Preface

This book is mainly about fluid mechanics, but it is first intended to MSc and professionals who need to make use of fluid mechanics skills for applications pertaining to chemical and process engineering. This objective explains the presentation of fluid mechanics as given in this book. The foundations of the discipline are generally not set out, but the book endeavours to help students and professionals to use the tools of fluid mechanics in a pertinent way, while attempting to point out the key ideas associated with the concepts encountered.

As an example, the ability to use Navier-Stokes equations appropriately is more important, to most practitioners, than the ability to prove them. It is of course very interesting to have reflected upon that proof at some point, but this can be found in other books, and this is not the intended objective of this book. Besides, I will be very happy if this book can prove useful for specialists in fluid mechanics, giving them the opportunity to discover important applications of fluid mechanics in the field of chemical engineering.

The book is divided into three parts.

The first part is about the basics of fluid mechanics. Emphasis is on general theorems that constitute the tools used in the first instance by engineers. Chapter 2 forms the main foundation of that part, which then branches into short chapters tackling the key notions implemented by a specialist in process engineering (hydraulic circuits, pumps, rheometry, etc.). The concepts of dimensional analysis are also emphasized (Chapter 3).

The second part deals with mixing phenomena associated with turbulence. In that part, notions relating to turbulence are first presented. The problems associated with dispersion and mixing in connection with chemical reactions are then considered. The key notion, from a fundamental standpoint, regards the interrelation between the phenomena of turbulence and that of molecular diffusion, the latter being the actual cause for mixing that allows a chemical reaction to occur.

Toward the end of this part, elementary models for the simulation of reacting flows are also presented.

The third part presents the tools of fluid mechanics used in mechanical fluid/solid and fluid/fluid separation processes. Process unit operations considered include filtration, fluidization, and centrifugal separation. I have also tried to provide, in that part, means for understanding more complex approaches regarding the modeling of a solid particle's dynamics within a fluid flow (Chapter 16) and a presentation of the physics of a granular material, which will often be of interest to specialists in process engineering.

Although the whole treatment might not seem very ambitious, my goal was primarily to specify the elementary notions in fields related to fluid mechanics, in order to facilitate access to other, more specialized books.

This book draws its material chiefly from the courses I have been teaching for about 10 years at the École Nationale Supérieure en Génie des Technologies Industrielles, an engineering curriculum at the University of Pau and the Adour Region (UPPA) in the chemical and process engineering specialization. For the sake of consistency, I have endeavored to expand the coverage of the subject matter by complementing certain parts of my lectures. As this is an adaptation of a book previously published in French, and of course drawn from material originally taught to French students, there were of course issues regarding the references. I am fully aware that some of the literature in French will not be available to non-French speakers, and I apologise for this, but it would have been unfair not to keep these citations, as they were significant sources for writing the book. Wherever possible English substitutions to the French references have been provided, and where not, additional English textbooks have been suggested as a complement to the reading of the book.

I wish to thank the UPPA for giving me an opportunity to lecture in these topics. I am thankful to my colleagues S. Alexandrova, A. Saboni, and D. Graebling, from the UPPA, for their insightful discussions that proved invaluable to me while writing this book. Beyond this, their friendship has been a tremendous support for me throughout this critical work.

I have also used my experience in research and education while writing the various chapters of this book.

It is important to me to mention first my first teaching experiences, when I joined a team in Grenoble, teaching fluid mechanics at the École Nationale des Travaux Publics de l'Etat. The course taught by C. Le Provost, who was then in charge, emphasized the use and understanding of tools rather than the proof of

their validity. I have tried to emphasize and retain that approach as far as possible in this book. Later, I was lucky to receive an invaluable educational tutoring from R. Moreau, M. Favre-Marinet, and A. Temperville, at the École Nationale Supérieure d'Hydraulique et de Mécanique de Grenoble and at Joseph Fourier University.

This book also includes the legacy of the one year I spent (1988–1989) on secondment to the Centre d'Etudes et de Recherche de Grenoble (ALSTHOM group)[1], when I learnt a great deal alongside specialists in industrial hydraulics. My thanks to P. Chantrel, who was my supervisor and also to the whole team in this regard.

My thesis supervisor, E. Hopfinger, might not recognize much of himself in this book. Yet, I received my training, first and foremost, from him during my PhD years. He was instrumental in expanding my knowledge base. More importantly, by making himself available to me, he enabled me to get acquainted with the way he saw and tackled fluid mechanics. Those years were undoubtedly the richest and the most momentous in my professional life. I wish to express to him my recognition and my gratitude.

Lastly, I thank the experts who agreed to read this book and took time to offer very useful reviews in order to improve it and rectify errors. Jean-Luc Achard monitored the whole enterprise and I thank him for that, although I often cursed him during the editing stage for obvious reasons! Nevertheless, he has remained a true friend since 1982.

Mathieu Mory
January 2011

1 Now a subsidiary of the Environne'Tech company (http://cerg-fluides.com/)