ABSTRAK

Micro Electric Vehicle (MEVi) merupakan salah satu solusi transportasi ramah lingkungan yang memerlukan sistem penggerak dan penyimpanan energi yang efisien untuk mendukung berbagai kondisi operasi kendaraan. Efisiensi penggunaan energi dipengaruhi oleh perubahan kecepatan, percepatan, beban kendaraan, dan kemiringan lintasan yang menyebabkan perubahan kebutuhan arus, daya, dan konsumsi energi selama akselerasi maupun pengereman. Penelitian ini bertujuan untuk menganalisis dan mengoptimasi pembebanan dinamis pada *Micro Electric Vehicle* (MEVi) menggunakan pendekatan *Response Surface Methodology* (RSM), serta merumuskan rekomendasi kapasitas baterai berdasarkan kondisi operasi optimum yang diperoleh. Metode penelitian dilakukan melalui pengujian eksperimental dengan variasi kecepatan, percepatan, tingkat pengereman, beban kendaraan, dan kemiringan lintasan. Data arus, tegangan, daya, dan konsumsi energi dianalisis menggunakan regresi linear dan *Analysis of Variance* (ANOVA), kemudian dimodelkan dan dioptimasi menggunakan *Response Surface Methodology* (RSM). Hasil penelitian menunjukkan bahwa peningkatan kecepatan, percepatan, beban kendaraan, dan kemiringan lintasan menyebabkan peningkatan kebutuhan arus, daya, dan konsumsi energi. Hasil regresi linear menunjukkan hubungan positif antara variabel operasi kendaraan dengan respons sistem, sedangkan analisis ANOVA menunjukkan bahwa faktor dominan yang memengaruhi respons berbeda pada setiap kondisi operasi. Pemodelan menggunakan RSM mampu merepresentasikan hubungan antara variabel pengujian dan respons sistem dengan tingkat kesesuaian model yang baik terhadap data eksperimen serta menghasilkan kondisi operasi optimum pada berbagai kondisi lintasan dengan nilai *desirability* berkisar antara 0,725–0,962. Berdasarkan kondisi konsumsi energi tertinggi sebesar 111,15 Wh/km dan target jarak tempuh 100 km, diperoleh rekomendasi kapasitas baterai sebesar 225 Ah pada sistem 51,2 V dengan energi total 11,52 kWh. Hasil penelitian ini dapat digunakan sebagai acuan dalam optimasi pembebanan dinamis, penentuan kondisi operasi kendaraan yang optimum, serta perancangan kapasitas sistem penyimpanan energi pada *Micro Electric Vehicle* (MEVi).

Kata kunci: Akselerasi, MEVi, Pembebanan Dinamis, Pengereman, RSM, Optimasi, Battery Sizing.

ABSTRACT

Micro Electric Vehicle (MEVi) is an environmentally friendly transportation solution that requires an efficient propulsion and energy storage system to support various vehicle operating conditions. Energy efficiency is influenced by variations in vehicle speed, acceleration, payload, and road gradient, which affect current demand, power consumption, and energy usage during both acceleration and braking. This study aims to analyze and optimize the dynamic loading conditions of a Micro Electric Vehicle (MEVi) using the Response Surface Methodology (RSM) approach and to formulate battery capacity recommendations based on the obtained optimal operating conditions. The research was conducted through experimental testing under various operating conditions, including vehicle speed, acceleration, braking level, payload, and road gradient. Current, voltage, power, and energy consumption data were analyzed using linear regression and Analysis of Variance (ANOVA), followed by modeling and optimization using Response Surface Methodology (RSM). The results indicate that increases in vehicle speed, acceleration, payload, and road gradient lead to higher current demand, power consumption, and energy usage. Linear regression analysis revealed positive relationships between the vehicle operating variables and the system responses, while ANOVA demonstrated that the dominant factors affecting the responses varied under different operating conditions. The RSM model successfully represented the relationship between the input variables and the system responses with good agreement to the experimental data and identified the optimal operating conditions for different road profiles, with desirability values ranging from 0.725 to 0.962. Based on the highest energy consumption of 111.15 Wh/km and a target driving range of 100 km, the recommended battery capacity was 225 Ah for a 51.2 V system, providing a total energy capacity of 11.52 kWh. The findings of this study can serve as a reference for optimizing dynamic loading conditions, determining optimal vehicle operating conditions, and designing energy storage system capacity for Micro Electric Vehicle (MEVi) applications.

Keywords: *Acceleration, MEVi, Dynamic Loading, Braking, RSM, Optimization, Battery Sizing.*