2006 TAIWAN INTERNATIONAL SCIENCE FAIR

CATEGORY : Chemistry

PROJECT : Reflex Charging Frequency

AWARDS : Chemistry Second Award

FINALISTS : Denis Guangyin Chen

COUNTRY : New Zealand

CATERGORY: **CHEMISTRY**
TITLE: **Reflex Charging Frequency**
NAME: **Denis Guangyin Chen**
COUNTRY: **New Zealand**

Abstract

a. PURPOSE OF RESEARCH

Reflex charging, or burp charge, is a prove method of effectively charging secondary batteries under extremely high current. It is commonly used in military and aerospace applications where short recharge time and long cell life are essential. Eric C. Darcy, a NASA chemical engineer, in his 1998 PhD thesis, 'Investigation of the response of Ni-MH cells to burp charging', outlined some of the most important theories behind this seemingly miraculous technique. However, due to the technical limitations of his equipment, Darcy was unable to determine the effects of varied reflex charging frequencies. This research overcame this problem by using a purposed built multi-frequency programmable reflex charger (PRESTO ALPHA I), and aimed to optimize chemical energy storage by searching for an optimum charging frequency.

b. PROCEDURES

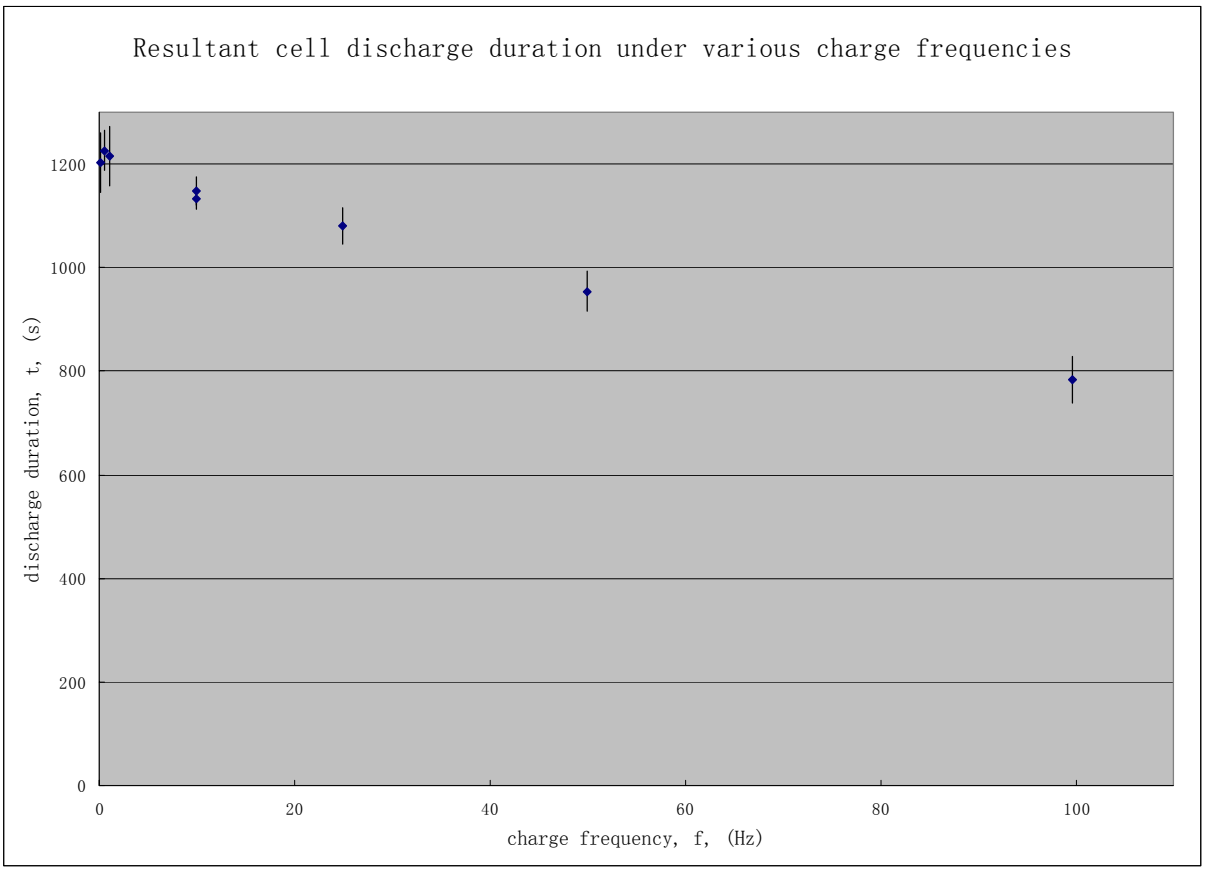
This investigation examined response of an AA Ni-MH cell to various charging frequencies under the same current. The cell was charged at 7 different frequencies ranging from 0.1Hz to 100Hz with the same wave front proportion (the total integral area of current discharged during the reflex charging process remained the same for all frequencies) for 15 minutes. After 15 minutes of rest, the cell was discharged on a constant resistor until cell voltage falls below a prescribed value. The duration of discharge was used as an indication of the resultant cell capacity from charging.

c. RESULTS

Calibrated charge frequency, f, (Hz)	rounded average discharge duration, (s)
0.100±0.002	1200±60
0.499±0.008	1230±40
1.00±0.02	1220±60
10.0±0.2	1130±20
24.9±0.4	1080±40
49.9±0.8	950±40
100±2	780±50

Processed replica data:

Calibrated charge frequency, f, (Hz)	rounded average discharge duration, (s)
10.0±0.2	1150±30



d. CONCLUSIONS

The results showed that increased charge frequency, given the same wave front proportion and current, will result in a less effective charge, that is to say, shorter discharge duration. This is particularly distinctive at higher frequencies close to 100Hz and can be modeled by the mathematical relationship $T = (-0.000248f^3 + 0.0517f^2 - 7.04f + 1220) \pm 16\%$. It was evident that reduced discharge pulse width (with higher frequency), was less effective in reaping the benefits of reflex charging.

The results showed no conclusive optimum charge frequency due to relatively large uncertainties. But if an optimum charge frequency existed, it was most likely to lie on the interval [0.499, 0.1] Hz.

The above phenomena may be explained by the theory that with higher charging frequencies (i.e. >10Hz) the reactance of secondary cells became more dominant (since the reflex wave front can be thought of as a series of transformed odd sinusoidal signals). Greater proportion of the high frequency alternating signal was short circuited to the negative terminal of power supply, resulting in reduced chemical energy storage.

評語

It is a nice , Wative piece of work . By Controlling the charging freq , the charging the conventional concept that continuous recharge is the only way to resfore a battery .