

**SIMULATION AND OPTIMIZATION OF
UP FLOW ANAEROBIC SLUDGE BLANKET REACTORS (UASBS)
IN A DAIRY WASTE WATER TREATMENT PLANT**

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ABSTRACT

Anaerobic digestion is commonly used in industrial waste water treatment applications and it is a combination of many biochemical and physicochemical processes. Modeling and simulation of an anaerobic digestion is very vital to identify the behavior of industrial waste water treatment plant to optimize its operations.

In this research, anaerobic digestion model called ADM1 (Anaerobic digestion model no 1) developed by IWA task group is applied to model and simulate UASB reactors. ADM1 model comprises with dynamic state variables which represent all biological and physicochemical reactions. This model was built in simulator called Aquasim 2.1f (Reichert, 1998). To model UASB reactors, simplified model is proposed based on different research compartments. UASB modeled by simulator taking as three CSTR compartments named sludge bed, blanket and settler. Influent for experimented waste water plant is waste water generated from dairy plant.

Experiments were conducted at waste water treatment plant (WWTP) under three volumetric flow rates $10\text{m}^3/\text{d}$, $15\text{m}^3/\text{d}$ and $25\text{m}^3/\text{d}$. Three parameters such as cumulative gas volume, pH and COD were measured. At the same volumetric flow rate WWTP was simulated with the new model and parameters such as VFA, gas composition, inhibition and biomass growth rates were obtained.

By varying recycle ratio from bed to blanket and settler to blanket, appropriate recycle ratio is replaced to get best fitted model. (bed to blanket-0.8 and settler to blanket 0.6).

Optimization was performed under two scenarios, i.e. by varying volumetric flow rates and input COD level. It was found that above $30\text{m}^3/\text{d}$ UASB become unstable producing 21% of CH_4 and 75% of CO_2 . Also it can be found that 7500mgCOD/l can be treated at the volumetric rate of $30\text{m}^3/\text{d}$ without any instability.

Key Words: UASB, dairy wastewater, anaerobic digestion, ADM1

DEDICATION

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



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I believe that my research will contribute something for Environmental Engineering and anaerobic digestion .

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LIST OF ABBRIVATIONS

Abbreviation	Description
AA	Amino Acid
ASTM	American Society of testing and materials
AD	Anaerobic Digestion
ADM	Anaerobic Digestion Model
CIP	Clean In Place
COD	Chemical Oxygen Demand
CSTR	Continuously Stirred Tank Reactor
DOC	Degradable Organic Carbon
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
LCFA	Long Chain Fatty Acids
MLVSS	Mixed Liquor Volatile Suspended Solids
ODE	Ordinary Differential Equation
OLR	Organic loading rate
SRT	Solids Retention Time
TS	Total Solids
TSS	Total Suspended solids
UASB	Up flow Anaerobic Sludge Blanket
VFA	Volatile Fatty Acids
VSS	Volatile Suspended Solid
WWTP	Waste Water Treatment Plant



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