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FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT REPORT

INVESTIGATING THE EFFICIENCY OF RICE HUSK ASH AS AN ADSORBENT IN DYE REMOVAL FROM TEXTILE WASTEWATER.

CASE STUDY: FINE SPINNERS UGANDA LTD.

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

May 2017

DECLARATION

I, Kwikiriza Benon, the undersigned, an undergraduate student at Busitema University and author of the research report entitled "Investigating the efficiency of rice husk ash as an adsorbent in dye removal from textile wastewater" solemnly declare that this research is my original work that has been done and prepared by myself under the guidance and supervision of Mr. Okirya Martin. This report has not been previously or concurrently submitted for the award of any academic degree, diploma or a similar title at this or any other university. The materials borrowed from other sources and included in my research have been properly cited and acknowledged. I thus declare that this research work assigned the title "Investigating the efficiency of rice husk ash as an adsorbent in dye removal from textile wastewater" is faithful records of bonafide and original research work carried out by myself. All information in this document has been obtained and presented in accordance with academic rules and ethical conduct, and as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Students Signature .....

Date 26th May 2017. .....

APPROVAL

This is to certify that this research report entitled "Investigating the efficiency of rice husk ash as an adsorbent in dye removal from textile wastewater" is a record of bonafide work carried out by the candidate under my supervision and is worthy for the partial fulfilment of the requirements for the award of a Bachelor of Science degree in Water Resources Engineering.

.....

Mr. Okirya Martin

Date:.....

DEDICATION

I dedicate this report to my beloved parents who labored tirelessly to enable me see the light of education as well as friends and classmates for their sincere and unwavering support. It is due to the unconditional love, moral and emotional support that each of you provided that has enabled me conduct such a painstaking and successful research. All your contributions will be cherished lifelong, even beyond academic spheres.

ACKNOWLEDGEMENT

I take this opportune moment to judiciously thank God for enabling me finish this piece of work. In a special way, I convey my belated, heartfelt and sincere thanks to my lecturers. It is with immense pleasure that I acknowledge my debt to my revered supervisor Mr. Okirya Martin. It is because of his priceless intellectual guidance, innovative and constructive ideas that paved way for the successful completion of this research. Deepest appreciation for the valuable guidance, constructive criticism and encouragement during every stage of this project. This work would not have been possible without his supervision, for it was a privilege to work under his tutelage. I wish to acknowledge Uganda industrial Research Institute for allowing me to use their laboratory facilities and the professional assistance exhibited by their staff members. Special thanks to Fine Spinners Uganda LTD for providing me with wastewater samples used in this research. I also extend my heartfelt gratitude to Busitema University top management for allowing me attend a 2 weeks academic conference organized by the University of Tokyo, Japan in March, 2017. It was inspiring as I presented my research paper and had intellectual discussions with fellow think tanks from around the globe. It provided me a deeper insight on how textile wastewater from garment and apparel industries were posing great challenges to people in Bangladesh and thus I saw the much desired need for my research to address such a social-environmental issue posed by garment industry in Bangladesh and elsewhere in the world. It was a great learning platform and a repository of knowledge and ideas towards my research career as I shared with avid learners. Many thanks go to my fellow undergraduate colleagues. Last but not least, I would like to thank everybody who played a very important role towards the completion of this work, as well as expressing my apology that I could not mention the names one by one.

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ACRONYMS

RHA	Rice Husk Ash
UIRI	Uganda Industrial Research Institute
FSUL	Fine Spinners Uganda Limited
UV/Vis	Ultra Violet Visible Spectrophotometer
NYTIL	Nyanza Textile Industries Limited
RMG	Ready Made Garments
MB	Methyl Blue
STL	Spent Tea Leaves
AC	Activated Carbon
COD	Chemical Oxygen Demand
BOD	Bio Chemical Oxygen Demand
TDS	Total Dissolved Solids
-COOH	Carboxyl group
-OH	Hydroxyl group
nm	Nano meters
HCl	Hydrochloric acid
NaOH	Sodium Hydroxide
rpm	Revolutions per minute
FTIR	Fourier Transform Infra-red spectrometer
SiO_2	Silica
KBr	Potassium Bromide

ABSTRACT

Advanced wastewater treatment techniques such as adsorption are economically and environmentally essential in the removal of non-biodegradable toxic compounds from industrial wastewater. The research study focuses on the use of rice husk ash to treat textile waste water. Samples of textile wastewater were collected from the final clarifier of Fine Spinners Uganda LTD and rice husks were got from local rice milling machines in Busitema trading centre. Batch tests were performed to investigate the use of rice husk ash as a potential adsorbent for dyes. Adsorption capacity was found to vary with pH, temperature, adsorbent dosage and contact time. The adsorbent was analysed by using FT-IR analysis technique which was done at Uganda Industrial Research Institute laboratories. The experimental result shows that RHA has good potential to remove dyes from effluent and good potential as an alternative low cost adsorbent. Experiments were carried out in triplicates and average value computed for each. The volume of wastewater samples was kept constant throughout all experiments at 25ml. Initial conditions of the wastewater were measured and found to be: concentration of 1.0000g/litre, temperature of 26°C and pH of 6. In all experiments, a sample of original wastewater was included, to which no RHA added so as to act as a blank solution. This was meant to be a control experiment and confirm that the observed results in actual experiment are actually due to the presence of the adsorbent, RHA and as well investigate whether there was any adsorption at the walls of the conical flasks. The alternative experiments had adsorbent RHA added to the wastewater to act as actual experiment. From the experimental investigations, the maximum percentage removal for dyes in textile industrial wastewater was calculated and obtained at an optimum bio-adsorbent dosage of 20mg, an optimum contact time of 150 minutes, an optimum temperature of 40^0C and an optimum pH of 5. The combination of optimum conditions yielded a percentage removal of 93.03% which is promising. The results obtained can help to design an appropriate wastewater treatment plant to minimize the adverse impacts caused by textile industrial wastewater.

CHAPTER ONE
INTRODUCTION

1.1 Prelude

Saving water to save the planet and to make the future of mankind safe is what we need now. With the growth of mankind, society, science and technology, our world is reaching to new high horizons but the cost which we are paying or will pay in near future is surely going to be too high. Among the consequences of this rapid growth is environmental disorder with a big pollution problem. Anthropogenic activities have caused a great harm to the quality of our lifeline, i.e. water. Because of fast depletion of the freshwater resources, there seems to be a crisis of the same. Water pollution is a global concern and, it is high time that we realize the gravity of the situation. Removing pollutants from water is the crying need of the hour and developing a cost effective and environmentally safe method to achieve the same is a challenging task for Water resources engineers. After all, it is the future of mankind, which is at stake

A dye is a colored substance that has an affinity to the substrate to which it is being applied. Dyes appear to be colored because they absorb some wavelengths of light more than others. Humans are estimated to use dyes for thousands of years and the earliest use of the colorant is believed to be by Neanderthal man about 180,000 years ago. The year 1856 witnessed a historic discovery of first synthetic dye, Mauvine, by Perkin. In due course of time, these synthetic dyes gained huge popularity and began to be synthesized on a large scale. In fact, it has reached to a level of annually, over $7.0x10^5$ and nearly 1000 different types of dyes are produced worldwide. Owing to their complicated chemical structures, dyes are difficult to treat with municipal waste treatment operations. Even a small quantity of dye does cause high visibility and undesirability. Moreover, the color produced by dyes in water makes it aesthetically unpleasant

They can have acute or chronic effects on exposed organisms, which depend on the concentration of the dye and the exposed time. In addition to that, many dyes are considered to be toxic and even carcinogenic.

Few decades earlier the dye selection, applications and uses were not given much importance. With the growing health concerns, it was in the 1980s that people started paying much attention to dye wastes. An indication to the magnitude of this problem can be inferred from the fact that two percent of dyes produced are directly discharged into aqueous effluents. With the increased stringent laws on industrial discharge, it has become very important to treat this wastewater.

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