



FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF POLYMER, TEXTILE AND INDUSTRIAL
ENGINEERING
DISSERTATION

**BENEFICIATION OF LITHIUM MATERIALS FROM PEGMATITE ORES IN
RUKUNGIRI FOR ENERGY STORAGE APPLICATIONS**

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*This Dissertation is submitted to the Directorate of Graduate Studies, Research and
Innovations in partial fulfillment of the requirements for the award of the degree of
Master of Science in Materials Engineering of Busitema University*

SEPTEMBER 2024

Declaration

I Ssebagala Ivan, Registration Number BU/GS22/MME/11 declare that all the work about this research is entirely mine and it has not been submitted to either this University or any other organization for funding or as a partial fulfilment for award of any degree or certificates.

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Acknowledgements

First of all, I would like to thank so much my entire family for the courage, patience and support rendered to me during the course of this research and for understanding me so I could emerge victorious.

Secondly, great thanks to the department of Polymer, Textile and Industrial Engineering for the continued guidance and support rendered to me including lab facilities, reading space, seminars, academic counseling and course content delivery that enabled me to gain skills as well as creating for me a favorable environment for effective research and data analysis.

In a special way, my academic supervisors including Dr. Kigozi Moses and Associate Professor Samson Rwahwire have been the foundation for my research completion through academic guidance and all associated lab work, may the good lord grant you'll your wishes.

Lastly, many thanks to the Almighty God for providing me with the knowledge, wisdom and understanding that enabled me comprehend each step of the research and come up meaningful research output.

Approval

This is to certify that the research titled “Beneficiation of lithium materials from pegmatite ores in Rukungiri for energy storage applications” was reviewed and approved by the undersigned as fulfilling the requirements for a Master of Science in Materials Engineering.

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Submitted to Busitema University in partial fulfillment of the requirements for the Master of Science in Materials Engineering.

2024, Tororo, Uganda.

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Abbreviations/Acronyms

Li-ion	Lithium ion
ICEVs	Internal Combustion Engine Vehicles
EVs	Electric Vehicles
GSM	Geological Survey Map
DMS	Dense Media Separation
SDGs	Sustainable Development Goals
XPS	X-ray Photoelectron Spectroscopy
CV	Cyclic Voltammetry
GCD	Galvanostatic Charge-Discharge
EIS	Electrochemical Impedance Spectroscopy
PLS	Pregnant Leach Solution
LIB	Lithium-ion Batteries
GHG	Green-House Gases
P. E	Purification Efficiency
K	Potassium
Na	Sodium
Ca	Calcium
Li	Lithium
EDL	Electric double-layer
EES	Electrochemical energy storage
ISRM	International Society of Rocks Mechanics

%RE	Percentage Recovery Efficiency
M_{ext}	Mass of lithium concentrate
M_{rsd}	Mass of residue
M_{ore}	Mass of ore used
URA	Uganda Revenue Authority
NPV	Net Present value
IRR	Internal Rate of Return
PI	Profitability index

Abstract

Lithium, the new gold! Over the past decades, several lithium-based energy storage systems have been studied by various scholars due to the increased demand for this engineering material in the energy sector given its unique properties of high capacitance, energy density, high stability at elevated temperatures etc., supported by discovery of several lithium deposits around the world. This has created a thread of reliable and strong energy storage systems both small and large hence supporting the technological transition in several sectors including the transport industry worldwide. In this study, lithium materials beneficiated and extracted from local pegmatite ore in Rukungiri by leaching and sulfuric acid method respectively and meant for energy storage were investigated for electrochemical properties. Results showed that the pegmatite ore had a UCS of 69MPa, trace lithium content of 0.1ppm and an elemental composition of spodumene with high possibility of crushing for nanoscale disintegration of existing materials. The optimization of the sulfuric acid method realized a 53% lithium recovery at a grade of 54ppm while the non-charged lithium materials exhibited capacitance of 502 μ F, specific capacitance 13.5mF/g, and energy density (1.74mWh) together with power density per mass of 50W/g. The project was financially viable with NPV, IRR, PI and payback periods all revealing positive results. In conclusion, the Nyabushenyi lithium deposit has trace lithium that can be upgraded given advanced beneficiation techniques yet suitable for hybrid and electric double-layer capacitors energy storage systems that require high charge-discharge frequencies and higher power densities per mass as opposed to the primary energy systems like LIBs that require higher energy densities.

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