BUSITEMA UNIVERSITY
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FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES AND MINING ENGINEERING

FINAL YEAR PROJECT REPORT

INVESTIGATING THE POTENTIAL IMPACT OF LANDFILL LEACHATE ON GROUNDWATER QUALITY

CASE STUDY: KITEEZI LANDFILL

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A project report submitted in partial fulfillment for the award of a Bachelor's Degree in Water Resources Engineering.

MAY 2018

DECLARATION

I OKUMU KENETH hereby declare that this submission is my own work towards the BSc. In water resources engineering and that to my best of knowledge it contains no materials previously published by another person nor material which has been accepted for the award of any other degree in the University except where due acknowledgement has been given in the text.

Signature .....

Date 31/May/2018

DEDICATION

I dedicate this work to my beloved parents Mr. Jackson Mayende, sweet mommy Agness Natocho and to all dear brothers, sisters and friends for their unending support, sacrifice and commitment to my education and well-being. May the Almighty God bless you and reward you abundantly.

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ABSTRACT

Leachate is the aqueous effluent generated as a consequence of rainwater percolation through wastes and the inherent water content of wastes themselves. Its quality is the result of biological, chemical and physical processes in landfills combined with the specific waste composition and the landfill water regime. The standards to which leachate must adhere for landfills within developing nations, such as Uganda, comparatively little research has been performed in order to justify any sort of criteria for leachate effluent and the necessary treatment required to reach those levels. In this research, Physical, chemical and bacteriological analyses were carried out of groundwater samples from two boreholes located near kiteezi landfill, and leachate samples at the treatment plant to ascertain the potential impact of the landfill leachate on the groundwater quality. The samples from borehole locations with radial distances of 50, and 200 m, respectively, away from the landfill and two leachate samples both at the inlet and outlet of the treatment plant were collected for analysis. The parameters determined were the turbidity, temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD), total iron, nitrate, chloride, calcium and heavy metals like copper, zinc, lead and chromium. The results of this research show that some of the effluent parameters such as BOD, COD, cadmium, E. coli and total coliforms exceeded the permissible discharge limits of NEMA. The results of groundwater quality from the two wells near the landfill reflected higher concentrations of BOD, lead, cadmium and bacteriological parameters. However, in other cases such as leachate control and monitoring, surface water contamination, landfill gas, offensiveodor and handling of hazardous waste, the control measures were not effective enough for the reduction of the nuisances at the landfill. The objectives of this research report wereto characterize the leachate composition in the kiteezi landfill, to determine the groundwater quality of boreholes around the landfill and analyze, compare and generate water quality index. Therefore, this paper provides insight regarding how the leachate puts impact to the groundwater quality.

APPROVAL

This is to certify that this research report entitled "Investigating the potential impact of landfill leachate on groundwater quality" is a record of bonafide work carried out by the candidate under my supervision and is worthy for the partial fulfillment of the requirements for the award of a Bachelor of Science degree in Water Resources Engineering.

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LIST OF ACRONYMS

MSW	Municipal Solid Waste
MWDL	Municipal Waste Disposal Landfills
UNEP	United Nations Environmental Program
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
Mg/l	milligram per litre
C& DD	Construction and Demolition Debris
USEPA	United States Environmental Protection Agency
TOC	Total Organic Carbon
XOCs	Xenobiotic Organic Compounds
PCBs	Polychlorinated Biphenyls
MSWM	Municipal solid Waste Management
EPR	Extended Producer Responsibilities
ISWM	Integrated Solid Waste Management
NEMA	National Environmental Management Authority
WHO	World Health Organization
UBOS	Uganda Bureau of Statistics
μS/cm	Micro Siemens per centimeter
KCCA	Kampala Capital city Authority
UIRI	Uganda Industries Research Institute
WQI	Water Quality Index

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Groundwater is a valuable resource often used for industry, commerce, agriculture and most importantly for drinking. Often, the raw water used for domestic purposes is vulnerable to contamination due to the human influence resulting in pollution. Groundwater pollution is mainly due to the process of industrialisation and urbanisation that has progressively developed over time without any regard for environmental consequences (Longe& Balogun 2010). In recent times, the impact of leachate on groundwater and other water resources has attracted a lot of attention because of its overwhelming environmental significance. Leachate migration from wastes sites or landfills and the release of pollutants from sediments (under certain conditions) pose a high risk to the groundwater resources if not adequately managed (Ikem et al.2002).

Waste disposal has always been an important issue for human societies. Solid wastes are disposed on or below the land surface resulting in potential sources of groundwater contamination. One of the most common waste disposal methods is landfilling; a controlled method of disposing solid wastes on land with the dual purpose of eliminating public health and environmental hazards and minimizing nuisances without contaminating surface or subsurface water resources.(Papadopoulou et al., 2006).Currently, the use of municipal waste disposal landfills (MWDL) is the predominant waste management practice in many countries. However, there are potential public health and environmental implications associated with solid waste landfills.

The solid waste that is collected from the five divisions of Kampala City is dumped at the Kiteezi landfill site. However, people living near the landfill site have complained that this landfill has made their place uninhabitable and that their land has lost value. These conflicts stem from bad odor, leachate (which pollutes water resources), scattering of wastes from the dumping sites by wind and scavengers like Marabou storks, and other nuisances such as vermin, mosquitoes and flies (Mwiganga and Kansiime, 2005). The landfill is currently operated by the privately owned Otada Construction Company. Upon arrival at the site the waste is weighed and

Leachate was characterized by high contents of organic, inorganic and bacteriological concentrations, this showed that groundwater through wells near the landfill was being contaminated.

The descriptive statistical analysis shows a significant impact caused by the landfill leachate on groundwater quality since the variance between the sampled wells near the landfill is not the same. Also the F statistics value of 9.3 is greater than the F critical and lies in the rejection region.

The high levels of bacteriological contamination of the water from the boreholes is an indication of faecal pollution of human wastes from the landfill and health problems such as typhoid fever or worm infestation are imminent when such water is consumed.

The high mean value recorded for the biological oxygen demand in well II suggests that pollution of some sort has taken place in the study area. Leachate from the landfill might have played a significant role in the pollution of the well.

It is also evident from the water quality index calculation, most of the wells are classified under poor and unsuitable for drinking water purposes.

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