

**TREATMENT EFFICIENCY EVALUATION OF THREE
MACROPHYTES FOR DOMESTIC WASTEWATER USING PILOT
CONSTRUCTED WETLAND SYSTEM**

JUSTIN, DILLULLA LAZARUS

(19PCI02082)

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CONSTRUCTED WETLAND SYSTEM**

BY

JUSTIN, DILLULLA LAZARUS

19PCI02082

B.Eng. Agric. & Biosystems Engineering, Landmark University, Omu-Aran

**A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE
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THE AWARD OF MASTER OF ENGINEERING (M. ENG.) DEGREE IN
CIVIL ENGINEERING IN THE DEPARTMENT OF CIVIL
ENGINEERING, COLLEGE OF ENGINEERING, COVENANT
UNIVERSITY**

OCTOBER, 2021

ACCEPTANCE

This is to attest that this dissertation was accepted in partial fulfilment of the requirement for the award of Master of Engineering (M. Eng.) degree in Civil Engineering, Department of Civil Engineering, College of Engineering, Covenant University, Ota.

Mr. John A. Philip

(Secretary, School of Postgraduate Studies)

Signature and Date

Prof. Akan B. Williams

(Dean, School of Postgraduate Studies)

Signature and Date

DECLARATION

I, **JUSTIN, DILLULLA LAZARUS (19PCI02082)** declare that this research work was carried out by me under the supervision of Professor David O. Olukanni, of the Department of Civil Engineering, Covenant University. I also solemnly declare that to the best of my knowledge, no part of this report either wholly or partially has been submitted here in Covenant University or elsewhere in a previous application for the award of a degree. All sources of data and scholarly publications have been duly acknowledged.

JUSTIN, DILLULLA LAZARUS

Signature and Date

CERTIFICATION

We certify that this dissertation titled “**TREATMENT EFFICIENCY EVALUATION OF THREE MACROPHYTES FOR DOMESTIC WASTEWATER USING PILOT CONSTRUCTED WETLAND SYSTEM**” is an original research work carried out by **JUSTIN, DILLULLA LAZARUS (19PCI02082)** in the Department of Civil Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria under the supervision of Professor David O. Olukanni. We have examined and found this work acceptable as part of the requirements for the award of Master of Engineering in Civil Engineering.

Prof. David O. Olukanni

(Supervisor)

Signature and Date

Prof. Anthony N. Ede

(Head of Department)

Signature and Date

Prof. Ezechiel O. Longe

(External Examiner)

Signature and Date

Prof. Akan B. Williams

(Dean, School of Postgraduate Studies)

Signature and Date

DEDICATION

I dedicate this research work to God Almighty, for his wisdom and strength given to me to carry out this research. I also want to dedicate this research to my parent/guardians, for their love and support towards fulfilling my goals and ambitions.

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TABLE OF CONTENTS

CONTENTS	PAGE
COVER PAGE	i
ACCEPTANCE	iii
DECLARATION	iv
CERTIFICATION	v
DEDICATION	vi
ACKNOWLEDGEMENT	vii
LIST OF FIGURES	xi
LIST OF TABLES	xii
LIST OF ABBREVIATIONS	xiii
ABSTRACT	xiv
CHAPTER ONE: INTRODUCTION	1
1.1 Background study	1
1.2 Problem Statement	4
1.3 Aim	5
1.4 Objectives	5
1.5 Justification for the study	5
1.6 Scope of Study	6
CHAPTER TWO: LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Global Water quality and scarcity situations	8
2.3 Treated wastewater Reuse opportunities	9
2.4 Advantages of CWs over Conventional Wastewater Treatment Systems	9

2.5	Purification Mechanism in Constructed Wetlands	11
2.5.1	Types of constructed wetlands for wastewater treatment	12
2.5.2	Macrophytes for Wastewater Treatment	16
2.5.3	Pollutant removal capacity of the selected macrophytes	17
2.5.4	Water hyacinth (<i>Eichhornia crassipes</i>)	18
2.5.5	Water lettuce (<i>Pistia stratiotes</i>)	20
2.5.6	Common Duckweed (<i>Lemna minor</i>)	22
2.6	Constructed wetland substrate	25
2.7	Constructed wetland microorganisms	26
2.8	Key constructed Wetland design and operation Parameters	26
2.8.1	Environmental Protection Agency Effluent Discharge Standards	28
2.9	Gaps in Knowledge	30
	CHAPTER THREE: MATERIALS AND METHOD	31
3.1	Set-up Location	31
3.2	Experimental Design	31
3.3	Plant collection and cultures	33
3.3.1	The Laboratory Test Parameter Includes	33
3.4	Experimental procedure	33
3.5	Sampling, Tests and Analysis	34
3.5.1	Sample collection and laboratory tests	34
3.5.2	Materials and Equipment	34
3.5.3	Sample Preservation	35
3.5.4	Electrical Conductivity	35
3.5.5	Total Suspended Solids (TSS)	37

3.5.6	Turbidity	37
3.5.7	Result analysis	37
CHAPTER FOUR: RESULTS AND DISCUSSION		38
4.1	Results of Initial wastewater Analysis	38
4.2	Treated Effluent Quality of the three Macrophytes	39
4.2.1	Total Suspended Solids Removal	42
4.2.2	Total Phosphorus Removal	42
4.2.3	Total Nitrogen Removal	44
4.2.4	Biochemical Oxygen Demand Removal	44
4.2.5	Chemical Oxygen Demand Removal	45
4.2.5	E.coli Removal	46
4.3	Comparison of average treatment performance of three macrophytes	47
4.4	Correlation of Treated Effluent values with EPA/NESREA standard	48
4.5	Observations	49
CHAPTER FIVE: CONCLUSION AND RECOMMENDATION		50
5.1	Conclusion	50
5.2	Recommendations	51
5.3	Contributions to Knowledge	51
REFERENCES		53

LIST OF FIGURES

FIGURE	TITLE OF FIGURES	PAGE
Figure 2.1:	Classification of constructed Wetlands	13
Figure 2.2:	Hybrid constructed Wetland	15
Figure 2.3:	Free water surface flow constructed wetland	15
Figure 2.4:	Water Hyacinth Plant.	21
Figure 2.5:	Water Lettuce Plant	21
Figure 2.6:	Common Duckweed plant	21
Figure 3.1:	Constructed wetland Design Set-up	32
Figure 3.2:	Complete set-up of Constructed wetland with plants	33
Figure 3.5:	Water Sampling and Laboratory Test equipment	37
Figure 3.51:	Laboratory Test Process	37
Figure 4.1:	Raw wastewater concentration Vs EA/NESREA standard Limits	40
Figure 4.20:	TSS Removal Efficiency by the Three aquatic macrophytes	42
Figure 4.21:	Removal Efficiency of TP for the three aquatic macrophytes	42
Figure 4.22:	TN removal Efficiency for the Three aquatic macrophytes	44
Figure 4.23:	BOD ₅ removal Efficiency of the three aquatic macrophytes	44
Figure 4.24:	COD removal Efficiency of three aquatic macrophytes	47
Figure 4.25:	E.coli removal Efficiency of the three aquatic macrophytes	47
Figure 4.30:	Correlation of Treated Effluents with EPA/NESREA standard values	49

LIST OF TABLES

TABLE	TITLE OF TABLES	PAGE
Table 2.1:	Constructed Wetland Systems Vs Conventional Wastewater Treatment Systems	10
Table 2.2:	Summary of pollutant removal rate of water hyacinth	19
Table 2.3:	Summary of pollutant removal rate of water lettuce	22
Table 2.4:	Summary of pollutant removal rate of duckweed	23
Table 2.5:	Heavy metals removal Efficiency of Common aquatic macrophytes	23
Table 2.6:	Recommended design and operational parameters for constructed wetlands	27
Table 2.7:	Summary of Constructed wetland type selection criteria for maximum efficiency	28
Table 2.8:	Major characteristics of typical domestic wastewater	29
Table 2.9:	EPA Effluent discharge standard values	30
Table 4.1:	Initial wastewater characteristics	39
Table 4.2a:	Treated Effluent values for the three aquatic macrophytes	41
Table 4.2b:	Removal Efficiency of the three aquatic macrophytes	41
Table 4.3:	Average Removal Efficiency of the three aquatic macrophytes	49

LIST OF ABBREVIATIONS

BOD: Biochemical Oxygen Demand

COD: Chemical Oxygen Deman

CWs: Constructed Wetlands

CWWTS: Conventional Wastewater Treatment systems

EC: Electrical Conductivity

EPA: Environmental Protection Agency

FWSFCW: Free-Water Surface Flow Constructed Wetland

HLR: Hydraulic Loading Rate

HRT: Hydraulic Retention Time

NESREA: National Environmental Standards and Regulations Enforcement Agency

SSFCW: Sub-Surface Flow Constructed Wetland

TDS: Total Dissolved Solids

TN: Total Nitrogen

TP: Total Phosphorus

TSS: Total Suspended Solids

WHO: World Health Organization

ABSTRACT

The need to treat wastewater prior to disposal into the environment is of utmost importance. The use of constructed wetland systems (CWS) is becoming more popular due to their operational efficiency and cost-effective advantages over conventional treatment methods. However, the efficiency of CWS depends on the efficiency of their most vital component; aquatic macrophytes in reducing wastewater pollutants. Therefore, this study was aimed at investigating the treatment efficiency of water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*) and duckweed (*Lemnar minor*) using pilot CWS. It also examined the conformity of the treated effluents with National Environmental Standards and Regulations Enforcement Agency (NESREA) effluent discharge/reuse limits. All the 14 NESREA standard effluent discharge parameters were analysed. However, special attention was given to six (6) of the parameters; Total Suspended Solids (TSS), Total Phosphorus (TP), Total Nitrogen (TN), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and E.coli which were above the standard discharge limits. Four pilot CWS were built using 150L tanks for the three plants and a control reactor. Local substrates; sand and gravel were used to optimize the pilot CW reactors. Effluents samples were collected every 7 days for 3 weeks, while maintaining 80% plant population. The result of pollutant removal efficiencies showed that water hyacinth and lettuce attained optimum results at 14 days hydraulic retention time (HRT) with 99.30% and 99.35% COD and TP removal, respectively. Water hyacinth was better at reducing BOD, COD, EC, TDS, DO and TC with efficiency of 97.31, 85.04, 90.35, 89.66, 95.95 and 65.99%, respectively. However, lettuce was more efficient in removing TSS, TP and E.coli at 96.24%, 97.55% and 94.43%, respectively. While duckweed reduced more of E.coli; 94.43% and TN; 90.83%. Generally, the overall results proved that water hyacinth was more efficient, but all the three macrophytes were efficient in domestic wastewater treatment. Also, the treated wastewater effluents passed NESREA limits, hence it is fit for discharge/or reuse purpose. This study is therefore a major contributor to SDG6 (clean water and sanitation).

Keywords: Domestic wastewater, wastewater treatment, constructed wetlands, macrophytes, water hyacinth, water lettuce, duckweed, sustainable technology.