ABSTRAK

Kereta *hybrid trainer* PNM *car* adalah kereta berpenggerak dengan 4 sumber energi meliputi *generator set*, *battery*, *catenary*, dan *fuel cell*. Tipe baterai yang diterapkan pada kereta *hybrid trainer* PNM *car* adalah baterai *Lithium Iron Phosphate* ($LiFePO_4$). *State of Charge* (SoC) merupakan parameter baterai yang penting untuk mencapai efektivitas manajemen daya dengan *duty cycle* tertentu. Estimasi SoC yang akurat sangat penting karena dapat memprediksi rentang kapasitas baterai tersisa dan menentukan strategi *battery management system* sehingga menghindari terjadinya *overcharging* dan *overdischarging* yang merusak baterai. Pada penelitian ini estimasi SoC kondisi *discharge* menggunakan pemodelan *equivalent circuit model* (ECM) *Thevenin* karena bentuk pemodelan sederhana dan dapat merepresentasikan perilaku dinamis baterai secara akurat. Pemodelan *equivalent circuit model* (ECM) *Thevenin* baterai *cell Lithium Iron Phosphate* ($LiFePO_4$) terdiri dari parameter resistansi internal (R_0) bernilai

ABSTRACT

The PNM hybrid trainer car is a powered car with 4 energy sources including a generator set, battery, catenary, and fuel cell. The type of battery applied to the hybrid train PNM car is the lithium iron phosphate battery. ($LiFePO_4$). The State of Charge (SoC) is an important battery parameter for achieving efficient power management with a specific duty cycle. Acœurate SoC estimates are crucial because they can predict the remaining battery capacity range and determine battery management system strategies to avoid overcharging and overdischarging that damage the battery. In this study, SoC estimates thedischarge condition using Thevenin's equivalent circuit model (ECM) because the modeling form is simple and can represent the dynamic behavior of the battery accurately. Thevenin lithium iron phosphate battery cell (LiFePO4) consists of an internal resistance parameter (R_0) of 0,02482884 Ω, a polarization resistance (R_P) of 2,107 Ω, polarization capacitance (C_P) of 0,0001219 F, and an open circuit voltage (VoC) of 2,499995 V. The results of the study showed that based on the estimated state of charge (SoC) chart against time shows a reverse relative relationship, where the longer the time of discharge (charge release) the less battery load stored. In addition, the more the discharge and charging cycle increases, the rate of optimization of work and health (health) of $LiFePO_4$ battery cells decreases.

Keywords: *Hybrid Train Trainer PNM Car, LiFePO4 Battery, Estimated State of Charge, Equivalent Circuit Model (ECM) Thevenin*