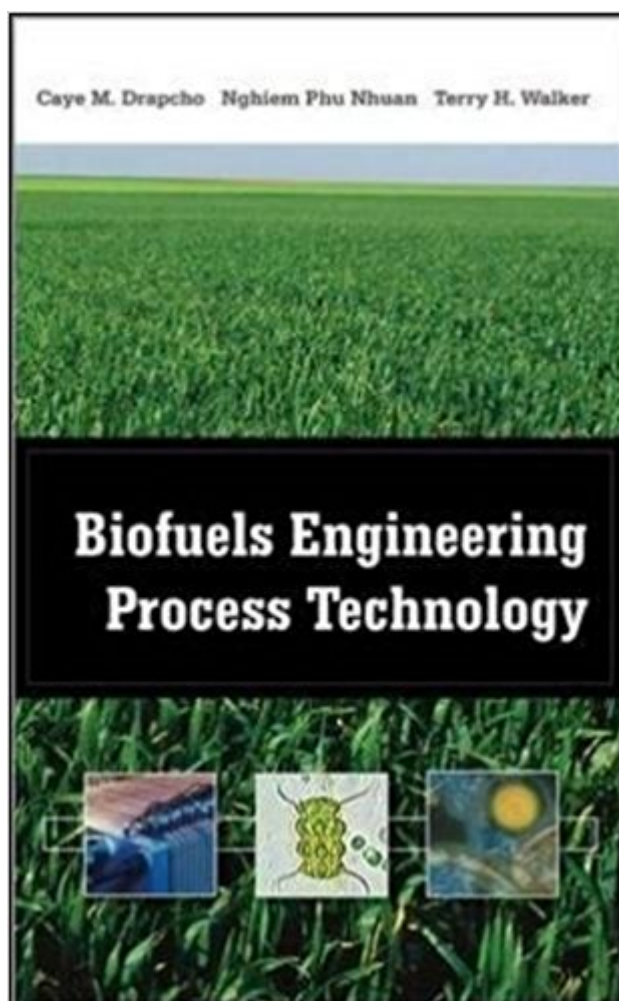




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Biofuels Engineering Process Technology (Mechanical Engineering)



Synopsis

New Process Technology for Developing Low-Cost, Environmentally Safe Biofuels Rising fuel prices have created a surge in the worldwide demand for biofuels made from plant and animal feedstocks. Filled with a wealth of illustrations, Biofuels Engineering Process Technology fully explains the concepts, systems, and technology now being used to produce biofuels on both an industrial and small scale. Written by a team of leading biofuels experts, this lucid guide presents a complete introduction to biofuels and biorefining processes—state-of-the-art information on biofuels processed from fermentations of ethanol, hydrogen, microbial oils, and methane—new material on the production of biodiesel from plant and algal oils—and the use of microbial fuel cells to produce bioelectricity. Biofuels Engineering Process Technology takes readers step by step through: The key concepts, systems, and technology of biofuels A review of the basic concepts of fermentation pathways and kinetic modeling of bioreactors Biofuels produced from fermentations of agricultural feedstocks and biomass—ethanol, hydrogen, microbial oils, and methane Biodiesel fuels processed from the chemical conversion of microbial and plant oils Bioelectricity produced from microbial fuel cells The latest sustainable biorefinery concepts and methods Inside This Cutting-Edge Biofuels Engineering Guide — Introduction — Fuels from Fermentations: Ethanol — Hydrogen — Microbial Oils — Methane — Fuel from Chemical Conversion of Plant and Algal Oils: Biodiesel — Microbial Fuel Cells — Technical Resources

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Customer Reviews

Caye M. Drapcho, Ph.D., is an Associate Professor and the Graduate Coordinator in the Department of Biosystems Engineering at Clemson University. She has over 13 years of experience in bioprocess and bioreactor design. Nhuan Ph^o Nghi^am, Ph.D., is a Senior Research Biochemical Engineer in the Crop Conversion Science and Engineering Research Unit at the Eastern Regional Research Center, Agricultural Research Service, U.S. Department of Agriculture, and also an Adjunct Professor in the Department of Agricultural and Biological Engineering at Clemson University. He has more than 20 years of experience in bioprocess engineering in industrial and federal research laboratories. Terry Walker, Ph.D., is an Associate Professor in the Department of Biosystems Engineering at Clemson University. He has over 10 years of experience in bioprocess engineering, specializing in fungal fermentation, bioproduct separations, and bioavailability studies.

Its a straight forward book. It has all that you needs. The book explains everything needed for the biofuel processes.

Biofuels Engineering Process Technology by Drapcho et al. A McGraw Hill Publication
2008
Reviewed by: Dr. Joseph S. Maresca
The authors begin by explaining the justification for alternative energy. The reasons set forth are:
o diminishing oil reserves and the increasing difficulty and cost of extraction
o global climate change consideration
o increasing fuel prices
o the need for energy independence
The largest oil reserves are in Saudi Arabia, Canada, Iran, Iraq, Kuwait, UAE and Venezuela. Geothermal and solar energy have less than 20% efficiency at the current technological learning curve but zero emissions. Biofuels are substantially carbon neutral according to the authors. There was a considerable presentation on fuels derived from fermentations; such as, ethanol, hydrogen, microbial oils and methane. The strategy for a bioreactor design is based upon the maximum rate of production formation, biomass production or substrate utilization. Fuel treatments to reduce fire hazards can contribute 54 MT (million tons) of bio mass yearly. Muni solid waste has the potential for biofuel production. Vegetable based fuels capture solar energy through plants and photosynthetic pigments. These veggie based fuels sequester CO₂ from the atmosphere as a primary carbon source. The carbon is biologically converted to greater energy starches, celluloses, proteins and oils as storage and structural compounds. Some algae can

convert CO₂ to 60% - 70% of their dry weight in the form of storage oils. Microalgae have very versatile growing conditions dating back to the earliest eukaryotic organisms on the earth. Algae can inhabit many different environments as long as water and micronutrients exist alongside. Algae have been shown to accumulate a high level of lipids consisting of over 80% of their dry weight. The microbial fuel cell or MFC is a specialized biological reactor where the electrons processed during microbial metabolic activity are intercepted to provide useful electric power. In an MFC, the oxidation of the electron donor compound is physically separated from the terminal electron acceptor. The microbes are grown in the anode chamber where the electron donor compound is oxidized, with the electrons transferred to the anode instead of oxygen or an external electron acceptor. MFCs convert chemical to electrical energy. Emissions from biodiesel in combustion engines are greatly reduced compared to the petroleum diesel. Nonetheless, nitrogen oxide emissions constitute a drawback. Decreases in NO emissions are possible with corrections in injection timing and combustion temperatures. These incremental costs may add more steps to the process and (by implication) more costs. The thermodynamic properties with respect to temperature of biodiesel fuels compared to diesel are higher for biodiesel. Higher flash points result in a safer fuel for handling. Density and viscosity of biodiesel is higher than for petroleum fuels and alcohols. Electricity from gasification of biomass has a low production cost at 5 cents per KWH. Simultaneous esterification of free fatty acids to alkyl esters will occur due to increased biodiesel yields from lower quality feedstocks. Esterification involves two reactants (alcohol + acid) to form an ester product. Esters are common in organic chemistry and may smell like fruit. This characteristic leads to the application of esters in fragrances. Ester bonds may be found in polymers. The yield of the product in esterification may be improved by using Le Chatelier's principle. Esterification is a reversible reaction as opposed to an irreversible one. Hydrolysis or "water splitting" is the addition of water and a catalyst like NaOH to an ester to arrive at the sodium salt of the carboxylic acid and alcohol. As a result of this reversibility, many esterification reactions are equilibrium reactions. These reactions go to completion by Le Chatelier's principle. An irreversible process is a process that cannot return both the system and the surroundings to the original state(s) assuming a reversal of the original process. Most processes, of course, are irreversible processes (or nonequilibrium processes). Letting air from a balloon released into a room is an irreversible process. Overall, these irreversible processes are a consequence of the second law of thermodynamics, which is frequently defined in terms of the entropy or disorder of a system. There are several ways to phrase the second law of thermodynamics. There is a limit on how efficient any transfer of heat can be. According to the second law of thermodynamics, some heat will be lost in the process. This loss explains why it is not

possible to have a completely reversible process in everyday life. For example, a car engine doesn't give back the fuel it took to drive up a hill even if the car coasts down a mile long hill thereafter. The authors concentrate efforts substantially on biofuels. Ultimately, the "Artificial Sun" may prove to be the game changer. Shortly, a scientific team will begin attempts to ignite a tiny manufactured star inside a lab and trigger a thermonuclear reaction. Its goal is to generate temperatures of more than 100 million degrees Celsius and pressures billions of times higher than those found anywhere on earth, from a tiny speck of fuel. The National Ignition Facility (NIF) in Livermore will utilize a laser that concentrates 1,000 times the electric generating power of the United States into a billionth of a second. The result should be an explosion in the reaction chamber which will produce 10 times the amount of energy used to create it. Until now, such fusion has only been possible inside nuclear weapons and highly unstable plasmas created in incredibly strong magnetic fields. The work at Livermore could change the historical applications mix. Source: NIF, Livermore

Overall, the authors provide a very thorough rendition of biofuels engineering with excellent reference materials at the end of each chapter. Readers who are conversant in organic chemistry, materials science, structure of matter and thermodynamics will appreciate the superior technical presentation embodied in this text. There is an extensive scientific presentation of conversion factors and constants at the end of the book.

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