



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES

ENGINEERING

FINAL YEAR PROJECT

**Investigating effectiveness of cactus mucilage on water bacteria
aggregation.**

BY

MUGIRI AMANDO

REG NO: BU /UP/2015/682.

[Email.mugiriamando92@gmail.com](mailto:mugiriamando92@gmail.com)

Tel No: +256-754 804552 / +256-789 271364.

Main Supervisor. MR. YORONIMO OKETCHO

***Presented as partial fulfillment of the award of Bachelor's Degree in Water
Resources Engineering.***

ABSTRACT

Flocculants are mostly used where solid-liquid separations are required in wastewater and potable water production facilities. Conventional flocculants include inorganic metal salts and synthetic organic polymers. The cost, availability, and effects of nonbiodegradable nature of these flocculants have led to the widespread study of natural flocculants.

Current natural flocculants being studied are plant-based materials. In this study, the extract of *Opuntia Ficus-indica* cactus was evaluated as a natural flocculant for bacteria and floating sediment. The *Opuntia Ficus-indica* cactus is also known as the nopal or prickly pear. Using simple extraction techniques non-gelling (NE) mucilage extracts were isolated from fresh cactus pads.

Laboratory tests were used to determine the flocculation and removal of suspended sediment and bacteria caused by mucilage dosing. Throughout this study the mucilage's potential as a flocculant was evaluated by varying its concentration on synthetic water prepared from kaolin and raw water

The extracts consist primarily of polysaccharides and differences in physical structure between mucilage types were seen using atomic force microscopy and transition electron microscopy.

Cactus extract is an effective natural coagulant which can be used in improving the physicochemical and bacteriological parameters of water in terms of pH, turbidity and conductivity.

During coagulation process, cactus coagulant doesn't much affect pH of water as it remains within recommended range. This is reducing the high cost of the current water treatment systems where there is a need of adjusting pH of water after each water treatment.

Bacterial reduction was due to antimicrobial agent in cactus extract as well as settling time. Cactus extract protein produce a positive charge in water that acts attract dominant negatively charged particles like microbes to form flocs.

Antimicrobial peptides extract act by disrupting bacterial cell membranes inhibiting essential enzymes of gram negative and gram positive. Also, bacterial removal was due to alkaline

condition produced by cactus extract which inhibit the growth of acidophiles and extreme alkaliphiles

Cactus cladodes can be qualified as natural flocculant in water treatment due to its effectiveness, moreover it minimizes the use of chemical flocculants.

Therefore, its efficacy was further explored. Mucilage was most effective with dosages of Cactus mucilage extract concentration of 2.450g dissolved in 50ml of distilled water (0.049g/ml) for the parameters in raw water sample. Using the optimal concentration of 2ml of extract solution, 1 litter of raw of water could be treated with only 49 g of mucilage powder.

Based on the extraction method used in this work, 1 g of mucilage powder can be obtained from a cactus pad weighing approximately 10 g (wet weight) of cactus cladodes.

Mucilage remained an effective flocculant over a wide range of suspended contaminant concentrations showing that mucilage is a versatile flocculant that can be tailored for a variety of applications. Overall, this work shows that the *O. Ficus Indica* cactus is an effective flocculant for suspended sediments and bacteria where bacteria aggregation efficiency was 84.55%.

DECLARATION.

I do hereby declare that the final year research work reported herein, has been performed by me and this work has neither been submitted not being concurrently submitted in candidature for award of any degree at any other University.

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MUGIRI AMANDO

Student No: BU/UP/2015/682.

DEDICATION.

This research work is dedicated to my father Mr. Byamugisha alexander, my sister Komugisha Catheline and Mr. Gakiza Epaphra for patience and unfailing support throughout my academic endeavors.

May God bless their hands

ACKNOWLEDGEMENT.

Am greatly indebted to the following persons who assisted during the course of the research project in various ways as follows:

Mr. Oketcho yolonimo, for supervising the research work and his encouragement, guidance, valuable suggestions, enthusiastic support, personal understanding without them this study would not have been successful.

Staff in the chemistry department of faculty of science and education for their input and assistance in various ways during laboratory test and analysis.

I thank my fellow past and current water engineering student for the guidance.

APPROVAL.

This is to confirm that this report has been written and presented by MUGIRI AMANDO giving the details of his research project work on Investigating effectiveness of cactus mucilage on water bacteria aggregation.

SUPERVISOR: MR. YORONIMO OKETCHO

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LIST OF ACRONYMS.

COD Chemical oxygen demand

BOD Biochemical oxygen demand

NEMA National Environmental Management Authority.

WHO World Health Organization.

TSS Total Suspended Solids

IWRM Integrated Water Resources Management.

TDS Total Dissolved Solids.

UNBS - Uganda National Bureau of Standards

AWWA American Water Works Authority.

GDWQ - Guidelines for drinking water.

AOAC - Association of Official Analytical Chemist.

UNICEF - United Nations International Children's Emergency Fund.

ISO - International Standard Organization

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CHAPTER ONE.

1.1 BACKGROUND

Drinking water is a basic human need including food. Thus, drinking water is essential for wellbeing and a healthy of human being. In developing countries, a big section of population dependent on raw water for consumption purposes without any treatment. These water source can be polluted by various ways like fertilizers from agricultural runoff, human and animal feces.

Also, to add on that, unhygienic handling of water during transportation and storage facilities in homesteads can contaminate water.

The world health organization has estimated that all diseases and sickness in the world is caused by polluted water and lack of enough water however. This could be prevented by improving on drinking water, hygiene and water resource management.

In Uganda with recognition of the importance of improved water and sanitation, government is extending water supply systems to people without access to improved sources of drinking water still this leaves more people without access to safe water.

People at greatest risk due to unsafe water are people living under unsanitary conditions. But this can be reduced through provision of household water treatment methods.

1.2 Problem statement.

Conventional disinfecting and flocculants methods which include use of chlorine, inorganic metal salts and organic synthetic polymers, have demonstrated potential in reducing pathogens and suspended contaminants in water significantly. However, potential side effects of using these non-biodegradable chemicals have led to the environmental ecological degradation threats and at household level these synthetic chemicals are expensive in terms of the cost and availability hence low adoption for treating potable water.