetition of underlying bases between chapters, which are often cross-referenced, and in retrospect connect and multiplicity of otherwise narrowly viewed phenomena.

Written over a period of 10 years, encompassing 70 years of experimental and design consulting experiences, results in numerous cited references not necessarily following in timely sequences. The reader is assumed to be aware of related contents of *Fluidization and Fluid-*

Particle Systems published by Reinhold in 1960, which serves as background to the subsequent 55 years covered in this volume.

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