Integrated Process Modelling of a Thermophilic Biogas Plant

Authors : Obiora E. Anisiji, Jeremiah L. Chukwuneke, Chinonso H. Achebe, Paul C. Okolie

Abstract : This work developed a mathematical model of a biogas plant from a mechanistic point of view, for urban area clean energy requirement. It aimed at integrating thermodynamics; which deals with the direction in which a process occurs and Biochemical kinetics; which gives the understanding of the rates of biochemical reaction. The mathematical formulation of the proposed gas plant follows the fundamental principles of thermodynamics, and further analysis were accomplished to develop an algorithm for evaluating the plant performance preferably in terms of daily production capacity. In addition, the capacity of the plant is equally estimated for a given cycle of operation and presented in time histories. A nominal 1500m3 biogas plant was studied characteristically and its performance efficiency evaluated. It was observed that the rate of biogas production is essentially a function of enthalpy ratio, the reactor temperature, pH, substrate concentration, rate of degradation of the biomass, and the accumulation of matter in the system due to bacteria growth. The results of this study conform to a very large extent with reported empirical data of some existing plant and further model validations were conducted in line with classical records found in literature.

Keywords : anaerobic digestion, biogas plant, biogas production, bio-reactor, energy, fermentation, rate of production, temperature, therm

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