CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35690

Project Title

What Is the Effect of Temperature on the Discharge Rate of Lithium Ion Batteries?

Abstract

Objectives/Goals

The objective of this project was to see if freezing temperature (0°C) would accelerate or decelerate the discharge rate of lithium-ion batteries in comparison to the discharge rate at room temperature (21°C). This project also observed the trends of discharge for both room temperature tests and freezing temperature tests and analyzed the meanings of the results.

Methods/Materials

Materials:
Digital Multimeter, 3V lithium-ion batteries, Freezer, Thermometer, Digital Timer, 22-ohm, .5 watt, 5% tolerance resistor.

Methods:
Taking voltage readings on digital multimeter, Wiring a series circuit

Results

The average discharge for the experimental group, which was tested in freezing temperature (0°C), showed a slower rate of discharge, reaching 0V at an average rate of 4 hours, in contrast to the room temperature positive control, which discharged fully at an average of 3 hours 50 minutes. Also, scattered periods of slight recharging were recorded for each of the freezing temperature trials, and no recharging occurred during the positive or negative control trials.

Conclusions/Discussion

The results of this investigation suggest that freezing temperatures can slightly decelerate the discharge rate of lithium-ion batteries. Further, this deceleration may be due to a partial freezing of the electrolyte substance in the charge mechanism of the battery that allows ions to move from cathode to anode. The freezing could cause some ions at the anode side of the separator to travel back to the cathode side, which results in slight recharge periods. Also, each test including a resistor in the circuit (the positive and experimental tests) involved the battery discharging to 0V straight from a voltage reading greater than 1V. This explains why portable devices such as cell phones and laptops # which use lithium-ion batteries # often display a reading greater than 1% (such as 7% or 12%) right before dying. Further studies could investigate these conclusions by testing batteries in temperatures in the negative degrees Celsius to test the theory that the electrolyte freezes and causes the battery to recharge.

Summary Statement

This project tested whether freezing temperature (0°C) would accelerate or decelerate the discharge rate of lithium-ion batteries in comparison to room temperature conditions (21°C).

Help Received

Used digital multimeter borrowed from electrical technician Jamie Guting.