CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0917

Project Title
Can Temperature Affect the Self-Discharge Rate of Primary and Secondary Cell Batteries?

Abstract

Objectives/Goals
This project investigated the effects of cooling batteries to slow their self-discharge rate. All batteries suffer from self-discharge, or loss of stored charge in a battery even when not in use. Because high temperatures speed up internal chemical reactions and colder temperatures slow them down, the hypothesis was that batteries exposed to colder temperatures would retain more charge than batteries kept at room temperature. The results of this experiment would be beneficial because it indicates less primary cells batteries need to end up in landfills, and less energy would be needed to keep recharging secondary cells.

Methods/Materials
To perform the experiment, 60 batteries were purchased: 30 primary cells, which included 15 Alkaline and 15 Lithium batteries; and 30 secondary cells, 15 NiMH (nickel-metal hydride), and 15 NiCd (nickel-cadmium) batteries. The volts of the batteries were tested using a multimeter and recorded. Next, five of each type of battery were placed in plastic bags, then in three different environments: room temperature, a refrigerator, and a freezer. The batteries were taken out at weekly intervals and the voltage was measured over a four-week period.

Results
At room temperature the NiMH batteries lost an average of .1162 volts, in the refrigerator .0548 volts, and in the freezer .0386 volts. The NiCds lost an average .0654 volts at room temperature, .0288 volts in the refrigerator, and .0102 volts in the freezer. At room temperature the Lithium batteries lost an average .0006 volts, .0106 volts in the refrigerator, and in the freezer an average .0088. The alkaline lost an average .0024 volts at room temperature, in the refrigerator .0002 volts, and in the freezer 0 volts were lost.

Conclusions/Discussion
The results showed that secondary cells retained 15%-17% more of their charge when placed in the freezer over room temperature. The primary cells did not need the refrigeration, because of their low discharge rate, and there was an actual loss of charge by the lithium batteries when put in the colder environments. This project proved my hypothesis to be correct -- since the secondary cells have a high self-discharge rate they should be placed in colder environments for maximum charge retention, but primary cells, because of their low self-discharge rate, should not be put in these lower temperatures.

Summary Statement
This project investigated the effects of cooling batteries to slow their self-discharge rate.

Help Received
Dr. Kirt Williams helped with multimeter selection and measurement.