FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF POLYMER, TEXTILE AND INDUSTRIAL ENGINEERING

FINAL YEAR PROJECT

EXTRACTION OF SILICA FROM SUGARCANE BAGASSE ASH USING LEACHING METHOD

BY

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This final year project proposal report is submitted to the faculty of engineering in partial fulfillment of the requirement for the award of the Degree of Bachelor of Polymer, Textile and Industrial Engineering of Busitema University

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DECLARATION

We declare to the best of our knowledge that this final year project proposal report is as a result of our research and effort and it has never been presented or submitted to any institution or university for an academic award.

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Approval

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Abstract

This current study examined the use of traditional extraction methods as well as the most recent findings in the extraction of silica from agricultural wastes, specifically sugarcane bagasse, employing inorganic acids to make nano-silicon. The primary methods addressed here are the leaching processes that use strong acids like hydrochloric acid and sodium hydroxide as a base for the ash treatment. Sugarcane bagasse has been discovered as the most cost-effective source of silica from a prospective raw material for the synthesis of nano-silicon.

Sugarcane bagasse has emerged as a particularly good and sustainable source of both customized silica particles. The capacity to modify tailored silica particles at the nanoscale from sugarcane bagasse-based silica is thoroughly explained. Silica is a key raw element with numerous industrial applications, and extensive research is being conducted to efficiently extract it from industrial agro-waste, such as sugarcane bagasse. The production of highly pure silicon nanoparticles from sugarcane bagasse ash was an important synthetic route in lowering manufacturing costs, and it provided values for the mass of the leached sugarcane bagasse ash and the volumes of NaOH used to obtain the optimal values of silica extraction from sugarcane bagasse ash.

The purpose of this research is to extract silica from sugarcane bagasse ash hence reduce the challenges of environmental pollution and health complications and diseases due to improper disposal of sugarcane bagasse ash into landfills.

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Acronyms

SBA……..Sugarcane bagasse ash

SEM……. Scanning Electron Microscopy

XRD…… X-ray Powder Diffraction

FTIR…… Fourier Transform Infrared Spectroscopy

HCl……Hydrochloric acid

NaOH……Sodium hydroxide

CHAPTER ONE

1.0 Introduction

This chapter describes the background, problem statement, objectives of the study, significance of the study and scope of the study.

1.1 Background

Sustainable and environmentally friendly chemistry face a difficulty when it comes to adding value to large-scale produced agro-industrial solid wastes.

The 21st century has focused on finding inventive and unique solutions to minimize environmental impacts by reducing waste and environmental contamination.

The biggest agricultural by-products in the world are sugarcane bagasse, corn cobs, wheat straw, and rice husk and straw. Sugarcane bagasse, which are significant renewable sources and have a high silicon concentration, is highlighted among these by-products as the main source of silica for this research due to the high amount of silica in its composition.

Large-scale production of both solid and liquid wastes by industrial activity creates serious economic and environmental issues, making the management of industrial wastes in an economic and ecological way a topic of great interest on a global scale. As a result, using waste materials can reduce the expense of land filling. One of the biggest crops in the world is sugarcane. With a global harvest of 1.75 billion tons, it is farmed on over 25 million hectares in more than 90 nations. (Natarajan et al., 2019) The primary force behind sugarcane farming is the global need for sugar, which accounts for 80% of all sugar production. Brazil and India are the two countries that produce the most sugar. Most of Africa is home to sugarcane farms.

With an output of about 650000 metric tonnes, the kingdom of Eswatini is Africa's greatest producer of sugarcane, followed by Egypt, which produces 595000 metric tonnes. By 2019, Kenya had the second-largest production capacity in East Africa, behind Uganda, which had a capacity of roughly 514000 metric tonnes. The amount of sugarcane produced in Uganda in 2020 was 5.78 million tonnes. Uganda's sugarcane production climbed at an average yearly rate of 3.76 percent from 1.72 million tonnes in 1971 to 5.78 million tonnes in 2020.

In addition to providing a necessary staple like sugar, the Ugandan sugar business employs about 20,000 people directly and another 50,000 indirectly. Additionally, it aids in the construction of

References

Abdulkadir, T. S., Oyejobi, D. O., & Lawal, A. A. (2014). *EVALUATION OF SUGARCANE BAGASSE ASH AS A REPLACEMENT*.

Arnaldo, J., Costa, S., & Paranhos, C. M. (2018). Systematic evaluation of amorphous silica production from rice husk ashes. *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2018.05.028

Ash, B., Materials, C., Xu, Q., Ji, T., Gao, S., Yang, Z., & Wu, N. (2018). *Characteristics and Applications of Sugar Cane*. 1–19. https://doi.org/10.3390/ma12010039

Chindaprasirt, P., & Rattanasak, U. (2020). Eco-production of silica from sugarcane bagasse ash for use as a photochromic pigment filler. *Scientific Reports*, *10*(1), 1–8. https://doi.org/10.1038/s41598-020-66885-y

Faizul, C. P., Abdullah, C., & Fazlul, B. (2013). *Review of Extraction of Silica from Agricultural Wastes using Acid Leaching Treatment . 626*, 997–1000. https://doi.org/10.4028/www.scientific.net/AMR.626.997

Fardhyanti, D. S., Dewi, R., Putri, A., Fianti, O., & Fitrianingsi, A. (2018). *Synthesis of Silica Powder from Sugar Cane Bagasse Ash and Its Application as Adsorbent in Adsorptive-distillation of Ethanol-water Solution*. *2002*, 1–6.

Mwavu, E. N., Kalema, V. K., Bateganya, F., Byakagaba, P., Waiswa, D., Enuru, T., & Mbogga, M. S. (2018). *Expansion of Commercial Sugarcane Cultivation among Smallholder Farmers in Uganda : Implications for Household Food Security*. 1–15. https://doi.org/10.3390/land7020073

Natarajan, S., Subramaniyam, S. T., & Kumaravel, V. (2019). Fabrication of hydrophobic coatings using sugarcane bagasse waste ash as silica source. *Applied Sciences (Switzerland)*, *9*(1). https://doi.org/10.3390/app9010190

Norsuraya, S., Fazlena, H., & Norhasyimi, R. (2016). Sugarcane Bagasse as a Renewable Source of Silica to Synthesize Santa Barbara Amorphous-15 (SBA-15). *Procedia Engineering*, *148*, 839–846. https://doi.org/10.1016/j.proeng.2016.06.627

Ramezani, M., Reza, M., & Kazemzadeh, A. (2014). Applied Surface Science Preparation of

silane-functionalized silica films via two-step dip coating sol – gel and evaluation of their superhydrophobic properties. *Applied Surface Science*, *317*, 147–153. https://doi.org/10.1016/j.apsusc.2014.08.095

Rovani, S., Santos, J. J., Corio, P., & Fungaro, D. A. (2018). *Highly Pure Silica Nanoparticles with High Adsorption Capacity Obtained from Sugarcane Waste Ash*. https://doi.org/10.1021/acsomega.8b00092

Silviana, S., Sa'adah, A. N., Saputra, K. B., Naftalina, B. E., Kroon, C. R., Catherine, G. N., Subianto, L., Annisa, M. E., Maghfira, R. U., Azzahra, T. D., & Febriansyah, Y. M. (2022). Superhydrophobic coating based on silica derived from bagasse modified with vinyltriethoxysilane and copper (Cu) as antibacterial agent. *IOP Conference Series: Earth and Environmental Science*, *963*(1), 0–18. https://doi.org/10.1088/1755-1315/963/1/012023

Vikram, A. S. V. (2017). *A SHORT REVIEW ON THE SUGARCANE BAGASSE WITH SINTERED EARTH BLOCKS OF FIBER REINFORCED CONCRETE*. *8*(6), 323–331.

Worathanakul, P., Payubnop, W., & Muangpet, A. (2009). Worathanakul, Payubnop, Muangpet - 2009 - Characterization for post-treatment effect of bagasse ash for silica extraction. *World Academy of Science, Engineering and Technology*, *32*, 360–362.