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Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF GINNING AND TEXTILE ENGINEERING

PROJECT REPORT

FUNCTIONAL FINISHING OF BARKCLOTH FOR ANTIMICROBIAL PROPERTIES USING ZINC OXIDE NANOPARTICLES

BY

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DECLARATION

I, OKINYI SAMM YOUMA, confirm that the work presented in this research project is my own. Where information has been derived from other sources, I confirm that this has been indicated in the project report.

Signature: ....

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Love you both!

APPROVAL

This project report has been submitted for examination with approval from the following supervisors:

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LIST OF ACRONYMS

SEM – Scanning Electron Microscope.

XRD- X-ray Diffraction spectrometer

FTIR- Fourier Transform InfraRed Spectroscopy

w.o.f- Weight of Fabric

S. *Aureus*- Staphylococcus Aureus

E. *Coli*- Escherichia Coli

CFU- Colony Forming Units(Total bacteria count)

UIRI- Uganda Industrial Research Institute

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ABSTRACT

Barkcloth a naturally occurring cellulosic non-woven fabric has recently obtained attention in the research community for applications in the apparel and a wide range of industrial fields such as automobile, household furnishing and construction due to its unique properties such as excellent mechanical strength, good thermal and sound absorption properties and its biodegradability. Functional finishing of textile materials for antimicrobial properties on the other hand has also been of great interest more especially with the advent of nanotechnology. Zinc Oxide nanoparticles have shown antibacterial activity with higher efficiency, and has also been used for self-cleaning and U.V protection due to the lower band gap energy of ZnO i.e 3.37 eV, causing higher antibacterial activity for it even under dark conditions (Hirota et al., 2010).

In this work, barkcloth was treated with different concentration of zinc oxide nanoparticles using the pad-dry-cure method and the test organism used were Gram-negative *Escherichia coli* (*E. coli*) and Gram-positive *Staphylococcus aureus* (*S. aureus*) chosen as model bacteria to evaluate the antibacterial activity of Zinc oxide Nanoparticle. Anti-microbial activity was determined using AATCC 100 Antimicrobial Test Method for Textile Fabrics (Assessment of Antimicrobial Finishes on Textile Materials). The coated barkcloth samples with concentration 0.6 g/L showed a significant percentage reduction of the both the gram +ve and gram –ve bacteria, with the gram negative E coli bacteria demonstrating a high susceptibility to the zinc oxide nanoparticle than gram positive S aureus, thus it can therefore be used for hospital furnishing and in other areas like automobile for anti-microbial protection

Keywords: Barkcloth, Zinc oxide nanoparticles (ZnONPs), Antimicrobial.

CHAPTER ONE

1.0 INTRODUCTION

This chapter discusses; functionalisation of barkcloth for antimicrobial properties of the barkcloth, problem statement, the objectives of the project, the justification giving its purpose and finally the limits of the project.

1.1 Background

Research is going on worldwide with the focus on new quality requirements that include maintaining the intrinsic functionality of textiles with antimicrobial properties through an eco-friendly production process.(Morais & Guedes, 2016)

Health and hygiene awareness in the increasing population in the globe has increased the demand for bioactive textiles (textiles with antimicrobial properties). Antimicrobial resistance has been categorised as a global health problem that threatens the gains achieved by anti-infectives. The world is therefore coming together to mobilize efforts to combat the problem. In May 2015, the WHO member countries passed a resolution and approved a Global Action Plan that clearly outlines actions member countries should take to combat the problem (WHO, 2015).

An antimicrobial finish on a textile not only protects the user from microorganisms for medical, or hygiene purposes but also prevents biodeterioration caused by microorganisms for example fungi, mold and mildew. (Gao & Cranston, 2008).

As a result, the number of different antimicrobial agents suitable for textile application on the market has increased dramatically.(Aubert-Viard et al., 2015; Vasilev, Cook, & Griesser, 2009) These antimicrobial have differences in chemical structure, effectiveness, method of application, and influence on people and the environment as well as cost.(Purwar & Joshi, 2004).The antimicrobial agents that have already been used as an antimicrobial finish on textile materials include silver, copper, metal salts, quaternary ammonium compounds, polyhexamethylene biguanides, triclosan biopolymer chitosan, N-halamine.(Chang, Tu, Wu, Hsueh, & Hsu, 2008; Fraise, Lambert, & Maillard, 2008; Xiang et al., 2014; Xiao, Chen, Wei, & Wu, 2009).

Several major classes of antimicrobial agents are used in the textile industry. They are generally not new *per se* and have been in use in other industries, e.g. as food preservatives, disinfectants, swimming pool sanitizers or in wound dressings. These antimicrobial agents can be either attached to the textile surface or

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