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PERFORMANCE OF LITHIUM ION BATTERY FOR HIGH SPEED TRAIN APPLICATION, Petia Guerrero, Arturo L. Sotomayor, P. Majumdar*, Northern Illinois University, Department of Mechanical Engineering, DeKalb, IL 60115, pmajumdar@niu.edu

High speed trains are an energy efficient mode of transportation that could greatly benefit from the application of a regenerative braking system. Lithium iron phosphate ($LiFePO_4$) batteries are a great choice for application of regenerative braking because of their high energy density and long cycle life. Before applying regenerative braking to high speed trains, experiments must be conducted to test the performance and surface temperature variations of battery cells to be able to design an efficient complete battery unit. To perform these tests, a $LiFePO_4$ battery cell was placed in an environmental control chamber where it was charged and discharged using a battery testing system at different charge rates and temperatures. To monitor the surface temperature variation, seven thermocouples were placed on the battery cell while being tested in the chamber and another was placed in the chamber to measure the ambient temperature. The data from the battery testing system was then analyzed to determine the efficiency and capacity of the cell during each test. The results show that the $LiFePO_4$ battery cell's overall performance enhances as the charge rate decreases. The battery cell was tested at 10A (1.0C), 7.5A (0.75C), and 5A (0.5C) charge rates of which the 5A rate had the best overall performance. The temperatures in which the battery was tested include -10°C, 1°C, 20°C, 30°C, and 50°C. The battery performed the best in the range between 20°C and 50°C for all three of the charge rates. The thermocouple data showed that the surface temperature of the battery cell increased as you get closer to the terminals with the highest temperature being found in between the terminals. From these results we can conclude that in application to regenerative braking system, a battery operating at a lower charge rate is preferred and when designing a complete battery pack. A thermal management system should be taken into account for the increased temperature in the surface around the terminals when constructing a battery system.

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