BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

WATER RESOURCES ENGINEERING PROGRAMME

FINAL YEAR PROJECT REPORT

DESIGN OF A CAR WASH WASTEWATER TREATMENT AND RECYCLING SYSTEM.

(Case study: Clock Tower Car Wash)

OBURA DENIS

BU/UG/2012/170

Email: deniseobura@gmail.com.

Tel.:+256 706922931

SUPERVISOR(S)

MAIN SUPERVISOR: Mr. Muyingo Emmanuel

CO-SUPERVISOR: Mr. Mugisha Moses

A final year project report submitted to the Department of Mining and Water Resources Engineering as a partial fulfillment of the requirements for the award of a Bachelor of Science degree in Water Resources Engineering

MAY 2016

ABSTRACT

Uganda is a highly motorized society. Kampala as a city, has a high number of vehicles as the seat of power in Uganda. Most of the vehicle washing activities in Kampala city are carried out in streets. Cars that are washed in streets pollute streams, rivers, bays and estuaries (Huybrechts *et al.*, 2002). Wastewater from car washing stations contains a number of impurities that include; sand and dust, free oil, grease, detergents, phosphates, paint residues, rubber, volatile organic compounds (VOC's), and rubbish.

The main objective of this project was to design a car wash wastewater treatment and recycling system and the case study area being Clock Tower Car Wash- Kampala. The project involved a review of several literature pertaining to car wash effluent treatment and recycling systems, characterizing and quantifying the waste water composition, designing the various components of the car wash wastewater treatment and recycling system and finally economic analysis of the project was done.

Relevant equations were used in the design of various components of the Car wash wastewater treatment and recycling system. From the research carried out, wastewater generated from Clock Tower Car Wash was 16,800 litres per day and the highest number of vehicles that could be washed in a particular day being 100 vehicles, with 5 heavy vehicles and 95 light vehicles. The wastewater being discharged showed poor physical chemical characteristics and thus needs treatment before discharge or reuse. Conveyance pipes were sized, then treatment units; 2 Oil water separator tanks, 2 slow sand filters, clear water well plus water pump, and overhead tank were sized. An economic analysis of the system was done using benefit cost ratio approach and it was found to be 2.0. This means that the project is viable and thus should be implemented to curb down environmental degradation and reduce on the cost of fresh water from National Water and Sewerage Corporation (NWSC).

DECLARATION

I OBURA DENIS do declare that this project report on the design of a car wash wastewater treatment and recycling system is as a result of my own research and has never been presented in any academic institution for any award.

Signature: ..... Date: 27TH/05/2016

APPROVAL

This project report on the Design of a car wash wastewater treatment and Recycling System has been written under the supervision of;

Main supervisor

Name.....Signature ..... Date.....

Co-supervisor

Name.....Signature ..... Date.....

DEDICATION

This report is dedicated to my father Mr. Enabu Michael and my mother Mrs. Janet Enabu for their tireless efforts and sacrifices throughout my education.

ACKNOWLEDGEMENT

I thank the Almighty God for the great provision and guidance towards my final year project accomplishment.

I would also like to thank my academic supervisors Mr. Muyingo Emmanuel and Mr. Mugisha Moses and the entire staff of the department of Mining and Water Resource Engineering Busitema University who endeavored their best to guide me where necessary throughout this project, may the good Lord bless them.

With great concern, I send my sincere appreciation to my father Mr. Enabu Michael and my dear mother Mrs. Janet Enabu for all the material and financial support they offered throughout my education.

Finally, in special attention, I convey my sincere appreciation to my elder brother Olobo Bosco and sister Ariekot Joyce for their financial support and encouragement. May the Almighty God reward them abundantly.

ACRONYMS

BOD_5	Five day Biochemical Oxygen Demand
m	meter
ms/ cm	milliseconds per centimeter
m/ s	meters per second
mg/ l	milligrams per liter
ml	milliliter
mm	millimetres
gpd/ft	gallons per day per feet
APHA	American Public Health Association
NTUs:	Nephelometric Turbidity Units
TDS:	Total Dissolved Solids
NWSC	National Water and Sewerage Corporation
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
CVWF	Central Vehicle Washing Facilities
CPHEEO	Central Public Health and Environmental Engineering Organization
UEC	Upstream Engineering Centre
AS	Anionic Surfactant
µPVC	Un-plasticized Poly Vinyl Chloride
pH	Hydrogen Potential

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

CHAPTER ONE

1.0 INTRODUCTION

This chapter outlines the relevant information and clearly shows the problem of interest for the intended research. It stipulates how this study will help reduce the problem through fulfillment of the objectives discussed below.

1.1 Background

Water is one of the most precious needs for life on earth. In developed countries, carwash industry is conscious of the need for wastewater treatment and water reclamation as a way of protecting the scarce fresh water resources from pollution. Worldwide, environmental legislation and guidelines concerning this specific issue have been released. Examples show that in Queensland, Australia, it is mandatory for the use of at most 70 L of fresh water in a single car wash, and in Europe some countries restrict the water consumption to 60–70 L per car and/or impose reclamation percentage (70–80%) (Boussu et al., 2007). However, developing countries are still behind to develop conscious for their wastewater produced by carwash industries.

Uganda is a highly motorized society. Kampala as a city, has a high number of vehicles as the seat of power in Uganda. It has a good urban environment being one of the most beautiful urbanities in East Africa. However, the climate is dusty despite the well planned road network. Therefore, like any other motorized society the vehicles are bound to get dirty more frequently thus, requiring frequent washing. Most of the vehicle washing activities in Kampala city are carried out in streets. Cars that are washed in streets pollute streams, rivers, bays and estuaries (Huybrechts *et al.*, 2002). Wastewater from car washing stations contains a number of impurities that include sand and dust, free oil, grease, detergents, phosphates, Volatile Organic Compounds (VOCs), heavy metals, and also rubbish. According to Uganda Revenue Authority in 2011, there were 635,656 motor vehicles plying Uganda,s roads, an increase from 50,102 in 1991. According to statistics, the number of vehicles plying Uganda's roads increased by over 500,000 (100%). Assuming each of these cars was hand washed with 70 litres of water per week, the volume of untreated car wash effluent discharged to the environment per year would be approximately 2.3 billion litres. The predominant metal contaminants in diffuse urban runoff are copper (Cu), lead

REFERENCES

1. Moores, J., Pattinson, P., Hyde, C. (2010). Enhancing the control of contaminants from NewZealand's roads: results of a road runoff sampling programme. New Zealand Transport Agency research report 39 retrieved from http://www.nzta.govt.nz/resources/research/reports/395/docs/395.pdf June 2011.
2. Janik, A. Kupiec (2007), Trends in Modern Car Washing. Vol. 16, No.6, (2007) 927-931.
3. Central Vehicle Wash Facilities (CVWF), 16 January 2004. UFC 4-214-03
4. APHA (1998). Standard methods for the examination of water and wastewater. 18th Edition. American Public Health Association, Washington, DC pp 45-60.
5. Prabhata K. Swamee, (2008). Design of water supply pipe networks published by John Wiley Sons, Inc., Hoboken, New Jersey. ISBN 978-0-470-17852-2Rubio J, Zaneti RN.
6. Boussu K, Kindts K, Vandecasteele C, Van der Bruggen B. (2007), Applicability of nanofiltration in the carwash industry. Separation and Purification Technology; 54:139–46.
7. Praba K., (2006), Water &Waste Water Engineering.
8. Madwar.K, Tarasi.H (2002), "Desalination techniques for industrial wastewater reuse", Desalination **152**, 325.
9. Nordic Ecolabelling Board, (October 2000 – October 2007) "Ecolabelling of vehicle wash installations. Criteria Document" 074/1.
10. Norland.J, Norland.E, (2001), "Prestigious Market Creates Unique Challenges". Auto Laundry News 12, 1.
11. Williams.E, (2003), "Drying Systems", Auto Laundry News 4, 1.
12. US Army Corps of Engineers, (January 2010), AED Design Requirements: Oil/Water Separators
13. Stokes, George Gabriel. 1845. Transactions, Cambridge Philosophical Society 8, no. 287.
14. American Petroleum Institute. 1990. "Design and Operation of Oil-Water Separators, Publication 421, American Petroleum Institute. American Petroleum Institute, Washington, D.C.
15. Ermens, R. (2007). Literature Review: Urban River Contaminants. Prepared by URS NewZealand for Environment Canterbury. Environment Canterbury Report No. U07/100H.