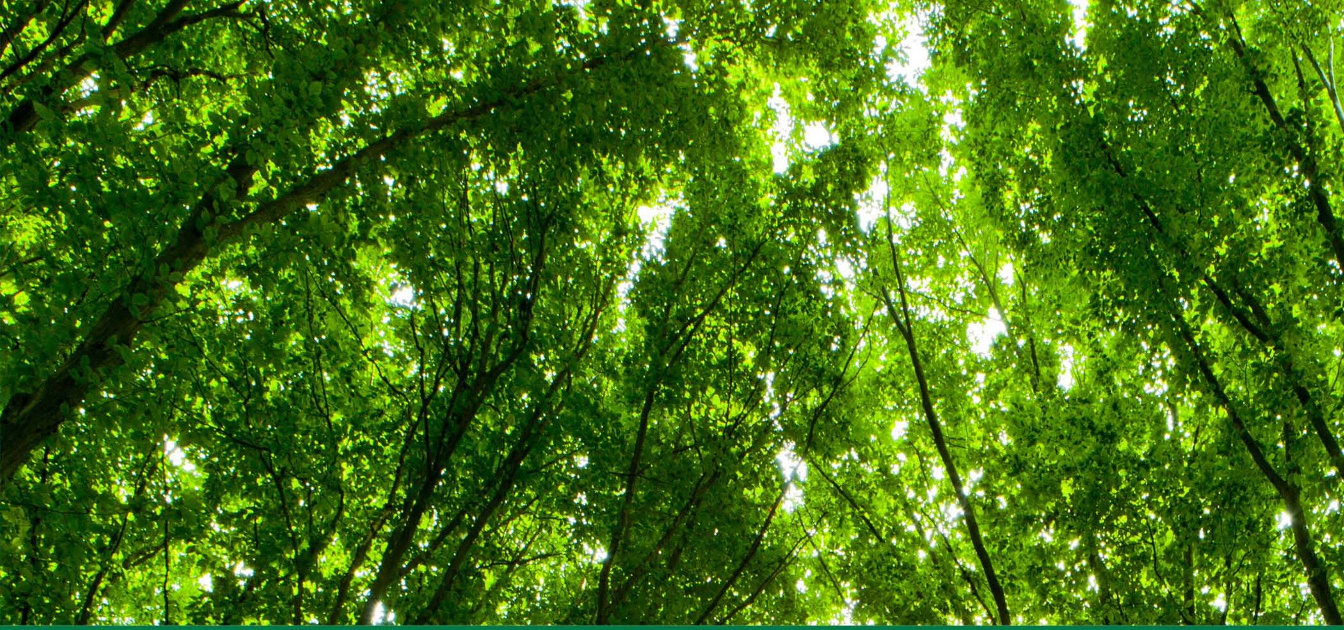
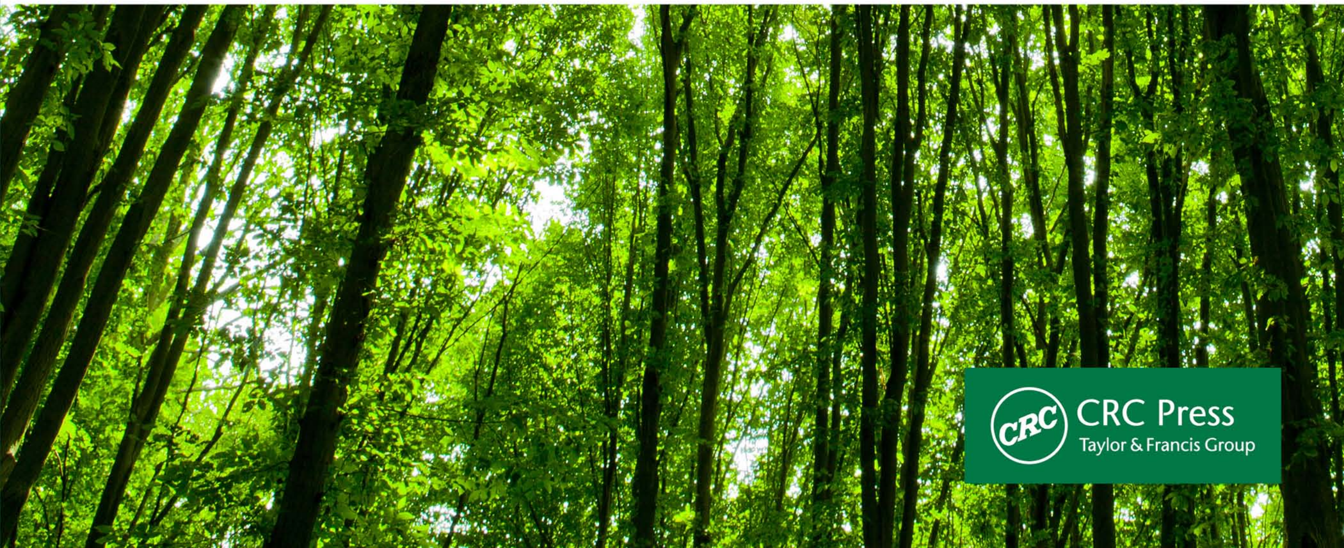


PROGRESSIVE THERMOCHEMICAL BIOREFINING TECHNOLOGIES

Edited by
Sonil Nanda and Dai-Viet N. Vo



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Contents

Preface

Considering the deleterious impacts of fossil fuels on the environmental and natural ecosystems, it has become imperative to make a paradigm shift towards renewable fuels, chemicals and materials. The exhaustive everyday usage of fossil fuels and processed petrochemical products is the leading cause for the increase in greenhouse gas emissions; global warming; climate changes; acid rain; ozone layer depletion; pollution of air, water and soil as well as accumulation of nonbiodegradable materials in the soil and oceans. On the contrary, biofuels, biochemicals and biomaterials derived from renewable wastes such as nonedible plant biomass (e.g., agricultural and forestry biomass), energy crops, microalgae, municipal solid waste, sewage sludge, and other biogenic residues seem to be carbon neutral. Therefore, the global interest in biorefining technologies, especially thermochemical and biological conversion processes, is gaining momentum in academic and industrial perspectives. This book covers the research and development of some cutting-edge thermochemical technologies related to the conversion of waste biomass, namely pyrolysis, liquefaction, torrefaction, carbonization, gasification, and reforming, to name a few.

Chapter 1 by Subathra et al. makes a state-of-the-art review of various biorefinery approaches for various biomasses. The survey identifies the vital role of biofuels to address the environmental issues caused by fossil fuels. Chapter 2 by Wu et al. reviews the production, characterization, and combustion of solid and liquid biofuels produced from renewable wastes. Chapter 3 by Patel et al. reviews various technologies for the conversion of municipal solid waste to biofuels through physical routes (e.g., refinement, briquetting, and pelletizing), thermochemical routes (e.g., torrefaction, gasification, liquefaction, pyrolysis, and incineration) and biological routes (e.g., anaerobic digestion and fermentation). Chapter 4 by Patel et al. discusses the pragmatic concerns of mixed plastic waste and its potential for conversion into high-energy fuels and chemicals by thermochemical processes such as pyrolysis, liquefaction, and gasification. Chapter 5 by Sarker et al. describes the torrefaction of lignocellulosic biomass, its process parameters and operating conditions as well as the physicochemical characteristics of torrefied materials. Chapter 6 by Anno-Kusi et al. gives an overview of the influence of binders on the densification of torrefied biomass. The application of pellets as well as techno-economic and lifecycle assessments of the torrefaction and pelletization process are discussed in this chapter. Chapter 7 by Monir et al. describes the conversion of lignocellulosic biomass into syngas using the co-gasification process with several feedstocks followed by a discussion on energy efficiency and environmental impacts. Chapter 8 by Phung et al. describes the clean technologies involved in the purification of glycerol along with the several reaction processes for glycerol conversion into value-added industrial products. Chapter 9 by Islam et al. reviews the substrates used in microbial fuel cells along with their performance, limitations, and prospects. Chapter 10 by Nguyen et al. attempts to provide insights on the relationship between oil price fluctuations, environmental quality, foreign direct investment, and renewable energy consumption, especially in East Asian countries.

We sincerely hope that this book will immensely benefit the students and researchers working on biofuels and biochemicals generated from the thermochemical conversion of waste biomass. We are grateful to all the authors for contributing their high-quality manuscripts to develop this book. We also express our sincere thanks to Ms. Renu Upadhyay and Ms. Jyotsna Jangra from CRC Press for their enthusiastic assistance and support in the preparation of this book.

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Chapter

Lignocellulosic Biomass Conversion to Syngas through Co-Gasification Approach

By Minhaj Uddin Monir, Azrina Abd Aziz, Fatema Khatun, Dai-Viet N. Vo, Nadzirah Mohd Mokhtar

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ABSTRACT

This chapter includes an up-to-date description of the conversion of lignocellulosic biomass into syngas using co-gasification process. Due to the increasing demand for energy and environmental crisis, alternative strategies for the development of energy are urgently needed. Lignocellulosic biomass, which is mostly available all over the world could play a significant role and valorized the non-biomass resources for syngas or alternative fuel production. The efficiency of an environmentally friendly co-gasification technique has been discussed in this chapter. Energy or exergy efficiency through co-gasification is greater than that of single biomass gasification, and recent scientific literature has agreed on the acceptability of the co-gasification process. The potential co-gasification feedstocks of biomass that would enhance the gasification process will be the non-biomass of coal, peat, charcoal and petcoke. Therefore, the co-gasification technique has the potential to produce syngas from lignocellulosic biomass combined with broadly targeted non-biomass feedstocks.

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