Microbial Fuels

Technologies and Applications

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Dark Fermentative Hydrogen Production: From Concepts to a Sustainable Production

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7.1 Hydrogen as Energy Source

The use of renewable sources and environmentally friendly processes is considered a priority for the construction of a sustainable energy future. The harmful impact of fossil fuels and the fact that we are reaching a disrupting point regarding environmental damage require the rapid implementation of new energy systems and a substantial increase in the use of alternative, unconventional energy sources. Hydrogen (H_2) is considered one of the most promising sources as a clean energy vector, because of its high energy density (120 MJ/kg) and carbon-free combustion (Argun and Kargi, 2011). Hydrogen is the simplest and most abundant element on earth; however, it barely exists in nature in its molecular state. Instead, it is almost always found as part of other compounds from which it should be separated, either by thermochemical processes or through biological conversion.

Currently, the dominant technology for direct H_2 production consists in the steam reforming of hydrocarbons, as well as additional thermochemical methods, such as electrolysis and thermolysis (Saratale et al., 2013). The major obstacles of the current H_2-producing methods are the high production costs and energy demand involved in the production process. Therefore, there is an imperative need to come up with strategies that can make the process more sustainable and economically feasible.

7.1.1 Biohydrogen

The production of H_2 from renewable resources, such as water, organic wastes or biomass, either biologically or photobiologically, is termed "biohydrogen" (bioH_2). Compared with the thermochemical route, biological H_2 production is more favorable, owing to its environmentally friendly and energy-saving production process. The biological conversion occurs at near-ambient temperature and pressure, at far less extreme conditions, which lower the energy requirements substantially. Additionally, it is well suited for decentralized energy production in small-scale installations located