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BOOK REVIEW

A. FAGHRI, **Heat Pipe Science and Technology.** Taylor and Francis, 1995, 912 pp, 1-56032-383-3, Cloth 149.50.

The monograph by A. Faghri is the most profound book on fundamental heat and mass transfer processes in the field of heat pipes so far. Written to cover simple, intermediate and advanced approaches to the theoretical and experimental analysis of heat pipes, this book emphasizes both the physical significance and mathematical manipulations, as well as the technological and experimental issues.

This is a valuable and complete resource for engineers, designers of heat pipe systems, and graduate students alike who need a comprehensive overview of the current research and fundamental principles of heat pipe science.

The author is the leading active scientist in the field of heat pipes who has made significant contributions in all aspects of heat pipe science over the last two decades. Fourteen chapters cover the subject matter, with about 400 illustrations and 900 pages.

After the Introduction, which serves as an overview and also discusses the principles of operation of various heat pipe systems and current and potential applications, Chapter 2 deals with solid–liquid–vapour phenomena, driving forces, and interfacial heat and mass transfer in vaporization and condensation.

This complete presentation is very important for a fundamental understanding of the various phenomena in heat pipes.

Chapter 3 considers steady-state modeling and simulation of heat pipe systems including the liquid flow in capillary structures and compressible and incompressible vapor flow. Various orders of approximation such as one-, two- and three-dimensional analyses are presented.

The analysis includes both closed form analytical and numerical methodology.

Expressions for effective pore radius, permeability, porosity and effective thermal conductivity for various wick structures are summarized in different tables. Chapter 4 describes various heat transport limitations of heat pipes and the development of appropriate relations to predict these limits.

Some new and important limits such as continuum flow and frozen startup limitations are presented for the first time. Chapter 5 is specifically devoted to the theoretical analyses and experimental prediction of continuum transient and frozen startup operation of heat pipes. The models presented in this chapter range from the complete two-dimensional conservation equations to a simple closed-form analysis. No other heat pipe book offers such accurate and detailed presentation as does this chapter. A considerable amount of theoretical and experimental development has been made by various scientists related to two-phase closed thermosyphons since it is a simple but effective heat transfer device. These efforts are summarized and presented in Chapter 6.

Chapter 7 provides a comprehensive review of the existing rotating and revolving heat pipe analyses. A detailed description and analysis of several types of variable conductance heat pipes, capable of operating at nearly isothermal condenser conditions with varying heat inputs, is presented in Chapter 8.

Capillary pumped loops (CPL) and loop heat pipes systems (LHP) have been extensively studied by many investigators during recent years due to their high heat transport capacity compared to conventional heat pipes.

Chapter 9 is devoted fully to the physical description and thermal modeling of these devices in order to understand the operational mechanisms. I should note CPL was invented and developed by U.S. scientists and LHP by Russian scientists. The author has provided background to both technologies. The relatively new field of micro/miniature heat pipes for electronic components cooling is considered in Chapter 10.

This chapter discusses sophisticated models to predict performance characteristics of micro/miniature heat pipes and existing techniques to build them. One of the most commonly known applications of the heat pipe is in heat-pipe-based heat exchangers.

Chapter 11 covers this topic in detail, where various basic designs are discussed, including methods for the evaluation of their performance. Since some specific applications require nonconventional shapes of heat pipes, modeling of these nonconventional heat pipes is discussed in Chapter 12.

Chapter 13 covers the mechanism and performance characteristics of some special effects such as osmosis, electrohydrodynamics, vibration and electromagnetohydrodynamics of heat pipes to achieve better performances.

Chapter 14 presents in detail the current practices of manufacturing and testing low-, intermediate- and high-temperature heat pipes. This includes evacuation and charging as well as evaluation of fluid and wick properties.

Numerous publications on the subject cited in the text are referenced at the end of each chapter including the most recent developments that have taken place in the field.

The text finishes with complete tables of thermophysical properties and typical existing experimental data on heat pipes, and a comprehensive subject index.

Finally, I would like to recommend this invaluable book to engineering practitioners, academic researchers working in the heat pipe field, and graduate students, as the most complete and consistent resource on heat pipe fundamentals and mathematical modeling.

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