

INVESTIGATION OF STABILITY OF PLUG FLOW ANAEROBIC DIGESTER USING MATHEMATICAL MODELING

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Department of Chemical & Process Engineering

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Sri Lanka

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DECLARATION PAGE OF THE CANDIDATE AND SUPERVISOR

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ABSTRACT

Anaerobic treatment has gained wide acceptance as a sustainable technology for treatment of solid wastes and waste water. But in the local context this technology is not rapidly advancing due to process failures and poor technology management. Most of the failures are reported in the anaerobic solid waste treatment than waste water treatment. Recently, novel plug flow reactor system has been installed in few local institutions to treat semi solid wastes with improved efficiency. However lack of understanding of operational parameters and functional units of this reactor system has led to suboptimal operation and thereby low gas production and methane yield.

Objective of this study is to develop dynamic mathematical model for plug flow reactor system and propose new strategies to enhance the methane yield and stability of the process. The anaerobic digestion model No. 1 (ADM 1) developed by the international water association (IWA) task group for mathematical modeling of anaerobic digestion process is the most sophisticated model established for full- scale industrial applications. In this work ADM1 was implemented in the simulation software package called AQUASIM 2.1f and advective diffusive reactor compartment was initially used to model the plug flow reactor. To be able to model the actual plug flow reactor system as installed two scenarios are introduced i.e. advective diffusive reactor compartment followed by two continuous stirred tank reactors for collection of slurry and gas. The simulation was done for the different hydraulic retention times and feed flow rates for the substrate of food waste. As second scenario, series of CSTR reactors was used to model plug flow reactor and simulated as before. Simulation results on advective-diffusive reactor model reveal that accumulation of gasses in the slurry cause an inhibition in methane production. In series of CSTR model, when the food waste alone was used at low hydraulic retention times, pH decreases drastically and cause to process inhibition in the first reactor. This inhibition radiates towards the other connected CSTR reactors and after a certain periods of time total methane production terminates.

Keywords: Anaerobic digestion, Plug flow reactor, ADM 1,

DEDICATION

Dedicated with gratitude to my loving **PARENTS** for being the greatest pliers of my life...



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I believe that my research will make a small contribution to the vast ocean of research done in the field of Chemical and Process engineering...

H.D.S.S. Karunarathne

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LIST OF ABBREVIATIONS

AA	Amino acids
AD	Anaerobic digestion
ADM 1	Anaerobic digestion model 1
COD	Chemical oxygen demand
LCFA	Long chain fatty acids
TVFA	Total volatile fatty acids
UASB	Up flow anaerobic sludge blanket
VFA	Volatile fatty acids
IWA	International Water Association
CSTR	Continuous stirred tank reactor



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