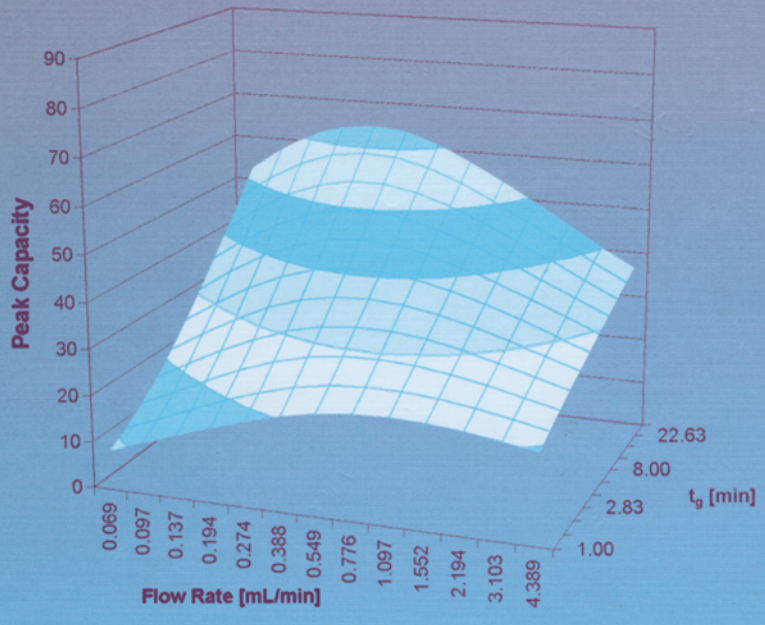
HPLC METHOD DEVELOPMENT FOR PHARMACEUTICALS

Edited by
Satinder Ahuja
Henrik Rasmussen



VOLUME 8 Series Editor Satinder Ahuja

SEPARATION SCIENCE AND TECHNOLOGY

HPLC METHOD DEVELOPMENT FOR PHARMACEUTICALS

This is Volume 8 of

SEPARATION SCIENCE AND TECHNOLOGY

A reference series edited by Satinder Ahuja and Henrik Rasmussen

HPLC METHOD DEVELOPMENT FOR PHARMACEUTICALS

Edited by

Satinder Ahuja

Ahuja Consulting, Inc.,
Calabash, North Carolina

Henrik Rasmussen

Johnson & Johnson Pharmaceutical Research and Development, LLC
Raritan, New Jersey

ELSEVIER
ACADEMIC
PRESS

Amsterdam – Boston – Heidelberg – London – New York – Oxford –
Paris – San Diego – San Francisco – Singapore – Sydney – Tokyo

Academic Press is an imprint of Elsevier
84 Theobald's Road, London WC1X 8RR, UK
Radarweg 29, PO Box 211, 1000 AE Amsterdam, The Netherlands
Linacre House, Jordan Hill, Oxford OX2 8DP, UK
30 Corporate Drive, Suite 400, Burlington, MA 01803, USA
525 B Street, Suite 1900, San Diego, CA 92101-4495, USA

First edition 2007

ISBN: 978-0-12-370540-2

For information on all Academic Press publications
Visit our website at books elsevier.com

Printed and bound in Italy

07 08 09 10 11 10 9 8 7 6 5 4 3 2 1

CONTENTS

2. HPLC Theory

Y.V. KAZAKEVICH

3. HPLC Columns and Packings

UWE D. NEUE, BONNIE A. ALDEN, EDWARD R. GROVER, ERIC S. GRUMBACH, PAMELA C. IRANETA, AND ALBERTO MÉNDEZ

4. Column Characterization and Selection

DÓRA VISKY

15. Method Development for Biomolecules

JULEE L. DRIVER AND DOUGLAS E. RAYNIE

16. Method Validation

M. ILIAS JIMIDAR, PATRICK HEYLEN, AND MAURITS DE SMET

17. Troubleshooting in High Performance Liquid Chromatography

HAROLD MCNAIR AND LEE N. POLITE

18. Molecularly Imprinted Polymers as Sorbents for Separations and Extractions

MYRA T. KOESDJOJO, YOLANDA H. TENNICO, AND VINCENT T. REMCHO

This Page Intentionally Left Blank

PREFACE

High pressure, or high performance, liquid chromatography (HPLC) is the method of choice for checking purity of new drug candidates, monitoring changes during scale up or revision of synthetic procedures, evaluating new formulations, and running control/assurance of the final drug product.

While numerous texts on HPLC are available, there are several unique concerns for pharmaceuticals that have not been discussed previously in one single book:

- Strategies have to be developed for instrument qualification and validation to meet various regulatory requirements.
- HPLC methods need to meet stringent validation requirements before they are utilized for any pharmaceutical evaluations.
- Impurities and degradation products to be separated are frequently not known and must be elucidated as part of the method development process.

The aim of this book is to provide an extensive overview of modern HPLC method development that addresses these unique concerns. For the purpose of providing a single source of information, an attempt has to been made to address all topics relevant to HPLC method development. The book is comprised of two major sections:

1. Review and update of the current state of the art and science of HPLC, including theory, modes of HPLC, column chemistry, retention mechanisms, chiral separations, modern instrumentation (including ultrahigh-pressure systems), and sample preparation.

Emphasis has been placed on implementation and on providing a practical perspective.

2. Focus on unique requirements for HPLC in a pharmaceutical setting. These include:
   - Strategies for software and hardware validation to allow for use in a regulated laboratory.
   - An overview of the pharmaceutical development process (clinical phases, chemical, and pharmaceutical development activities) to bring method development discussion into context.
   - A comprehensive discussion of how HPLC is used in each phase of pharmaceutical development and how methods are developed to support activities in each phase.
   - A discussion of method validation activities that provides an extension of ICH guidelines (i.e., provides an interpretation of ICH guidelines).
   - A comprehensive discussion of troubleshooting and prevention of problems.
   - A review of the emerging field of molecularly imprinted polymers and its potential applications in pharmaceutical analyses.

The book is intended to be particularly useful for both novice and experienced HPLC method development chemists in the pharmaceutical industry and for managers who are seeking to update their knowledge. We would like to thank the authors for their contributions that will make this book serve as a definitive reference source of HPLC method development for researchers, analysts, managers, and regulators of the pharmaceutical industry.

Satinder (Sut) Ahuja
Henrik Rasmussen