World Academy of Science, Engineering and Technology
International Journal of Chemical and Molecular Engineering
Vol:11, No:06, 2017

Control System Design for a Simulated Microbial Electrolysis Cell

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Abstract : Hydrogen is considered as the most important energy carrier and fuel of the future because of its high energy density and zero emission properties. Microbial Electrolysis Cell (MEC) is a new and promising approach for hydrogen production from organic matter, including wastewater and other renewable resources. By utilizing anode microorganism activity, MEC can produce hydrogen gas with smaller voltages (as low as 0.2 V) than those required for electrolytic hydrogen production (≥ 1.23 V). The hydrogen production processes of the MEC reactor are very nonlinear and highly complex because of the presence of microbial interactions and highly complex phenomena in the system. Increasing the hydrogen production rate and lowering the energy input are two important challenges of MEC technology. The mathematical model of the MEC is based on material balance with the integration of bioelectrochemical reactions. The main objective of the research is to produce biohydrogen by selecting the optimum current and controlling applied voltage to the MEC. Precise control is required for the MEC reactor, so that the amount of current required to produce hydrogen gas can be controlled according to the composition of the substrate in the reactor. Various simulation tests involving multiple set-point changes disturbance and noise rejection were performed to evaluate the performance using PID controller tuned with Ziegler Nichols settings. Simulation results shows that other good controller can provide better control effect on the MEC system, so that higher hydrogen production can be obtained.

Keywords : microbial electrolysis cell, hydrogen production, applied voltage, PID controller
Conference Title : ICCBEA 2017 : International Conference on Chemical, Biomolecular Engineering and Applications
Conference Location : Venice, Italy
Conference Dates : June 21-22, 2017