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PUBLIC WORKS SECTION

Applications of Anaerobic Baffled Reactor in Wastewater Treatment Using Agriculture Wastes

A Thesis

submitted to the Faculty of Engineering
Ain Shams University for the Fulfillment
of the Requirement of M.Sc. degree
in Civil Engineering

By

Aya Mohamed Osman Hassan
B.Sc. in civil Engineering
Faculty of Engineering – Ain Shames University - Cairo, Egypt

Supervisors

Prof. Dr. Mohamed Ali Ahmed Fergala
Professor of Sanitary & Environmental Engineering
EGYPT, Cairo, Ain Shams University, Faculty of Engineering

Prof. Dr. Walid Abd El-Azim Ibrahim El-Barky
Professor of Sanitary & Environmental Engineering
EGYPT, Alexandria, Alexandria University, Faculty of Engineering

Dr. Hossam Mostafa Hussien Ahmed
Associate Professor of Sanitary & Environmental Engineering
EGYPT, Cairo, Ain Shams University, Faculty of Engineering

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Presented by

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Faculty of Engineering – Ain Shams University – Cairo, EGYPT

THESIS APPROVAL

Examiners Committee:	**Approved**
Prof. Dr. Usama Fathy Mahmoud Mohamed, Professor of Sanitary Engineering & Head of Civil Eng. Dept. Shebin El Kom Faculty of Engineering, El-Azhar University	----------------
Prof. Dr. Mohamed EL Hosseiny EL Nadi, Professor of Sanitary & Environmental Engineering Faculty of Engineering Ain Shams University	----------------
Prof. Dr. Mohamed Ali Ahmed Fergala, Professor of Sanitary & Environmental Engineering Faculty of Engineering Ain Shams University	----------------

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Prof. Dr. Walid Abd El-Azim Ibrahim El-Barky Professor of Sanitary & Environmental Engineering Faculty of Engineering Alexandria University	-----------------
Dr. Hossam Mostafa Hussien Ahmed Professor of Sanitary & Environmental Engineering Faculty of Engineering Ain Shams University	-----------------

STATEMENT

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the department of Public Works Faculty of Engineering, Ain Shams University.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others

Date: - ---/-- /2019

Signature: - ----------------

Name: - ***Aya Mohamed Osman Hassan***

Dedication

This thesis is dedicated to those who contributed to educating, raising and supporting me to be able to accomplish in this picture.

A special dedication to

MY SUPPORTIVE PARENTS

and to

My wonderful

Sisters and Relatives

and finally
special dedication to

MY LOVELY HUSBAND

for encouraging me to complete this work and for always being there for me.

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Finally, the author dedicates this thesis to her parents and her husband

ABSTRACT

Egypt and some developing countries are facing a shortage of water needs, so it is necessary to develop low cost technology to suit these countries and optimize the use of surrounding water. Achieving high efficiencies in anaerobic baffled reactor (ABR) for reducing chemical oxygen demand (COD) has always been an outstanding challenge for most researchers as most experiments focus on using fibers in ABR to reduce COD. In this paper a new material was introduced as a replacement for fibers which is the agricultural waste such as palm fibers and ficus trees. The Effect of using agricultural wastes on the performance of the (ABR) in reducing COD was tested for four different stages (start-up, steady state, shock and final). Both palm fibers and ficus trees samples achieved higher COD removal efficiency as compared to previous studies. The palm fiber samples achieved the highest COD removal efficiency in the four stages as compared to the ficus tree samples.

An exploration regarding the applicability, development and possible future presentation of the an-aerobic baffled reactor (ABR) for the wastewater treatment has been carried out. The reactor design has been established since early 1980s and has several benefits compared to well-established systems. It contains, good flexibility to organic loading and hydraulic, virtuous biomass retaining time, sludge yield reduces, also capacity towards partially separate between different stages for an-aerobic process. The slow rate of changes for populations of bacteria allowing well advanced resistance to alternate the environmental parameters for instance pH and temperature and protection against contaminated materials. There are many alterations such as insertion of an-aerobic polishing stage, resulting in a reactor which can treat difficult wastewaters which now require many units, eventually expressively reducing capital cost. The main idea of the study is to investigate the behavior of these reactors and prove the use of biofilm in refining treatability, to promote the use of both type of biofilm, i.e. ficus fiber and palm fiber. Several important factors have been worked out i.e. temperature, no. of baffles in the reactor, shape of baffled and location of reactor in order to avoid lighting. For all the tested reactors, influent and effluent COD concentration, influent and effluent pH, temperature in reactor and flow rate, in all reactor stage (start-up, steady state, shock load and final stage), pH in all partition from reactors during shock load stage were examined. Results discovered the “ABR C" scenario gave the highest COD % removal as compared to other two scenarios. Simple experimental arrangement was used to see the treatability feature of synthetic wastewater. when tested under altered COD (500 - 1000 and 2000 mg/l) with flow rate 38 l/d and pH value 8.5. pH effect on treatability was explored too.

Keywords: Anaerobic baffled reactor, organic load rete, Biomass, hydraulic retention time, Biodegradation.

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“LIST OF ABBREVIATIONS”

ABBREVIATIONS

“A = Cross-sectional area
ABR = An-aerobic Baffled Reactor,
ABR (A) = Conventional an-aerobic baffled reactor,
ABR (B) = An-aerobic baffled reactor with focus fiber media,
ABR (C) = An-aerobic baffled reactor with palm fiber media,
ACF = Activated Carbon Fiber
AD = Anaerobic Digestion
ADS = Anaerobically Digested Sludge
AHR = An-aerobic Hybrid Reactor
AMBR = An-aerobic Migrating Blanket Reactor
AS = Activated Sludge
ASB = Anaerobic Sludge Blanket
ASBR = Anaerobic Sludge Bed Reactor
ASR = Anaerobic Stage Reactor
BOD = Biochemical Oxygen Demand
CABR = Carrier Anaerobic Baffled Reactor
COD = Chemical Oxygen Demand
CW = Chemical Wastewater
DI-ABR= Divisional Influent Anaerobic Baffled Reactor
E = Effectiveness factor
F/M = Food to microorganism’s ratio
GF = Glass Fiber
GSS = Gas Solids Separator
HFCWs= Horizontal Flow Constructed Wetlands
H_G = Reactor height to accommodate gas collection and storage
H_L = Reactor height based on liquid volume
HRT = Hydraulic Retention Time
H_T = Total reactor height
HUASB= Hybrid Up-flow Anaerobic Sludge Blanket reactor
MLSS = Mixed Liquor Suspended Solids
MLVSS = Mixed Liquor Volatile Suspended
Na = Not Available
NRC = National Research Center
^oC = Temperature
OMW = Olive Mill Wastewater
OLR = Organic Loading Rate
pH = Hydrogen ion concentration
PVA = Polyvinyl Alcohol
PVAF = Polyvinyl Alcohol Fiber
Q = Flow rate
RF = Rumen Fluid
SDB = Sludge Drying Bed
SI-ABR= Single Influent Anaerobic Baffled Reactor
SLR = Sludge Loading Rate
S_o = Influent COD, kg COD/m^3BOD
SRT = Solid Retention Time
SS = Suspended Solids
SW = Synthetic Wastewater

T = Time
TACR = Thermophilic Anaerobic Contact Reactor
TDS = Total Dissolved Solids
TN = Total Nitrogen
TOC = Total Organic Carbon
TS = Total Solids
TSS = Total Suspended Solid
UASB = Up-flow Anaerobic Sludge Blanket
UASR = Up-flow Anaerobic Sponge Reactor
VFA = Volatile Fatty Acid
VFCWs = Vertical Flow Constructed Wet lands
V_L = Total liquid volume of reactor
V_n = nominal (effective) liquid volume of reactor, m^3
Vs = Volatile Solids
V_w = volume of water
WHPCO = Wet Hydrogen Peroxide Catalytic Oxidation
WWTP= Wastewater Treatment Plant"

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