Brought to you by INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

Scopus

Back

Optimization of Solar Hybrid Gravity System with Battery Energy Storage for Elevation Systems

Journal of Science and Mathematics Letters • Article • *Open Access* • 2024 •
DOI: 10.37134/jsml.vol12.2.12.2024

Ismail, Mohd Ridhuan Bin [a]; Majid, Zafri Azran Abdul [b]; Ihsan, Sany Izan [a]; Azmi, Mohd Syahriman Mohd [c]; Sopian, Kamaruzzaman [d]; +1 author

[a] Department of Mechanical Engineering, Kulliyyah of Engineering, International Islamic University Malaysia, Kuala Lumpur, 50728, Malaysia

Show all information

0
Citations

Full text Export Save to list

Document Impact Cited by (0) References (16) Similar documents

Abstract

This research studies the performance and efficiency of a solar hybrid gravity system integrated with battery energy storage. The study aims to optimize the design using a 50-Watt Solar PV, an 18Ah SLA Battery, and a Water Gravity Energy Storage Tank. Energy consumption was evaluated using the SLA Battery, Solar PV, and a 22-Watt Water Pump at various tank heights to measure efficiency improvements and battery lifespan extension. The methodology involved three procedures with five data loggers: a flow meter, a pyranometer, and three unit Watt Meter. Initially, a fully charged SLA Battery was tested at different tank heights (1.5m to 3.5m) every 15 minutes. Subsequently, the 50-Watt Solar PV was tested directly at a 3-meter height. Lastly, the Solar Hybrid Gravity System with Battery Energy Storage was monitored for seven days at a 3-meter height. Results indicated a 600% increase in battery performance at 80% Depth of Discharge (DOD), suggesting the battery's optimal use as a backup power source, thereby extending its lifespan. The SLA Battery shows a 22.1%

charging and discharging loss at 5% DOD, while the 22-Watt Water Pump is achieved an 11.0 L/min rate at peak solar radiation, with a maximum motor power of 24.32 Watts. The minimum solar radiation required for efficient pump operation was 300 W/m^2. In conclusion, the study optimizes the solar hybrid gravity system's energy efficiency, reduces battery dependence, and enhances battery lifespan, promoting sustainable solutions for elevation applications. © 2024, Universiti Pendidikan Sultan Idris. All rights reserved.

Author keywords

battery efficiency; energy optimization; gravity energy storage; Solar energy; water pumping

Funding details

Details about financial support for research, including funding sources and grant numbers as provided in academic publications.

Funding sponsor	Funding number	Acronym
Kulliyyah of Engineering		
International Islamic University Malaysia See opportunities by IIUM		IIUM

Funding text

The authors wish to express their gratitude to Kulliyyah of Engineering (KOE), International Islamic University Malaysia (IIUM) and ENVIRO-AXIS SDN. BHD. for lab facilities and technical knowledge support.

Corresponding authors

Corresponding author: Z.A.A. Majid

Affiliation: Department of Diagnostic Imaging and Radiotherapy, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia, Pahang, Kuantan, 25200, Malaysia

Email address amzafri@iium.edu.my

© Copyright 2025 Elsevier B.V., All rights reserved.

Abstract

Author keywords

Funding details

Corresponding authors

About Scopus

What is Scopus

Content coverage

Scopus blog

Scopus API

Privacy matters

Language

日本語版を表示する

查看简体中文版本

查看繁體中文版本

Просмотр версии на русском языке

Customer Service

Help

Tutorials

Contact us

ELSEVIER

Terms and conditions ↗ Privacy policy ↗ Cookies settings

All content on this site: Copyright © 2026 Elsevier B.V. ↗, its licensors, and contributors. All rights are reserved, including those for text and data mining, AI training, and similar technologies. For all open access content, the relevant licensing terms apply.

RELX™