Pinch Analysis and Process Integration: A User Guide on Process Integration for the Efficient Use of Energy

By Ian C. Kemp, 2nd ed, Butterworth-Heinemann/Elsevier, 2007, 416 pp., $72.95.

Pinch analysis is one of the most impressive developments that have impacted process design over the past three decades. It has provided an insightful basis for the holistic analysis of energy systems using rigorous thermodynamic techniques, coupled with composite representations of heating and cooling systems. While the initial concepts were developed in the early 1970s, the technology has shown signs of maturity starting in the early 1980s, with early success in addressing the problem of synthesizing heat exchange networks (HENs), and determining targets for heating and cooling utilities.

The first edition of this book was published in 1982, and was authored by Linnhoff and coworkers. The book was an immediate hit and was largely recognized as a must-read for those interested in learning pinch analysis. Twenty five years later, Ian Kemp has published the second edition of the book. Generally speaking, the second edition has maintained much of the strengths of the first edition and added new developments and extended case studies. The book contains 10 chapters. Chapters 1 and 2 provide an overview of pinch analysis, its history, motivation, basic concepts in heat exchange, and a recipe for constructing heat-recovery pinch diagram. Chapter 3 gives useful guidelines on extracting energy to enable proper targeting. This is an important subject that is typically confusing to beginners and may result in suboptimal targets. The book provides five useful guidelines during the data extraction phase. Chapter 3 also discusses the various types of utilities and how they be properly placed using the concept of grand composite curves. Additionally, the tradeoff between fixed and operating costs is discussed. Chapter 4 describes how the network of heat exchangers can be systematically designed to reach the identified utility targets. Designs above and below the pinch point are determined, and alternative designs are generated. The issue of combined heat and power (or process cogeneration) is described in Chapter 5. Various thermodynamic cycles are described and linked to pinch analysis. Additionally, the impact of cogeneration of emissions targeting is explained. This is an important subject given the increasing concern about the industrial emission of greenhouse gases. In Chapter 6, techniques for process modification (such as the plus/minus rule) are described. Additionally, systems such as reactors, distillation, and flash are briefly discussed. Batch systems are addressed in Chapter 7, along with a discussion on startup and shutdown. Recognizing the importance of knowhow and practical applications, Chapters 8 and 9 provide guidelines on how to carry out a pinch analysis for heat recovery and for various case studies. Finally, Chapter 10 gives a brief summary of the key themes and findings of the book.

This edition has maintained the elegance of the first edition, and has presented clear tools in an easy-to-follow format in the area of energy integration. The case studies have also been carefully selected to elucidate the basic concepts and to impart useful knowhow. However, this edition has been faithful to the key messages and tools of the first edition perhaps to a fault. Many recent developments have taken place since the publication of the first edition, which rendered a much broader domain of pinch analysis than just energy systems. While energy integration was the first success story in pinch analysis and, therefore, the focus of the first edition, two other branches of process integration have evolved and achieved much recognition in theory and industrial applications. These are: mass integration and property integration. Pinch analysis has been successfully used in both. There is a very brief mention of wastewater minimization and hydrogen optimization problems. The rest of mass integration and the whole field of property integration have not been included. Perhaps the rationale for not including mass integration and property integration is that the subtitle of the book is: *A User Guide on Process Integration for the Efficient Use of Energy* which emphasizes the energy aspects. However, process integration has grown to mean much more than energy. Additionally, while visualization tools provide very useful insights, much progress has been made in the area of mathematical programming for process integration. This area has also not been tackled in the book.

Overall, this book is an excellent source for those interested in learning the fundamentals and applications of pinch analysis for heat recovery and energy systems.

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