Biotechnology and Energy Use (Electrotechnology Series, Vol. 8)

Authors	Robert J. Clerman, Rajani Joglekar, Robert P. Ouellette, Paul N. Cheremisinoff
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Reviewer	Massoud T. Simnad

The authors define the objective of this book to be an evaluation of the potential impact of bioindustry on industrial energy use. More than 60 biotechnology applications involving advanced uses of fermentation and enzyme technology (e.g., food, energy, and waste treatment) are reviewed. These studies were sponsored by Electricité de France and were carried out at the Metrek Division of the Mitre Corporation and the New Jersey Institute of Technology. The recent developments in this field are considered to be "revolutionary," with the most far reaching aspect being recombinant DNA technology or "genetic engineering." For example, microbial production and development of immobilized enzymes for industrial enzymes are expected to total approximately $500 million by 1985. An objective of the studies that are reported is to identify those applications that have near-term commercialization and that are likely to affect energy consumption patterns. This book presents a concise review of the principal tools of biotechnology, surveys the key industrial sectors, and gives brief descriptions of individual applications. These include food production, energy, waste treatment, chemicals, and metals recovery.

The first chapter provides an overview of biotechnology applications. The principal tools of biotechnology are described in terms of the several component techniques that apply across a wide range of applications, i.e., whole cell fermentation, enzyme technology, and genetic engineering. The key industrial sectors that are studied are then surveyed and the status of bioindustry is assessed. Biotechnology is considered to be a highly dynamic field, particularly because the use of microbial systems can reduce the energy consumption due to lower operating temperatures and pressures. However, the technical hurdles to be overcome are also discussed. These include the difficulty in conversion from batch to continuous processing; sensitivity to variations in temperature, pH, nutrient, etc.; susceptibility to viral infection or contamination with toxins; and quality and quantity control. The applications of special interest to energy and nuclear power include cellulose waste treatment to produce alcohol (prepilot/commercial); methane production utilizing cow manure by direct anaerobic digestor operation (full-scale operation); production of liquid hydrocarbons from algae (pilot scale); production of ethanol from starch (commercial); production of uranium by extraction of bacterial leaching (commercial); and uranium mining site restoration and waste water treatment by bacterial leaching (pilot plant).

The bacterial restoration of *in situ* uranium mine operations, leached with ammonium carbonate solutions, has received much attention. The bacteria "Nitrosomonas" oxidize ammonium to nitrite, and the bacteria "Nitrobactor" oxidize nitrite to nitrate. Other denitrifying bacteria will reduce nitrate to nitrous oxide or ammonium ion. Bacterial restoration of mining and milling waters has been accomplished successfully at several mining ventures by using algae and higher aquatic plants that accumulate or entrap heavy metals.

Uranium extraction by bacterial leaching consists of the solubilization of the uranium from their ores by mineral sulfide oxidation and release of the metals. In hydrometallurgical processes, bacterial leaching is an important emerging technique for the extraction of metals. This type of *in situ* mining by bacterial leaching is said to be an attractive option due to the reduced environmental impact over conventional mining, the feasibility of extraction from deeper deposits, and the favorable economics of mining low-grade mineral resources. Nevertheless, the commercial production of uranium by this process in Canada (Agnew Lake Mine Ltd.) was discontinued in 1981.

This Monograph is a very well written and objective source of information on the important topic of biotechnology.

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Superconductor Materials Science (Metallurgy, Fabrication and Applications) Series B: Physics

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This large volume is based on the NATO Advanced Study Institute Conference, which was held August 20-30, 1980, in Sintra, Portugal. The focus of the lectures involved the science and applications of superconductors, concentrating primarily on the materials aspects. The first part of the book reviews the basic principles, properties, and fabrication technology of the practical superconducting materials. The following parts include descriptions of phase diagrams and mechanical properties of superconductors. Novel new techniques of fabrication of materials, such as *in situ* and powder metallurgy techniques, are reviewed. The practical fabrication technology receives extensive coverage. Amorphous materials and materials development for small-scale devices, such as Josephson junctions and SQUID devices, are also discussed.

Large-scale applications of superconductivity are described in some detail. Superconducting magnets appear to