

**DYNAMIC MODELING AND SIMULATION OF THE
IMPACT OF LIPID INHIBITION ON ANAEROBIC
DIGESTION OF DESICCATED COCONUT
WASTEWATER**

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Master of Science in Environmental Engineering and Management

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DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The above candidate has carried out research for the Masters thesis/dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor:

Signature of the Supervisor:

Date:

DEDICATION

Dedicated with gratitude to my loving **FATHER**, who has not been with me today, and **MOTHER** for being the greatest blessings of my life.

ACKNOWLEDGEMENT

It is a great pleasure to express my deep sense of gratitude to many individuals for their cooperation and for being supportive throughout the research project. It would not have been possible to complete this without the kind support, patience and guidance of the following people.

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ABSTRACT

Desiccated Coconut Wastewater is categorized as a lipid-rich wastewater that can be treated using anaerobic digestion. Within the anaerobic digester, lipids are hydrolyzed into Long Chain Fatty Acids (LCFAs) and glycerol. LCFAs cause potential inhibitory effects significantly on acetoclastic methanogens and deteriorate digester performance. To study the impact of LCFA inhibition, the BioWin 6.2 integrated Anaerobic Sludge Digestion Model (ASDM) was extended with the lipid inhibition function. Out of all kinetic constants used in the rate equations, maximum specific growth rate of acetate degraders ($\mu_{\max_acetate}$), half saturation rate of acetate degraders ($K_{s_acetate}$) and LCFA inhibition constant (K_{i_LCFA}) are the most sensitive parameters toward methane production. The calibrated model with lipid inhibition (Model 2) showed a higher negative impact on COD reduction, acetoclastic methanogen concentration, and methane production compared to model without lipid inhibition (Model 1), indicating a significant impact of lipid inhibition on anaerobic digestion. If Model 1 is used to simulate anaerobic digestion of lipid rich wastewater, deviations between the actual results and the model predicted results will be high. Thus, Model 2 can be used as a tool to predict the COD reduction, effect on the acetoclastic methanogens, and methane production in anaerobic digestion, which utilizes lipid-rich wastewater.

Keywords: Lipid inhibition, LCFA, Anaerobic digestion, BioWin, Simulation

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LIST OF ABBREVIATIONS

Abbreviation	Description
AD	Anaerobic Digester
ADM1	Anaerobic Digester Model No.1
ASDM	Anaerobic Sludge Digestion Model
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DC	Desiccated Coconut
DCWW	Desiccated Coconut Wastewater
ISS	Inert Suspended Solids
LCFA	Long Chain Fatty Acid
UD	User Defined
VFA	Volatile Fatty Acid
$\mu_{\max}$	The maximum rate of substrate degradation per unit weight of micro-organisms, h^{-1}
K_s	Half saturation constant
K_i	Inhibition constant

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