

ABSTRAK

Pesatnya perkembangan industri kendaraan bermotor, berdampak negatif terhadap peningkatan efek rumah kaca. Solusi sementara adalah kendaraan listrik dengan baterai aluminium udara yang menjanjikan densitas energi tinggi, ramah lingkungan, dan biaya rendah. Dampak yang muncul dari baterai metal adalah *Memory Effect*, *Memory effect* baterai terjadi ketika kapasitas baterai yang dapat diisi ulang berkurang karena pengosongan yang tidak sempurna sebelumnya. Maka dibutuhkan pengisi daya yang dapat menginisiasi pengisian dan *cut off* ketika kapasitas baterai sudah terisi penuh.

Dalam penelitian ini, diterapkan teknik fast charging baterai Alumunium-Udara (Al-Air) dengan memanfaatkan logika fuzzy untuk mengendalikan temperatur dan tegangan selama proses pengisian menggunakan metode Pulse Width Modulation (PWM). Proses fuzifikasi dalam penelitian ini menggunakan metode Mamdani, dengan defuzzifikasi menggunakan metode Center Of Gravity (COG). Diharapkan bahwa pendekatan ini dapat mempercepat proses pengisian tanpa meningkatkan temperatur baterai melewati batas maksimum yang telah ditentukan, dan pada saat yang sama mengatasi masalah overcharging.

Hasil pengujian kalibrasi sensor tegangan menunjukkan kesalahan maksimum sebesar 0,2418 %. Sementara itu, pengujian kalibrasi sensor suhu baterai menghasilkan kesalahan maksimum sebesar 4,6819 %. Eksperimen dengan menggunakan fast charger dan pendekatan logika fuzzy terbukti berhasil melindungi baterai dari potensi risiko *overcharging* dan *overheat*. Dengan Keunggulan ini diharap *charger* baterai dapat secara kontinyu mengisi daya baterai dengan aman, dan menghilangkan *memory effect*.

Kata Kunci : Baterai Alumunium-Udara (Al-Air), *Memory Effect*, *charger*, *Fuzzy Logic*, PW

ABSTRACT

Rapid development of the automotive industry has had a negative impact on the increase in greenhouse gas effects. As a temporary solution, the development of electric vehicles with aluminum-air batteries is promoted as an alternative that offers high energy density, environmental friendliness, and lower costs. While providing a solution, this increase also brings about several challenges such as limited capacity, long charging times, and the risk of overcharging. One of the impacts arising from the use of metal batteries is the phenomenon of Memory Effect, where the rechargeable battery's capacity decreases due to incomplete discharge in previous cycles. Therefore, a charger is needed that can initiate charging and cut off when the battery capacity is full.

In this research, a fast charging technique is applied to Aluminum-Air (Al-Air) batteries using fuzzy logic to regulate temperature and voltage during the charging process using Pulse Width Modulation (PWM) method. The fuzzification process in this research uses the Mamdani method, with defuzzification using the Center Of Gravity (COG) method. The goal is to accelerate the charging process without raising the battery temperature beyond the set limits, while addressing the issue of overcharging.

Results of the voltage sensor validation test show a maximum error of 0.2418%. Meanwhile, the battery temperature sensor calibration test produced a maximum error of 4.6819%. Experiments using fast chargers and fuzzy logic approaches have proven successful in protecting batteries from potential risks of overcharging and overheating. With these advantages, it is hoped that the battery charger can continuously charge the battery safely and eliminate memory effects.

Keywords : *Alumunium-air Battery, Memory Effect, charger, Fuzzy Logic, PWM*