

OPTIMISATION OF AN ANAEROBIC CO-DIGESTION PROCESS

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(09 / 8072)



University of Moratuwa, Sri Lanka.
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University of Moratuwa

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Thesis submitted in partial fulfillment of the requirements for the degree
Master of Science

Department of Chemical & Process Engineering

University of Moratuwa

Sri Lanka

May 2011

DECLARATION OF THE CANDIDATE AND SUPERVISOR

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ABSTRACT

Anaerobic co-digestion, ACD, is regarded as a key environmental technology in industrial, agricultural and domestic sectors for integrated solid and liquid waste treatment and renewable energy production. The main objective of this thesis is to optimize the wet co-digestion process of canteen food waste by combined experimental and mathematical modeling approaches.

Anaerobic co-digestion of canteen food waste with water hyacinth, *Gliricidia* and Rice straw was conducted in this study. Two batch experiments were performed to find out the best co-substrate for co-digestion and subsequently to investigate the effect of increasing co-substrate fractions. Concurrently, dynamic batch modeling results from ADM1 is used to validate the results from each experiment. Semi-continuously fed experiments were conducted to determine hydrolysis rate constants of best co-substrate mixtures by combining parameter estimation of ADM1. The highest total Chemical Oxygen Demand (TCOD) removal and the highest average biogas production were obtained when *Gliricidia* was used as co-substrate. Total biogas production increased with increasing co-substrate concentration. Hydrolysis parameters were estimated using simulated total gas flow rate and experimental gas flow rate. Estimated hydrolysis rate constant for carbohydrates is higher than for the protein and lipids. Increase of *Gliricidia* contents in co digestion feed mixtures did not influence hydrolysis rate constants.

Keywords: Anaerobic Co-digestion, Optimization, ADM1, Mathematical Modeling, AQUASIM 2.1f, Canteen Food Waste, *Gliricidia*,

DEDICATION

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



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K. W. N. Dilnayana.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AA	Amino Acids
ASTM	American Society for Testing and Materials
APHA	American Public Health Association
ADM1	Anaerobic Digestion Model No.1
AD	Anaerobic Digestion
ACD	Anaerobic Co-digestion
CFTOOL	Curve Fitting Tool
COD	Chemical Oxygen Demand
CSTR	Continuous Stirred Tank Reactor
DOC	Degradable Organic Carbon
FAS	Ferrous Ammonium Sulfate
HAc	Acetic acid
HBu	Butyric acid
HPr	Propionic acid
HRT	Hydraulic Retention Time
HVa	Valeric acid
IC	Inorganic Carbon
IN	Inorganic Nitrogen
IWA	International Water Association
KOH	Potassium Hydroxide
LCFA	Long Chain Fatty Acids
MSW	Municipal Solid Waste
OLR	Organic Loading Rate
TCOD	Total Chemical Oxygen Demand
TS	Total Solids
TVS	Total Volatile Solids
UASB	Up flow Anaerobic Sludge Blanket
VFA	Volatile Fatty Acids
VSS	Volatile Suspended Solids



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