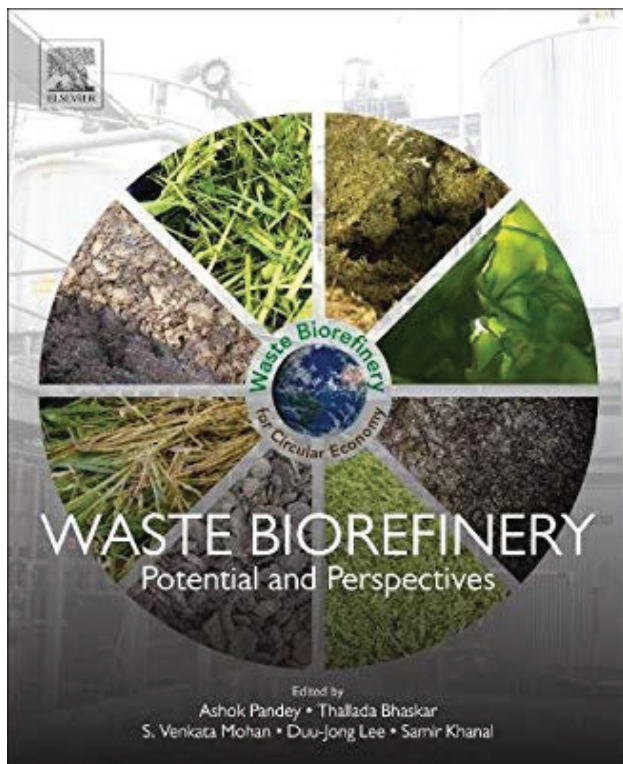


## BOOKS REVIEW



### WASTE BIOREFINERY: POTENTIALS AND PERSPECTIVES

by Thallada Bhaskar, Ashok Pandey, S. Venkata Mohan, Duu-Jong, and Lee Samir Kumar Khanal

The major drivers of bioenergy of this century include the improvement of energy security, addressing the issue of finite amounts of fossil fuels and natural resources and mitigation of the effects of climate change.

Consequently, due to the currently ongoing energy crisis, focus on the production of biofuels and bio-products has increased worldwide. Biofuels and bio-products can be produced from biomass by means of a conversion process known as biorefinery.

However, the key questions we should attempt to provide an answer to are: 'are biofuels and bio-products fully sustainable?' and 'how might we solve the biofuel/bio-product vs food and tank or table debates?'. Indeed, at times precious plant-based resources, obtained using fertile land and water, are shifted from the production of food and feed to the generation of bio-energy or bio-materials, thus resulting in the development of a sensitive social issue. This may only be solved by eliciting a change in mentality: indeed, wastes

should no longer be regarded as residues to be treated and disposed of, but rather as a valuable resource that can be exploited as renewable feedstock for use in the production of bio-energy and chemicals. This is precisely the strategy adopted by the so-called "waste biorefinery" approach which is investigated in detail in the book "Waste biorefinery: potentials and perspectives". The latter incisively shows how true sustainability can be achieved by valorising what has until now been considered a useless residue, whilst at the same time helping to identify cost-effective strategies.

The book is divided into 26 Chapters grouped into 8 broad Sections. Section A relates to an analysis of the waste feedstocks suitable for use in biorefinery and the most recent technologies that contribute towards enhancing the sustainability and efficiency of the conversion process. In particular, it is highlighted how the waste biorefinery fits perfectly within the circular economy regenerative system. Section B provides a detailed insight into the advanced and innovative methods for biomass conversion, namely thermochemical and combined gasification-fermentation. Likewise, Sections C, D, and E focus on the wide range of possibilities related to the valorisation of food waste, municipal solid waste, and lignocellulosic waste, respectively. Food waste is preferentially used as a substrate in anaerobic digestion and acidogenic fermentation processes in order to gain biogas and biological monomers, respectively. Pyrolysis is the method investigated for use in the conversion of municipal solid waste into bio-energy products. Lignocellulosic resources are efficiently valorised in a number of ways, including hydrothermal treatment, pyrolysis, microwaves, and ultrasounds. Since lignin cell walls are particularly difficult to break down, specific pre-treatments, such as the use of ionic liquids, are also illustrated in the book. Furthermore, Section F explores the innovative field of water-based biorefinery relating to both the recovery of resources through bioelectrochemical systems and the potential of exploiting microalgae biomass. In the first part, nutrients, metals, energy, and chemical products are investigated and a series of case studies commented on. In the second part, in addition to considering microalgae cultivation for use in the production of bio-fuels, closing the loop of the microalgae biomass is the main goal, demonstrating an expanding market for food and feed additive production, and for high-value chemicals. Section G deals with biorefinery projects on the cutting edge of scientific research. At the beginning of the section, three types of biomass residues generated in arid/semiarid regions (palm tree residues, seawater biomass residues, and organic fraction of municipal solid waste) are reviewed. Subsequently, castor biorefinery is carefully explained with a special focus on castor oil and the different



extraction methods applied. Insect-based bioconversion is another hot topic addressed in this section. Indeed, insects are capable of stabilizing organic waste while enabling the recovery of bio-fuels, fertilisers, food, and polymers. The last chapter describes how advanced thermochemical technologies, with particular focus on pyrolysis, are capable of converting low-value materials such as deinking residues from the paper industry into value-added products. Finally, Section H provides a discussion on integrated technologies and approaches associated with lignocellulosic biomass, including pre-treatments required, and describes a case study of a woody biomass biorefinery in Japan.

To conclude, through a balanced combination of different branches of science: chemistry, biology, engineering, and biotechnology, this book provides data-based information on the state of the art of biogenic waste utilisation within the field of biorefinery in which waste and resources are interchangeable.

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