Book review

Biomass for sustainable applications: pollution remediation and energy

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The rapidly growing world population brings about higher energy demands to maintain a good standard of living. The development of environmentally benign, renewable and sustainable energy production methods is one of the most important concerns for the near future. Another concern is protecting and recreating clean water sources. Industrial activities, while creating goods of a great value for mankind, contaminate water, soil, and atmosphere leading to pollution. *Biomass for sustainable applications* edited by Sarra Gaspard and Mohamed Chaker Ncibi offers a compilation of biomass based applications for a sustainable future. The main aim is to present the role of biomass in reducing pollution, such as water treatment and generating renewable energy. Thus, the focus is not biomass-based fuel utilization and its efficiency, but presentation of the wide variety of applications available. The compilation of contributions by different researchers exhibits the importance of a multidisciplinary research approach to implement sustainable technologies.

The book is well-structured and is presented in two parts, first focusing on biomass for pollution remediation (chapters 1–5) and second on energy production and storage (chapters 6–9). Industrial activities result in distribution of many hazardous substances that may contaminate water. With growing population the concern of clean water supply increases. Conventional water treatment methods are considered to be expensive and most of the time not sufficiently powerful for meeting the standards. Chapter 1 describes the use of bioresources as adsorbents for sustainable water treatment processes that can lead to a new and cost-effective alternative. Biosorption is described as the ability of some types of biomass to remove and concentrate certain chemical species

from aqueous media. Some of the algae, woody biomass, mosses, fungi, agricultural waste and raw plants can result in acting as coagulants or flocculants. The mechanisms of their actions are described, along with factors affecting biosorption and the required conditions. Examples of applications and experimental results are given.

Activated carbon widely used in water treatment can be produced from biomass, such as agricultural by-products or waste. Chapter 2 presents the thermochemical means of active carbon preparation and its characterization. Important parameters for successful wastewater treatment and adsorption results of various applications for the removal of inorganic and organic pollutants are discussed.

Phytoremediation can be used for soil remediation and pollution attenuation, and even for soil restoration and the prevention of groundwater pollution. It relies on natural, synergistic relationships among plants, microorganisms and the environment. The role of man lies in assisting nature by choosing an appropriate plant-microbe community for a given site. Chapter 3 describes four main aspects of phytoremediation: phytostabilization, phyto-degradation, photovolatilization and phytoextraction. Various plants are discussed based on their natural abilities of diminishing the pollution of the soil.

Chapter 4 tells the reader about the function and ability of microorganisms in soil treatment. A general description of types of contaminants found in polluted soils is presented. The roles of fungi and bacteria in soil remediation are described, along with targeted contaminants and removal mechanisms. One other class of species used in soil treatment is biomass-derived chemicals, such as biosurfactants. They increase the solubility and emulsification of contaminants. However, their production costs have to be optimized and soil remediation activities based on individual sites are to be investigated in greater detail.

Chapter 5 begins with the description of general approaches to biological waste gas treatment. Microorganisms can degrade contaminants in an aerobic environment, and thus act as biofilters. Bioreactors used as a medium for the reaction of biomass based species with contaminants such as biofilters, biological trickling beds and

bioscrubbers are discussed. Process descriptions in terms of operating conditions and yields, modeling parameters and industrial applications of these bioprocesses are given.

Wastewater is considered to be a potential and perfect feedstock for bioenergy generation due to the high contents of degradable organic materials, including bacteria. Chapter 6 describes a variety of metabolic options of bacteria as biocatalyst to produce various kinds of energy, such as biohydrogen, biomethane, bioelectricity, bioalcohols, bioplastic and lipids.

Chapter 7 summarizes the recent research performed aiming at utilization of biomass for renewable energy generation. The value of plantae and marine biomasses, along with agro-industrial wastes, in producing ecofriendly fuels, bioethanol, biodiesel and biomethane is discussed. A number of different natural feedstocks including woods, grasses, algae, agricultural residues, industrial byproducts and household wastes are analyzed for their capability to produce liquid or gaseous fuels.

Hydrogen represents a means of storable energy carrier with high potential energy content and minimal hazard to the environment. It can be produced under mild conditions using solar energy and renewable resources. Chapter 8 describes photocatalytic hydrogen production from water and biomass derivatives, such as ethanol, glycerol, sugars and methane.

The development of better electrochemical storage systems is one of the important aspects of sustainable energy use. Most of the electrochemical storage systems found on the market are carbon-based devices. Nanoporous carbonaceous materials can be produced from biomass and used in electrochemical storage systems such as supercapacitors. Chapter 9 describes basics of electrochemical double layer capacitors, ways to increase energy density, active materials used in fabrication of the devices and key parameters storage systems, such as large surface area and pore volume.

To conclude, the book presents a multidisciplinary approach in viewing and utilizing biomass, thus it will be interesting for environmental and chemical engineers, and biologists. The book can be used as a textbook or reference book for biomass valorization courses. Finally, maintaining the balance within our world seems to be manageable, if we use nature's power and human's ability to solve problems.

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