ANAEROBIC DIGESTER APPLICATION TO PRODUCE ORGANIC MANURE FROM CASSAVA PEELS AND PALM OIL SLUDGE FOR SUSTAINABLE CROP GROWTH

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF ENGINEERING (M.ENG) DEGREE IN CIVIL ENGINEERING IN THE DEPARTMENT OF CIVIL ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA

APRIL 2024

ACCEPTANCE

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

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(Secretary, School of Postgraduate Studies) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I, **OJUKWU, CHUKWUEBUKA NOBLE (15CI02752)**, thus declare that I undertook the study for this project under the supervision of Prof. David O. Olukanni of the Department of Civil Engineering, Covenant University. I therefore also solemnly declare that, to the best of my knowledge, no part of this report has previously been presented in whole or in part to Covenant University or to any other institution in an application for the award of a degree. All informational sources, including academic journals, have been properly acknowledged.

OJUKWU, CHUKWUEBUKA NOBLE

Signature and Date

CERTIFICATION

We certify that this dissertation titled **"ANAEROBIC DIGESTER APPLICATION TO PRODUCE ORGANIC MANURE FROM CASSSAVA PEELS AND PALM OIL SLUDGE FOR SUSTAINABLE CROP GROWTH"** is an original research work carried out by **OJUKWU, CHUKWUEBUKA NOBLE (15CI02752)** in the Department of Civil Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria under the supervision of Prof. 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**

Dr. Olatokunbo M. Ofuyatan
(Head of Department) **Signature and Date**

Prof. Akinwale Oladotun Coker
(External Examiner) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

This research work is dedicated primarily to God Almighty, the source of all wisdom, knowledge, and understanding, in profound appreciation of His grace and favour evident throughout the course of conducting this research. Additionally, I extend this dedication to my ever-supportive parents, siblings, and friends for their unwavering love, support, encouragement, and compassion that have accompanied me throughout my academic journey. It is my hope that, in achieving this milestone, I can contribute to the realization of their dreams for me.

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LIST OF ABBREVIATIONS

MSW	Municipal Solid Waste
AD	Anaerobic Digestion
C: N	Carbon to nitrogen ratio
CD	Cow dung
CP	Cassava peel
CW	Crop waste
GHG	Greenhouse gas
HC	Hemicellulose
HRT	Hydraulic retention time
K	Potassium
L	Liter
Mt/y:	Million Metric Tons Per Year
N	Nitrogen
OLR	Organic loading rate
P	Phosphorus
PE	Polyethylene
POS	Palm oil sludge
TS	Total solids
VFA	Volatile fatty acid
VS	Volatile solids
LOD	Limit of Detection

ABSTRACT

This study explores environmental sustainability through a focused examination of innovative waste management approaches in agriculture. The primary emphasis is on the application of digestate, a byproduct of anaerobic digestion, as organic manure. Utilizing a purpose-built anaerobic digester compliant with ISO (International Organization for Standardization) standards, a substrate mix comprising cassava peels, palm oil sludge, cow dung, crushed eggshells, and water underwent processing. The digestate extraction involved a constructed screw press designed to segregate liquid and solid components. The liquid fraction was stored at room temperature, while the solid fraction underwent a drying process. Transitioning to the planting phase, four experimental variables were introduced: a control group, soil with chemical fertilizer, soil with solid fraction of digestate fertilizer, and soil with liquid fraction of digestate fertilizer. Fertilization was applied at a rate of 1 gram per kilogram of soil. Over a two-month period, significant impacts on plant growth were observed across the various fertilization methods. Notably, the soil treated with liquid fraction of digestate fertilizer exhibited advantages in leaf count, stem width, and crop yield, culminating in a total yield of 99 seeds. In conclusion, the incorporation of digestate as organic manure demonstrates clear potential for enhancing sustainable agriculture practices. The specially designed anaerobic digester and screw press offers an economic waste-to-resource solution, supported by experimental outcomes highlighting the benefits of digestate. Recommendations include further research to optimize digestate composition and application methods tailored to crop-specific requirements. This study contributes insights to the evolving field of sustainable agriculture, emphasizing eco-friendly practices in waste management and crop cultivation.

Keywords: Anaerobic co-digestion, Cassava peels, Palm oil sludge, Digestate, Sustainable crop growth.