Preface

Air emissions include air pollution emissions and greenhouse gas emissions. Effective air emission control requires multidisciplinary expertise in engineering, education, physics, chemistry, mathematics, medical science, psychology, agriculture, architecture, business management, economics, and politics. It is a difficult task for the author(s) of any single book to address all aspects of air emissions. The focus of this book is on engineering science and technology, upon which effective air emission control program must be built. It does not prescribe social, economic, and political factors that lie outside the scope of this book.

This book aims at senior undergraduate and graduate students with educational backgrounds in mechanical, chemical, and/or environmental engineering. It can also be used by professionals with similar training background. It focuses on the basic concepts and engineering applications of technologies for the control of air emissions resulted from fossil fuel combustion.

This book is divided into three parts. The general basic concepts introduced in Part I are necessary to the understanding of air emission engineering topics in Parts II and III. Part II presents the engineering applications of the principles introduced in Part I. Part III covers some emerging topics related to air emission engineering and they include carbon capture and storage, nanoaerosol, indoor air quality.

Following a brief introduction to air emission in Chap. 1, Chaps. 2–4 present the general basic properties of gases and aerosol particles. They are necessary to understand the formation and behavior of air emissions. Chapters 5 and 6 present basic principles for the separation of unwanted gases and particulates from the contaminated air. These are the principles for the related engineering applications in Parts II and III such as syngas cleaning, carbon capture, and flue gas cleaning.

Part II of the book introduces the strategies for precombustion (Chaps. 7 and 8), in-combustion (Chap. 9) and postcombustion (Chap. 10) air emission control, step by step, from a process point of view. While air dispersion model (Chap. 11) is a powerful tool for air quality assessment and impact prediction, air dispersion itself is also a measure for air emission control by dilution.

Part III includes special topics related to the scope of this book, but they do not fit into the process introduced above. Chapter 12 is devoted to carbon sequestration and storage, which are of increasing interest to the society. Although debates are still ongoing, it is time to summarize the techniques that have been developed for CO_2 capture and storage. There may be some overlapping between this chapter and the other parts of this book. Chapter 13 presents an emerging topic of air pollution, nanosized air pollution. Nanomaterials are now widely used in many industries, for example, improved combustion efficiency, environmental protection, health, and solar panel fabrication. The unique properties of nanoaerosol and its implications on monitoring and filtration technologies are covered. Indoor air quality is introduced in Chap. 14. Indoor air quality is related extensively to air pollution. The sources of indoor air pollutants are different from their outdoor counterparts, as are their control techniques. The last chapter is about air quality and air emission monitoring techniques. They are commonly needed in industrial practices, government standard enforcement, and research and development in a laboratory setting.

The seed from which this book has grown was the engineering lecture notes that I have developed over the last 10 years. More teaching materials are available at this link: http://tan.uwaterloo.ca/book.html. They include PowerPoint presentations, extra assignment problems, and the solutions to the practice problems. They will be updated without notice.

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