COMPARATIVE PERFORMANCE ANALYSIS OF LEAD ACID AND LI-ION BATTERIES OF E-BIKES USED IN SRI LANKA

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Degree of Master of Science

Department of Electrical Engineering
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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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Signature: Date: 02/02/2025

The above candidate has carried out research for the Master's thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. (Ms.) R.M.T. Damayanthi

UOM Verified Signature

10-02-2025

Signature of the Supervisor: Date:

DEDICATION

I would like to dedicate my M.Sc. research dissertation to my beloved parents and my husband, who throughout my life have continuously provided me with their utmost support, guidance, and encouragement. Their love and sacrifices have constituted the base of my achievements, and without them, this work would not have been in place.

ACKNOWLEDGEMENT

I would like to take this opportunity to express my sincere gratitude to everyone who supported me throughout this project on the battery performance evaluation of E-bikes. Their motivated help, invaluable feedback, and open guidance were essential to the successful completion of this work. I deeply appreciate their insightful opinions on the various challenges I encountered during the project.

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ABSTRACT

The use of electric vehicles is highly popular nowadays. When considering electric vehicles, E-bikes and electric three-wheelers are the most popular in Sri Lanka due to their affordability. Evaluating the performance of E-bikes requires a focus on battery performance. In this research, specific drive cycles were initially analyzed to identify current consumption and speed variations. Using the mean values derived from drive cycle analyzing, battery performance was evaluated. The number of cycles of the battery was considered the primary performance measurement characteristic. Both lead-acid and lithium-ion batteries were tested, with samples representing the maximum and minimum capacities of each type used in E-bikes in the Sri Lankan market. The batteries were discharged under laboratory conditions to 100% Depth of Discharge (DOD), and temperature variations were recorded. Meanwhile, the consumer usage patterns of E-bikes were identified, considering the Asian context. Based on this, the number of cycles for each battery type considering the temperature, was calculated based on daily consumer usage patterns. From this, the replacement time of each battery type and the economic benefit for consumers were calculated. The findings indicate that although lithium-ion batteries have a higher initial cost compared to lead-acid batteries, they offer a longer lifespan, and greater cost-efficiency over time. As a result, lithium-ion batteries were identified as the most suitable option for Sri Lankan E-bike users. This research provides valuable insights for consumers and policymakers to make informed decisions about battery choices for E bikes.

Keywords: E bikes, Life cycle, Temperature, Battery

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
HHI	Herfindahl-Hirschman Index
CL	Cycle Life
Q_{diss}	Total heat dissipation
q_{conv}	Heat dissipated by convection
q_{rad}	Heat dissipated by radiation
$q_{exhaust}$	Heat dissipation by exhausting gas
T_{case}	Surface temperature
$T_{ambient}$	Ambient temperature
h	Convective heat transfer coefficient
A	Area
SOH	State of Health
SOC	State of Charge

LIST OF APPENDICES