Synthesis Lectures on Chemical Engineering and Biochemical Engineering

SYNTHESIS COLLECTION OF TECHNOLOGY

Atul H. Bari · Hemantkumar N. Akolkar · Navnath T. Hatvate · A. K. Haghi

# Eco-Friendly Textile Processes

Springer

# Synthesis Lectures on Chemical Engineering and Biochemical Engineering

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# Preface

The textile industry, one of the oldest and most dynamic sectors, has shaped economies, cultures, and societies for centuries. From its roots in natural fibers to today's global, technology-driven enterprise, textiles remain central to trade and livelihoods. However, this progress comes at a cost, as the industry is highly resource intensive, consuming vast amounts of water and energy while generating pollution and waste.

This book, *Eco-Friendly Textile Processing*, addresses these challenges and explores pathways for sustainable transformation. It highlights the industry's environmental footprint and presents advances in energy and water efficient technologies, green chemistry solutions, and innovative smart fabrics. Together, the chapters offer a comprehensive view of how textiles can evolve from a resource heavy model to one that is cleaner, circular, and resilient.

Chapter 1 sets the context by introducing the global significance of the textile industry, its complex value chain, and the pressing sustainability challenges such as water pollution, energy demand, air emissions, and waste generation. It also highlights pathways such as Green Supply Chain Management, certifications, and Corporate Social Responsibility initiatives that frame the broader sustainability discourse.

Chapter 2 focuses on drying technologies, one of the most energy intensive operations in textile processing. It explores eco-friendly alternatives including heat recovery systems, renewable heating sources, infrared drying, microwave-assisted techniques, and hybrid systems that demonstrate significant potential for reducing energy consumption and emissions.

Chapter 3 examines eco-friendly chemical treatment methods, particularly in wet processing. It highlights how green chemistry, enzyme-based processes, supercritical $CO_2$ dyeing, plasma treatment, and bio-based finishing agents can reduce chemical loads and effluent toxicity while maintaining or improving fabric quality and performance.

Chapter 4 looks ahead to emerging trends, showcasing the potential of smart textiles and advanced materials that combine functionality with sustainability. From biopolymers

and nanomaterials to responsive fabrics and digital integration, this chapter envisions a future where innovation and environmental responsibility go hand in hand.

Together, these chapters provide a structured exploration of sustainable textile processing. It is hoped that this book will serve as a resource for researchers, industry practitioners, policymakers, and students committed to fostering a textile sector that not only sustains economies but also safeguards the environment for future generations.

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