WILEY

Sandip Kumar Lahiri

Profit Maximization Techniques for Operating Chemical Plants

Profit Maximization Techniques for Operating Chemical Plants

Profit Maximization Techniques for Operating Chemical Plants

Sandip Kumar Lahiri
National Institute Of Technology, Durgapur, India

WILEY

This edition first published 2020

Registered Offices
John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial Office
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

For details of our global editorial offices, customer services, and more information about Wiley products visit us at www .wiley.com.

Wiley also publishes its books in a variety of electronic formats and by print-on-demand. Some content that appears in standard print versions of this book may not be available in other formats.

Library of Congress Cataloging-in-Publication Data

Names: Lahiri, Sandip Kumar, 1970- author.
Title: Profit maximization techniques for operating chemical plants / Dr Sandip Kumar Lahiri.
Description: First edition. | Hoboken, NJ : John Wiley & Sons, Inc., 2020. | Includes bibliographical references and index.
Identifiers: LCCN 2019058766 (print) | LCCN 2019058767 (ebook) | ISBN 9781119532156 (hardback) | ISBN 9781119532217 (adobe pdf) | ISBN 9781119532170 (epub)
Subjects: LCSH: Chemical engineering–Cost effectiveness. | Engineering economy. | Profit.
Classification: LCC TP155.2.C67 L34 2020 (print) | LCC TP155.2.C67 (ebook) | DDC 660.068/1–dc23
LC record available at https://lccn.loc.gov/2019058766
LC ebook record available at https://lccn.loc.gov/2019058767

Cover Design: Wiley
Cover Images: © David Burton/Getty Images, © Lightspring/Shutterstock

Set in 10/12pt WarnockPro by SPi Global, Chennai, India

Printed and bound by CPI Group (UK) Ltd, Croydon, CR0 4YY

10 9 8 7 6 5 4 3 2 1

Dedicated to my Parents, wife Jinia and two lovely children Suchetona and Srijon

Contents

Figure List

Table List

Preface

In chemical process industries there is an ongoing need to reduce the cost of production and increase the profit margin. Due to cut-throat competition at the global level, the major chemical process industries are now competing to optimize raw material and utility consumption, to increase equipment and process performance, to reduce emissions, and to minimize pollution.

Profit maximization is the buzzword of today's chemical process industries. Profit maximization in running chemical plants itself is a huge challenge, which needs to be addressed by holistic vision and procedures. However, there are no dedicated books available to discuss basic concepts, provide practical methods, and explain industrial application procedures.

This book is written to fill this gap with the following people in mind: practicing process or chemical engineers, production engineers, supervisors, senior technicians working in chemical, petrochemical, pharmaceuticals, paper and pulp, oil and gas companies, and petroleum refinery across the globe. This book will also become very useful for large numbers of managers, general managers, top-level senior executives, and senior technical service consultants, whose main jobs include strategic planning and implementation of various optimization projects to increase profit in chemical process industries. Undergraduate and postgraduate chemical engineering students and business students who want to pursue careers in the chemical field will also greatly benefit from this book. The book is aimed at providing practical tools to people who face challenges and wish to find opportunities for improving profit in running chemical plants. It aims to convey concepts, theories, and methods in a straightforward and practical manner.

This book provides engineers in all practical aspects of a profit maximization project in running plants, as well as expert guidance on how to derive maximum benefits. The book will present the core of a systematic approach covering profit optimization strategy, solution methodology, supporting structure, and assessment methods. In short, it will describe what it takes to make sizable reductions in operating costs for process plants and how to sustain profit improvement benefits.

Short on theory and long on step-by-step information, it covers everything plant process engineers and technical managers need to know about identifying, building, deploying, and managing profit improvement applications in their companies. Readers are able to take away methods and techniques for identifying, analysis, optimization, engineering design, and monitoring that are required to identify, assess, implement, and sustain profit improvement opportunities.

The main feature of this book, which differentiates it from other available books on the market, is its practical content, which helps the reader to understand all the steps of profit maximization project implementation in an actual commercial plant. The key features of this book that differentiate it from other available chemical engineering books are summarized below:

- The reader can develop a thorough understanding of steps for building a profit maximization application in running a chemical plant. All practical considerations to identify, build, and deploy a profit improvement project in the commercial running of the plant form the essence of this book.
- The benefits of this effective approach include identification of large profit improvement projects by applying assessment methods, capturing hidden opportunities in process operation by the use of advance monitoring and fault diagnosis, increasing plant capacity by a systematic way of performing a test run and debottlenecking study, optimizing process performance through various online conventional and stochastic optimization procedures, pushing the plant operation towards multiple constraints by advance process control, and maintaining continuous improvement by using regular review and performance matrices.

Overview of Contents

The chapter contents are described below.

Concept of Profit Maximization

The first chapter contains the foundation of the profit maximization project in running process industries. Sweating of assets and deriving maximum benefit from assets forms the essence of profit maximization. After implementation of data historian software in the last decade, todays chemical process industries (CPI) are very data rich but unfortunately remain information poor. No effective platform is still available to utilize this large amount of data. This chapter explains the emergence of knowledge-based industries and only CPIs employing knowledge to drive the business are likely to survive in the future. This essentially means generating an effective platform that can generate knowledge from available business data and use this knowledge to develop a unified framework to support faster business decisions to respond to external market uncertainties. This chapter gives an overview of how to build a framework where advanced computational knowledge and experience-based heuristics are applied to utilize this wealth of data to maximize profit. In simple terms, profit maximization means maximization of dollar ($)/h generation from the plant while subject to constraints that all process and safety constraints need to be honored and all equipment limitations should not be violated. The need for profit maximization in today's competitive market is explained in this chapter.

Big Picture of the Modern Chemical Industry

Currently the chemical industry is slowly entering into a new era called the data analytics and artificial intelligence stage, commonly known as industry 4.0. Disruptive technologies like artificial intelligence, machine learning, big data analytics, and the internet of