

# PHARMACEUTICAL MANUFACTURING HANDBOOK

---

## Production and Processes

**SHAYNE COX GAD, PH.D., D.A.B.T.**

Gad Consulting Services  
Cary, North Carolina

 **WILEY-INTERSCIENCE**  
A JOHN WILEY & SONS, INC., PUBLICATION

# **PHARMACEUTICAL MANUFACTURING HANDBOOK**

**Production and  
Processes**

# PHARMACEUTICAL MANUFACTURING HANDBOOK

---

## Production and Processes

**SHAYNE COX GAD, PH.D., D.A.B.T.**

Gad Consulting Services  
Cary, North Carolina

 **WILEY-INTERSCIENCE**  
A JOHN WILEY & SONS, INC., PUBLICATION

Copyright © 2008 by John Wiley & Sons, Inc. All rights reserved

Published by John Wiley & Sons, Inc., Hoboken, New Jersey  
Published simultaneously in Canada

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 750-4470, or on the web at [www.copyright.com](http://www.copyright.com). Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permission>.

**Limit of Liability/Disclaimer of Warranty:** While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services or for technical support, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic formats. For more information about Wiley products, visit our web site at [www.wiley.com](http://www.wiley.com).

***Library of Congress Cataloging-in-Publication Data is available.***

ISBN: 978-0-470-25958-0

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

## CONTRIBUTORS

**Susanna Abrahmsén-Alami**, AstraZeneca R&D Lund, Lund, Sweden, *Oral Extended-Release Formulations*

**James Agalloco**, Agalloco & Associates, Belle Mead, New Jersey, *Sterile Product Manufacturing*

**Fakhrul Ahsan**, Texas Tech University, Amarillo, Texas, *Nasal Delivery of Peptide and Nonpeptide Drugs*

**James Akers**, Akers Kennedy & Associates, Kansas City, Missouri, *Sterile Product Manufacturing*

**Raid G. Alany**, The University of Auckland, Auckland, New Zealand, *Ocular Drug Delivery; Microemulsions as Drug Delivery Systems*

**Monique Alric**, Université d'Auvergne, Clermont-Ferrand, France, *Recombinant Saccharomyces Cerevisiae as New Drug Delivery System to Gut: In Vitro Validation and Oral Formulation*

**Sacide Alsoy Altinkaya**, Izmir Institute of Technology, Urla-Izmir, Turkey, *Controlled Release of Drugs from Tablet Coatings*

**Maria Helena Amaral**, University of Porto, Porto, Portugal, *Vaginal Drug Delivery*

**Anil Kumar Anal**, Living Cell Technologies (Global) Limited, Auckland, New Zealand, *Controlled-Release Dosage Forms*

**Gavin Andrews**, Queen's University Belfast, Belfast, Northern Ireland, *Effects of Grinding in Pharmaceutical Tablet Production*

**Sophia G. Antimisiaris**, School of Pharmacy, University of Patras, Rio, Greece, *Liposomes and Drug Delivery*

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.