

**BUSITEMA UNIVERSITY**  
**FACULTY OF ENGINEERING AND**  
**TECHNOLOGY**

**DEPARTMENT OF POLYMER, TEXTILE AND INDUSTRIAL**  
**ENGINEERING**

**FINAL YEAR PROJECT**

**GREEN SYNTHESIS OF SILICA NANOPARTICLES FROM**  
**RICE HUSK FOR CHROMIUM (VI) REMOVAL FROM**  
**LEATHER TANNERY WASTEWATER**

**By**

**MUMBERE EDGAR (BU/UG/2021/0081)**

**&**

**GALANDI ADAM (BU/UP/2021/0348)**

**MAY, 2025**



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**This final year project report is submitted to the Department of Polymer, Textile and Industrial Engineering in partial fulfillment of the requirement for an award of a Bachelor of Science in Polymer, Textile and Industrial Engineering of Busitema University.**

**MAY, 2025.**

## ABSTRACT

This study was aimed to explore the green synthesis of silica nanoparticles from rice husk for efficient adsorption of chromium (VI) from tannery wastewater. Rice husk, an abundant agricultural waste, was utilized to produce the silica nanoparticles through an eco-friendly approach.

The rice husk-based silica nanoparticles were synthesized using precipitation method. Their surface morphology, elemental composition, functional groups and crystallinity were determined using SEM, FTIR and XRD respectively. The effect of four factors on the removal efficiency was also investigated. These factors that included; initial chromium (VI) concentration (10-140 mg/L), PH (1-8), adsorbent dosage (0.1-8 g/L) and contact time (10 -100 minutes) and the process were optimized using RSM-CCD. Using this optimization technique, 31 experiments were conducted and the response modeled using a quadratic equation as function of the variables.

The optimal values of the variables were determined to be 28.05 mg/L, 1, 8 g/L and 100 minutes for initial chromium (VI) concentration, PH, adsorbent dosage and contact time respectively. The removal efficiency at these conditions was 83% and 75% with stock solution and real tannery wastewater respectively.

The significance of each of the terms in the model was evaluated using the probability of error value (p values), ANOVA p values and R-sq. P-values less than 0.050 showed that the terms were significant. From the analysis of variance, p value of 0.009 for the model, p 0.001 for linear effects implying considerable significance and R-sq. 75.74%.

The adsorption isotherms performed showed that the adsorption process followed Freundlich model since it had a higher R-sq (0.97242) than Langmuir.

## DECLARATION

We, **MUMBERE EDGAR** and **GALANDI ADAM**, jointly declare that this work entitled “Green synthesis of silica nanoparticles for Chromium (VI) removal from Tannery Wastewater” has been entirely written by ourselves and has never been submitted to any institution of learning for academic recognition. All sources and references are duly acknowledged.

### 1. MUMBERE EDGAR

Signature

.....

Date

.....

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## APPROVAL

This is to approve that this final year project has been fully and reliably worked on and submitted to the Department of Polymer, Textile and Industrial Engineering under the guidance of the supervision of the assigned supervisors.

1. ASSOC. PROF. NIBIKORA ILDEPHONSE

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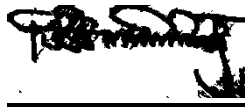


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21<sup>st</sup> /May/2025

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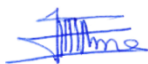
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Date

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Date: 19/05/2025

## **DEDICATION**

We dedicate this project to all those involved in sustainable manufacturing and environment remediation through sustainable waste management.

## **ACKNOWLEDGEMENT**

Firstly, we appreciate the Almighty God for according us good health and protection.

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## **Abbreviations/ Acronyms**

|             |                                           |
|-------------|-------------------------------------------|
| Cr.....     | Chromium                                  |
| SEM.....    | Scanning Electron Microscopy              |
| XRD.....    | X-ray Diffraction                         |
| SiNPs.....  | Silica Nanoparticles                      |
| FT-IR.....  | Fourier Transform Infra-red               |
| Ph.....     | Potential of hydrogen ions                |
| WHO.....    | World Health Organization                 |
| NEMA.....   | National Environment Management Authority |
| SDG.....    | Sustainable Development Goals             |
| TEOS.....   | Tetraethyl Orthosilicate                  |
| RHA.....    | Rice Husk Ash                             |
| RSM.....    | Response Surface Methodology              |
| ANN.....    | Artificial Neural Networks                |
| GA.....     | Genetic Algorithm                         |
| MCDM.....   | Multiple Criteria Decision Making         |
| CCD.....    | Central Composite Design                  |
| BBD.....    | Box Behnken Design                        |
| ANOVA.....  | Analysis of Variance                      |
| UV-Vis..... | Ultraviolet visible                       |
| EDX.....    | Energy Dispersive X-ray                   |

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