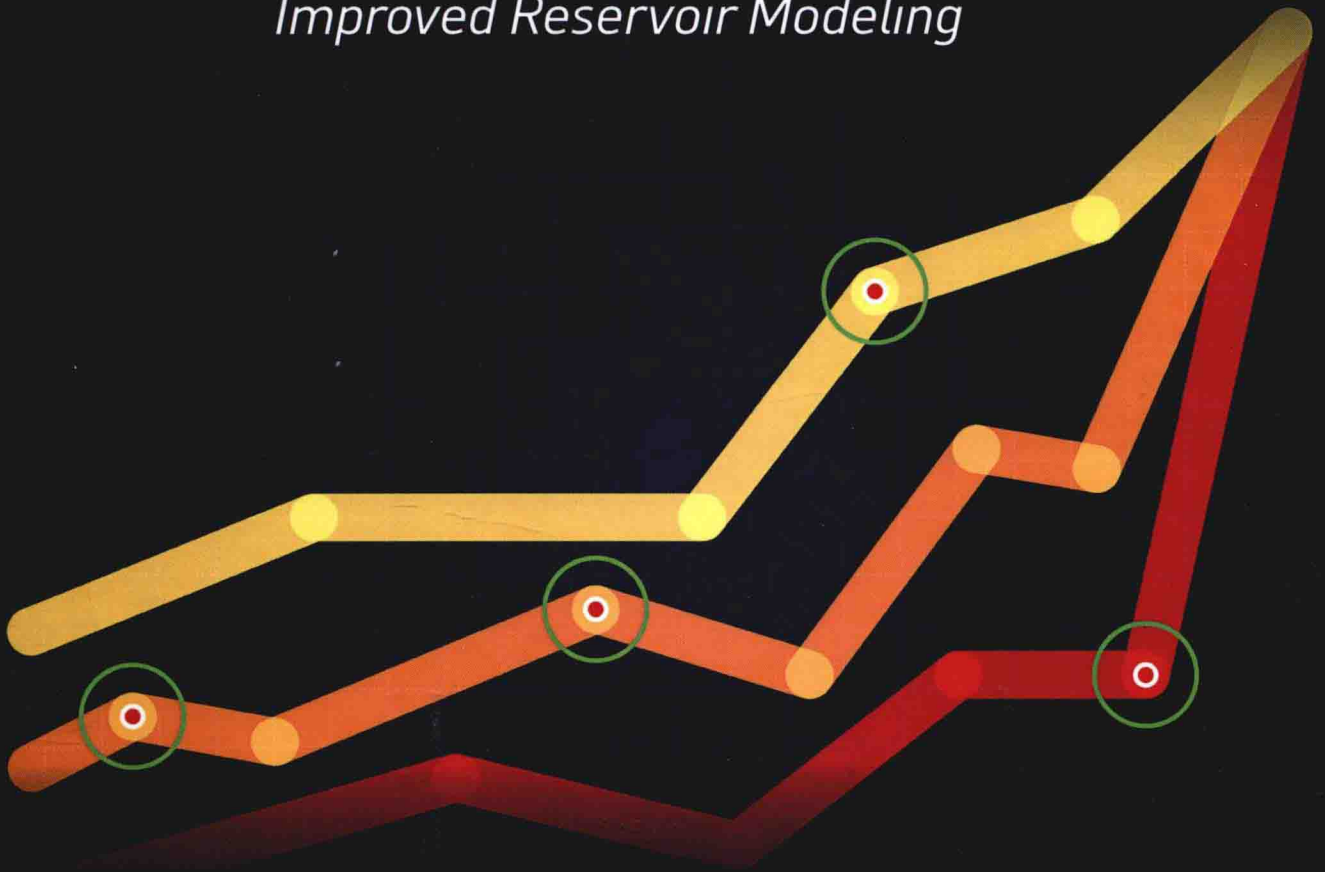


SECOND EDITION

EQUATIONS OF STATE AND PVT ANALYSIS

*Applications for
Improved Reservoir Modeling*



Tarek Ahmed



Equations of State and PVT Analysis

Applications for Improved Reservoir Modeling

Second Edition

Tarek Ahmed, PhD, PE



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Equations of State and PVT Analysis

Applications for Improved Reservoir Modeling

This book is dedicated to my wife Wendy

About the Author

Tarek Ahmed, PhD, PE, served as a professor of petroleum engineering at Montana Tech of the University of Montana from 1980 to 2002. He has worked for Anadarko Petroleum, Baker Hughes, and Talisman Energy. In 2012, Dr. Ahmed founded the consulting company Tarek Ahmed & Associates, Ltd. Dr. Ahmed has authored or coauthored several textbooks, including *Reservoir Engineering Handbook* and *Hydrocarbon Phase Behavior*, among others.

Preface

The primary focus of this book is to present the basic fundamentals of equations of state and PVT laboratory analysis, and their practical applications in solving reservoir engineering problems. The book is arranged so it can be used as a textbook for senior and graduate students, or as a reference book for practicing petroleum engineers.

Chapter 1 reviews the principles of hydrocarbon phase behavior and illustrates the use of phase diagrams in characterizing reservoirs and hydrocarbon systems. Chapter 2 presents numerous mathematical expressions and graphical relationships that are suitable for characterizing the undefined hydrocarbon-plus fractions. Chapter 3 provides a comprehensive and updated review of natural gas properties and the associated, well-established correlations that can be used to describe the volumetric behavior of gas reservoirs. Chapter 4 discusses the PVT properties of crude oil systems and illustrates the use of laboratory data to generate the properties of crude oil that can be used to perform reservoir engineering studies. Chapter 5 reviews developments and advances in the field of empirical cubic equations of state, and demonstrates their practical applications in solving phase equilibria problems.

Acknowledgments

It is my hope that the information presented in this textbook will improve the understanding of the subject of equations of state and phase behavior. Much of the material on which this book is based was drawn from the publications of the Society of Petroleum Engineers, the American Petroleum Institute, and the Gas Processors Suppliers Associations. Tribute is paid to the educators and authors who have made numerous and significant contributions to the field of phase equilibria. I would like to especially acknowledge the significant contributions that have been made to the field of phase behavior and equations of state to Donald Katz, M. B. Standing, Curtis Whitson, and Bill McCain.

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I hope my children Carsen and Asia will follow my footsteps and study petroleum engineering.

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