
# FACULTY OF ENGINEERING

## DEPARTMENT OF WATER RESOURCES AND MINING ENGINEERING

## FINAL YEAR PROJECT REPORT

# DESIGN AND FABRICATION OF A SAFE EMPTYING AND LOADING SYSTEM

**By**

**MANDALI DERRICK**

**BU/UP/2018/3641**

mandaliderrick@gmail.com

**0780-489015 / 0751-201161**

***A final year project report submitted to the department of water resources Engineering in partial fulfillment of the requirement for the award of the degree of Bachelor of science in water resources engineering***

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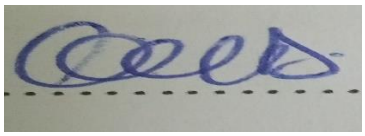
## Abstract

In the heavily populated urban slums of Sub-Saharan Africa, feacal sludge (FS), a byproduct of on-site sanitation systems, presents a management difficulty. Pit latrines are the most prevalent and economical onsite sanitation facilities in the Bwaise III zone of downtown Kampala City's informal settlements. However, when latrines fill up, problems arise from a lack of efficient technological choices. This later poses a lot of challenges including those associated with the disposal. Currently, vacuum tankers have an impact on the market, but they are primarily used to empty septic tanks in locations that are easily accessible rather than inaccessible locations where pit latrines and filled manholes are common. Due to accessibility issues, heavy traffic, and vast distances to treatment facilities, the collection and transportation of FS from slums is expensive. In response to the above challenges, a safe emptying and loading system was designed and constructed. The system is cheap, affordable and environmentally friendly. The system is made up of a suction rotary vane compression system and forklift which is a loading device. A suction rotary vane compression system is made up of a metallic drum, the rotary compressor coupled to the engine using a pulley and connected with pipe fittings. The forklift was fabricated from mild steel which is readily available, cheap and can be made from locally available materials and scrap materials. This comprises of mainly hand-winch, the fork and a frame. The prototype was tested at Busitema university workshop and the test results were tabulated, graphs of discharge vs suction time, suction time vs elevation, elevation vs discharge, load vs time were plotted. An economic analysis was carried out and it shows that the project is viable. Therefore, based on the limitations of the current design, further modifications and recommendations are advised.

## Declaration

I **Mandali Derrick**, declare that all the material portrayed in this project report is original and has never been submitted in for award of any Degree, certificate, or diploma to any university or institution of higher learning.

Signature



## Acknowledgment

I would like to extend my sincere thanks to the almighty GOD who has gifted me with life and has enabled me to reach this academic height as he has been the provider of all the requirements.

Special appreciation goes to Mr. Maseruka Benidicto for imparting in me the knowledge and guidance towards making this research and to exhibit professional morals.

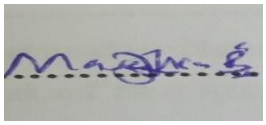
Great thanks to my beloved Parents, relatives and friends for their endless encouragement, financial support and advice given to me in the course of my academic struggle.

## Approval

This is to certify that the project report has been carried out under my supervision and this report is ready for submission to the Board of examiners and senate of Busitema University with my approval.

**SUPERVISOR:**

**MR. MASERUKA BENDICTO**

**SIGNATURE:** 

**DATE: ……16th ……/January…/2023**

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## List of acronyms

| Acronyms | Meaning |
|---|---|
| FSM | Feacal Sludge Management |
| UNICEF | United Nations International Children's Fund |
| MDG | Millennium Development Goals |
| SDG | Sustainable Development Goals |
| KCCA | Kampala City Council Authority |
| MAPET | Manual Pit Emptying Technology |
| SSM | Sewer Sucker Machine |
| SS | Stainless Steel |
| PVC | Polyvinyl Chloride |
| HDPE | High Density Polyethylene |
| WHO | World Health Organization |
| UBOS | Uganda Bureau of Statistics |
| NDP | National Development Plan |

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## Chapter one: Introduction.

This chapter entails the general information relevant to the research while clearly showing the problem of interest for the intended design. It includes how this study will help reduce the problems associated with faecal sludge management through fulfilling some of the listed objectives.

### 1.1: Background of the study.

In many developing countries, one of the biggest challenges facing urban settings is Faecal Sludge Management (FSM) where pit latrines fill faster than available capacities to empty, transport and safely treat or reuse the resulting sludge. Despite the progress, over half of the world's population, 4.2 billion people use sanitation services that leave human waste untreated, threatening human and environmental health (UNICEF, 2020). At the decline for meeting the MDGs in 2015, 2.1 billion ($10^9$) people had gained access to improved sanitation. However, 4.5 billion people lacked access to safely managed sanitation (Scott, 2019).

Many countries depend on onsite sanitation facilities. Onsite sanitation technologies like flush toilets connected to septic tanks, pit latrines serve around 2.7 billion people (Strande, 2014). It is estimated that 90% of the waste generated is discharged to the environment untreated and this leads to a concern in financial sustainability in solid waste management in developing and transitional country cities (UN-HABITAT, 2010).

The elevated population in Kampala City causes deficient access to FSM facilities with an estimated percentage of Over 90% using pit latrines of inadequate standards, 45% of the pit latrines are abandoned after 5 years when either full or broken down due to inadequate O&M (Sanz Uriarte and Mujica, 2016).

When pit latrines fill, fecal sludge must be either safely sequestered in situ or must be hygienically emptied, safely transported and adequately treated for reuse or disposal (al R. D., 2020). The methods available for scooping sewage include manual emptying using buckets, spades, desludging pumps and vacuum tankers. The Gulper pump is the most widely used in East Africa due to its simple design

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